The Approach to Immediate Handling of Secondary Byproducts of Water and Sewage Treatment in Which Radioactive Materials Were Detected

June 16, 2011
Nuclear Emergency Response Headquarters

On May 12, “The Approach to Immediate Handling of Secondary Byproducts of Sewage Treatment in Fukushima Prefecture” was put together in response to the fact that radioactive materials had been identified in dewatered sludge and other substances in facilities including sewage treatment plants in Fukushima Prefecture. Since then, radioactive materials have been detected in waterworks and sewage sludge in prefectures other than Fukushima, primarily in East Japan. For this reason, and taking into account the aforementioned approach document, the recommendation made by the Nuclear Safety Commission at the time of its drafting as well as “Near-term policy to ensure the safety for treating and disposing contaminated waste around the site of Fukushima Dai-ichi Nuclear Power Station of Tokyo Electric Power Company” (6/3/2011 Nuclear Safety Commission decision; hereinafter referred to as “Regarding the Ensuring of Safety”, attachment 1), we have organized the results of inquiries by relevant ministries and agencies on the immediate handling policy for waterworks sludge (including those generated by industrial waterworks), dewatered sludge generated by sewage treatment plants and community waste water treatment facilities, as well as the results of incinerating or melting this dewatered sludge (hereinafter referred to as “dewatered sludge, etc.”), as follows.

1. Treatment, Transport, Storage and Disposal of Dewatered Sludge, etc.
   (1) It is important to work to reduce the amount of radiation that area residents and workers are exposed to, based on the below approach outlined in “Regarding the Ensuring of Safety”
      ① In treating, transporting and storing, there is a need to ensure that exposure dose for area residents does not exceed 1mSv/year,
while also taking extraordinary care to limit the exposure dose for area residents by making additional improvements to the environment around the treatment plant.

It would also be desirable to limit the exposure dose of workers who conduct treatment and other operations to under 1mSv/year where possible. In processes where material with relatively high concentration of radioactive substances is handled, there is a need to appropriately manage the amount of exposure for workers by taking measures such as strict adherence to “The Ordinance on Prevention of Ionizing Radiation Hazards” (Ministry of Health and Welfare order #41, 1972; hereinafter referred to as “Ionizing Radiation Rule”).

Disposal safety should be judged according to these guideline values: Following the end of the disposal facility's controlled management, exposure dose for area residents should be under 10µSv/year as assessed according to a basic scenario and under 300µSv/year as assessed according to variable scenario. Dewatered sludge, etc. should be handled appropriately based on this approach, and according to their concentration of radioactive materials.

**Incineration and Melting**

(2) Material capable of compaction through incineration, melting or other means should be compacted as needed, while being appropriately managed in observance of “Regarding the Ensuring of Safety” in (1). For example, when proceeding to incinerate dewatered sludge with high concentration of radioactive cesium (over 500,000Bq/kg as a rule), measures such as ensuring the appropriate capability for the facility's particulate trap should be taken. In addition, a system to seal the resulting ash in a container is needed, in order to prevent dispersal.

**Storage**

(3) Dewatered sludge, etc. should be compacted as needed, then stored in an appropriate facility such as water supply facility, sewage treatment plant and community waste water treatment facility. Cautions to be taken in storing dewatered sludge, etc. are noted in Attachment 2.
(4) In addition to the above, landfill sections of controlled disposal facilities that normally dispose of dewatered sludge, etc. in its landfill may be used for provisional storage, as long as an appropriate distance is maintained from property lines of residential and similar areas, according to the below chart. In addition, in those cases where the combined concentration of $^{134}$Cs and $^{137}$Cs in the dewatered sludge has dropped as a result of solidification or dilution, the material will be assessed according to the end concentration (applies hereinafter).

<table>
<thead>
<tr>
<th>Rough distance from the property line</th>
<th>$^{134}$Cs and $^{137}$Cs combined</th>
</tr>
</thead>
<tbody>
<tr>
<td>70m</td>
<td>Under 100,000Bq/kg</td>
</tr>
<tr>
<td>50m</td>
<td>Under 70,000Bq/kg</td>
</tr>
<tr>
<td>40m</td>
<td>Under 60,000Bq/kg</td>
</tr>
<tr>
<td>20m</td>
<td>Under 40,000Bq/kg</td>
</tr>
<tr>
<td>6m</td>
<td>Under 20,000Bq/kg</td>
</tr>
<tr>
<td>No restrictions</td>
<td>Under 8,000Bq/kg</td>
</tr>
</tbody>
</table>

(5) For dewatered sludge for which the combined total for $^{134}$Cs and $^{137}$Cs exceeds 100,000Bq/kg, it would be desirable to store them if at all possible within the prefecture where the dewatered sludge was generated, in a facility where radiation can be appropriately shielded.

Disposal

(6) Calculations show that if dewatered sludge with combined $^{134}$Cs and $^{137}$Cs concentration of under 100,000Bq/kg is disposed in a landfill accompanied by appropriate long-range measures and with no residential or similar use allowed for the site, the resulting exposure dose for area residents would be less than 10μSv/year. However, long-term management as well as investigation into the environmental conservation approach is needed for sites where landfill disposal took place under differing conditions. Given this fact, landfill sites for dewatered sludge with combined $^{134}$Cs and $^{137}$Cs concentration of under 8,000Bq/kg will not be open to
residential or similar use for the present. Landfill disposal itself is permitted, in accompaniment with appropriate measures such as installation of soil strata and measures for watertightness.

In addition, when disposing dewatered sludge with combined $^{134}\text{Cs}$ and $^{137}\text{Cs}$ concentration of under 8,000Bq/kg and using the site as farmland or residence, and when disposing dewatered sludge with concentration of over 8,000Bq/kg and under 100,000Bq/kg, landfill disposal is possible following individual safety assessment on whether the disposal meets (or not) the guideline value indicated in “#3: Regarding Disposal” in “Regarding the Ensuring of Safety”, and after exploring methods of long-term management.5

If implementing landfill disposal by either method, prefectures and other governments where the controlled disposal facility is located should perform necessary measures such as monitoring6 and facility deployment management until the safety of the controlled disposal facility site can be secured.

As for disposal without additional individual safety assessment of dewatered sludge having combined $^{134}\text{Cs}$ and $^{137}\text{Cs}$ concentration between 8,000Bq/kg and 100,000Bq/kg in a controlled disposal facility, with no residential or similar use allowed for the site, we will continue to weigh the environmental conservation approach.

(7) In terms of the dewatered sludge, etc. stored under (5), the rule will be to meet the guideline value for disposal indicated in “Regarding the Ensuring of Safety”. The specifics of disposal will continue to be weighed.

(8) Emitting operators who seek to dispose dewatered sludge, etc. should publicly release the method of landfill disposal (the method to be used by the contractor if subcontracting to waste disposal operator), verify that disposal is being implemented properly, and report to the prefecture on a regular basis. On receiving these reports, the prefecture should release them to the public without delay.

(9) When implementing landfill disposal of dewatered sludge, etc., should a waste disposal operator be unable to perform the work, the
prefecture and the emitting operator of dewatered sludge, etc. will manage the dewatered sludge, etc. that has been disposed of in a landfill.

2. Use of Secondary Byproducts That Use Dewatered Sludge, etc.
   (1) Given reduction of concentration of radioactive substances in the incoming dewatered sludge, etc. to below certain levels, or aggregation or dilution with other raw materials, there is no impediment to using those products manufactured through reuse of dewatered sludge, etc. whose concentration is reasonably assured to have been reduced to under the clearance level prior to market distribution.7

   (2) One example is the use of cement for raw concrete or foundation reinforcement, a process which is controlled up to the stage where the cement is mixed with raw concrete or soil. Given that the cement will be diluted to at least double the volume, the permitted concentration at the cement stage would be double that of the clearance level. However, if the product is to be bagged and sold on the open market as cement, it needs to be brought under the clearance level at the cement stage, before being distributed to stores.

   (3) Regarding products such as gardening soil, for which assessment regarding reuse has not been finalized, the proper course would be to voluntarily refrain from distributing the product for the time being. Distribution will resume in the future, after safety has been assessed by the relevant ministries and agencies according to the way in which these products are being used.

   (4) In order to properly implement the use of secondary byproducts, it would be appropriate to take ongoing measurements of the concentration of radioactive substances in dewatered sludge, etc. at water supply facilities, sewage treatment facilities and community waste water treatment facilities for communities where concentration above a certain level was detected.

3. Worker Safety and Health Management
   (1) Appropriate and regular measurement of radiation concentration
should be taken for exhaust from dewatered sludge incineration and melting treatment plants and waste water from landfill disposal facilities, and any suitable measures taken as needed by the relevant party, in order to reduce exposure to the lowest level reasonably achievable, and to properly implement landfill disposal and secondary byproduct use. Operators who emit dewatered sludge, etc. should record the amount as well as the radiation concentration of dewatered sludge to be provisionally stored.

(2) Should there be a risk that the effective dose from external radiation within sewage treatment facilities, waterworks, waste disposal facilities exceed the standard (1.3mSv over 3 months or 2.5µSv/h) set by Article 3 Paragraph 1 of “The Ordinance on Prevention of Ionizing Radiation Hazards” (Ministry of Health and Welfare order #41, 1972; hereinafter referred to as “Ionizing Radiation Rule”), or if the dewatered sludge, etc. qualifies as radioactive material as defined by Article 2 Paragraph 2 of the Ionizing Radiation Rule, the relevant provisions of the Ionizing Radiation Rule should be strictly adhered to in order to secure the safety of the workers. In addition, it should be noted that if dewatered sludge, etc. qualifies as radioactive material as defined by Article 2 Paragraph 2 of the Ionizing Radiation Rule, the Rule may also come into effect for facilities that take receipt of these as cement or paving material. Furthermore, when handling dewatered sludge with radioactive substance concentration near the lower limit set in Article 2 Paragraph 2 of the Ionizing Radiation Rule, it would be desirable to measure and control the exposure of workers, in observance of “2) Regarding Treatment, Transport and Storage” of “Regarding the Ensuring of Safety”.

(3) For cases where dose received by workers exceeds 1mSv/year, in order to reduce exposure to the lowest level reasonably achievable, the relationship between the radioactive concentration of dewatered sludge etc. and the dose received by workers should be reassessed around 6 months following the accident, based on the radioactive concentration detected in dewatered sludge at this point.

4. Notes

(1) The radioactive concentration of dewatered sludge, etc. is thought to
undergo daily changes according to regional differences and presence of precipitation. In addition, given the nature of the material, it is difficult for sewer operators or cement operators to control the concentration of radioactive substances, beyond diluting the generated sludge. The upper limit of radioactive concentration, set by logarithmically transforming calculation results, is simply a guideline, and even values that exceed the limit but have the same number of digits may not necessarily represent a significant difference in safety from a radiological protection perspective. Even in cases where the measured value exceeds the radioactive concentration given as a guideline, an appropriate response may be mounted without necessarily resorting to recovery, depending on the result of an assessment using detailed calculation of the radiation dose.

(2) Should there be any changes in the future, such as the detection of radioactive concentration far exceeding those recorded so far in dewatered sludge, etc., a suitable response, including a reassessment of this approach, will be implemented.

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1 Assessed based on “Regarding the Technological Exploration Towards the Deployment of a Clearance System in Radiation Hazard Prevention Law” (The Working Group on Clearance Technology, Radiation Safety Regulations Exploratory Committee of the Ministry of Education, Culture, Sports, Science and Technology; called “RI Clearance Report” as of January 2010), an existing waste-related exposure assessment based on the Nuclear Safety Commission’s approach.

2 The effect of skyshine was assessed during operation, in accordance with “Regarding the Upper Limit of Concentration of Radioactive Materials as It Relates to Landfill Disposal of Low-Level Radioactive Solid Waste” (Nuclear Safety Commission, 05/21/2007)

3 The concentration of radioactive material that would result in a dose of less than 10µSv/year for area residents was assessed based on “RI Clearance Report”, assuming that residential or similar use was disallowed for the site.

4 This is the concentration of radioactive material for which test calculations show that the dose received by landfill workers will not exceed 1mSv/year, as a result of an assessment based on the “RI Clearance Report”.

5 Ultimately, safety will be assessed according to the nature and volume of the dewatered sludge, etc. to be disposed (if these are in provisional mixed storage in the same controlled disposal facility with other waste that includes admixture or adhesion of radioactive substances, these other waste are also included), type and concentration of radioactive material, and the conditions set by the unique natural and social environment of the controlled disposal facility site, and the following points verified:

   a. The lead entity for the control and monitoring of dewatered sludge, etc.
b. The duration for which radiological protection control is needed

c. The final depth of the covering soil

d. The treatment measures for radioactive substances at seepage water treatment plant

e. Site use conditions for the final disposal site following its shutdown

f. Other points necessary for radiological protection

g. Measures to be undertaken by the prefecture or the emitting operator of dewatered sludge, etc. in order to ensure strict adherence to A through F

6 Includes measuring the concentration of radioactive substances in the seepage water or the ground water, to verify that it falls below the concentration limit indicated in Attached Table 1 in “Notice of Dose Limit, etc., Based on Provisions of Regulations Related to Nuclear Fuel Material Fabrication Operations” (Science and Technology Agency Notice #13, 2000)

7 The clearance-level concentration of radioactive substances for metal and concrete pieces pursuant to the provisions of Article 61-2-4 of Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors, “Regulation on Verifying the Concentration of Radioactive Substances Contained in Materials Used in Refinery Plants and Other Facilities” (2005 METI ordinance #112) is 0.1Bq/g for $^{134}$Cs and 0.1Bq/g for $^{137}$Cs, and is set such that the sum of percentages yielded by dividing the concentration value with the clearance concentration level according to each radioactive nuclide does not exceed the integer 1.