Marine Monitoring: Confidence Building and

Data Quality Assurance Project

Inter-laboratory comparisons 2014-2016

Determination of radionuclides

in seawater, sediment and fish

IAEA
International Atomic Energy Agency

IAEA Environment Laboratories

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SUMMARY REPORT

With a view to assisting the Government of Japan in its objective of making the Sea Area Monitoring Plan comprehensive, credible and transparent, the IAEA, through its Environment Laboratories, is helping to ensure the high quality of data and to prove the comparability of the results. A 3-year project "Marine Monitoring: Confidence Building and Data Quality Assurance" (2014 – 2016) was initiated as a follow-up activity to recommendations made on marine radioactivity monitoring in a report issued by the IAEA in 2013 (https://www.iaea.org/sites/default/files/final_report120214.pdf) related to the decommissioning of the Fukushima Daiichi Nuclear Power Station, which reviewed Japan's efforts to plan and implement the decommissioning of the plant. Six interlaboratory comparisons (ILCs) and three proficiency tests (PTs) were organized during this project. The PT results published so far can be accessed on the IAEA web pages[1]. This report focuses on ILCs, which are a standard means for laboratories to assess the quality of their measurement results as compared to that of other participating laboratories and identify any potentially needed improvements. Within this project, joint sampling campaigns to collect seawater (Fig A), sediment and fish samples were undertaken. The resulting samples were subsequently analysed in each participating laboratory and the results were compared.

FIG. A. Collection of seawater samples for interlaboratory comparison immediately offshore Fukushima Daiichi Nuclear Power Plant (November 2014).

In total, ten laboratories participated in at least one of the ILCs: seven from Japan (participating on behalf of the Japanese authorities); the IAEA Environment Laboratories in Monaco; and, for the purpose of additional transparency, one laboratory from Ireland and one from New Zealand, both members of the network of Analytical Laboratories for the Measurement of Environmental Radioactivity (ALMERA).

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[1] 2014 Proficiency Test report accessible at
http://www-pub.iaea.org/MTCD/Publications/PDF/IAEA_AQ_43_web.pdf

Surface seawater samples were collected during each of the six sampling missions at five sampling stations in the proximity of the Fukushima Daiichi nuclear power plant. The sampling of marine sediment was done during missions in May 2015 and May 2016 at five sampling stations in the proximity of the Fukushima Daiichi nuclear power plant. Five batches of fresh fish samples (cod, flounder and mackerel) caught at locations in the vicinity of Fukushima Daiichi Nuclear Power Plant were collected during missions in November 2015, while six batches of fresh fish samples (olive flounder, chum salmon, Japanese Spanish mackerel and John Dory) were caught in November 2016.

Radionuclides in seawater, sediment and fish were determined by participating laboratories using radioanalytical methods, including liquid scintillation counting (for ^{3}H), gas-flow proportional counting (for ^{90}Sr), alpha-ray spectrometry (for ^{238}Pu and $^{239+240}$Pu) and gamma-ray spectrometry (for ^{134}Cs and ^{137}Cs).

The laboratories' results were collected by the IAEA, compared and evaluated with statistical tests. For one of the exercises an independent ALMERA laboratory in Hungary assisted in the collection and assessment of the data. From the statistical analysis it can be concluded that the overwhelming majority of the results are not significantly different from each other (see examples in Figs. B − D for seawater, sediment and fish samples, respectively). An analysis of the whole data set demonstrated that 362 out of the 369 statistical tests applied to the data for different radionuclides and samples, i.e. over 98%, were passed with a high level of confidence (99%). Given that departures found are minor, i.e. for 1.9% of the statistical tests applied to the data, it can be said with confidence that the respective laboratories are reporting reliable and comparable results for the tested radionuclides in seawater, sediment and fish samples prepared and analysed according to each laboratory's regularly used methods.
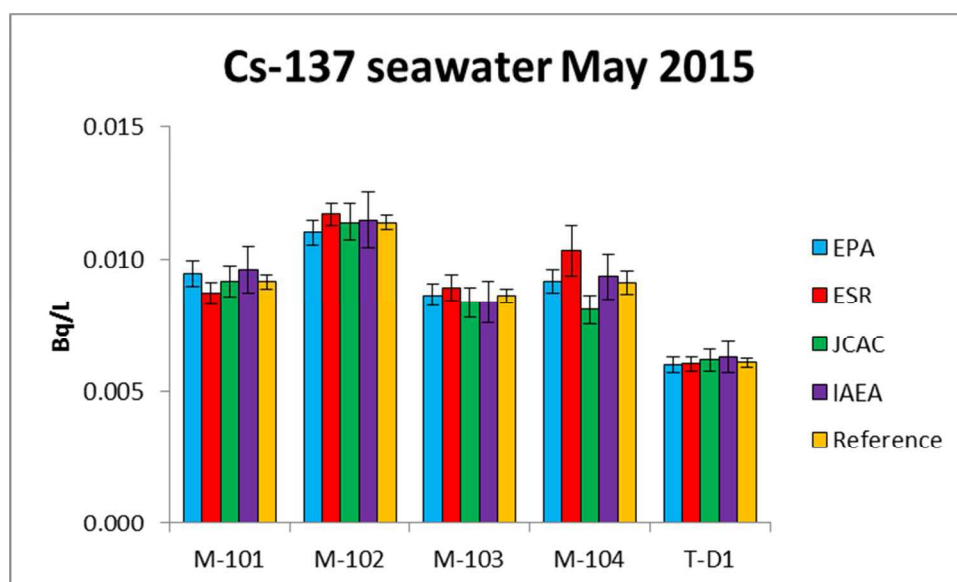

FIG. B. Example of results of an interlaboratory comparison exercise organised in May 2015: Good agreement was obtained between activity concentrations of ^{137}Cs in five seawater samples reported by laboratories in Japan (Japan Chemical Analysis Center - JCAC), Ireland (Environmental Protection Agency − EPA), New Zealand (Institute of Environmental Science and Research − ESR) and the IAEA (for details please refer to extended report).
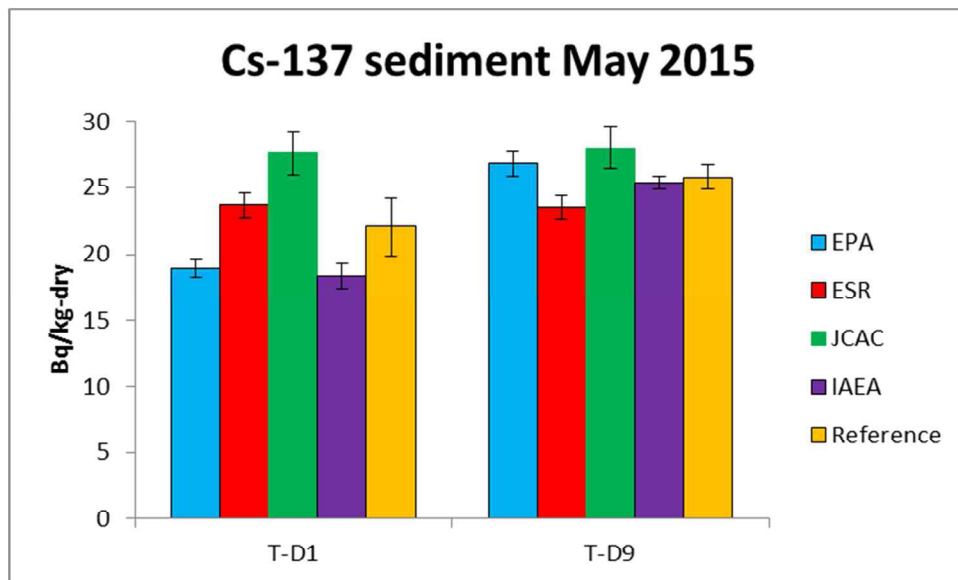
FIG. C. Example of results of an interlaboratory comparison exercise organised in May 2015: Good agreement was obtained between massic activities of ^{137}Cs in two sediment samples reported by laboratories in Japan (Japan Chemical Analysis Center - JCAC), Ireland (Environmental Protection Agency – EPA), New Zealand (Institute of Environmental Science and Research – ESR) and the IAEA (for details please refer to extended report).
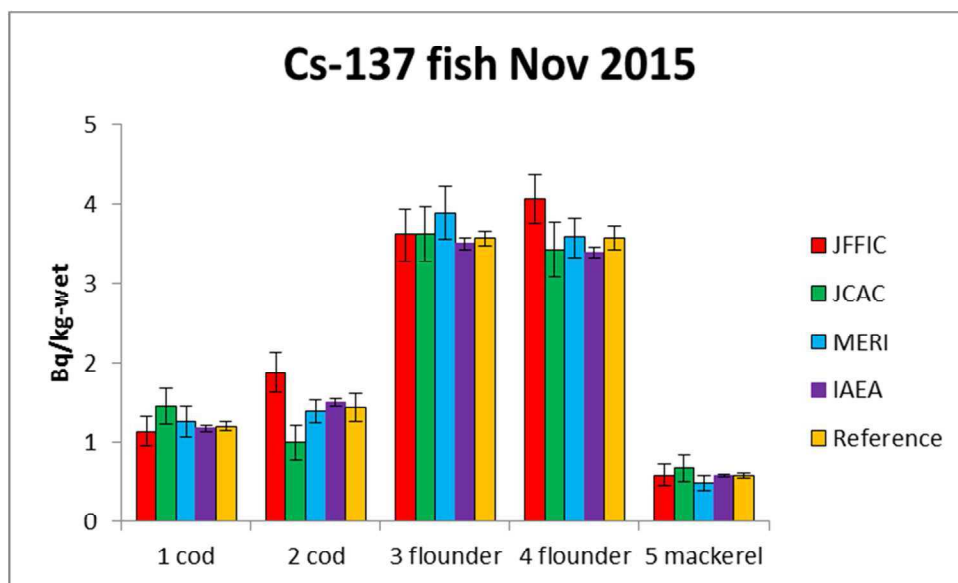

FIG. D. Example of results of an interlaboratory comparison exercise organised in November 2015: Good agreement was obtained between massic activities of ^{137}Cs in five fish samples reported by laboratories in Japan (Japan Frozen Foods Inspection Corporation – JFFIC; Japan Chemical Analysis Center – JCAC; Marine Ecology Research Institute – MERI) and the IAEA (for details please refer to extended report).

Following the six missions organized in 2014 – 2016, the IAEA can report that Japan's sample collection procedures follow the appropriate methodological standards required to obtain representative samples. The results obtained in ILCs demonstrate a high level of accuracy and competence on the part of the Japanese laboratories involved in the analyses of radionuclides in marine samples for the Sea Area Monitoring programme.