BROWNS FERRY NUCLEAR PLANT UNITS 1, 2, AND 3

# EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

## Supplemental Information

## SECOND HALF 1979

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

SUPPLEMENTAL INFORMATION

SECOND HALF 1979

1. Regulatory Limits

a. Fission and Activation Gases:

(1) Instantaneous -

$$\frac{Q_1}{0.13} + \frac{Q_2}{1.46} \leq 1$$

$Q_1$ = release rate from building exhaust vents in Ci/sec.

$Q_2$ = release r te from main stack in Ci/sec.

(2) Quarterly - $\leq$ 0.10 Ci/sec. as average

b. & c. Iodines and particulates, half-lives >8 days

(1) Instantaneous -

$$\frac{Q_3}{0.33} + \frac{Q_4}{44} \leq 1$$

$Q_3$ = release rate from building exhaust vents in µCi/sec.

$Q_4$ = release rate from main stack in µCi/sec.

(2) Quarterly - $\leq$ 0.80 µCi/sec. as average

d. Liquid effluent: $1 \times 10^{-7}$ µCi/ml (ref. 10 CFR 20, Appendix B, note 3C, Table II, column 2).

e. Tritium

(1) Liquid - $\leq$ 3.0E-3 µCi/cc (ref. 10 CFR 20, Table II, column 2)

(2) Airborne - $\leq$ 2.0E-7 µCi/ml (ref. 10 CFR 20, Table I, column 2)

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SUPPLEMENTAL INFORMATION (CONTINUED)

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2. Maximum Permissible Concentrations

   a. Fission and Activation Gases: Not Applicable

   b. Iodines: Not Applicable

   c. Particulates, half-lives >8 days: Not Applicable

   d. Liquid effluents: sum of indv. MPC ratios $\leq 1$

      (ref. 10 CFR 20, Appendix B, note 1)

3. Average Energy - Not Applicable

4. Measurements and Approximations of Total Radioactivity

   a., b. & c. Fission and Activation Gases, Iodines, and Particulates:

   Airborne effluent gaseous activity is continuously monitored and recorded; additionally, grab samples are taken and analyzed monthly to determine specific radionuclide activity concentrations. Stack and building vent effluent flow rates are calculated once a shift based on the configuration of operating exhaust fans. The flow rate data is consolidated weekly to determine the volume of airborne effluents released from the plant.

   Charcoal and particulate samples are taken and analyzed at least weekly to determine specific activity concentrations. The total activity released from the plant is then calculated by taking weekly activity concentration values and multiplying them by the weekly airborne effluent volume.

   Allowance is made for a plus or minus one sigma counting error associated with $\gamma$ isotopic analyses.

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SUPPLEMENTAL INFORMATION (CONTINUED)

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4. Measurements and Approximations of Total Radioactivity (Continued)

d. Liquid Effluents

Gross beta, gamma and total $\beta$ isotopic activity concentrations are determined on each batch of liquid effluent prior to release. The total curie content of a released batch is determined by multiplying the highest of the above three activity concentrations by the total volume discharged. The total activity released during a month is then determined by summing the activity content of each batch discharged during the month.

Allowance is made for plus or minus one sigma counting error associated with the total $\beta$ isotopic analyses.

| 5. Batch | | Value | | Units |
|---|---|---|---|---|
| | | Third Quarter | Fourth Quarter | |
| a. | Liquid | | | |
| (1) | Number of batches released | 62 | 104 | Each |
| (2) | Total time period for batch releases | 16529 | 36310 | Minutes |
| (3) | Maximum time period for a batch release | 600 | 880 | Minutes |
| (4) | Average time period for batch releases | 266.6 | 349.13 | Minutes |
| (5) | Minimum time period for a batch release | 10 | 205 | Minutes |
| (6) | Average stream flow during period of release of effluent into a flowing stream[1] | | | |
| b. | Gaseous | | | |
| | None | | | |

[1] To be supplied by others.

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LIQUID EFFLUENTS - SUMMATION OF ALL RELEASES

| | | Unit | Third Quarter | % Error | Fourth Quarter | % Error |
|---|---|---|---|---|---|---|
| A. | Fission and Activation Products | | | | | |
| | 1. Total Releases(1) | Curies | 9.43E-01 | ±1.5E+01 | 4.61E+00 | ±1.5E+01 |
| | 2. Average Diluted Conc. During Period | uCi/ml | 1.27E-08 | | 2.25E-08 | |
| | 3. Percent of Applicable Limit | % | 4.72 | | 2.31E+01 | |
| B. | Tritium | | | | | |
| | 1. Total Release | Curies | 8.70E-01 | ±5.0E+00 | 3.92E+00 | ±5.0E+00 |
| | 2. Average Diluted Conc. During Period | uCi/ml | 1.17E-08 | | 1.96E-08 | |
| | 3. Percent of Applicable Limit (3E-03u Ci/ml) | % | 4.12E-04 | | 6.53E-04 | |
| C. | Dissolved and Entrained Gases | | | | | |
| | 1. Total Release | Curies | <9.30E-02 | ±2.8E+00 | <1.76E-01 | ±2.8E+00 |
| | 2. Average Diluted Conc. During Period | uCi/ml | <1.25E-09 | | <8.75E-10 | |
| | 3. Percent of Applicable Limit (6E-06 uCi/ml) | % | 2.08E-02 | | 1.46E-02 | |
| D. | Gross Alpha Radioactivity | | | | | |
| | 1. Total Release | Curies | <2.98E-06 | ±1.7E+01 | 2.42E-05 | ±1.7E+01 |
| E. | Volume of Waste Release | | | | | |
| | (before dilution) | Liters | 4.98E-06 | ±5.0E+00 | 9.51E+06 | ±5.0E+00 |
| F. | Volume of Dilution Water for Period | Liters | 1.44E+10 | ±1.0E+01 | 2.01E+11 | ±1.0E+01 |

(1) Based on pre-release analyses which are not decay corrected.

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LIQUID RELEASES FOR SECOND HALF 1979 BATCH MODE

| Isotope | Curies | Third Quarter | Fourth Quarter |
|---|---|---|---|
| 1. Strontium-89 | | 5.39E-04 | 8.54E-04 |
| 2. Strontium-90 | | 1.06E-03 | 1.87E-03 |
| 3. Cesium-134 | | <5.27E-03 | <2.19E-02 |
| 4. Cesium-137 | | <8.08E-03 | <2.85E-02 |
| 5. Iodine-131 | | <4.83E-03 | <2.59E-02 |
| 6. Cobalt-58 | | <3.16E-03 | <8.30E-03 |
| 7. Cobalt-60 | | 2.67E-02 | <6.66E-02 |
| 8. Iron-59 | | <1.84E-03 | <3.59E-03 |
| 9. Zinc-65 | | <4.68E-02 | 1.30E-01 |
| 10. Manganese-54 | | <5.16E-03 | <7.82E-02 |
| 11. Chromium-51 | | 8.49E-02 | <1.20E-01 |
| 12. Zirconium-Niobium-95 | | <7.14E-03 | <1.31E-02 |
| 13. Molybdenum-99 | | <8.21E-04 | 6.32E-03 |
| 14. Technetium-99m | | <8.21E-04 | 6.32E-03 |
| 15. Barium-Lanthanum-140 | | <6.58E-04 | <1.73E-03 |
| 16. Cerium-141[(1)] | | <1.12E-03 | <4.67E-03 |
| 17. Sodium-24 | | <4.24E-02 | <1.14E-01 |
| 18. Fluorine-18 | | 1.06E-03 | <3.50E-03 |
| | Total for Period | <2.42E-01 | <6.35E-01 |

(1) Calculated by multiplying $Cs^{134}$ by a factor of 0.2133. (Established by ratio $Ce^{141}/Cs^{134}$ in March 1979).

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LIQUID RELEASES FOR SECOND HALF 1979 BATCH MODE (CONTINUED)

| Isotope | Curies | Third Quarter | Fourth Quarter |
|---|---|---|---|
| Others (Not Required for Reg. Guide 1.21) | | | |
| 1. | Xenon-133 | <8.00E-03 | <5.82E-02 |
| 2. | Xenon-135 | 4.56E-03 | <2.21E-02 |
| 3. | Iodine-133 | <1.37E-03 | <1.37E-02 |
| 4. | Cesium-136 | <1.55E-03 | <4.24E-03 |
| 5. | Manganese-56 | <4.26E-04 | <6.43E-04 |
| 6. | Antimony-122 | <1.38E-03 | <4.23E-03 |
| 7. | Antimony-124 | <1.69E-03 | <3.32E-03 |
| 8. | Copper-64 | <7.09E-02 | <1.49E-01 |
| 9. | Arsenic-76 | <1.11E-02 | <3.06E-02 |
| 10. | Arsenic-74 | <1.82E-03 | <3.84E-03 |

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SOLID WASTE AND IRRADIATED FUEL SHIPMENTS

A. Solid Waste Shipped Off-Site for burial or disposal (not irradiated fuel)

| 1. Type of Waste | | Unit | Third Quarter | Fourth Quarter |
|---|---|---|---|---|
| a. | Spent resins, filter sludges, evaporator bottoms, etc. | $m^3$ | 189.9 | 156.7 |
| | | Ci | 639.3 | 973 |
| b. | Dry compressible waste contaminated equip., etc. | #17H drums | 816 | 993 |
| | | Ci | 32.7 | 126.5 |
| c. | Irradiated Components, control rods, etc. | | 29 | N/A |
| | | | 5.9 | |
| d. | Other (describe) Boxes | Boxes | 167 | 321 |
| | | Ci | 1.74 | .74 |

2. Estimate of major nuclide composition (by type of waste)

| | | | Third Quarter | Fourth Quarter | | | |
|---|---|---|---|---|---|---|---|
| a. | 1. | Chromium-51 | 245/639.3 | 232/973 | % | 38.32 | 23.84 |
| | 2. | Zinc-65 | 215/639.3 | 494/973 | % | 33.63 | 50.77 |
| | 3. | Iodine-131 | 14.2/639.3 | 23.1/973 | % | 2.22 | 2.37 |
| | 4. | Cesium-137 | 46.5/639.3 | 56.1/973 | % | 7.27 | 5.76 |
| | 5. | Cesium-134 | 29.1/639.3 | 37.4/973 | % | 4.55 | 3.84 |
| | 6. | Cobalt-58 | 13.5/639.3 | 15.7/973 | % | 2.11 | 1.61 |
| | 7. | Cobalt-60 | 38.3/639.3 | 47.1/973 | % | 5.99 | 4.84 |
| | 8. | Zirconium-95 | 6.37/639.3 | <5.79/973 | % | .996 | .60 |
| | 9. | Niobium-95 | 7.80/639.3 | 8.91/973 | % | 1.22 | .91 |

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

SECOND HALF 1979

SOLID WASTE AND IRRADIATED FUEL SHIPMENTS (CONTINUED)

2. Estimate of major nuclide composition (by type of waste) (Continued)

| | | | Third Quarter | Fourth Quarter | Unit | Third Quarter | Fourth Quarter |
|---|---|---|---|---|---|---|---|
| a. | 10. | Lanthanum-140 | 2.24/639.3 | <3.68/973 | % | .350 | .38 |
| | 11. | Antimony-124 | <.619/639.3 | <.72/973 | % | .097 | .074 |
| | 12. | Strontium-90 | .242/639.3 | .25/973 | % | .038 | .026 |
| | 13. | Manganese-54 | 8.09/639.3 | 9.85/973 | % | 1.26 | 1.01 |
| | 14. | Silver-110M | 8.73/639.3 | 8.52/973 | % | 1.36 | .87 |
| | 15. | Iron-59 | <1.37/639.3 | <1.33/973 | % | .214 | .14 |
| | 16. | Other Nuclides | 2.24/639.3 | 28.55/974 | % | .350 | 2.93 |
| b. | 1. | Chromium-51 | 12.53 | 30.16 | % | 38.32 | 23.84 |
| | 2. | Zinc-65 | 11.00 | 64.22 | % | 33.63 | 50.77 |
| | 3. | Iodine-131 | .726 | 3.00 | % | 2.22 | 2.37 |
| | 4. | Cesium-137 | 2.38 | 7.29 | % | 7.27 | 5.76 |
| | 5. | Cesium-134 | 1.49 | 4.86 | % | 4.55 | 3.84 |
| | 6. | Cobalt-58 | .690 | 2.04 | % | 2.11 | 1.61 |
| | 7. | Cobalt-60 | 1.96 | 6.12 | % | 5.99 | 4.84 |
| | 8. | Zirconium-95 | .325 | .76 | % | .996 | .60 |
| | 9. | Niobium-95 | .400 | 1.15 | % | 1.22 | .91 |

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

SECOND HALF 1979

SOLID WASTE AND IRRADIATED FUEL SHIPMENTS (CONTINUED)

2. Estimate of major nuclide composition (by type of waste) (Continued)

| | | | Third Quarter | Fourth Quarter | Unit | Third Quarter | Fourth Quarter |
|---|---|---|---|---|---|---|---|
| b. | 10. | Lanthanum-140 | .114 | .48 | % | .350 | .38 |
| | 11. | Antimony-124 | .032 | .09 | % | .097 | .074 |
| | 12. | Strontium-90 | .012 | .03 | % | .038 | .026 |
| | 13. | Manganese-54 | .412 | 1.28 | % | 1.26 | 1.01 |
| | 14. | Silver-110M | .445 | 1.10 | % | 1.36 | .87 |
| | 15. | Iron-59 | .700 | .18 | % | 2.14 | .14 |
| | 16. | Other Nuclides | .114 | 3.71 | % | .350 | 2.93 |
| c. | Irradiated Components, Control Rods, etc. | | | | | | |
| | Spent Fuel Racks | | 5.89 | None | | | |
| d. | 1. | Chromium-51 | 6.67E-01 | 1.76E-01 | % | 38.32 | 23.84 |
| | 2. | Zinc-65 | 5.85E-01 | 3.76E-01 | % | 33.63 | 50.77 |
| | 3. | Iodine-131 | 3.86E-02 | 1.75E-02 | % | 2.22 | 2.37 |
| | 4. | Cesium-137 | 1.26E-01 | 4.26E-02 | % | 7.27 | 5.76 |
| | 5. | Cesium-134 | 7.91E-02 | 2.84E-02 | % | 4.55 | 3.84 |
| | 6. | Cobalt-58 | 3.67E-02 | 1.19E-02 | % | 2.11 | 1.61 |
| | 7. | Cobalt-60 | 1.04E-01 | 3.58E-02 | % | 5.99 | 4.84 |
| | 8. | Zirconium-95 | 1.73E-02 | 4.44E-03 | % | .996 | .60 |
| | 9. | Niobium-95 | 2.12E-02 | 6.37E-03 | % | 1.22 | .91 |

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

SECOND HALF 1979

SOLID WASTE AND IRRADIATED FUEL SHIPMENTS (CONTINUED)

2. Estimate of major nuclide composition (by type of waste) (Continued)

| | | | Third Quarter | Fourth Quarter | Unit | Third Quarter | Fourth Quarter |
|---|---|---|---|---|---|---|---|
| d. | 10. | Lanthanum-140 | 6.09E-03 | 2.81E-03 | % | .350 | .38 |
| | 11. | Antimony-124 | 1.69E-03 | 5.48E-04 | % | .097 | .074 |
| | 12. | Strontium-90 | 6.61E-04 | 1.92E-04 | % | .038 | .026 |
| | 13. | Manganese-54 | 2.19E-02 | 7.47E-03 | % | 1.26 | 1.01 |
| | 14. | Silver-110M | 2.37E-02 | 6.44E-03 | % | 1.36 | .87 |
| | 15. | Iron-59 | 3.72E-03 | 1.04E-03 | % | .214 | .14 |
| | 16. | Other Nuclides | 6.09E-03 | 2.17E-02 | % | .350 | 2.93 |

3. Solid Waste Disposition

| Number of Shipments | | Mode of Transportation | Destination |
|---|---|---|---|
| Quarter | Quarter | | |
| 50 | 46 | Truck | Barnwell, S.C. |

3. Irradiated Fuel Shipments (disposition)

| Number of Shipments | | Mode of Transportation | Destination |
|---|---|---|---|
| Quarter | Quarter | | |
| N/A | N/A | N/A | N/A |

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

SECOND HALF 1979

GASEOUS EFFLUENTS - SUMMATION OF ALL RELEASES

| Summation of All Releases | Unit | Third Quarter | % Error | Fourth Quarter | % Error |
|---|---|---|---|---|---|
| A. Fission and Activation Gases | | | | | |
| 1. Total Release | Ci | <1.02E+05 | ±7.6E+00 | <6.68E+04 | ± 7.6E+ |
| 2. Average release rate for period | uCi/sec. | <1.30E+04 | | <8.50E+03 | |
| 3. Percent of technical specification limit | % | 2.6E+01 | | 1.70E+01 | |
| B. Iodines | | | | | |
| 1. Total Iodine-131 | Ci | 4.51E-03 | ±1.22E+01 | 3.03E-02 | ± 1.22E |
| 2. Average release rate for period | uCi/sec. | 5.74E-04 | | 3.85E-03 | |
| 3. Percent of technical specification limit | % | 1.44E-01 | | 9.62E-01 | |
| C. Particulates | | | | | |
| 1. Particulates with half-lives >8 days | Ci | <4.63E-02 | ±1.05E+01 | <1.86E-02 | ± 1.05E |
| 2. Average release rate for period | uCi/sec. | <5.89E-03 | | <2.37E-03 | |
| 3. Percent of technical specification limit | % | 1.47E+00 | | 5.92E-01 | |
| 4. Gross alpha radioactivity | Ci | <1.02E-06 | | <3.45E-07 | |
| D. Tritium | | | | | |
| 1. Total release | Ci | 1.42E+01 | ±3.00E+00 | 5.65E+00 | ± 3.00E |
| 2. Average release rate for period | uCi/sec. | 1.81E+00 | | 7.19E-01 | |
| 3. Percent of technical specification limit | % | 1.46E+00 | | 8.54E-01 | |
| 4. Ground level release | Ci | 1.34E+01 | | 5.29E+00 | |
| 5. Elevated release | Ci | 8.34E-01 | | 3.65E-01 | |

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GASEOUS EFFLUENTS - ELEVATED RELEASE

| | Unit | Third Quarter | Fourth Quarter |
|---|---|---|---|
| 1. Fission Gases | | | |
| Krypton-85 | Ci | <1.83E+01 | <4.31E+00 |
| Krypton-85m | Ci | <2.08E+02 | <3.06E+01 |
| Krypton-87 | Ci | <4.69E+01 | <3.32E+01 |
| Krypton-88 | Ci | <1.74E+02 | <3.52E+01 |
| Xenon-133 | Ci | <3.12E+03 | <3.45E+02 |
| Xenon-135 | Ci | <2.56E+01 | <2.05E+00 |
| Xenon-135m | Ci | <1.48E+02 | <4.75E+01 |
| Xenon-138 | Ci | <1.26E+03 | <2.96E+02 |
| Others (specify) | | | |
| Argon-41 | Ci | <8.98E+00 | <3.38E+00 |
| Unidentified | Ci | N/A | N/A |
| Total for Period | | <5.01E+03 | <7.97E+02 |
| 2. Iodines | | | |
| Iodine-131 | Ci | 3.32E-03 | 5.94E-03 |
| Iodine-133 | Ci | <2.03E-03 | <2.08E-03 |
| Iodine-135 | Ci | <1.46E-03 | <1.53E-03 |
| Total for Period | | <6.81E-03 | <9.55E-03 |

EFFLUENT AND WASTE DISPOSAL SEMIANNUAL REPORT

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GASEOUS EFFLUENTS - ELEVATED RELEASE (Continued)

| | Unit | Third Quarter | Fourth Quarter |
|---|---|---|---|
| 3. Particulates | | | |
| Strontium-89 | Ci | 4.95E-06 | 4.78E-06 |
| Strontium-90 | Ci | 8.54E-07 | 7.28E-06 |
| Cesium-134 | Ci | <3.46E-05 | <3.77E-05 |
| Cesium-137 | Ci | <3.90E-05 | <3.84E-05 |
| Barium-140 | Ci | <4.27E-05 | <4.81E-05 |
| Zirconium-95 | Ci | <1.47E-04 | <2.36E-04 |
| Niobium-95 | Ci | <3.31E-05 | <3.59E-05 |
| Cobalt-58 | Ci | <4.17E-05 | <3.55E-05 |
| Manganese-54 | Ci | <4.34E-05 | <3.84E-05 |
| Zinc-65 | Ci | 9.56E-05 | 1.12E-04 |
| Iron-59 | Ci | <7.61E-05 | <8.19E-05 |
| Cobalt-60 | Ci | 3.19E-04 | 9.50E-05 |
| Others (specify) | | | |
| Lanthanum-140 | Ci | <1.78E-04 | <9.76E-05 |
| Total for Period | Ci | <1.06E-03 | <8.68E-04 |
| 4. Tritium | Ci | 8.34E-01 | 3.65E-01 |

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GASEOUS EFFLUENTS - GROUND LEVEL RELEASES

| | | Unit | Third Quarter | Fourth Quarter |
|---|---|---|---|---|
| 1. | Fission Gases | | | |
| | Krypton-85 | Ci | <8.55E+04 | <6.06E+04 |
| | Krypton-85m | Ci | <2.79E+02 | <1.48E+02 |
| | Krypton-87 | Ci | <6.92E+02 | <3.98E+02 |
| | Krypton-88 | Ci | <1.03E+03 | <1.25E+02 |
| | Xenon-133 | Ci | <6.27E+02 | <3.80E+02 |
| | Xenon-135 | Ci | <2.27E+02 | <1.74E+02 |
| | Xenon-135m | Ci | <1.46E+03 | <7.56E+02 |
| | Xenon-138 | Ci | <6.57E+03 | <3.16E+03 |
| | Others (specify) | | | |
| | Argon-41 | Ci | <4.28E+02 | <2.45E+02 |
| | Unidentified | Ci | N/A | N/A |
| | Total for Period | Ci | <9.68E+04 | <6.60E+04 |
| 2. | Iodines | | | |
| | Iodine-131 | Ci | 1.19E-03 | 1.39E-03 |
| | Iodine-133 | Ci | <4.66E-03 | <2.57E-03 |
| | Iodine-135 | Ci | <3.25E-02 | <1.68E-02 |
| | Total for Period | Ci | <3.83E-02 | <2.08E-02 |

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GASEOUS EFFLUENTS - GROUND LEVEL RELEASES (Continued)

| | Unit | Third Quarter | Fourth Quarter |
|---|---|---|---|
| 3. Particulates | | | |
| Strontium-89 | Ci | 1.20E-05 | 5.90E-05 |
| Strontium-90 | Ci | 2.68E-05 | 1.01E-04 |
| Cesium-134 | Ci | <1.07E-03 | <4.88E-04 |
| Cesium-137 | Ci | <1.19E-03 | <6.29E-04 |
| Barium-140 | Ci | <1.21E-03 | <6.96E-04 |
| Zirconium-95 | Ci | <2.22E-03 | <1.31E-03 |
| Niobium-95 | Ci | <1.22E-03 | <6.47E-04 |
| Cobalt-58 | Ci | <1.86E-03 | <6.37E-04 |
| Manganese-54 | Ci | <2.18E-03 | <7.85E-04 |
| Zinc-65 | Ci | 1.22E-02 | 5.90E-03 |
| Iron-59 | Ci | <2.27E-03 | <1.24E-03 |
| Cobalt-60 | Ci | 1.63E-02 | 3.58E-03 |
| Others (specify) | | | |
| Lanthanum-140 | Ci | <3.50E-03 | <1.68E-03 |
| Total for Period | Ci | <4.52E-02 | <1.77E-02 |
| 4. Tritium | Ci | 1.34E+01 | 5.29E+00 |