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Office of Radiation Regulations
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Perspective of the Laws Concerning the Prevention from Radiation Hazards due to Radioisotopes and Others and the Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors

If all the revisions for the Ship Safety Act and Civil Aeronautics Act were executed as consulted, in association with employment of the 2003 Edition of the Regulations for the Safe Transport of Radioactive Material, there would be conflicts between the above two Acts and the Laws Concerning the Prevention from Radiation Hazards due to Radioisotopes and Others and the Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors concerning the handling of: (a) the change of the classification for low risk α-ray emitting radioactive materials; and (b) setting of the surface density for surface-contaminated objects that are excluded from the transport regulations.

1. Review in the past

The above points (a) and (b) were reviewed once in the Radiation Council as part of discussions on whether to employ the 1985 Edition of the Regulations for the Safe Transport of Radioactive Material to the domestic legislation. At the time, a report "Review on whether to employ the Regulations for the Safe Transport of Radioactive Material (1985) to the domestic legislation" (by Primary Committee of the Radiation Council, February 1990) was compiled. The report can be summarized as follows with respect to the requirements for each transport mode.

- For the criteria on the surface dose of vehicles for land transportation, the domestic law is partially stricter than the Regulations for the Safe Transport of Radioactive Material for the purpose of preventing inconveniences that may be caused by administrative intervention. On the revision of those two Acts referred to above, the existing domestic criteria, if they are stricter than the Regulations for the Safe Transport of Radioactive Material, need to be maintained.
- Regarding the sea transport and air transport, the IMDG Code and Annex 18 of the Convention on International Civil Aviation, which incorporate almost all Regulations for the Safe Transport of Radioactive Material, shall govern the imports from overseas. Thus basically, those need to be employed in order to avoid any disruption in international transport.

Having set forth the policy as above, the report concluded as follows at the end.

It will not be appropriate to employ point (a), for the reasons that there will be an adverse impact on the public or on those who are engaged in transporting work due to the items' surfaces that contact with the outer environment, and that there will be a conflict with other existing rules. Even without employing (a), the contracts and agreements

between consigners, consignees, and carriers shall enable decontamination easily to secure smooth international transportation. It is also pointed out that it would be practically difficult to identify the alpha emitter nuclides and to determine whether or not they would be classified as low risk nuclides during the course of transportation.
It is also concluded that an employment of point (b) will not be appropriate for a reason that it would conflict with the existing laws to employ a definition of contamination only to the regulations regarding the transportation.
Thus, points (a) and (b) were discussed in the course of reviewing the possibility of employment of the 1985 Edition of Regulations for the Safe Transport of Radioactive Material, and the Radiation Council concluded that neither of them will be employed.

2. The difference from the present revision

Concerning the above (a) and (b), the difference between the study to employ the 1985 Edition of Regulations for the Safe Transport of Radioactive Material to the domestic legislation and the current study (regarding the 2003 Edition of Regulations for the Safe Transport of Radioactive Material) is that now all contracting members must cover the IMDG Code and Annex 18 of the Convention on International Civil Aviation in the related domestic laws and regulations. There is no other change for the technical standards or the concept. Therefore, there is no need to employ (a) and (b) in the Laws Concerning the Prevention from Radiation Hazards due to Radioisotopes and Others and the Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors because they are not bound by the IMDG Code or Appendix 18 of the Convention on International Civil Aviation.

Also, those concepts are not used in SS115 (BSS: International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources), thus the concepts of (a) and (b) may be considered to be unique to transportation.

3. Perspective of the Laws Concerning the Prevention from Radiation Hazards due to Radioisotopes and Others and the Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors

The perspective of the Laws Concerning the Prevention from Radiation Hazards due to Radioisotopes and Others and Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors is as follows, and there should be no issues to be discussed.

(a) Change of the classification for low risk α-ray emitting radioactive materials

The classification for low risk α-ray emitting radioactive materials is a concept unique to transportation, thus there is no need to employ it immediately in the Laws Concerning the Prevention from Radiation Hazards due to Radioisotopes and Others or the Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors. Besides, the objects that are assumed to be the target in this discussion have never been imported to Japan or there are no specific plans for them to be imported in the future, therefore, even if the Ship Safety Act and Civil Aeronautics Act are supposed to cover this topic, there should be no problem.

(b) Setting of the surface density for surface-contaminated objects that are excluded from transport regulations

This concept is unique to transportation, basically the same as (a) above, and there is no immediate need to employ it in the Laws Concerning the Prevention from Radiation Hazards due to Radioisotopes and Others or the Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors.

Besides, the dose from the surface contaminated objects that are excluded from the Ship Safety Act and Civil Aeronautics Act shall be approximately 500 μSv/y even by a quite conservative assessment (Attachment). Thus, there should not be a problem also from a radiation protection perspective.

Attachment

Surface concentration limit

Yoshio Ikezawa

1. In the 1961 Edition of the Regulations for the Safe Transport of Radioactive Material (IAEA Safety Series No. 6, 1961), a report by Fairbairn is used as an explanation of the surface concentration limit, shown in the appendix of Safety Series No.7 (1961). The Fairbairn report follows an example presented by Dunster (Health Physics Vol.8, 353-56), the logic of which is demonstrated in the following paragraphs.

2. The relationship between the surface contamination density S ($\mu Ci/nm^2$) and the air contamination by the radioactive materials released from the contaminated surface ($\mu Ci/cm^3$) shall be given as follows by introducing the re-suspension factor K (cm^{-1}).

   $C\ (\mu Ci/cm^3) = K\ (cm^{-1}) \times S\ (\mu Ci/cm^2)$ (1)

   Therefore, if a certain value of the re-suspension factor K (cm^{-1}) is given, the maximum allowable surface contamination density S_M ($\mu Ci/cm^2$) for a specified nuclide could be derived from the maximum permissible concentration (MPC)a of that nuclide.
   Equation (1) holds under the following conditions.
   (a) There is no ventilation.
   (b) All contamination is considered as loose contamination.
   (c) The contaminated surface is sufficiently large and the contamination is distributed evenly.

   Dunster used 2×10^{-8} (cm^{-1}) as the re-suspension factor K (cm^{-1}). For the value of the maximum permissible concentration (MPC)a, instead of using each nuclide, the following nuclides were used from ICRP Pub.2 (1958) as the most dangerous nuclides.

   ^{239}Pu as α-nuclide (MPC)a = 2×10^{-12} ($\mu Ci/cm^3$)
   ^{210}Pb as β-nuclide (MPC)a = 3×10^{-11} ($\mu Ci/cm^3$)
   (The maximum permissible concentration (MPC)a is based on 40 hours/week and 50 weeks/year.)

   Suppose the surface contamination density values for α-nuclide and β-nuclide are S_α and S_β, respectively.
   $S_\alpha = C/K = 2 \times 10^{-12}\ (\mu Ci / cm^3) / 2 \times 10^{-8}\ (cm^{-1}) = 1 \times 10^{-4}$ ($\mu Ci / cm^2$)
   $\fallingdotseq 10^{-4}\ (\mu Ci/cm^2) = 4\ (Bq/cm^2)$
   $S_\beta = C/K = 3 \times 10^{-11}\ (\mu Ci / cm^3) / 2 \times 10^{-8}\ (cm^{-1}) = 1.5 \times 10^{-3}$ ($\mu Ci / cm^2$)
   $\fallingdotseq 10^{-3}\ (\mu Ci/cm^2) = 40\ (Bq/cm^2)$

   The value of the maximum permissible concentration (MPC)a for a radiation worker was given as the value corresponding to the dose of 5 (rem)/y = 50 (mSv/y), and at the time, the public exposure limit was controlled at 1/10 of this value: 0.5 (rem)/y = 5 (mSv/y). Considering this relation, the surface contamination density limit

for the transported items that could possibly contact with the public was set by multiplying by 1/10, as α-nuclide: 0.4 (Bq/cm^2) and β-nuclide: 4 (Bq/cm^2).

3. However, the calculation of equation (1) is based on the following conditions, thus the safety factor is significantly large, which is considered to be extremely conservative.
   (a) With no ventilation, the maximum permissible concentration (MPC)a in the interior air is constantly maintained.
   (b) All surface contamination is loose contamination.
   (c) The contaminated surface is sufficiently large; the contamination is distributed evenly; and the contaminated particles are dispersed from all over the contaminated surface onto the floor.
   (d) The concentration limit in the air for the most dangerous nuclide is used to calculate the surface contamination density limit, and that is applied to other nuclides with lower risk also.
   (e) Since the items are transported in a short period of time, and there is no possibility that transported items are in contact with the public for a long period of time, the conditions of 40 hours/week, 50 weeks/year for the inhalation time of contaminated air are extremely conservative.

   Thus, the estimated safety factor is considered at least 100, and may be over 1000.

4. In the 1965 Edition of the Regulations for the Safe Transport of Radioactive Material, IAEA gave a definition of the surface contamination that is not applicable for the transport regulations, in order to streamline the transportation activity of the radioactive materials. At this time, the surface contamination density limit on the transporting items was set based on an extremely conservative evaluation. This perspective shall be followed for the definition of the surface contamination. Therefore, by additionally making the safety factor ten times greater (0.04 Bq/cm^2 for α-nuclides, and 0.4 Bq/cm^2 for β-nuclides), the exposed dose will fall substantially below 500 μSv/y via any exposure pathway, and thus it was considered that the exposure from the surface contamination would not be very serious.