

FOR INFORMATION ONLY

NINE MILE POINT NUCLEAR STATION

RADIATION PROTECTION PROCEDURES

PROCEDURE NO. RP-6

THE PACKAGING AND TRANSPORTATION OF RADIOACTIVE MATERIAL

<u>APPROVALS</u>	<u>SIGNATURES</u>	<u>DATE AND INITIALS</u>		
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NIAGARA MOHAWK POWER CORPORATION

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THIS PROCEDURE NOT TO BE
USED AFTER January 1986
SUBJECT TO PERIODIC REVIEW.

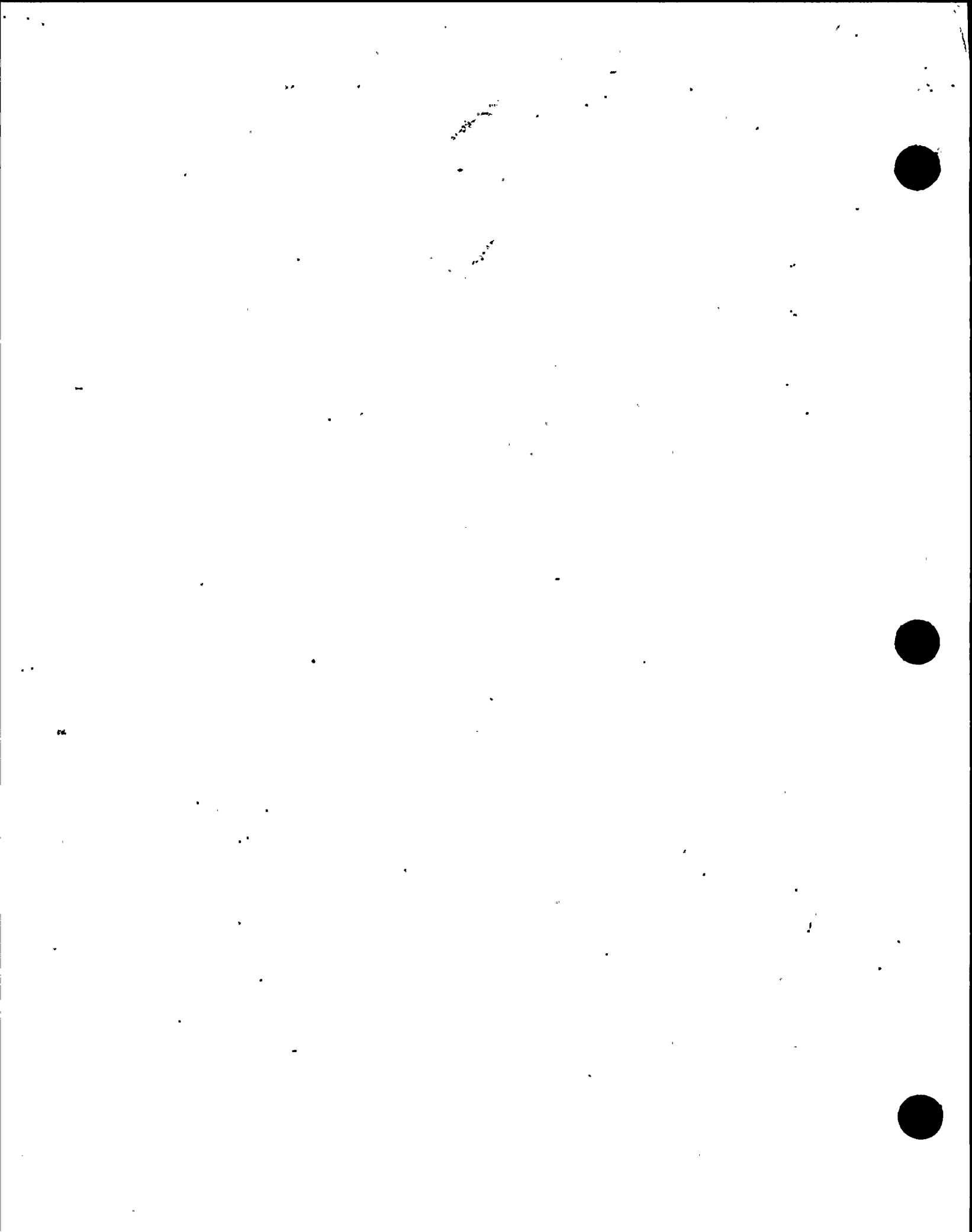


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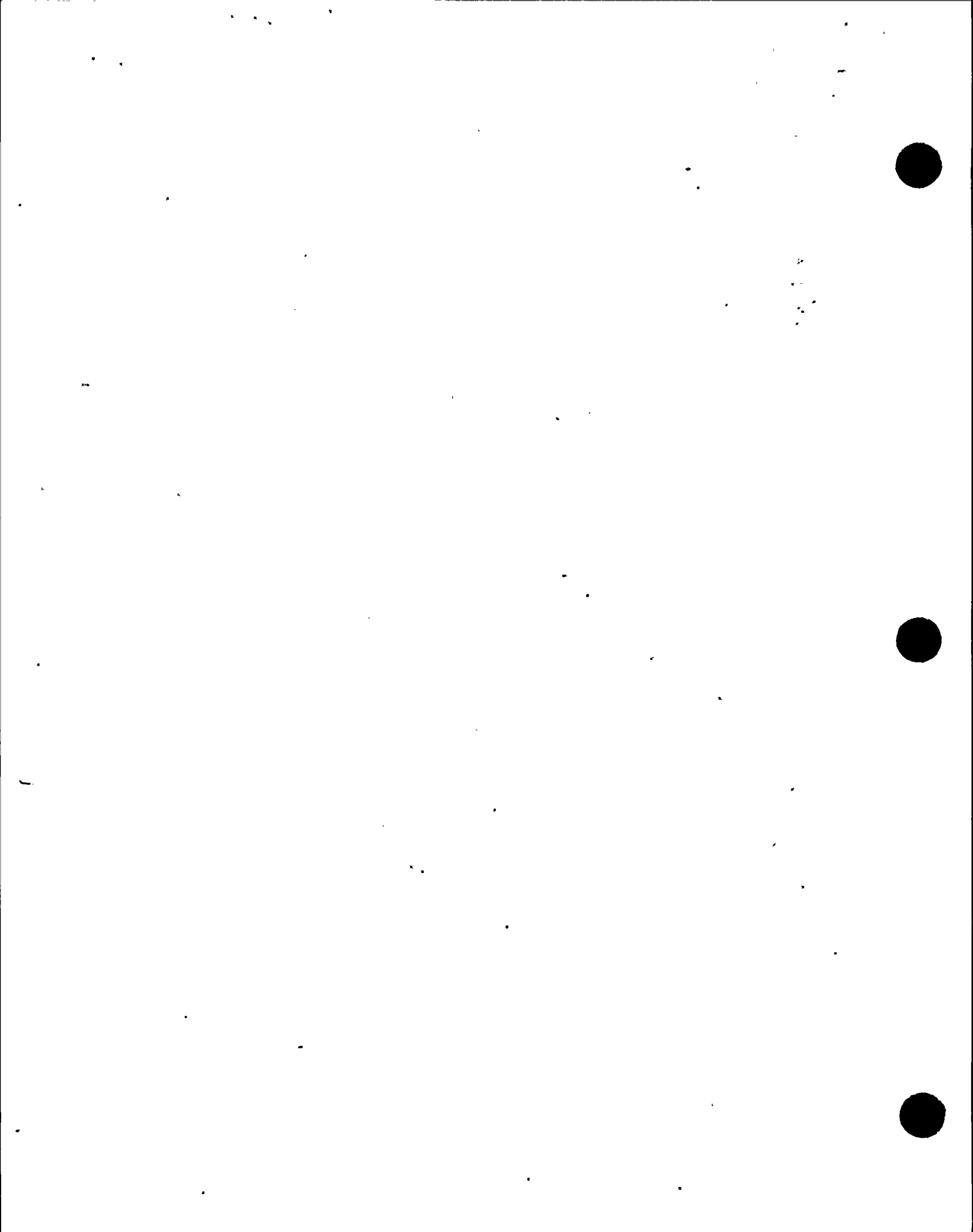
FIGURE:

TITLE

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1	Waste Shipment Radionuclide Summary Sheet
2	Shipment Preparation Worksheet
3	Waste Classification Worksheet - A
4	Waste Classification Worksheet - B
5	Radioactive Materials Classification Worksheet



THE PACKAGING AND TRANSPORTATION OF RADIOACTIVE MATERIAL

1.0 PURPOSE

- 1.1 The purpose of this procedure is to provide instructions to authorized personnel for documenting, packaging and transporting radioactive material from Nine Mile Point Nuclear Station.

2.0 RESPONSIBILITIES

- 2.1 The Superintendent, Chemistry and Radiation Management shall be responsible for the administration of this procedure.
- 2.2 The Supervisor Chemistry and Radiation Protection and Supervisor Radwaste Operations or an authorized alternate shall be responsible for the implementation of this procedure.
- 2.3 Personnel authorized to prepare radioactive material for transportation from Nine Mile Point Nuclear Station shall be responsible to package, label, have surveyed, document and transport the radioactive material in accordance with the requirements outlined in this procedure.
- 2.4 All responsible Department Heads, Supervisors, and authorized personnel responsible for the implementation of this procedure shall be trained in this procedure.

3.0 REQUIREMENT AND ACCEPTANCE CRITERIA

- 3.1 The requirements will be satisfied when radioactive material is shipped from Nine Mile Point Nuclear Station in accordance with this procedure and the required data recorded and a copy submitted to the Supervisor Chemistry and Radiation Protection and, for radwaste shipments, Supervisor Radwaste Operations, or designated alternates for review.

3.2 Technical Specifications

- 3.2.1 Tech. Specification No. 6.11, requires procedures for Personnel Radiation Protection to be prepared consistent with the requirements of 10CFR20 (see reference for exact wording).

3.3 10 CFR 20

The regulations in 10 CFR 20 establish standards for protection against radiation hazards arising from licensed activities. It is the purpose of 10 CFR 20 to control the possession, use and transfer of licensed material and the radiation emanating from it.

3.4 10 CFR 61

"No person may receive, possess and dispose of radioactive waste containing source, special nuclear or byproduct material at a land disposal facility unless authorized by a license issued by the Commission pursuant to this part, or unless exemption has been granted by the Commission under § 61.6."

3.5 10 CFR 71

3.5.1 10 CFR 71.3 "A Licensee subject to the regulations in this part may not (a) deliver any licensed materials to a carrier for transport or (b) transport licensed material except as authorized in a general license or a specific license issued by the Commission, or as exempted in this part." (See referenced section as appropriate.)

3.6 49 CFR 173.1 (b)

3.6.1 "A shipment that is not prepared for shipment in accordance with this subchapter may not be offered for transportation by air, highway, rail or water. It is the duty of each person who offers hazardous materials for transportation to instruct each of his officers, agents and employees having any responsibility for preparing hazardous materials for shipment as to applicable regulations in this subchapter." (See referenced section as appropriate.)

3.7 Station

3.7.1 External surfaces of all packages containing radioactive materials shall be surveyed in accordance with procedures specified below and/or in Procedure RP-3.

3.7.2 The Radiation Survey Log Sheets (RSLs), their attachments, and the Radioactive Shipment Record (RSR) and/or Radioactive Shipment Manifest Form shall serve as records for all surveys.

4.0 SPECIAL EQUIPMENT

4.1 Thyac, Victoreen Model No. 490 (S-RTP-17).

4.2 Cutie Pie, Victoreen Instrument Model 740A and Model 740F (S-RTP-15).

4.3 RO-2A, Eberline Ion Chamber (S-RTP-52).

4.4 RO-2, Eberline Ion Chamber (S-RTP-52B).

4.5 Survey Instrument, Eberline Instrument, Model E-520 (S-RTP-53).

- 4.6 Portable Neutron Rem Counter (PNR-4), Eberline (S-RTP-40).
- 4.7 BC-4 Beta Counter, Eberline (V.A.4).
- 4.8 Model PC-5 Proportional Counter (V.A.6-N).
- 4.9 Ge-Li Multi-Channel Analyzer (V.A.7-N).
- 4.10 Disc Smears and other wipe-test material, envelopes, or plastic bags to carry sample material (see RP-3).
- 4.11 Labels and/or signs, placards.

5.0 DEFINITIONS (49CFR173.403)

- 5.1 Package - Means the packaging together with its radioactive contents as presented for transport.
- 5.2 Packaging - Means the assembly of components necessary to ensure compliance with the packaging requirements in the prescribed regulations.
- 5.3 Radioactive Contents - Means the radioactive material, together with any contaminated liquids or gases, within the package.
- 5.4 Radioactive Material - Means any material having a specific activity greater than 0.002 microcuries per gram ($\mu\text{Ci/g}$).
- 5.5 Specific Activity - Means the activity of the radionuclide per unit mass of that nuclide. The specific activity of a material in which the radionuclide is essentially uniformly distributed is the activity per unit mass of the material.
- 5.6 Transport Index - Means the dimensionless number (rounded up to the first decimal place) placed on the label of a package to designate the degree of control to be exercised by the carrier during transportation, and determined as follows:
 - (a) The number expressing the maximum radiation level in millirem per hour at one meter (3.3 feet) from the external surface of the package; or
 - (b) For Fissile Class II packages or packages in a Fissile Class III shipment, the number expressing the maximum radiation level at one meter (3.3 feet) from the external surface of the package, or the number obtained by dividing 50 by the allowable number of packages which may be transported together, whichever is larger.
- 5.7 A₁ - Means the maximum activity of special form radioactive material permitted in a Type A package.
A₂ - Means the maximum activity of radioactive material other than special form or low specific activity radioactive material permitted in a Type A package.

- 5.8 Non-Fixed Radioactive Contamination - Means radioactive contamination that can be readily removed from a surface by wiping with an absorbant material.
- 5.9 Fissile Material - Means material that is fissionable and includes one or more fissile radionuclides. Fissile radionuclides are Plutonium-238, Plutonium-239, Plutonium-241, Uranium-233, and Uranium-235. A fission is a nuclear transformation in which the nucleus of an atom splits into at least two other nuclei and releases a relatively large amount of energy.
- 5.10 Normal Form Radioactive Material - Means radioactive material which has not been demonstrated to qualify as "Special Form Radioactive Material".
- 5.11 Special Form Radioactive Material - Means radioactive material which satisfies the following conditions:
- (A) It is either a single solid piece or is contained in a sealed capsule that can only be opened by destroying the capsule;
 - (B) The piece or capsule has at least one dimension not less than 5 millimeters (0.197 inch); and
 - (C) It satisfies the Impact Test, Percussion Test, Bending Test, Heat Test, and Leaching Assessment of 49 CFR 173.469.
- 5.12 Hazardous Material - Means a substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated.
- 5.13 Class A Waste - Is waste that is usually segregated from other waste classes at the disposal site. The physical form and characteristics must meet the minimum requirements of 10 CFR 61.56 (a).
- 5.14 Class B Waste - Is waste that must meet more rigorous waste form requirements to ensure stability after disposal. Class B waste form must meet the minimum and stability requirements of 10 CFR 61.56.
- 5.15 Class C Waste - Is waste that not only must meet more rigorous requirements on waste form to ensure stability but also requires additional measures at the disposal facility to protect against inadvertant intrusion.
- 5.16 The definition of other classifications and amounts are written within the procedure.

6.0 PROCEDURE

6.1 Prerequisites

- 6.1.1 The shipper shall establish if the material is radioactive, its "A" value, classification and waste class, if applicable.

6.1.2 The packaging of radioactive material shall be so designed and constructed and the contents so limited that under normal conditions of transport: (49 CFR 173.24a)

1. There will be no significant release of materials to the environment,
2. The effectiveness of the package will not be substantially reduced, and
3. There will be no mixture of gases or vapors which could significantly reduce the effectiveness of the package as a result of increased heat or pressure or through an explosion.

6.2 Precautions

6.2.1 Qualified and authorized personnel shall package radioactive material to be shipped from Nine Mile Point Nuclear Station.

6.2.2 Qualified and authorized personnel shall perform final radiological surveys of packages containing radioactive materials.

6.3 Incoming Survey

6.3.1 Upon the arrival of any radioactive materials or transport vehicle (tractor/trailer), the entire unit shall be receipt inspected for transferable/fixed contamination and dose rate survey by the Radiation Protection Department according to procedures described in RP-3 and RP-4 prior to entry into the restricted area.

6.3.2 All contamination surveys (smears) shall be checked with the appropriate beta/gamma detector and 25% checked for alpha.

6.3.3 The following data shall be entered on the Radiation Survey Log Sheet.

6.3.3.1 Description:

- a. Type of shipment (i.e., empty spent resin cask, etc.)
- b. Shipment number
- c. Tractor number
- d. Trailer number
- e. Cask identification number, if applicable
- f. Liner number, if applicable

6.3.3.2 Results

- a. Date and time.
- b. ~~Fixed~~ contamination levels.
- c. ~~Removable~~ contamination levels (beta, gamma), (enter number analyzed).
- d. ~~Removable~~ contamination levels (alpha), (enter the number analyzed)
- e. Background radiation levels
- f. Additional information as required by RP-4.

6.4 Radiological Analysis of Radioactive Shipment

6.4.1 Spent Resin, Filter Sludge, Concentrated Waste

6.4.1.1 Sampling and analysis of spent resins, filter sludge and concentrated waste shall be in accordance to with NI-PSP-14.

6.4.1.2 Refer to the Waste Shipment Radionuclide Summary Sheets (Attachment 1) of NI-PSP-14 for the radionuclide concentrations of waste shipments.

6.4.2 Dry Active Waste and Miscellaneous Waste Materials

6.4.2.1 The latest radioisotopic analysis (NI-PSP-14, Waste Shipment Radionuclide Summary Sheet) of concentrated waste is used as the radioisotopic analysis for the shipment of dry active waste.

6.4.2.2 Consult supervision for situations when the curie content is to be determined by an alternate means.

6.4.3 Other Shipments

6.4.3.1 GeLi analysis of representative samples will normally be performed. Consult supervision for specific requirements.

6.5 Description of Worksheets

6.5.1 Waste Shipment Radionuclide Summary Sheet (NI-PSP-14)

6.5.1.1 This worksheet provides the Radioactive Waste radionuclide analysis data required to perform this procedure (Attachment 1), and must accompany the shipment.

6.5.1.2 For other shipments, appropriate nuclide analysis data will be used.

6.5.2 Shipment Preparation Worksheet

6.5.2.1 This worksheet provides a systematic approach to performing calculations in this procedure. (Attachment 2)

6.5.2.2 This worksheet is required for all radioactive shipments, but does not accompany the shipments.

6.5.3 Waste Classification Worksheet - A

6.5.3.1 This worksheet provides a systematic approach to classifying spent resin, filter sludge, and concentrated waste. (Attachment 3).

6.5.3.2 This worksheet does not apply to shipments that are not Radioactive Waste.

6.5.4 Waste Classification Worksheet B

6.5.4.1 This worksheet provides a systematic approach to classify dry active waste and miscellaneous waste materials. (Attachment 4).

6.5.4.2 This worksheet does not apply to shipments that are not Radioactive Waste.

6.5.5 Radioactive Materials Classification Worksheet

6.5.5.1 This worksheet provides a systematic approach to determining the shipping requirements. (Attachment 5).

6.5.5.2 This worksheet is required for all radioactive shipments, but does not accompany the shipment.

6.6 Determination of Radioactive Shipment Total Curie Content

6.6.1 Spent Resin and Filter Sludge (Dewatered or Solidified); Solidified Concentrated Waste

6.6.1.1 Transfer the radionuclide and concentration data ($\mu\text{Ci/ml}$) from the Waste Shipment Radionuclide Summary Sheet (NI-PSP-14) to columns 1 and 2 of the Shipment Preparation Worksheet.

6.6.1.2 Total the concentration column (column 2) to obtain the total activity per ml.

6.6.1.3 Determine the total curie content by multiplying the total concentration by the shipment volume and convert results to millicurie units.

Example

$$\frac{1.5 \mu\text{Ci}}{\text{ml}} \times 70 \text{ ft}^3 \times \frac{2.83 \times 10^4 \text{ ml}}{\text{ft}^3} \times \frac{\text{mCi}}{10^3 \mu\text{Ci}} = 2.97 \times 10^3 \text{ mCi}$$

(Total Concentration) x (Shipment Volume) x (Conversion Factor) x (Conversion Factor)

6.6.1.4 Show all work on the Shipment Preparation Worksheet - and enter the results in the Column 3 box.

6.6.2 Dry Active Waste - LSA Box

6.6.2.1 Transfer the radionuclide and concentration data ($\mu\text{Ci/ml}$) from the latest Concentrated Waste Shipment Radionuclide Summary Sheet (NI-PSP-14) to column 1 and 2 of the Shipment Preparation Worksheet, and determine the total activity per ml.

6.6.2.2 Obtain a radiation reading at a point that is a distance 3 times the box's largest dimension (i.e., if the box is 8' long the reading would be taken at 24').

6.6.2.3 Apply the above radiation reading into the following formula

$$\frac{(1.67 \times 10^{-4})(\text{Radiation Reading})(\text{Reading Distance})^2}{\text{Average Gamma Energy}} = \text{Curie}$$

Example:

LSA Box 8' Long, 0.1 mR/hr @ 24 feet

$$\frac{(1.67 \times 10^{-4})(0.1)(24)^2}{1} = 9.62 \times 10^{-3} \text{ Ci}$$

6.6.2.4 Show all work on the worksheet and enter the results in millicuries in the column 3 box.

6.6.3 Dry Active Waste - Barrels

6.6.3.1 Transfer the radionuclide and concentration data ($\mu\text{Ci/ml}$) from the latest Concentrated Waste Shipment Radionuclide Summary Sheet (NI-PSP-14) to Column 1 and 2 of the Shipment Preparation Worksheet, and determine the total activity per ml.

6.6.3.2 Obtain a radiation reading at 3' from the barrel at mid-height, in mR/hr.

6.6.3.3 Determine curie content as follows:

$$(4.8 \times 10^{-3})(3' \text{ radiation reading}) = \text{Curie Content}$$

6.6.4 Laboratory Shipments

6.6.4.1 Transfer the radionuclide and concentration data ($\mu\text{Ci/ml}$) from the Spectral Analysis Print-out and enter into Columns 1 and 2 of the Shipment Preparation Worksheet.

6.6.4.2 Follow the instructions of steps 6.6.1.2 - 6.6.1.4

6.6.5 Other shipments

6.6.5.1 Consult supervision for specific requirements and enter appropriate data in Columns 1, 2, and 3 of Shipment Preparation Worksheet.

6.7 Determine Radionuclide Fractional Abundance

6.7.1 Divide each radionuclide concentration (column 2, Shipment Preparation Worksheet) by the total curie concentration (summation of column 2).

6.7.2 Enter the results in column 4.

6.8 Determine the Curie Content of each Radionuclide

6.8.1 Multiply the total curie content determined in section 6.6 (column 3, box) by the fractional abundance (column 4).

6.8.2 Enter the results in Column 5.

6.9 Determination of "A" value

6.9.1 Mixed Radionuclide Shipment

6.9.1.1 In the case of a mixture of different radionuclides, where the identity and activity of each radionuclide is known, the permissible activity of each radionuclide R_1, R_2, \dots, R_n must be such that $F_1 + F_2 + \dots + F_n$ is not greater than unity, when -

$$F_1 = \frac{\text{Total Activity of } R_1}{A_1(R_1)}$$

$$F_2 = \frac{\text{Total Activity of } R_2}{A_1(R_2)}$$

$$F_n = \frac{\text{Total Activity of } R_n}{A_1 R_n}$$

Where $A_1 (R_1, R_2 \dots R_n)$ is the value of A_1 or A_2 as appropriate for the nuclide $R_1, R_2 \dots R_n$.

NOTE: A_1 and A_2 values are presented in Tables 1 and 2.

6.9.1.1.1 Convert the column 5 activities, mCi, (Shipment Preparation Worksheet) to Curies. Enter into column 6.

6.9.1.1.2 Enter the A_2 value for each radionuclide in the appropriate column 8, 11, or 14. "A" values are listed in Table 1.

ex. Co-60 $A_2 = 7$ Column 14
Cm-242 $A_2 = 0.2$ Column 11
Pu-239 $A_2 = 0.002$ Column 8

6.9.1.1.3 Divide curie values of each radionuclide listed in column 6 by the appropriate A_2 value listed in columns 8, 11 or 14. Enter the results in appropriate column 9, 12 or 15.

6.9.1.1.4 Sum columns 9, 12 and 15, then sum these results. Interpret as follows:

$$(9) + (12) + (15) \leq 1 \quad \text{Type A}$$

$$(9) + (12) + (15) > 1 \quad \text{Type B}$$

NOTE: If the (9), (12), (15) is greater than 1 the package may still qualify for the LSA provisions.

6.9.1.2 For mixed fission products, where a detailed analysis of the mixture is not carried out, the following activity limits apply:

- a. $A_1 = 10$ curies.
- b. $A_2 = 0.4$ curies.

6.9.1.3 A single radioactive decay chain is considered to be a single radionuclide when the radionuclides are present in their naturally occurring portions and no daughter nuclide has a half-life either longer than 10 days or longer than that of the parent nuclide. The activity to be taken into account and the A_1 or A_2 value to be applied are those corresponding to the parent nuclide of that chain. When calculating A_1 or A_2 values, radiation emitted by daughters must be taken into account. However, in the case of radioactive decay chains in which any daughter nuclide has a half-life either longer than 10 days or greater than that of the parent nuclide, the parent and daughter nuclides are considered to be mixtures of different nuclides.

6.9.1.4 When the identity of each radionuclide is known but the individual activities of some of the radionuclides are not known, the formula given in Section 6.9.1.1 must be applied. To establish the values of A_1 or A_2 as appropriate, all the radionuclides whose individual activities are not known (but whose total activity is known) must be classed in a single group and the most restrictive value of A_1 or A_2 applicable to any one of them shall be used as the value of A_1 and A_2 in the denominator of the fraction.

6.9.1.5 Where the identity of each radionuclide is known but the individual activity of the radionuclides is not known, the most restrictive value of A_1 or A_2 applicable to any one of the radionuclides present is the applicable value.

6.9.1.6 When the identity of the radionuclides is not known, the value of A_1 is 2 curies and the value of A_2 is 0.002 curies. However, if alpha emitters are known to be absent, the value of A_2 is 0.4 curies.

6.9.2 Single Radionuclide Shipments

6.9.2.1 For single radionuclides of known identity, the values of A_1 and A_2 are those given in the table in Table 1. The values of A_1 and A_2 are also applicable for radionuclides contained in (α, n) or (γ, n) neutron sources.

6.9.2:2 For any single radionuclide of known identity, which is not listed in Table 1, the values of A_1 and A_2 shall be determined in accordance with the following:

6.9.2.2.1 If the radionuclide emits only one type of radiation, A_1 is determined in accordance with the following paragraphs. For radionuclides emitting different kinds of radiation, A_1 is the most restrictive value of those determined for each kind of radiation. However, in both cases, A_1 is restricted to a maximum of 1000 curies. If a parent nuclide decays into shorter lived daughter, of a half-life not greater than 10 days, A_1 is calculated for both the parent and the daughter, and the more limiting of the two values is assigned to the parent nuclide.

- a. For gamma emitters, A_1 is determined by the expression: $A_1 = 9\Gamma$ curie where Γ is the gamma-ray constant, corresponding to the dose in roentgens per hour at 1 meter per curie; the number 9 results from the choice of 1 rem per hour at a distance of 3 meters as the reference dose-equivalent rate. (See Radiological Health Handbook for gamma ray constants.)
- b. For x-ray emitters, A_1 is determined by the atomic number (Z) of the nuclide:
 $Z < 55$ $A_1 = 1000$ curies
for $Z > 55$ $A_1 = 200$ curies
- c. For beta emitters, A_1 is determined by the maximum beta energy (E_{max}) according to the following table:

A_1 FOR BETA EMITTERS -1

Emax (MeV)	A_1 (curies)
< 0.5	1000
0.5 - < 1.0	300
1.0 - < 1.5	100
1.5 - < 2.0	30
> 2.0	10

- d. For alpha emitters, A_1 is determined by the expression:
 $A_1 = 1000 A_3$
where A_3 is the value listed in the following table:

A_3 FOR ALPHA EMITTERS

ATOMIC NO.	PHYSICAL HALF LIFE		
	< 1000 DAYS	1000 DAY - 10^6 YRS	> 10^6 YRS
1-81	3 Ci	50 mCi	3 Ci
> 81	2 mCi	2 mCi	3 Ci

6.9.2.2.2 For assignment of A_2 values, A_2 is the more restrictive of the following values:

- a. The corresponding A_1 .
- b. The value A_3 obtained from Table for Alpha Emitters.

6.9.2.3 For any single radionuclide whose identity is unknown, the value of A_1 is 2 curies and the value of A_2 is 0.002 curies. However, if the atomic number of the radionuclide is less than 82, the value of A_1 is 10 curies and the value of A_2 is 0.4 curies.

6.10 Waste Classification (Not required for non-Radwaste shipments)

6.10.1 Spent Resin, Filter Sludge, Concentrated Waste

6.10.1.1 Use Waste Classification Worksheet A. (Attachment 3)

6.10.1.2 Column 1 lists the radionuclides required for waste classification per 10 CFR 61.55, Table 1.

6.10.1.3 Column 2 - enter the radionuclide concentration. Obtain from the Waste Shipment Radionuclide Summary Sheet (N1-PSP-14).

NOTE: TRU with half-life greater than 5 years, Pu-241, Cm-242 must be entered as nCi/gm.

6.10.1.4 Column 3 lists the Class A limits for the 10 CFR 61.55 Table 1 radionuclides.

6.10.1.5 Column 4 - divide the column 2 radionuclide concentrations by the column 3 limits.

6.10.1.6 Sum column 4, enter the value.

6.10.1.7 Interpret the column 4 summation as follows:

$\sum (4) \leq 1$ proceed to step 6.10.1.12

$\sum (4) > 1$ proceed to step 6.10.1.8

6.10.1.8 Column 5 - lists the Class C limits for the 10 CFR 61.55, Table 1 radionuclides.

6.10.1.9 Column 6 - divide the column 2 radionuclide concentrations by the column 5 limits.

6.10.1.10 Sum column 6, enter the value.

6.10.1.11 Interpret the column 6 summation as follows:

$\sum (6) \leq 1$ proceed to step 6.10.1.12

$\sum (6) > 1$, the waste is unsuitable for burial, contact supervision

- 6.10.1.12 Column 7 - lists the radionuclides required for waste classification per 10 CFR 61.55, Table 2.
- 6.10.1.13 Column 8 - enter the radionuclide concentration. Obtain from the Radionuclide Summary Sheet (NI-PSP-14).
- 6.10.1.14 Column 9 - lists the Class A limits for 10 CFR 61.55, Table 2 radionuclides.
- 6.10.1.15 Column 10 - divide the column 8 radionuclide concentrations by the column 9 limits.
- 6.10.1.16 Sum column 10, enter the value.
- 6.10.1.17 Interpret the column 10 summation as follows:
- $\sum (10) \leq 1$, proceed to step 6.10.1.26
- $\sum (10) > 1$, proceed to step 6.10.1.18
- 6.10.1.18 Column 11 - lists the Class B limits for the 10 CFR 61.55, Table 2 radionuclides.
- 6.10.1.19 Column 12 - divide the column 8 radionuclide concentrations by the column 11 limits.
- 6.10.1.20 Sum column 12, enter the value.
- 6.10.1.21 Interpret the column 12 summation as follows:
- $\sum (12) \leq 1$, proceed to step 6.10.1.26
- $\sum (12) > 1$, proceed to step 6.10.1.22
- 6.10.1.22 Column 13 - lists the Class C limits for the 10 CFR 61.55, Table 2 radionuclides.
- 6.10.1.23 Column 14 - divide the column 8 radionuclide concentrations by the column 13 limits
- 6.10.1.24 Sum column 14, enter the value
- 6.10.1.25 Interpret the column 14 summation as follows:
- $\sum (14) \leq 1$, proceed to step 6.10.1.26
- $\sum (14) > 1$, the waste is unsuitable for burial, contact supervision
- 6.10.1.26 Classify waste according to the following performed in sequence:

$\sum (4) < 1$ and $\sum (10) < 1$	Class A
$\sum (4) < 1$ and $\sum (12) < 1$	Class B
$\sum (4) < 1$ and $\sum (14) < 1$	Class C
$\sum (6) < 1$ and $\sum (10), (12),$ or $(14) \leq 1$	Class C
$\sum (6) > 1$ or $\sum (14) > 1$	Unsuitable of burial

6.10.2 Dry Active Waste

6.10.2.1 Transfer the curie content of each radionuclide obtained from column 5 of the Shipment Preparation Worksheet to the respective position in column 2 of Waste Classification Worksheet B (Attachment 4).

6.10.2.2 Determine the DAW radionuclide concentration in $\mu\text{Ci/ml}$ by the following formula and enter into column 3.

$$\text{mCi} \times \frac{1}{\text{shipment volume (ml)}} \times \frac{10^3 \mu\text{Ci}}{\text{mCi}} = \mu\text{Ci/ml}$$

NOTE: TRU with half life greater than 5 years, Pu-241, and Cm-242 must be expressed in nCi/gm; see section 6.10.2.3.

6.10.2.3 The TRU with half-life greater than 5 years, Pu-241 and Cm-242 must be converted to nCi/gm. To determine nCi/gm perform the calculation:

$$\frac{\text{nCi}}{\text{gm}} = \frac{\text{mCi}}{\text{Weight (gm)}} \times \frac{10^6 \text{nCi}}{\text{mCi}}$$

Obtain mCi from Column 2. Perform calculation on back of worksheet and enter the results in column 3

6.10.2.4 Column 4 - 10 CFR 61.55, Table 1 Class A limits

6.10.2.5 Column 5 - divide column 3 by 4

6.10.2.6 Sum column 5 and interpret

$\Sigma (5) \leq 1$, proceed to step 6.10.2.10

$\Sigma (5) > 1$, proceed to step 6.10.2.7

6.10.2.7 Column 6 - 10 CFR 61.55, Table 1, Class C limits

6.10.2.8 Column 7 - divide column 3 by Column 6.

6.10.2.9 Sum column 7 and interpret:

$\Sigma (7) \leq 1$, proceed to step 6.10.2.10

$\Sigma (7) > 1$, unsuitable for land burial, contact supervision

6.10.2.10 Column 8 - 10 CFR 61.55, Table 2 radionuclides

6.10.2.11 Column 9 - Transfer the curie content of each radionuclide obtained from column 5 of the Materials Shipment Preparation Worksheet.

6.10.2.12 Column 10 - determine the radionuclide concentration as per 6.10.2.2

6.10.2.13 Column 11 - 10 CFR 61.55, Table 2, Class A limits

6.10.2.14 Column 12 - divide column 10 by column 11

- 6.10.2.15 Sum Column 12 and interpret:
 $\Sigma(12) \leq 1$, proceed to step 6.10.2.22
 $\Sigma(12) > 1$, proceed to step 6.10.2.16.
- 6.10.2.16 Column 13 - 10 CFR 61.55, Table 2, Class B limits
- 6.10.2.17 Column 14 - divide column 10 by column 13
- 6.10.2.18 Sum column 14 and interpret:
 $\Sigma(14) \leq 1$, proceed to step 6.10.2.22
 $\Sigma(14) > 1$, proceed to step 6.10.2.19
- 6.10.2.19 Column 15 - 10 CFR 61.55, Table 2, Class C limits
- 6.10.2.20 Column 16 - divide column 10 by column 15
- 6.10.2.21 Sum column 16 and interpret
 $\Sigma(16) \leq 1$, proceed to step 6.10.2.22
 $\Sigma(16) > 1$, unsuitable for land burial, contact supervision
- 6.10.2.22 Classify waste according to the following performed in sequence:

$\Sigma(5) < 1$ and $\Sigma(12) < 1$	Class A
$\Sigma(5) < 1$ and $\Sigma(14) < 1$	Class B
$\Sigma(5) < 1$ and $\Sigma(16) < 1$	Class C
$\Sigma(7) < 1$ and $\Sigma(12), (14),$ or $(16) \leq 1$	Class C
$\Sigma(7) > 1$ or $\Sigma(16) > 1$	Unsuitable of burial

- 6.11 LSA Determination, (For all shipments except limited quantity)
- 6.11.1 Obtain the activity in mCi for each radionuclide listed in Column 5 of the Shipment Preparation Worksheet and convert to mCi/gm. Enter these values in the appropriate column (10, 13, 16).
- 6.11.2 Sum column (10) (APG₁), (13) (APG₂) and (16) (APG₃) and perform the following function
- $$\frac{\Sigma APG_1}{0.0001} + \frac{\Sigma APG_2}{0.005} + \frac{\Sigma APG_3}{0.3} =$$
- 6.11.3 Interpret the result as follows:
 ≤ 1 LSA
- 6.12 Decay Heat Calculation (Waste Casks and other casks with heat load specified)
- 6.12.1 Table 3 provides the watts/curie conversion factor for commonly shipped radionuclides.
- 6.12.2 Watts/curie conversion factors for radionuclides not listed.

6.12.2.1 Obtain E (MeV/disintegration) for the nuclide from the Chart of Nuclides, and calculate conversion factor as follows:

$$\frac{E(\text{Mev})}{\text{dis.}} \times \frac{3.7 \times 10^{10} \text{ dis}}{\text{Ci-sec}} \times \frac{\text{Watt-sec}}{6.243 \times 10^{12} \text{ Mev}} = \frac{\text{Watts}}{\text{Ci}}$$

6.12.2.2 If E is not given in the Chart of Nuclides, sum according to the following method:

1. All alpha energies MeV x Fract. _____
2. Average B+ energy (1/3 E max) _____
3. Average B- energy (1/3 Emax) _____
4. All e- energies (MeV) _____
5. All gamma energies MeV x Frac. _____

NOTE: Sum only the energies per isotope which have abundances greater than 10%

Example La-140

- | | |
|--|-----------------------------|
| 1. no alpha | 0 |
| 2. no B+ | 0 |
| 3. $\frac{2.75}{3} + \frac{1.69}{3} + \frac{1.36}{3}$ | <u>1.93</u> |
| 4. no e- energies | 0 |
| 5. .329 (.2) + .487 (.4) + .815 (.19)
+ .923 (.1) + 1.596 (.96) | <u>2.04</u>
3.97 MeV/dis |

6.12.3 Enter the Watts/curie conversion factor into column 17, Shipment Preparation Worksheet.

6.12.4 Multiply each radionuclide curie content (column 6) by column 17, enter results in Column 18.

6.12.5 Sum column 18. The sum is the decay heat in Watts.

6.12.6 Obtain and record maximum permitted heat in watts for the particular cask from the Certificate of Compliance.

6.12.7 Contact supervision if the calculated heat generation rate is greater than 90% of the permitted value.

6.13 Determination of Radioactive Materials Classification

Using the information generated in Sections 6.4 - 6.11 and the Radioactive Materials Classification Worksheet (Attachment 5) determine the classification as described in this section.

6.13.1 Fissile Classification - Refer to Section 5.9 for the definition of fissile material. The numerical values for package assignments as Fissile Class I, the transport indexes for Fissile Class II packages, and the vehicle limitations for Fissile Class III shipments shall be determined in accordance with 10CFR71.55 - 71.61. (49 CFR 173.455b)

6.13.1.1 The following packages are exempt from fissile material classification and from the fissile material standards of §§ 71.55-71.61, but are subject to all other requirements of this part (10CFR71.53):

- a. A package containing not more than 15 grams of fissile radionuclides. If material is transported in bulk, the quantity limitation applies to the conveyance; or
- b. A package containing irradiated natural or depleted uranium including the products of irradiation if the irradiation has taken place only in a thermal reactor; or
- c. A package containing homogenous hydrogenous solutions or mixtures where:
 1. The minimum ratio of the number of hydrogen atoms to the number of atoms of fissile radionuclides (H/X) is 5200;
 2. The maximum concentration of fissile radionuclide is five grams/liter; and
 3. The maximum mass of fissile radionuclides in the package is 800 grams, except for a mixture where the total mass of plutonium and uranium-233 exceeds one percent of the mass of uranium-235 the limit is 500 grams. If the material is transported in bulk, the quantity limitations apply to the vehicle, to a hold or compartment of an inland waterway craft, or to a hold, compartment, or defined deck area of a seagoing vessel; or
- d. A package containing uranium enriched in uranium-235 to a maximum of one percent by weight and with a total plutonium and uranium-233 content of up to one percent of the mass of uranium-235, if the fissile radionuclides are distributed homogeneously throughout the package contents, and do not form a lattice arrangement within the package; or
- e. A package containing any fissile material if it does not contain more than five grams of fissile radionuclides in any 10-liter volume, and if the material is packaged so as to maintain this limit of fissile radionuclide concentration during normal transport; or
- f. A package containing not more than one kilogram of plutonium of which not more than 20% by mass may consist of plutonium-239, plutonium-241, or any combination of those radionuclides; or
- g. A package containing liquid solutions of uranyl nitrate enriched in uranium-235 to a maximum of two percent by weight with total plutonium and uranium-233 not more than one-tenth percent of the mass of uranium 235.

6.13.2 Limited Quantity of Radioactive Materials - Means a quantity of radioactive material whose activity limits do not exceed the Activity Limits for Limited Quantities Instruments and Devices. (49CFR173.423) (See Chart 1, page 19)

6.13.3 A Type A package shall not contain radioactive contents with an activity greater than the following: (49 CFR 173.431)

- (a) For special form materials A_1 : or
- (b) For all other radioactive materials, A_2 .

6.13.4 A Type B(U) and Type B(M) package shall be used when the radioactive contents exceed A_1 or A_2 .

NOTE: Type B(U) is a unilateral approved package and Type B(M) is a multilateral approved package. For A_1 and A_2 values see Table 1.

6.13.5 Low Specific Activity (LSA) Materials - Means any of the following:

6.13.5.1 For uniform mixtures of nuclides, as determined in section 6.11.

6.13.5.2 Uranium or thorium ores and physical or chemical concentrates of those ores.

6.13.5.3 Unirradiated natural or depleted uranium or unirradiated natural thorium.

6.13.5.4 Tritium oxide in aqueous solutions provided the concentration does not exceed 5 millicuries per milliliter.

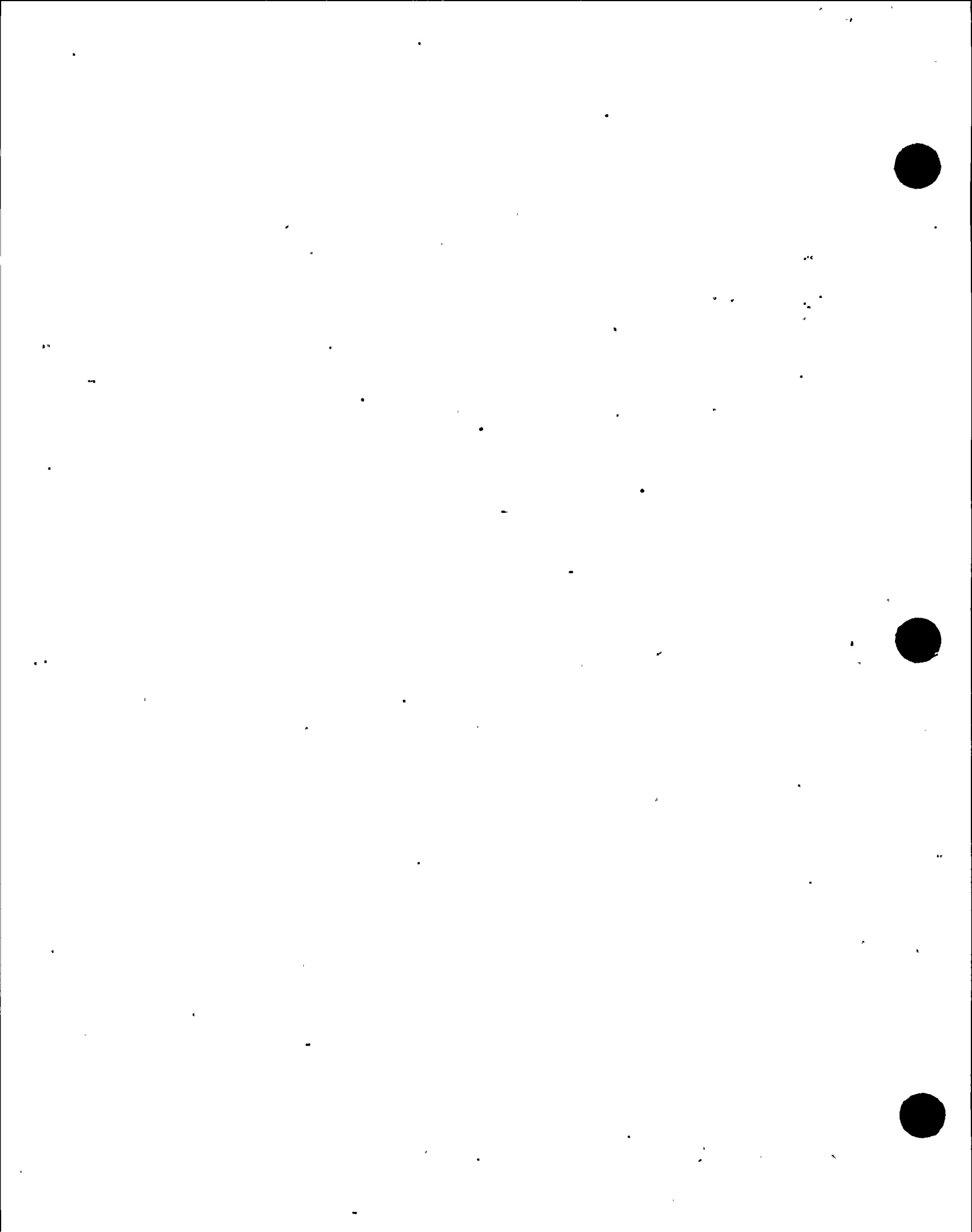
6.13.5.5 Externally contaminated nonradioactive materials may be considered as low specific activity provided the radioactive contamination is not readily dispersible (fixed) and the surface contamination is averaged over 1 square meter and does not exceed 0.0001 millicurie (220,000 dpm) per square centimeter for which the A_2 quantity is not more than .05 curie or 0.001 millicurie (2.2×10^6 dpm) per square centimeter for other radionuclides.

CHART 1
ACTIVITY LIMITS FOR LIMITED QUANTITIES INSTRUMENTS AND DEVICES

Nature of Contents	Instruments and devices		Materials package limits
	Instrument and article limits ¹	Package limits	
Solids:			
Special form.....	$10^{-2}A_1$	A_1	$10^{-3}A_1$
Other forms.....	$10^{-2}A_2$	A_2	$10^{-3}A_2$
Liquids:			
Tritiated Water			
<0.1Ci/liter.....	1000 Curies
0.1 Ci to 1.0 Ci/l	100 Curies
>1.0 Ci/liter....	1 Curie
Other liquids....	$10^{-3}A_1$	$10^{-1}A_1$	$10^{-4}A_2$
Gases:			
Tritium ²	20 Curies.....	200 Curies.....	20 Curies
Special form.....	$10^{-3}A_1$	$10^{-2}A_1$	$10^{-3}A_1$
Other forms.....	$10^{-3}A_2$	$10^{-2}A_2$	$10^{-3}A_2$

¹ For mixture of radionuclides see Section 6.9.1

² These values also apply to tritium in activated luminous paint and tritium absorbed on solid carriers.



6.13.6 Highway Route Controlled Quantity - Means a quantity within a single package which exceeds:

1. 3000 times the A_1 value for special form radioactive material;
2. 3000 times the A_2 value for normal form radioactive material
3. 30,000 curies, whichever is least.

6.13.7 Advance Notification Quantity (Nuclear Waste Only)(10CFR71.97)

6.13.7.1 Prior to transport of licensed material, an advance notification is required only when:

6.13.7.1.1 The licensed material is required by this part to be in Type B packaging for transportation.

6.13.7.1.2 The licensed material other than irradiated fuel is being transported to, through, or across state boundaries to a disposal site or to a collection point for transport to a disposal site:

6.13.7.1.3 The quantity of licensed material in a single package exceeds:

- a. 5,000 curies of special form radionuclides;
- b. 5,000 curies of uncompressed gases of Argon-41, Krypton-85m, Krypton-87, Xenon-131m, or Xenon-135;
- c. 50,000 curies of Argon-37, or of uncompressed gases of Krypton-85 or Xenon-133, or of Hydrogen-3 as a gas, as luminous paint, or adsorbed on solid material;
- d. 20 curies of other non-special form radionuclides for which A_2 is less than or equal to four curies; or
- e. 200 curies of other non-special form radionuclides for which A_2 is greater than four curies; and

6.13.7.1.4 The quantity of irradiated fuel is less than that subject to advance notification requirements of 10 CFR Part 73.

- NOTE:
1. Contact the Chemistry and Radiation Protection Supervisor or designee if advance notification is required.
 2. For all waste shipments, whether the above criteria apply or not, notification to Oswego Fire Control in accordance with the provisions of N1-WHP-2 is required.

6.14 Requirements for Shipping Radioactive Materials

6.14.1 Advance Notification (Nuclear Waste Only)(10CFR71.97)

When required (see Section 6.13.7), prior to transport of nuclear waste outside the confines of the licensee's plant, an advance notification made in writing must be sent to the appropriate governor or governor's designee and the director of the appropriate Nuclear Regulatory Commission Inspection and Enforcement Regional Office. The notification shall be postmarked seven days prior to estimated departure period (normally 7 days) or delivered four days prior if sent by messenger. A list of governor's designees is provided in Table 4 of this procedure and Table 5 contains a list of the Regional Offices. The advance notification shall furnish the following information. (10 CFR 71.97)

- a. Name, address, and telephone number of the shipper, carrier and receiver of the nuclear waste shipment.
- b. A description of the nuclear waste in the shipment as required by 49 CFR 172.202 and 172.203(d).
- c. The point of origin, destination, and arrival at state boundaries. Also the seven day period in which each of these are estimated to occur.
- d. Provisions for contacting during shipment, revision notice and cancellation notice.

6.14.2 General Transportation Requirements (49CFR173.448)

6.14.2.1 Each shipment of radioactive materials shall be secured in order to prevent shifting during normal transportation conditions.

6.14.2.2 Except as may be specifically required by the competent authority in the applicable certificate, a package of radioactive materials may be carried among packaged general cargo without special storage provisions, if:

- a. The heat output in watts does not exceed 0.1 times the minimum package dimension in centimeters; or
- b. The average surface heat flux of the package does not exceed 15 watts per square meter and the immediately surrounding cargo is not in sacks or bags or otherwise in a form that would seriously impede air circulation for heat removal.

6.14.2.3 Packages bearing labels prescribed in Section 6.14.5 may not be carried in compartments occupied by passengers, except in those compartments exclusively reserved for couriers accompanying those packages.

6.14.2.4 Mixing of different kinds of packages, including Fissile Class I packages with Fissile Class II packages, is authorized in accordance with Section 6.14.10.

6.14.2.5 No person shall offer for transportation aboard a passenger-carrying aircraft any single package with a transport index greater than 3.0 or an overpack with a transport index greater than 3.0.

6.14.2.6 No person shall offer for transportation aboard a passenger-carrying aircraft any radioactive material unless that material is intended for use in, or incident to, research, or medical diagnosis or treatment, or is excepted under the provisions of 49 CFR 175.10.

6.14.2.7 If an overpack is used to consolidate individual packages of radioactive materials, the packages shall comply with the packaging, marking, and labeling requirements of this procedure, and the following:

6.14.2.7.1 The overpack shall be labeled as prescribed in Section 6.14.5 except as follows:

a. The "contents" entry on the label may state "mixed" unless each inside package contains the same radionuclide(s).

b. The "number of curies" entry on the label must be determined by adding together the number of curie of the radioactive materials packages contained therein.

c. For a non-rigid overpack, the required label together with required package markings shall be affixed to the overpack by means of a securely attached, durable tag. The transport index shall be determined by adding together the transport indexes of the radioactive materials packages contained therein.

d. For a rigid overpack, the transport index shall be determined by-

1) Adding together the transport indexes of the radioactive materials packages contained in the overpack; or

2) Except for fissile radioactive materials, direct measurements as prescribed in Section 5.6 which have been taken by the person initially offering the packages contained within the overpack for shipment.

6.14.2.7.2 The overpack shall be marked as prescribed in Subpart D of Part 172 and §173.25(a).

6.14.2.7.3 The transport index of the overpack shall not exceed 3.0 for passenger-carrying aircraft shipments or 10.0 for cargo-only aircraft shipments.

6.14.3 Radiation Level Limitations (49CFR173.441)

6.14.3.1 Except as provided below the radiation level of a package designed for shipment under normal transport condition shall not exceed 200 mrem/hr at any point on the external surface of the package and the transport index does not exceed 10.

6.14.3.2 A shipment which exceeds the radiation levels above may be transported as an exclusive use shipment if the radiation level at any time during transportation does not exceed:

1. 200 mrem/hr on the external accessible surface of the package.
2. 200 mrem/hr at any point on the external surface (including upper and lower surfaces) of the vehicle.
3. 10 mrem/hr at 2 meters (6.6 feet) from the vehicle surfaces represented by the outer lateral surfaces.
4. 2 mrem/hr in any normally occupied position in the vehicle except that this provision does not apply to private motor carriers when the personnel are operating under a radiation protection program and wear radiation monitoring devices.

6.14.3.3 The accessible external surface of the package may be 1000 mrem/hr if the following conditions are met:

- a. The shipment is in a closed transport vehicle.
- b. The package is secured so that its position within the vehicle remains fixed during transportation.
- c. There are no loading or unloading operations between beginning and end of transportation.

6.14.4 Contamination Limits (49CFR173.443)

6.14.4.1 Except as provided below, the amount of non-fixed (removable) radioactive contamination on the external surfaces of each package shall not exceed the limits established in RP-3.

6.14.4.2 Upon approval from the Supervisor Chemistry and Radiation Protection or designee the removable contamination limits may be extended to the following:

Contaminant	Maximum Permissible Limits		
	$\mu\text{Ci}/\text{cm}^2$	dpm/cm ²	dpm/100cm ²
Beta-Gamma Emitting Radionuclides all Radionuclides with half-lives less than 10 days; natural uranium; natural thorium; uranium-235; uranium-238			
thorium 232: thorium 228 and thorium-230 when contained in ores or physical concentrates. All other	10 ⁻⁵	22	2200
alpha emitting radionuclides.	10 ⁻⁶	2.2	220

- 6.14.4.2.1 In the case of packages transported as exclusive use shipments, the removable radioactive contamination at any time during transport shall not exceed ten times the levels prescribed above.
- 6.14.4.2.2 Transport vehicles which utilize the provisions of Section 6.14.4.2.1 must be surveyed after each use and shall not be returned to service until the radiation dose rate at any accessible surface is less than 0.5 mrem/hr and no significant removable radioactive contamination present (RP-3 limits or with supervisory approval, Section 6.14.4.2.).
- 6.14.4.2.3 Provisions for closed vehicles used only for radioactive material shipments are provided in 49 CFR 173.443.
- 6.14.5 Labeling, Marking and Placarding Requirements (49CFR173.444 and 49CFR173.446)
- 6.14.5.1 Unless excepted from labeling by Sections 6.14.6 and 6.14.7.1 each package of radioactive material must be labeled according to this section.
- 6.14.5.2 All markings on packages containing radioactive materials shall be durable, in English and printed on or affixed to the surface of a package or on a label, tag or sign; shall be displayed on a background of a sharply contrasting color; shall be unobscured by labels or attachments; must be located away from any other marking that could substantially reduce its effectiveness and shall be the right size. (49CFR172.304)
- 6.14.5.3 Each package containing a radioactive material that also meets the definition of one or more additional hazards must be labeled as specified in this section in addition to the other hazard (i.e., RADIOACTIVE - CORROSIVE).
- 6.14.5.4 Each packaged in excess of 110 pounds (50 kg) shall have its gross weight plainly and durably marked on the outside of the package.
- 6.14.5.5 The proper labels will then be applied to opposite sides of the package.
- 6.14.5.6 Each specification packaging or approved packaging shall be marked according to the regulations governing the manufacturing of the package. For example, a specification 7A packaging shall have the following marks:

"USA DOT 7A TYPE A" and "RADIOACTIVE MATERIAL" (See 49CFR178.350-3 and 173.24[c])

NOTE: For markings required for each specification packaging refer to the proper regulation in 49CFR Part 178.

6.14.5.7 Each package which conforms to the requirements for a Type A or Type B packaging shall be plainly and durably marked on the outside of the package in letters at least 1/2 inch (13mm) high with the words "Type A" or "Type B" as appropriate.

6.14.5.8 Each package destined for export shipment must also have "USA" in conjunction with the specification marking or other package certificate identification (49CFR172.310).

6.14.5.9 Description of radioactive material labels are as follows:

- a. Radioactive White - I Label - It shall be white in color, with a single vertical bar on the lower half of the label that is bright red in color. (See Figure 1)
- b. Radioactive Yellow - II Label - The upper half of the label shall be bright yellow and the bottom half shall be white. Two vertical bars on the lower half of the label shall be bright red in color. (See Figure 2)
- c. Radioactive Yellow - III Label - It will have the upper half of the label in bright yellow and the bottom half shall be white. The three vertical bars in the lower half of the label shall be bright red in color. (See Figure 3)

6.14.5.10 The following applicable items of information shall be entered in the blank spaces on the radioactive material label by legible printing.

- a. Contents - Name of the radionuclides as taken from Table 1 (establish notation is acceptable ie. ^{60}Co). For mixtures of radionuclides the most restrictive radionuclides must be listed as space allows.
- b. Activity - Units shall be expressed in Curies. For a fissile material, in weight in grams or kilograms of the fissile radionuclides.
- c. Transport Index - As defined in Section 5.6.

6.14.5.11 The proper label to fix to a package of radioactive material is based on the radiation level at the surface of the package, the transport index and if appropriate, the fissile characteristics of the package. The proper category of label to be applied is determined by the following: (49CFR172.403)

TRANSPORT INDEX (T.I.)	RADIATION LEVEL AT PACKAGE SURFACE (R.L.)	FISSILE CRITERIA	LABEL CATEGORY
T.I. = 0	R.L. < 0.5 millirem per hour (mrem/hr)	Fissile Class I only, no Fissile Class II or III	White - I
T.I. < 1.0..	0.5 mrem/hr < R.L. < 50	Fissile Class I Fissile Class II with T.I. < 1.0, no Fissile Class III	Yellow - II
1.0 < T.I.	50 mrem/hr < R.L.	Fissile Class II with 1.0 < T.I. Fissile class III	Yellow - III

NOTE:

1. Any package containing a "Highway Route Controlled Quantity" must be labeled as Radioactive Yellow III.
2. Refer to Section 5.6 to determine the transport index.

6.14.5.12 The empty container label (Figure 4) shall be white in color, measure not less than 6 inches on each side, and printed in letters not less than one inch high in black ink. It will not have a radiation symbol and empty labels must be placed to cover old labels that haven't been removed, destroyed or obliterated from empty packages used for transporting radioactive materials. Empty containers may be shipped provided they comply with the following:

1. The surface dose rate does not exceed 0.5 mrem/hr.
2. The internal contamination does not exceed 1000 times the limits in Section 6.14.4.2
3. The external surface contamination (non-fixed) does not exceed the limits in RP-3 or with supervisory authorization, Section 6.14.4.2.
4. The empty label is affixed to the package according to 6.14.5.5 above.

6.14.5.13 Each motor vehicle, rail car, and freight container containing packaging labeled with Radioactive Yellow III label or loaded with Low Specific Activity materials shall be placarded (Figure 5 & 6) on the front, back, and both sides of the vehicle.

6.14.5.14 Each package of radioactive waste must be clearly labeled to identify whether it is Class A waste, Class B waste, or Class C waste as determined in Section 6.10. The label is to be applied to the container to be buried, not to the outside of the cask.

6.14.6 Excepted Materials

Some radioactive materials may fall into a classification of being excepted from general packaging requirements except for shipping papers. The following are requirements for such material:

6.14.6.1 Limited Quantities of Radioactive Material (49CFR173.421)

6.14.6.1.1 The quantities shall not exceed those amounts listed in Section 6.13.2.

6.14.6.1.2 The materials are packaged in strong tight packages that will not leak any radioactive material during conditions normally incident to transportation.

6.14.6.1.3 The radiation level shall not exceed 0.5mrem/hr. at any point on the external package surface.

6.14.6.1.4 The nonfixed surface contamination on the external surface does not exceed those in Section 6.14.4.

6.14.6.1.5 The outside of the inner packaging shall be marked radioactive.

6.14.6.1.6 The package does not contain more than 15 grams of Uranium-235 except as provided in Section 6.14.6.3.

6.14.6.2 Instruments and Articles (49CFR173.422)

6.14.6.2.1 The activity of the instrument or device does not exceed the relevant limit listed in Section 6.13.2.

6.14.6.2.2 The total activity per package does not exceed the relevant limit in Section 6.13.2.

6.14.6.2.3 The radiation level at 10cm (4in.) from any point on the external surface of any instrument or device does not exceed 10 mrem/hr.

6.14.6.2.4 The radiation level at any point on the external surface of a package bearing the instrument or device does not exceed 0.5 mrem/hr. or for exclusive use 2mrem/hr.

6.14.6.2.5 The non-fixed contamination on the external surface of the package does not exceed the limits in Section 6.14.4.

6.14.6.2.6 The package does not contain more than 15 grams of uranium except as provided in Section 6.14.6.3.

6.14.6.2.7 At least one external dimension of the package is not less than 10 centimeters (4in.).

6.14.6.3 Articles Containing Natural Uranium or Thorium (49CFR173.424)

6.14.6.3.1 The outer surface of the uranium or thorium is enclosed in an inactive sheath made of metal or other protective material.

6.14.6.3.2 The conditions in Sections 6.14.6.1.3, 6.14.6.1.4, and 6.14.6.1.5 are met.

6.14.7 Low Specific Activity (LSA) Materials (49CFR173.425)

6.14.7.1 Packaged shipments of LSA materials transported as exclusive use shipments are excepted from specification packaging, marking and labeling if they comply with the following: (49CFR173.425)

- a. Material must be packaged in strong tight packages so that there will be no leakage of radioactive material under conditions normally incident to transportation.
- b. Packages must not have any significant removable surface contamination (Section 6.14.5).
- c. The exterior of each outside package outside of the package must be stenciled or otherwise marked "Radioactive - LSA".
- d. External radiation levels must comply with Section 6.14.3.
- e. Shipments must be loaded by consignor and unloaded by consignee from the transport vehicle originally loaded.
- f. There must be no loose radioactive materials in car or vehicle.
- g. Shipment must be braced so as to prevent shifting of lading under conditions normally incident to transportation.
- h. The vehicle must be placarded with the placards prescribed in Section 6.14.5.
- i. Specific instructions for maintenance of exclusive use shipment controls must be provided by the shipper to the carrier. Such instructions must be included with the shipping paper information. (Section 6.11).
- j. Transport by aircraft is prohibited.

6.14.7.2 Unpackaged (bulk) shipments of LSA materials shall be transported only in exclusive use closed transport vehicles and shall comply with 49CFR173.425[c].

6.14.7.3 Package Requirements for LSA Materials with Greater than A₂ Quantities (10CFR71.52)

A package need not satisfy the additional requirements for Type B packages (10CFR71.51) if it contains only LSA material and is transported as exclusive use. A Type A package meeting the requirements of 10CFR71.41 - 10CFR71.47 must be used.

6.14.7.4 Package Requirements for Mixed Lading LSA (Non-Exclusive Use)

- a.. The materials must be packaged in a DOT Specification 7A, Type A package. (49 CFR 173.425[a])
- b. If the material is pyrophoric radioactive material it will first meet the requirements of Section 6.14.8. (49 CFR 173.418)
- c. If the material is oxidizing radioactive material, it will first meet the requirements of Section 6.14.9. (49 CFR 173.419)
- d. Contamination levels will not exceed those listed in Section 6.14.4.
- e. Radioactive materials will be packaged such that the radiation level does not exceed 200mrem/hr on the external surface of the package and the transport index does not exceed 10. (49CFR173.441)
- f. The general transportation requirements of Section 6.14.2 will be met.
- g. Each package will be marked with the proper shipping name - "Radioactive LSA - NOS". (49CFR172.300)
- h. Each package must be labeled with the name and address of the consignor or consignee except if the package will be transported by highway and will not be transferred from one carrier to another. (49CFR172.306)
- i. Each package of radioactive material in excess of 110 pounds in weight shall have the weight of the package marked on the outside of the package. (172.310 [a][1])
- j. Type A and/or Type B packages shall be marked with the words "Type A or Type B" as appropriate on the outside of the package. (49CFR172.310[a])
- l. Each package having an inside package containing radioactive liquid shall be packed with closures upward and the outside package labeled to indicate "This Side Up". (49CFR172.312[a])
- m. Refer to Section 6.14.6 of this procedure to determine the proper "Radioactive" white or yellow label to apply to each package.
- n. Each package of radioactive material which contains material that also meets the definition of another hazard, such as "Oxidizer" or "Corrosive" shall be labeled for all hazards present. (49CFR172.403[e])
- o. Each package will have 2 of the required labels on opposite sides of the package.

6.14.8. Pyrophoric Radioactive Materials 49 CFR 173.418

6.14.8.1 Pyrophoric radioactive materials, as referenced in 49 CFR 172.101 in quantities not exceeding A₂ per package shall be packaged in Type A packagings which are constructed of materials which will not react nor be decomposed by the contents. Contents must be:

- a. In solid form and must not be fissile unless excepted by Section 6.14.10.
- b. Contained in sealed and corrosion resistant receptacles with positive closures (friction or slip-fit covers or stoppers are not authorized);
- c. Free of water and any contaminants which would increase the reactivity of the material; and
- d. Made inert to prevent self-ignition during transport by either:
 1. Mixing with large volumes of inerting materials such as graphite or dry sand or other suitable inerting material or blended into a matrix of hardened concrete; or
 2. By filling the innermost receptacle with an appropriate inert gas.

6.14.8.2 In addition to the applicable requirements of 49 CFR 173.24 each package must be capable of passing the test conditions of 49 CFR 173.465 without leakage of contents.

6.14.9 Oxidizing Radioactive Material (49CFR173.419)

6.14.9.1 Certain oxidizing radioactive materials as referenced in 49 CFR 172.101 and which are not fissile materials and not in quantities exceeding A₂, shall be packed in suitable inside packagings of glass, metal or compatible plastic and suitably cushioned with a material which will not react with the contents. Inner packaging and cushioning shall be enclosed within an outside packaging of wood, metal, or plastic. The package shall be capable of meeting the applicable test requirements of 49 CFR 173.465 without leakage of contents. For shipment by air, the maximum quantity in any package may not exceed 11.3 kilograms (25 pounds).

6.14.10 Fissile Radioactive Material

6.14.10.1 Exceptions (49CFR173.453) - Fissile radioactive materials exempted from fissile packaging requirements which must be packaged as described for non-fissile material are prescribed in 49CFR173.453.

6.14.10.2 Fissile Class I Radioactive Material (49 CFR 173.455[a][1])

Packages which contain fissile material (see Section 5.9) may be transported in unlimited number, and in any arrangement. This class does not require nuclear critical safety controls during transport. A transport index is not assigned for the purpose of nuclear criticality safety control, but the external radiation levels may require one.

6.14.10.3 Fissile Class II Radioactive Material (49 CFR 173.455 [a][2])

Packages that may be transported together in any arrangement as long as the aggregate transport index of 50 is not exceeded. For nuclear criticality safety control, individual packages may have a transport index of not less than 0.1 and not more than 10. External radiation levels may require a higher transport index number. These shipments require no nuclear criticality safety control by the shipper during transport.

6.14.10.4 Fissile Class III Radioactive Materials (49CFR 173.403[a][3])

Packages that do not meet the requirements of Fissile Class I or II and are controlled to provide nuclear criticality safety during transportation through arrangement between the shipper and the carrier.

6.14.10.5 Shipping Controls for Mixing of Fissile Material Packages

Specific requirements for mixing fissile packages are specified in 49CFR173.459.

6.14.11 Requirements for Shipping with Other Than Commercial Carriers

Carriage by public highway requirements which must be verified to be met by other than commercial carriers (ie, company vehicle) are specified in 49CFR177. (177.804, 177.807, 177.817, 177.821, 177.822, 177.823, 177.825, 177.834, 177.842, 177.843, 177.854, 177.861, and 49CFR177 Appendix A).

6.15 Final Radiological Survey

6.15.1 Contamination

6.15.1.1 Contamination surveys of the loaded vehicle, transport tractor vehicle and the loading area shall be performed to insure the contamination levels are within acceptable limits prior to release.

6.15.1.2 Obtain a minimum of 25 smears using discs or other smear media from various external surfaces, including:

- a. Cask surfaces (if applicable)
- b. Vehicle (or trailer) floor
- c. Tractor or cab
- d. Vehicle tires
- e. Floor or Truck Bay area

6.15.1.3 Analyze all smears for beta-gamma contamination and at least 25% for alpha contamination.

6.15.1.4 Record the following on the Radiation Survey Log Sheet:

- a. Date and time
- b. Numbers or smears (beta/gamma and alpha)
- c. General location of smears
- d. Corresponding maximum contamination beta, gamma and alpha levels
- e. Detector instrument

6.15.1.5 Verify from the survey results that the contamination levels do not exceed the limits set forth in Section 6.14.4.

NOTE: If any of the contaminated levels exceed the limits established in 6.14.4, DO NOT SHIP. Notify the Supervisor Chemistry and Radiation Protection or Supervisor Radwaste Operations.

6.15.2 Radiation Survey

6.15.2.1 The loaded vehicle and transport vehicle shall be surveyed for beta-gamma exposure rates to ensure the shipment is within the limits established in Section 6.14.3.

6.15.2.2 Note the following on the Radiation Survey Log Sheet:

- a. Survey instruments
- b. Maximum contact reading
- c. Maximum 2 meter (6.6 feet) reading

6.15.2.3 Record the survey data on the Driver Vehicle Survey Form, Figure 8 or equivalent.

6.15.2.4 Verify from the survey results that the radiation levels do not exceed the limits specified in Section 6.14.3.

NOTE: If any of the radiation levels in Section 6.14.3 are exceeded, DO NOT SHIP. Notify the Supervisor Chemistry and Radiation Protection or Supervisor Radwaste Operations.

6.16 Shipping Papers

6.16.1 Description of Hazardous Materials required for RSR (and Bill of Lading when required). (49CFR172.202)

6.16.1.1 When shipping radioactive materials and non-hazardous materials in the same shipment, the manifest description of the contents must have the hazardous material listed first or entered in color (highlighted in contrasting color for copies). (49CFR172.200)

- 6.16.1.2. When shipping a Highway Route Controlled Quantity the description of the contents must contain the words HIGHWAY CONTROLLED QUANTITY.
- 6.16.1.3. The proper shipping name of the hazardous material prescribed in 49CFR172.101 or 49CFR172.102 or the hazardous materials table must be entered in the description (See Table 6). If the shipment contains hazardous and non-hazardous material, an (X) must be entered in the HM column or in front of the description.
- 6.16.1.4. The identification number as specified in the Hazardous Material Table (Table 6) or 49CFR172.101 or 49CFR172.102 must be entered.
- 6.16.1.5. Except for empty packaging, the total quantity of the hazardous material covered by the description must be entered, using the format in the following example.

Example: 2Ci, Radioactive Material, LSA, N.O.S., UN2912

6.16.2 Additional Manifest RSR Requirements

- 6.16.2.1. Enter the name of each radionuclide and a description of their physical and chemical forms, if the material is in normal form.
- 6.16.2.2. Enter the activity of each radionuclide in curies, millicuries, or microcuries. (Abbreviations as prescribed Table 1 are authorized.)
- 6.16.2.3. Check the category of label applied to each package.
- 6.16.2.4. Enter the transport index assigned to each package in the shipment bearing radioactive Yellow II or Radioactive Yellow - III labels.
- 6.16.2.5. For Fissile Class materials, enter the package class specification and weight in grams or kilograms of the fissile isotope plus:
- a. For packages containing exempt quantities (49CFR172.453) enter the words "Fissile Exempt".
 - b. In a Fissile Class III shipment, enter the notation "WARNING - FISSILE CLASS III SHIPMENT. DO NOT LOAD MORE THAN *** PACKAGES PER VEHICLE" (Asterisks to be replaced by appropriate number) "IN LOADING AND STORAGE AREAS, KEEP AT LEAST 20 FEET (6 METERS) FROM OTHER PACKAGES BEARING RADIOACTIVE LABELS."
 - c. If a Fissile Class III shipment is to be transported by water, a supplementary notation shall be added: "FOR SHIPMENT BY WATER, ONLY ONE FISSILE CLASS III SHIPMENT IS PERMITTED IN EACH HOLD."
- 6.16.2.6. For a package approved by the DOE or NRC, provide a notation of the package identification marking as prescribed in the applicable approval.
- 6.16.2.7. For export shipments or shipments in a foreign made package, provide a notation of the package identification marking as prescribed in the applicable International Atomic Energy Agency (IAEA) certificate of authority.

- 6.16.2.8 The RSR may serve as the manifest or Bill of Lading if it includes all required information. In addition to the RSR, a separate Bill of Lading provided by the carrier may be used.
- 6.16.2.9 If not provided on the RSR Form used, enter the license number of the recipient of each shipment.

NOTE: Confirm with supervision prior to shipment release that:

1. Recipient's license will allow receipt of type & quantity of material to be shipped.
2. The license has not expired.
3. NMPC possesses or has made arrangements to obtain a copy of the license.

6.16.3 Additional Waste Manifest Requirements (10CFR20.311)

- 6.16.3.1 Name, address and telephone number of waste generator.
- 6.16.3.2 Name, address and telephone number or name and EPA Hazardous Waste, Identification Number of waste transporter.
- 6.16.3.3 Must also indicate as complete as practicable: physical description of waste, volume, radionuclide identity and quantity, total radioactivity and principle chemical form.
- 6.16.3.4 Solidification agent must be identified.
- 6.16.3.5 If waste contains greater than 0.1% chelating agents, the weight percentage and chelating agent must be identified.
- 6.16.3.6 Waste Class; Class A, Class B, or Class C must be identified.
- 6.16.3.7 Total quantity of H-3, C-14, Tc-99 and I-129 must be shown.
- 6.16.3.8 Must include a certification by the waste generator that the transported materials are properly classified, described, packaged, marked and labeled and are in proper condition for transportation according to Department of Transportation regulations and the NRC.
- 6.16.4 The following documents accompany each offsite shipment of radioactive waste, and are explained more fully in N1-WHP-2.
- 6.16.4.1 Radiation Survey Log. This form is used to provide a method for identifying and documenting the results of the radiation surveys. (N1-WHP-2-11.0)
- 6.16.4.2 Radionuclide Analysis Program Result - This is a computer printout resulting from the gamma ray analysis of the waste product which is attached to a Spectral Analysis Printout. (N1-WHP-2-15.0)

- 6.16.4.3 Radioactive Shipment Record (RSR) - This form is used by the shipper to record the transfer of radioactive material. See Figure 7 for Niagara Mohawk's RSR form. When shipping to a burial site, use their RSR form. (N1-WHP-2-9.0)
- 6.16.4.4 Vehicle Survey Form - This form (Figure 8 or equivalent) illustrates the results of certain surveys to ensure the results are below the limits required for shipment. (N1-WHP-2-12.0)
- 6.16.4.5 Trip Routing Form - The Trip Routing Form is used to record the route of the shipment. (N1-WHP-2-14.0)
- 6.16.4.6 Bill of Lading - This form is the official document that identifies the waste being shipped. This document also gives conditions and responsibilities for handling and transporting waste. Depending on who the carrier is, the proper Bill of Lading should be used. (N1-WHP-2-13.0)
- 6.16.4.7 Exclusive use instructions - This form gives specific instructions and controls for exclusive use shipments to the carrier. (N1-WHP-2-8.0)
- 6.16.5 Additional shipping papers used or referred to when using a cask to ship radioactive waste:
- a. Cask Certification Document Review Form (N1-WHP-2-5.0)
 - b. Cask Data Form (N1-WHP-2-6.0)
 - c. User Check-Off Sheet (N1-WHP-2-10)
 - d. Certification Statement of Disposal of Enviro Safe TM High Integrity Containers (N1-WHP-2-7.0)
- 6.16.6 For shipment to Barnwell, South Carolina burial site, the following forms are also required:
- a. Radioactive Waste Shipment Certification Form (N1-WHP-2-16.2)
 - b. Radioactive Waste Shipment Prior Notification and Manifest Form (N1-WHP-2-16.3)
 - c. Burial Site Criteria and License(s)
- 6.16.7 When shipping to Richland, Washington burial site, these forms are also used or referred to:
- a. Low-Level Radioactive Waste Shipment Certification for Commercial Generator/Packers and Brokers and Carriers (N1-WHP-2-18.2)
 - b. Washington Prior Notification (N1-WHP2-18.1)
 - c. Burial Site Criteria and License(s)

NOTE: The numbers in brackets represent the section number in Waste Handling Procedure Number 2. The section number contains information on filling out the forms, use, responsibilities and distribution of copies.

6.17 Quality Control Requirements Prior to each Shipment of Radioactive Materials: (49CFR173.475)

- Before each shipment of any radioactive materials package, the shipper shall ensure by examination or appropriate test, that -
- 6.17.1 The packaging is proper for the contents to be shipped;
 - 6.17.2 The packaging is in unimpaired physical condition, except for superficial marks;
 - 6.17.3 Each closure device of the packaging, including any required gasket, is properly installed, secured, and free of defects;
 - 6.17.4 For fissile material, each moderator and neutron absorber, if required, is present and in proper condition;
 - 6.17.5 Each special instruction for filling, closing, and preparation of the packaging for shipment has been followed;
 - 6.17.6 Each closure, valve, or other opening of the containment system through which the radioactive content might escape is properly closed and sealed;
 - 6.17.7 Each packaging containing liquid in excess of A₂ quantity and intended for air shipment has been tested to show that it will not leak under an ambient atmospheric pressure of not more than 0.25 atmosphere, absolute, (0.25 kilograms per square centimeter or 3.6 psia). The test must be conducted on the entire containment system, or on any receptacle or vessel within the containment system, to determine compliance with this requirement;
 - 6.17.8 The internal pressure of the containment system will not exceed the design pressure during transportation; and
 - 6.17.9 External radiation and contamination levels are within the allowable limits specified in this procedure.
- 6.18 Additional Radioactive Material Shipment Information
- 6.18.1 For special requirements for carriage of radioactive materials by railway see 49CFR Part 174.
 - 6.18.2 For special requirements for carriage of radioactive materials by aircraft see 49CFR Part 175.

- 6.18.3 For special requirements for carriage of radioactive materials by vessel see 49CFR Part 176.
- 6.18.4 For special requirements for carriage of radioactive material by public highway see 49CFR Part 177.
- 6.18.5 Many of the procedures for handling of waste, including analysis, sampling, solidification processes, cask handling, cask loading, truck loading, etc. may be found in Nine Mile Point - Unit 1 Waste Handling Procedures. (NI-WHP). These procedures should be referred to in addition to this procedure when a shipment of waste is proposed.

6.19 Notification

- 6.19.1 Notify the Supervisor of Chemistry and Radiation Protection or an authorized alternate of any problems that cannot be resolved during the performance of this procedure prior to releasing any shipment.
- 6.19.2 If advance notification is required (Section 6.13.7) refer to Section 6.14.1 for content and cancelation requirements.

7.0 REFERENCES

- 7.1 Code of Federal Regulations, Title 49 - Transportation.
- 7.2 Code of Federal Regulations, Title 10, Part 71 - Packaging of Radioactive Material for Transport and Transportation of Radioactive Material under certain conditions.
- 7.3 Code of Federal Regulations, Title 10, Part 73 - Physical Protection of Plant and Materials.
- 7.4 International Atomic Energy Agency (IAEA) - Regulations for the Safe Transport of Radioactive Materials, Safety Series No. 6, 1973 Revised Edition (as amended).
- 7.5 Plant Chemistry and Radiation Protection Manual, Volume 4 - (applicable procedures).
- 7.6 Waste Handling Procedures - (NI-WHP) - Nine Mile Point Nuclear Station.
- 7.7 Radiological Health Handbook.
- 7.8 IE Bulletin 79-19 8/10/79.
- 7.9 Code of Federal Regulations, Title 10, Part 61 - Licensing Requirements For Land Disposal of Radioactive Waste
- 7.10 Code of Federal Regulations, Title 10, Part 20 - Standards for Protection Against Radiation

TABLE 1
A₁ AND A₂ VALUES FOR RADIONUCLIDES

Symbol of radionuclide:	Element and atomic number	A ₁ (Ci)	A ₂ (Ci)	Specific activity (Ci/g)
²²⁷ Ac	Actinium (89)	1000	0.003	7.2 × 10
²²⁸ Ac		10	4	2.2 × 10 ⁶
¹⁰⁵ Ag	Silver (47)	40	40	3.1 × 10 ⁴
^{110m} Ag		7	7	4.7 × 10 ³
¹¹¹ Ag		100	20	1.6 × 10 ⁵
²⁴¹ Am	Americium (95)	8	0.008	3.2
²⁴³ Am		8	0.008	1.9 × 10 ⁻¹
³⁷ Ar (compressed) or uncompressed)	Argon (18)	1000	1000	1.0 × 10 ⁵
⁴¹ Ar (uncompressed)		20	20	4.3 × 10 ⁷
⁴¹ Ar (compressed)		1	1	
⁷⁵ As	Arsenic (33)	1000	400	2.4 × 10 ⁴
⁷⁶ As		20	20	1.0 × 10 ⁵
⁷⁶ As		10	10	1.6 × 10 ⁶
⁷⁷ As		300	20	1.1 × 10 ⁴
²¹¹ At	Astatine (85)	200	7	2.1 × 10 ⁶
¹⁹³ Au	Gold (79)	200	200	9.3 × 10 ⁵
¹⁹⁶ Au		30	30	1.2 × 10 ⁵
¹⁹⁸ Au		40	20	2.5 × 10 ⁵
¹⁹⁹ Au		200	25	2.1 × 10 ⁵
¹³¹ Ba	Barium (56)	40	40	8.7 × 10 ⁴
¹³³ Ba		40	10	4.0 × 10 ²
¹⁴⁰ Ba		20	20	7.3 × 10 ⁴
⁷ Be	Beryllium (4)	300	300	3.5 × 10 ⁵
²⁰⁶ Bi	Bismuth (83)	5	5	9.9 × 10 ⁴
²⁰⁷ Bi		10	10	2.2 × 10 ²
²¹⁰ Bi (RaE)		100	4	1.2 × 10 ⁵
²¹² Bi		6	6	1.5 × 10 ⁷
²⁴⁹ Bk	Berkelium (97)	1000	1	1.8 × 10 ³
⁷⁷ Br	Bromine (35)	70	25	7.1 × 10 ⁵
⁸² Br		6	5	1.1 × 10 ⁶

TABLE 1 (Cont)
A₁ and A₂ Values for Radionuclides

Symbol of radionuclide	Element and atomic number	A ₁ (Ci)	A ₂ (Ci)	Specific activity (Ci/g)
¹¹ C	Carbon (6)	20	20	8.4 × 10 ⁸
¹⁴ C		1000	60	4.6
⁴⁵ Ca	Calcium (20)	1000	25	1.9 × 10 ⁴
⁴⁷ Ca		20	20	5.9 × 10 ⁵
¹⁰⁹ Cd	Cadmium (48)	1000	70	2.6 × 10 ³
^{115m} Cd		30	30	2.6 × 10 ⁴
¹¹⁵ Cd		80	20	5.1 × 10 ⁵
¹³⁹ Ce	Cerium (58)	100	100	6.5 × 10 ³
¹⁴¹ Ce		300	25	2.8 × 10 ⁴
¹⁴³ Ce		60	20	6.6 × 10 ⁵
¹⁴⁴ Ce		10	7	3.2 × 10 ³
²⁴⁹ Cf	Californium (98)	2	0.002	3.1
²⁵⁰ Cf		7	0.007	1.3 × 10 ³
²⁵² Cf		2	0.009	6.5 × 10
³⁴ Cl	Chlorine (17)	300	10	3.2 × 10 ⁻²
³⁸ Cl		10	10	1.3 × 10 ⁸
²⁴² Cm	Curium (96)	200	0.2	3.3 × 10 ³
²⁴³ Cm		9	0.009	4.2 × 10
²⁴⁴ Cm		10	0.01	8.2 × 10
²⁴⁵ Cm		6	0.006	1.0 × 10 ⁻¹
²⁴⁶ Cm		6	0.006	3.6 × 10 ⁻¹
⁵⁶ Co	Cobalt (27)	5	5	3.0 × 10 ⁴
⁵⁷ Co		90	90	8.5 × 10 ³
^{58m} Co		1000	1000	5.9 × 10 ⁸
⁵⁸ Co		20	20	3.1 × 10 ⁴
⁶⁰ Co		7	7	1.1 × 10 ³
⁵¹ Cr	Chromium (24)	600	600	9.2 × 10 ⁴
¹³⁹ Cs	Caesium (55)	40	40	7.6 × 10 ⁵
¹³¹ Cs		1000	1000	1.0 × 10 ⁵
^{134m} Cs		1000	10	7.4 × 10 ⁶
¹³⁴ Cs		10	10	1.2 × 10 ³

TABLE 1 (Cont)

A₁ and A₂ Values for Radionuclides

Symbol of radionuclide	Element and atomic number	A ₁ (Ci)	A ₂ (Ci)	Specific activity (Ci/g)
¹³⁵ Cs	Caesium (cont.)	1000	25	8.8 × 10 ⁻⁴
¹³⁶ Cs		7	7	7.4 × 10 ⁴
¹³⁷ Cs		30	10	9.8 × 10
⁶⁴ Cu	Copper (29)	80	25	3.8 × 10 ⁶
⁶⁷ Cu		200	25	7.9 × 10 ⁵
¹⁶⁴ Dy	Dysprosium (66)	100	20	8.2 × 10 ⁶
¹⁶⁴ Dy		1000	200	2.3 × 10 ⁵
¹⁶⁰ Er	Erbium (68)	1000	25	8.2 × 10 ⁴
¹⁷¹ Er		50	20	2.4 × 10 ⁴
^{152m} Eu	Europium (63)	30	30	2.2 × 10 ⁶
¹⁵² Eu		20	10	1.9 × 10 ²
¹⁵⁴ Eu		10	5	1.5 × 10 ²
¹⁵⁵ Eu		400	60	1.4 × 10 ³
¹⁸ F	Fluorine (9)	20	20	9.3 × 10 ⁷
⁵² Fe	Iron (26)	5	5	7.3 × 10 ⁶
⁵⁵ Fe		1000	1000	2.2 × 10 ³
⁵⁹ Fe		10	10	4.9 × 10 ⁴
⁶⁷ Ga	Gallium (31)	100	100	6.0 × 10 ⁵
⁶⁴ Ga		20	20	4.0 × 10 ⁷
⁷² Ga		7	7	3.1 × 10 ⁶
¹⁵³ Gd	Gadolinium (64)	200	200	3.6 × 10 ³
¹⁵⁹ Gd		300	20	1.1 × 10 ⁶
⁶⁸ Ge	Germanium (32)	20	10	7.0 × 10 ³
⁷¹ Ge		1000	1000	1.6 × 10 ⁵
³ H	Hydrogen(1) see T-tritium			
¹⁸¹ Hf	Hafnium (72)	30	25	1.6 × 10 ⁴
^{197m} Hg	Mercury (80)	200	200	6.6 × 10 ⁵
¹⁹⁷ Hg		200	200	2.5 × 10 ⁵
²⁰³ Hg		80	25	1.4 × 10 ⁴
¹⁶⁶ Ho	Holmium (67)	30	30	6.9 × 10 ⁵
¹²³ I	Iodine (53)	50	50	1.9 × 10 ⁶

TABLE 1 (Cont.)

A_1 and A_2 Values for Radionuclides

Symbol of radionuclide	Element and atomic number	A_1 (Ci)	A_2 (Ci)	Specific activity (Ci/g)	
^{125}I	Iodine (cont.)	1000	70	1.7×10^4	
^{126}I		40	10	7.8×10^4	
^{129}I		1000	2	1.6×10^{-4}	
^{131}I		40	10	1.2×10^5	
^{132}I		7	7	1.1×10^7	
^{133}I		30	10	1.1×10^6	
^{134}I		8	8	2.7×10^7	
^{135}I		10	10	3.5×10^6	
^{111}In		Indium (49)	30	25	4.2×10^5
$^{113\text{m}}\text{In}$			60	60	1.6×10^7
$^{114\text{m}}\text{In}$	30		20	2.3×10^4	
$^{115\text{m}}\text{In}$	100		20	6.1×10^6	
^{190}Ir	Iridium (77)		10	10	6.2×10^4
^{192}Ir		20	10	9.1×10^3	
^{194}Ir		10	10	8.5×10^5	
^{42}K	Potassium (19)	10	10	6.0×10^6	
^{43}K		20	10	3.3×10^6	
$^{85\text{m}}\text{Kr}$ (uncompressed)	Krypton (36)	100	100	8.4×10^6	
$^{85\text{m}}\text{Kr}$ (compressed)		3	3	8.4×10^6	
^{85}Kr (uncompressed)		1000	1000	4.0×10^2	
^{85}Kr (compressed)		5	5	4.0×10^2	
^{87}Kr (uncompressed)		20	20	2.8×10^7	
^{87}Kr (compressed)		0.6	0.6		
^{140}La	Lanthanum (57)	30	30	5.6×10^5	
LSA	Low specific activity material, see Section 1.7.3, 403				
^{177}Lu	Lutetium (71)	300	25	1.1×10^5	
MFP	Mixed fission products	10	0.4		
^{28}Mg	Magnesium (12)	6	6	5.2×10^6	
^{52}Mn	Manganese (25)	5	5	4.4×10^5	
^{54}Mn		20	20	8.3×10^3	

TABLE 1 (Cont)

A₁ and A₂ Values for Radionuclides

Symbol of radionuclide	Element and atomic number	A ₁ (Ci)	A ₂ (Ci)	Specific activity (Ci/g)
⁵⁶ Mn	Manganese (cont.)	5	5	2.2 × 10 ⁷
⁹⁹ Mo	Molybdenum (42)	100	20	4.7 × 10 ⁵
¹⁵ N	Nitrogen (7)	20	10	1.5 × 10 ⁹
²² Na	Sodium (11)	8	8	6.3 × 10 ³
²⁴ Na		5	5	8.7 × 10 ⁶
^{93m} Nb	Niobium (41)	1000	200	1.1 × 10 ³
⁹⁵ Nb		20	20	3.9 × 10 ⁴
⁹⁷ Nb		20	20	2.6 × 10 ⁷
¹⁴⁷ Nd	Neodymium (60)	100	20	8.0 × 10 ⁴
¹⁴⁹ Nd		30	20	1.1 × 10 ⁷
⁹⁹ Ni	Nickel (28)	1000	900	8.1 × 10 ⁻²
⁶³ Ni		1000	100	0.46 × 10 ²
⁶⁵ Ni		10	10	1.9 × 10 ⁷
²³⁷ Np	Neptunium (93)	5	0.005	6.9 × 10 ⁻⁴
²³⁹ Np		200	25	2.3 × 10 ⁵
¹⁸⁵ Os	Osmium (76)	20	20	7.3 × 10 ³
¹⁹¹ Os		600	200	4.6 × 10 ⁴
^{191m} Os		200	200	1.2 × 10 ⁶
¹⁹³ Os		100	20	5.3 × 10 ⁵
³² P	Phosphorus (15)	30	30	2.9 × 10 ⁵
²³⁰ Pa	Protactinium (91)	20	0.8	3.2 × 10 ⁴
²³¹ Pa		2	0.002	4.5 × 10 ⁻²
²³³ Pa		100	100	2.1 × 10 ⁴
* ²¹⁰ Pb	Lead (82)	100	0.2	8.8 × 10
²¹² Pb		6	5	1.4 × 10 ⁶
¹⁰³ Pd	Palladium (46)	1000	700	7.5 × 10 ⁴
¹⁰⁷ Pd		100	20	2.1 × 10 ⁶
¹⁴⁷ Pm	Promethium (61)	1000	25	9.4 × 10 ²
¹⁴⁹ Pm		100	20	4.2 × 10 ⁵
²¹⁰ Po	Polonium (84)	200	0.2	4.5 × 10 ³
¹⁴³ Pr	Praseodymium (59)	10	10	1.2 × 10 ⁶
²⁰¹ Pb	Lead (82)	20	20	201.7 × 10 ⁶

TABLE 1 (Cont)

A₁ and A₂ Values of Radionuclides

Symbiol of radionuclide	Element and atomic number	A ₁ (Ci)	A ₂ (Ci)	Specific activity (Ci/g)
¹⁴³ Pr	Praseodymium (cont.)	300	.20	6.6 × 10 ⁴
¹⁹¹ Pt	Platinum (78)	100	100	2.3 × 10 ⁵
^{193m} Pt		200	200	2.0 × 10 ⁵
^{197m} Pt		300	.20	1.2 × 10 ⁷
¹⁹⁷ Pt		300	.20	8.8 × 10 ⁵
²³⁸ Pu	Plutonium (94)	3	0.003	1.7 × 10
²³⁹ Pu		2	0.002	6.2 × 10 ⁻²
²⁴⁰ Pu		2	0.002	2.3 × 10 ⁻¹
²⁴¹ Pu		1000	0.1	1.1 × 10 ²
²⁴² Pu		3	0.003	3.9 × 10 ⁻³
²²³ Ra	Radium (88)	50	0.2	5.0 × 10 ⁴
²²⁴ Ra		6	0.5	1.6 × 10 ⁵
²²⁶ Ra		10	0.05	1.0
²²⁸ Ra		10	0.05	2.3 × 10 ²
⁸¹ Rb	Rubidium (37)	30	25	8.2 × 10 ⁴
⁸⁶ Rb		30	30	8.1 × 10 ⁴
⁸⁷ Rb		Unlimited	Unlimited	6.6 × 10 ⁻⁸
Rb (natural)		Unlimited	Unlimited	1.8 × 10 ⁻⁸
¹⁸⁶ Re	Rhenium (75)	100	20	1.9 × 10 ⁵
¹⁸⁷ Re		Unlimited	Unlimited	3.8 × 10 ⁻⁸
¹⁸⁸ Re		10	10	1.0 × 10 ⁴
Re (natural)		Unlimited	Unlimited	2.4 × 10 ⁻⁸
^{103m} Rh	Rhodium (45)	1000	1000	3.2 × 10 ⁷
¹⁰⁵ Rh		200	25	8.2 × 10 ⁵
²²² Rn	Radon (86)	10	2	1.5 × 10 ⁵
⁹⁷ Ru	Ruthenium (44)	80	80	5.5 × 10 ⁵
¹⁰³ Ru		30	25	3.2 × 10 ⁴
¹⁰⁵ Ru		20	20	6.6 × 10 ⁶
¹⁰⁶ Ru		10	7	3.4 × 10 ³
³⁵ S	Sulphur (16)	1000	60	4.3 × 10 ⁴
¹²² Sb	Antimony (51)	30	30	3.9 × 10 ⁵

TABLE 1 (Cont)

A₁ and A₂ Values for Radionuclides

Symbol of radionuclide	Element and atomic number	A ₁ (Ci)	A ₂ (Ci)	Specific activity (Ci/g)
¹²⁴ Sb	Antimony (cont.)	5	5	1.8 X 10 ⁴
¹²⁵ Sb		40	25	1.4 X 10 ³
⁴⁶ Sc	Scandium (21)	8	8	3.4 X 10 ⁴
⁴⁷ Sc		200	20	8.2 X 10 ⁵
⁴⁸ Sc		5	5	1.5 X 10 ⁶
⁷⁵ Se	Selenium (34)	40	40	1.4 X 10 ⁴
³¹ Si	Silicon (14)	100	20	3.9 X 10 ⁷
¹⁴⁷ Sm	Samarium (62)	Unlimited	Unlimited	2.0 X 10 ⁻⁸
¹⁵¹ Sm		1000	90	2.6 X 10
¹⁵³ Sm		300	20	4.4 X 10 ⁵
¹¹³ Sn	Tin (50)	60	60	1.0 X 10 ⁴
^{119m} Sn		100	100	
¹²⁵ Sn		10	10	1.1 X 10 ⁵
^{85m} Sr	Strontium (38)	80	80	3.2 X 10 ⁷
⁸⁵ Sr		30	30	2.4 X 10 ⁴
^{87m} Sr		50	50	1.2 X 10 ⁷
⁸⁹ Sr		100	10	2.9 X 10 ⁴
⁹⁰ Sr		10	0.4	1.5 X 10 ³
⁹¹ Sr		10	10	3.6 X 10 ⁶
⁹² Sr		10	10	1.3 X 10 ⁷
T (uncompressed)	Tritium (1)	1000	1000	9.7 X 10 ³
T (compressed)		1000	1000	
T (activated luminous paint)		1000	1000	
T (adsorbed on solid carrier)		1000	1000	
T (tritiated water)		1000	1000	
T (other forms)		20	20	
¹⁸² Ta	Tantalum (73)	20	20	6.2 X 10 ³
¹⁶⁰ Tb	Terbium (65)	20	10	1.1 X 10 ⁴
^{96m} Tc	Technetium (43)	1000	1000	3.8 X 10 ⁷
⁹⁶ Tc		6	6	3.2 X 10 ⁵

TABLE 1 (Cont)

A_1 and A_2 Values for Radionuclides

Symbol of radionuclide	Element and atomic number	A_1 (Ci)	A_2 (Ci)	Specific activity (Ci/g)
^{97m}Tc	Technetium (cont.)	1000	200	1.5×10^4
^{97}Tc		1000	400	1.4×10^{-3}
^{99m}Tc		100	100	5.2×10^6
^{99}Tc		1000	25	1.7×10^{-2}
^{125m}Te	Tellurium (52)	1000	100	1.8×10^4
^{127m}Te		300	20	4.0×10^4
^{127}Te		300	20	2.6×10^6
^{129m}Te		30	10	2.5×10^4
^{129}Te		100	20	2.0×10^7
^{131m}Te		10	10	8.0×10^5
^{132}Te		7	7	3.1×10^5
^{227}Th	Thorium (90)	200	0.2	3.2×10^4
^{228}Th		6	0.008	8.3×10^2
^{230}Th		3	0.003	1.9×10^{-2}
^{231}Th		1000	25	5.3×10^5
^{232}Th		Unlimited	Unlimited	1.1×10^{-7}
^{234}Th		10	10	2.3×10^4
Th (natural)		Unlimited	Unlimited	(see Table VIII)
Th (irradiated) ^a				
^{200}Tl	Thallium (81)	20	20	5.8×10^5
^{201}Tl		200	200	2.2×10^5
^{202}Tl		40	40	5.4×10^4
^{204}Tl		300	10	4.3×10^2
^{170}Tm	Thulium (69)	300	40	6.0×10^3
^{171}Tm		1000	10	1.1×10^3
^{230}U	Uranium (92)	100	0.1	2.7×10^4
^{232}U		30	0.03	2.1×10
^{233}U		100	0.1	9.5×10^{-3}
^{234}U		100	0.1	6.2×10^{-3}
^{235}U		100	0.2	2.1×10^{-6}
^{236}U		200	0.2	6.3×10^{-5}

TABLE 1 (Cont)

A₁ and A₂ Values for Radionuclides

Symbol of radionuclide	Element and atomic number	A ₁ (Ci)	A ₂ (Ci)	Specific activity (Ci/g)	
²³⁸ U	Uranium (cont.)	Unlimited	Unlimited	3.3 X 10 ⁻⁷	
U (natural)		Unlimited	Unlimited	(see 173.434)	
U (enriched)		<20%	Unlimited	Unlimited	(see 173.434)
		20% or greater	100	0.1	
U (depleted)		Unlimited	Unlimited	(see 173.434)	
U (irradiated) ^b					
⁴⁸ V	Vanadium (23)	6	6	1.7 X 10 ⁵	
¹⁸¹ W	Tungsten (74)	200	100	5.0 X 10 ³	
¹⁸⁶ W		1000	25	9.7 X 10 ⁻³	
¹⁸⁷ W		40	20	7.0 X 10 ⁵	
¹²⁹ Xe (uncompressed)		Xenon (54)	70	70	2.8 X 10 ⁴
¹²⁹ Xe (compressed)		5	5	2.8 X 10 ⁴	
^{131m} Xe (compressed)		10	10	1.0 X 10 ⁵	
^{131m} Xe (uncompressed)		100	100	1.0 X 10 ⁵	
¹³³ Xe (uncompressed)		1000	1000	1.9 X 10 ⁵	
¹³³ Xe (compressed)		5	5	1.9 X 10 ⁵	
¹³⁵ Xe (uncompressed)		70	70	2.5 X 10 ⁵	
¹³⁵ Xe (compressed)		2	2	2.5 X 10 ⁵	
⁸⁷ Y	Yttrium (39)	20	20	4.5 X 10	
⁹⁰ Y		10	10	2.5 X 10 ⁵	
^{91m} Y		30	30	4.1 X 10 ⁷	
⁹¹ Y		30	30	2.5 X 10 ⁴	
⁹² Y		10	10	9.5 X 10 ⁶	
⁹³ Y		10	10	3.2 X 10 ⁶	
¹⁶⁹ Yb		Ytterbium (70)	80	80	2.3 X 10 ⁵
¹⁷⁵ Yb		400	25	1.8 X 10 ⁵	
⁶⁵ Zn	Zinc (30)	30	30	8.0 X 10 ³	
^{69m} Zn		40	20	3.3 X 10 ⁶	
⁶⁹ Zn		300	20	5.3 X 10 ⁷	
⁹⁰ Zr	Zirconium (40)	1000	200	3.5 X 10 ⁻³	
⁹⁵ Zr		20	20	2.1 X 10 ⁴	
⁹⁷ Zr		20	20	2.0 X 10 ⁶	

TABLE 2

A₁ and A₂ values for radionuclides commonly shipped from Nine Mile Point Nuclear Station.

<u>Radionuclide</u>	<u>A₁(Ci)</u>	<u>A₂(Ci)</u>
Americium - 241	8	0.008
Antimony - 124	5	5
Cesium - 134	10	10
Cesium - 137	30	10
Cobalt - 58	20	20
Cobalt - 60	7	7
Iodine - 131	40	10
Manganese - 54	20	20
Plutonium - 239	2	0.002
Strontium - 90	10	.4
Uranium - 235	100	.2

TABLE 3

WATTS/CI Conversion Factors

<u>Radionuclide</u>	<u>Watts/Ci</u>	<u>Radionuclide</u>	<u>Watts/Ci</u>
Ba-140	6.16 E-3	La-140	2.23 E-2
C-12	2.97 E-4	Mn-54	8.16 E-3
Cm-242	3.66 E-2	Ni-59	6.34 E-3
Co-58	1.37 E-2	Ni-63	3.91 E-4
Co-60	1.67 E-2	Nb-94	1.24 E-2
Cs-134	7.23 E-3	Pu-241	1.19 E-4
Cs-137	6.93 E-3	Pu-242	2.9 E-4
H-3	1.19 E-4	Sb-124	1.72 E-2
I-129	1.13 E-3	Sr-90	3.27 E-3
I-131	5.75 E-3	Tc-99	8.48 E-4

TABLE 4

INDIVIDUALS RECEIVING ADVANCE NOTIFICATION OF NUCLEAR WASTE SHIPMENTS

States	Part 71	Part 73
Alabama	Col. Byron Prescott, Director, Alabama Department of Public Safety, P.O. Box 1511, Montgomery, AL 36192-0501, (205) 632-5069.	Same.
Alaska	Dr. Richard A. Neve, Commissioner, Alaska Department of Environmental Conservation Pouch O, Juneau, AK 99811, (907) 465-2600.	Same.
Arizona	Charles F. Trifford, Director, Arizona Radiation Regulatory Agency, 925 South 52nd Street, Suite 2, Tempe, AZ 85281, (602) 255-4845. After hours: (602) 998-4662.	Same.
Arkansas	E. F. Wilson, Director, Radiation Control and Emergency Management Programs, Arkansas Department of Health, 4815 West Markham Street, Little Rock, AR 72201, (501) 661-2301. After hours: (501) 661-2136 or 651-2000	Same.
California	E. E. Kynaston, Chief, California Highway Patrol, P.O. Box 898, Sacramento, CA 95804, (916) 445-6211.	Same.
Colorado	Captain John Callahan, Officer in Charge, Staff Services Branch, Colorado State Patrol, 4201 E. Arkansas Avenue, Denver, CO 80222, (303) 757-9422.	Same.
Connecticut	The Honorable Stanley J. Pac, Commissioner, Department of Environmental Protection, State Office Building, 185 Capitol Avenue, Hartford, CT 06106, (203) 566-2110.	Same.
Delaware	Henry James Decker, Secretary, Department of Public Safety, Highway Administration Building, P.O. Box 818, Dover, DE 19903-0818, (302) 738-4321.	Same.
Florida	Wallace Johnson, Public Health Physicist Supervisor, Department of Health & Rehabilitative Services Radiological Health Services, P.O. Box 15490, Orlando, FL 32858, (904) 299-0580.	Same.
Georgia	Kon M. Copeland, Director of the Office of Permits and Enforcement, Georgia Department of Transportation, 240 Virginia Avenue, Mableton, GA 30354, (404) 658-5435.	Same.
Hawaii	George R. Anyosh, Governor, State of Hawaii, State Capitol, Honolulu, HI 96813, (808) 548-5420	Same.
Idaho	Robert D. Funderburg, Manager, Radiation Control Section, Department of Health & Welfare Division of Environment, 450 W. State, 5th Floor, Statehouse, Boise, ID 83720, (208) 334-4107. After hours: (208) 362-5260.	Same.
Illinois	Gary N. Wright, Acting Director, Illinois Department of Nuclear Safety, 1035 Outer Park Drive, 5th Floor, Springfield, IL 62704, (217) 546-8100.	Same.
Indiana	John T. Shettle, Superintendent, Indiana State Police, 301 State Office Building, 100 North Senate Avenue, Indianapolis, IN 46204, (317) 232-8248 (24 hours).	Same.
Iowa	John D. Crandall, Director, Office of Disaster Services, Hoover State Office Building, Des Moines, IA 50319, (515) 281-3231	Same.
Kansas	Leon H. Marnett, P.E., Administrator, Radiological Systems, The Adjutant General's Department, Division of Emergency Preparedness, P.O. Box C-300, Topeka, KS 66601, (913) 233-9253, Ext. 321.	Same.
Kentucky	Donald R. Hughes, Sr., Supervisor, Radiation Control, Department for Health Services, 275 East Main Street, Frankfort, KY 40621, (502) 584-3700.	Same.
Louisiana	Col. Grover W. "Bo" Garrison, Head, Louisiana State Police, 265 South Foster Drive, P.O. Box 66614, Baton Rouge, LA 70899, (504) 925-6112.	Same.
Maine	John Brochu, Director, Bureau of Oil and Hazardous Materials, Department of Environmental Protection, Statehouse—Station #17, Augusta, ME 04333, (207) 289-2651 or (207) 773-6491.	Same.
Maryland	Lt. Colonel J. G. Lough, Chief, Field Operations Bureau, Maryland State Police, 1201 Roisterstown Road, Pikesville, MD 21208, (301) 456-3101.	Same.
Massachusetts	Robert M. Halsey, Director, Radiation Control Program, Massachusetts Department of Public Health, Room 770, 600 Washington Street, Boston, MA 02111, (617) 727-6214.	Same.
Michigan	Gene A. Rooker, Captain, Commanding Officer, Operations Division, Michigan Department of State Police, 714 S. Harrison Road, East Lansing, MI 48823, (517) 337-6100.	Same.
Minnesota	Deloris M. A. Krause, Operations Officer, Minnesota Division of Emergency Services, 85 State Capitol, St. Paul, MN 55155, (612) 296-0453. After hours: (612) 778-0800.	Same.
Mississippi	James E. Maher, Director, Mississippi Emergency Management Agency, P.O. Box 4501, Fondren Station, Jackson, MS 39216, (601) 354-7200.	Same.
Missouri	William Bealy, Director, State Emergency Management Agency, 1717 Industrial Drive, P.O. Box 116, Jefferson City, MO 65102, (314) 751-2321. After hours: (314) 751-2748.	Same.
Montana	Mr. Larry Lloyd, Chief, Occupational Health Bureau, Department of Health & Environmental Sciences, Room A113, Cogswell Bldg., Helena, MT 59620, (406) 449-3673.	Col. Caryn L. Gibertson, Administrator, Disaster and Emergency Services, Department of Military Affairs, 1100 North Last Chance Gulch, Helena, MT 59620, (406) 449-3034.

TABLE 4 (Cont.)

Nebraska	Col. Elmer J. Kohmetzcher, Superintendent, Nebraska State Patrol, P.O. Box 94907, State House, Lincoln, NE 68509, (402) 471-2406 or (402) 471-4545.	Same.
Nevada	John Vaden, Supervisor, Radiological Health, Division of Health, Consumer Health Protection Services, 505 East Kynkead Street, Room 103, Carson City, NV 89710, (702) 885-4750.	Same.
New Hampshire	Diane Tefft, Radiation Control Officer, Office of Radiation Control, Division of Public Health, Health and Welfare Building, Hazen Drive, Concord, NH 03301, (603) 271-4588.	Same.
New Jersey	Frank Cosolito, Acting Bureau Chief, Bureau of Radiation Protection, 380 Scotch Road, Trenton, NJ 08628, (609) 292-8392.	Same.
New Mexico	Alphonso A. Topp, Jr., Chief, Radiation Protection Bureau, Environmental Improvement Division, Health and Environment Department, P.O. Box 968, Santa Fe, NM 87504-0968, (505) 964-0020, ext. 279. After hours: (505) 827-9329.	Same.
New York	Donald A. Davitt, Director, Disaster Preparedness Program, Division of Military and Naval Affairs, Public Security Building, State Campus, Albany, NY 12226, (518) 457-2222.	Same.
North Carolina	Lt. Walter K. Chapman, Operations Officer, North Carolina Highway Patrol Headquarters, P.O. Box 27687, Raleigh, NC 27611, (919) 733-4030. After hours: (919) 733-3861.	Same.
North Dakota	Dana K. Mount, Director, Division of Environmental Engineering, North Dakota State Department of Health, 1200 Missouri Avenue, Bismarck, ND 58501, (701) 224-2348.	Same.
Ohio	James R. Williams, Nuclear Preparedness Officer, Disaster Services Agency, 2825 Granville Road, Worthington, OH 43065, (614) 889-7157.	Same.
Oklahoma	The Honorable Paul W. Reed, Jr., Commissioner of Public Safety, Oklahoma Department of Public Safety, 3600 N. Eastern Avenue, Oklahoma City, OK 73111, (405) 424-4011.	Same.
Oregon	Donald W. Godard, Administrator Siting and Regulation, Oregon Department of Energy, 102 Labor & Industries Building, Salem, OR 97310, (503) 378-8469.	Same.
Pennsylvania	Kenneth R. Lamson, Director of Response and Recovery, Pennsylvania Emergency Management Agency, B-151 Transportation and Safety Building, Harrisburg, PA 17120, (717) 783-8150.	Same.
Rhode Island	William A. Maloney, Associate Administrator, Motor Carriers, Division of Public Utilities and Carriers, 100 Orange Street, Providence, RI 02903, (401) 277-3500.	Same.
South Carolina	Heyward G. Shealy, Chief, Bureau of Radiological Health, South Carolina Department of Health and Environmental Control, 2600 Bull Street, Columbia, SC 29201, (803) 758-7808. After hours: (803) 758-5531.	Same.
South Dakota	Robert D. Gunderson, Division Director, Emergency and Disaster Services, Capitol Building, Basement, Pierre, SD 57501, (605) 773-3231.	Same.
Tennessee	J. A. Bill Graham, Radiological Physicist, Division of Radiological Health, Department of Public Health, 150 Ninth Ave., N., Terra Building, Nashville, TN 37219, (615) 741-7812.	Same.
Texas	Dr. Robert Barmstein, Commissioner, Texas Department of Health, Bureau of Radiological Health, 1100 West 49th Street, Austin, TX 78758, (512) 835-7000.	Col. James E. Adams, Director, Texas Department of Public Safety, 5805 N. Lamar Blvd., Austin, TX 78752, (512) 465-2000.
Utah	Darrell M. Warren, Director, Bureau of Radiation Control, 150 W. North Temple, P.O. Box 2500, Salt Lake City, UT 84110, (801) 533-8734.	Same.
Vermont	Commissioner Paul Philbrook, Vermont Dept. of Public Safety, c/o State Administration Bldg., 133 State Street, Montpelier, VT 05602, (802) 826-2144.	Same.
Virginia	Norman McTague, Office of Emergency and Energy Services, Operations Director, 7700 Midlothian Turnpike, Richmond, VA 23235, (804) 323-2300.	Same.
Washington	Nicholas D. Lewis, Chairman, Energy Facility Site Evaluation Council, Mail Stop PY-11, Olympia, WA 98504, (206) 459-8490.	Same.
West Virginia	Cecil H. Russell, Director, West Virginia Office of Emergency Services, State Capitol Building, Room EB-80, Charleston, WV 25305, (304) 348-5380.	No notifications are to be made
Wisconsin	Carol Z. Homersbach, Administrator, State of Wisconsin/Division of Emergency, Government, 4802 Sheboygan Ave., Room 99A, P.O. Box 7865, Madison, WI 53707, (608) 268-3232.	Same.
Wyoming	Thomas A. Schell, Wyoming State Liaison Officer, Radiological Health Services (Health and Medical Services), Hatheway Building, Cheyenne, WY 82002, (307) 777-7956. After hours: (307) 777-7244.	Same.
District of Columbia	Herbert T. Wood, Ph. D., Acting Deputy Bureau Chief, BCIS, OESQA, Department of Environmental Services, 415 12th Street, N.W., Room 314, Washington, DC 20004, (202) 724-4113. After hours: (202) 529-3349.	Same.
Puerto Rico	Pedro A. Galibert, Chairman, Environmental Quality Board, P.O. Box 11488, Santurce, PR 00910, (809) 725-8898 or (809) 725-5140.	Same.
Guam	Paul M. Calvo, Governor of Guam, Office of the Governor, P.O. Box 2950, Agaña, Guam 96910, 472-8931 or 472-8939.	Same.
Trust Territory of the Pacific Islands	Acting Deputy High Commissioner, Trust Territory of the Pacific Islands, Saipan, CM 96950, Saipan 9741.	Same.
Virgin Islands	Honorable Juan Luis, Governor, Government House, Charlotte Amalie, St. Thomas, Virgin Islands 00801, (809) 774-0001.	Same.
American Samoa	Honorable Peter Coleman, Governor of American Samoa, Territorial Capitol, Pago Pago, American Samoa 96799, 633-4116.	Same.
Commonwealth of the Northern Mariana Islands	Nicolas M. Guerrero, Director, Department of Natural Resources, Commonwealth of Northern Mariana Government, Saipan, CM 96950, #7125 or #7126.	Same.

TABLE 5

-UNITED STATES NUCLEAR REGULATORY COMMISSION REGIONAL OFFICES

	Address	Telephone (24 hours)
NRC Operations Center (Via NRC Operator)	USNRC, Office of Inspection and Enforcement, Washington, D.C. 20555.	(301) 492-7000 (FTS) 492-7000
Region I: Connecticut, Delaware, District of Columbia, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.	USNRC, 631 Park Avenue, King of Prussia, PA 19406.	(215) 337-5000 (FTS) 468-1000
Region II: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, Puerto Rico, South Carolina, Tennessee, the Virgin Islands, Virginia, and West Virginia.	USNRC, 101 Marietta St., Suite 3100, Atlanta, GA 30303.	(404) 227-4503 (FTS) 242-4503
Region III: Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Ohio, and Wisconsin.	USNRC, 709 Roosevelt Road, Glen Ellyn, IL 60137.	(312) 932-2500 (FTS) 384-2500
Region IV:¹ Arkansas, Colorado, Idaho, Kansas, Louisiana, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas, Utah, and Wyoming.	USNRC, 811 Ryan Plaza Drive, Suite 1000, Arlington, TX 76102	(817) 860-8100 (FTS) 728-8100
Region IV Field Office	USNRC Region IV Uranium Recovery Field Office, 730 Simms Street, P.O. Box 25325, Denver, CO 80225.	(303) 234-7232 (FTS) 234-7232
Region V: Alaska, Arizona, California, Hawaii, Nevada, Oregon, Pacific Trust Territories, and Washington.	USNRC, 1460 Marie Lane, Walnut Creek, CA 94596.	(415) 943-3700 (FTS) 463-3700

¹ For calls related to Material Control and Accounting matters, consult the following Regions: Arkansas—II, Colorado—V, Idaho—V, Kansas—II, Louisiana—II, Montana—V, Nebraska—II, New Mexico—V, North Dakota—III, Oklahoma—II, South Dakota—III, Texas—V, Utah—V, Wyoming—V.

TABLE 6

HAZARDOUS MATERIAL TABLE

(2) Hazardous materials descriptions and proper shipping names	(3) Hazard class	(3A) Identification number	(4) Label(s) required (if not excepted)	(5) Packaging		(6) Maximum net quantity in one package		(7) Water shipments		
				Excep- tions	Specific require- ments	Passenger carrying aircraft or railcar	Cargo only aircraft	Cargo ves- sel	Pass- enger vessel	Other require- ments
Radioactive material, empty packages.	Radioactive Material	UN2908	Empty	173.427				1.2	1.2	
Radioactive material, fissile, n.o.s.	Radioactive Material	UN2918	Radioactive	173.459	173.417			1.2	1.2	
Radioactive material, instruments and articles.	Radioactive Material	UN2911	None	173.422 173.424				1.2	1.2	
Radioactive material, limited quantity, n.o.s.	Radioactive Material	UN2910	None	173.421				1.2	1.2	
Radioactive material, low specific activity or LSA, n.o.s.	Radioactive Material	UN2912	Radioactive	173.421 173.422 173.424	173.425			1.2	1.2	
Radioactive material, n.o.s.	Radioactive Material	UN2982	Radioactive	173.421 173.422 173.424	173.415 173.418			1.2	1.2	
Radioactive material, special form, n.o.s.	Radioactive Material	UN2974	Radioactive	173.421 173.422	173.415 173.418			1.2	1.2	

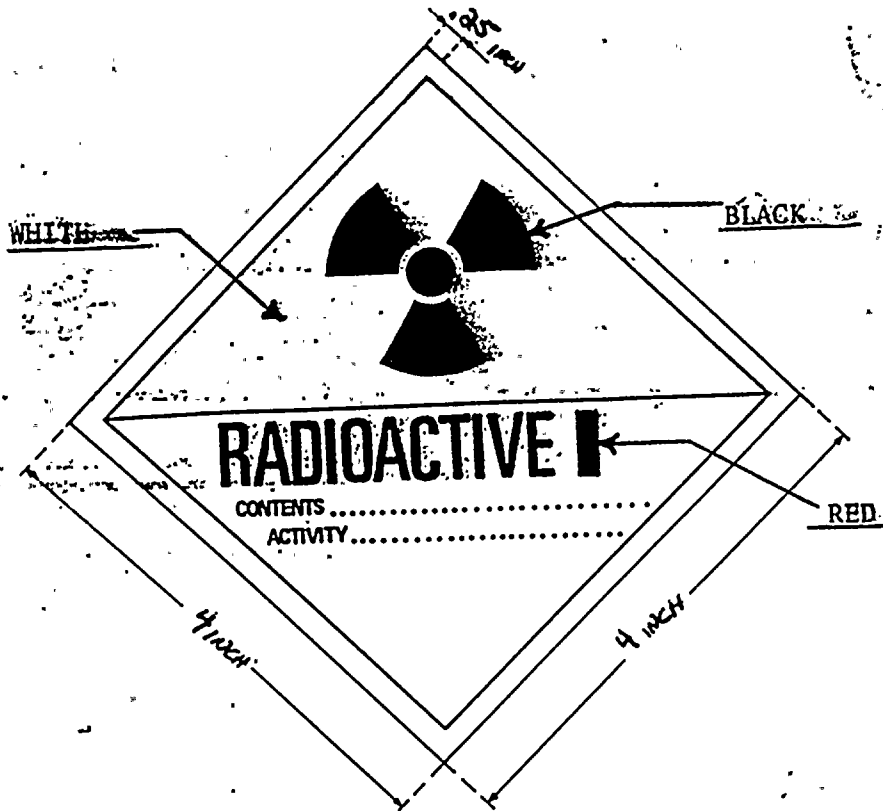


FIGURE 1 RADIOACTIVE WHITE - I LABEL

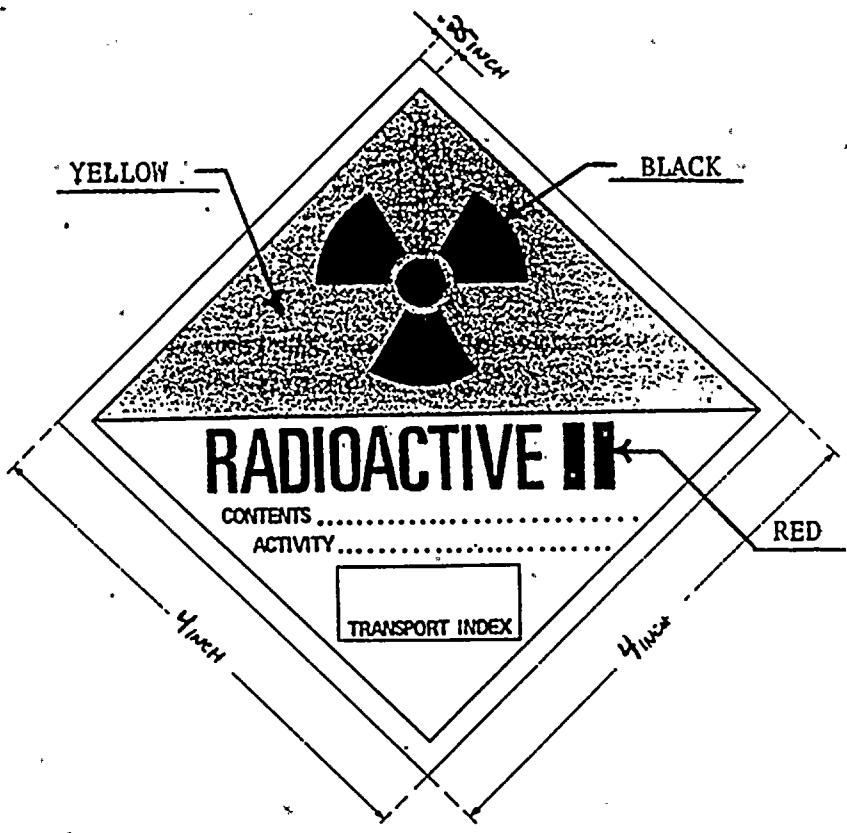


FIGURE 2 RADIOACTIVE YELLOW - II LABEL

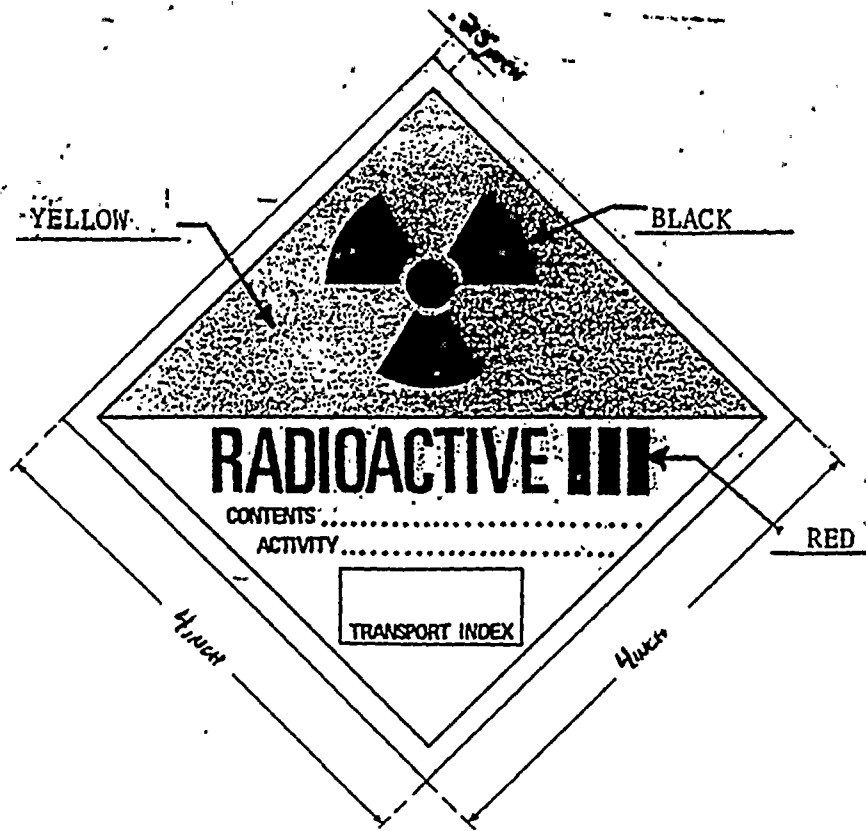


FIGURE 3 RADIOACTIVE YELLOW - III LABEL

EMPTY BLACK

FIGURE 4 "EMPTY LABEL"

FIGURE 7

Niagara Mohawk Power Corp.
P.O. Box 32
Lycoming, NY 13093

**RADIOACTIVE
SHIPMENT
RECORD**

Date: _____

Contact: _____

Phone: _____

Phone: _____

Ship Via: _____

Name: _____

Address: _____

Phone: _____

EPA HW ID No. _____

To: LIMITED QUANTITY

RADIOACTIVE - LSA

RADIOACTIVE WHITE I

License No: _____ RADIOACTIVE YELLOW II T. INDEX _____

From: RADIOACTIVE YELLOW III T. INDEX _____

OTHER: T. INDEX _____

License No: _____ PLACARD REQUIRED YES NO

HM	MATERIAL (IDENTITY AND CHEMICAL FORMULA)	ACTIVITY	RADIO NUCLIDE	RADIATION LEVEL FROM MATERIAL	CONTAINER RADIATION LEVEL		CONTAMINATION LEVEL dpm/100 cm ²
					TYPE	AT SURFACE	

TOTAL ACTIVITY _____

RSLs DATE: TIME: BY: .
NO _____

WASTE CLASS
A B C

APPROVAL:
This certifies that the transported materials are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation and the Nuclear Regulatory Commission.

VOLUME: _____
SOLIDIFICATION AGENT: _____
% CHELATING AGENT: _____
UN IDENTIFICATION NO: _____

X
Supervisor Chemistry and Radiation Protection

VEHICLE SURVEY FORM

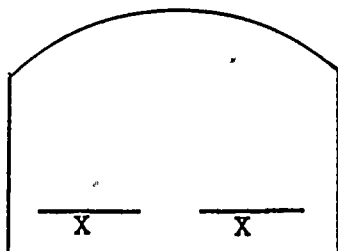
FIGURE 8

CUSTOMER: _____

DATE: _____

Survey Results at positions indicated by "X":

ALL READINGS IN MILLIREM/HOUR



in occupied positions

_____ at 2 meters
X

_____ at contact*
X

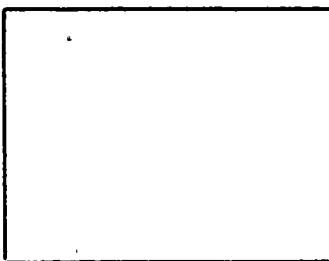
2 meters _____ X at contact* _____ X

_____ X

_____ X

_____ X

_____ X



X _____ at contact* X _____ at 2 meters

X _____

X _____

X _____

X _____

_____ at contact*

X

_____ at 2 meters

MAXIMUM PERMISSIBLE VALUES

10 at 2 meters
200 at contact*
2 in cab

*Uncorrected

INSTRUMENT _____
TRACTOR NO. _____
TECHNICIAN _____

NUMBER _____
TRAILER NO. _____
DATE _____

BATCH # _____
 SHIPMENT # _____
 SAMPLING DATE _____

ATTACHMENT 1

Waste Shipment Radionuclide Summary Sheet - Dewatered Waste

Isotope (or Parameter)	Determination Method	Column A	Scaling Isotope (or Parameter)	Column B	Column C	
		Gamma Isotopic, Tritium and Gross results (μ Ci/ml)		Scaling Factor	Radionuclide Summary μ Ci/ml	nCi/g
Co-60	i					
Cs-137	i					
Cs-134	i					
Mn-54	i					
Co-58	i					
	i					
	i					
	i					
Tritium	c					
Gross γ	i					
Cm-242	s		Gross γ			
Cm-243, 244	s		Gross γ			
Am-241	s		Gross γ			
Pu-238	s		Gross γ			
Pu-239	s		Gross γ			
TRU	s		Gross γ			
Pu-241	s		Gross γ			
C-14	s		Cs-137			
Tc-99	s		Cs-137			
I-129	s		Cs-137			
Sr-90	s		Cs-137			
Ni-63	s		Co-60			

$(P_{\text{waste}})_{\text{final}} = \text{_____ g/ml}$

*nCi/g

i = gamma isotopic analysis

s = scaling

c = calculation

 Technician / Date

 Supervisor / Date

NOTE: Attach γ isotopic report, Water Content Determination Worksheet, Gross γ Analysis Results.

BATCH # _____
 SHIPMENT # _____
 SAMPLING DATE _____

ATTACHMENT 1 (Cont.)

Waste Shipment Radionuclide Summary Sheet - Solidified Waste

Isotope (or Parameter)	Determination Method	Column A ₁	Column A ₂	Scaling Isotope or Parameter	Column B	Column C	
		Volume/Weight Uncorrected Gamma Isotopic, Tritium, Alpha results (μCi/ml)	Volume/Weight Corrected Results (μCi/ml)		Scaling Factor	Radionuclide Summary μCi/ml	nCi/g
Co-60	i			[REDACTED]			
Cs-137	i						
Cs-134	i						
Mn-54	i						
Co-58	i						
	i						
	i						
	i						
Tritium	c						
Gross	i	*	*				
Cm-242	s	[REDACTED]	Gross				
Cm-243, 244	s		Gross				
Am-241	s		Gross				
Pu-238	s		Gross				
Pu-239	s		Gross				
TRU	s		Gross				
Pu-241	s		Gross				
C-14	s		Cs-137				
Tc-99	s		Cs-137				
I-129	s		Cs-137				
Sr-90	s		Cs-137				
Ni-63	s		Co-60				

WCF = _____
 VCF = _____
 $(\rho_{\text{waste}})_{\text{final}} = \frac{\text{VCF} \times (\rho_{\text{waste}})_{\text{initial}}}{\text{WCF}}$
 = _____ x (_____) _____ g/ml

*nCi/g
 i= gamma isotopic analysis
 s= scaling
 c= calculation

 Technician / Date

 Supervisor / Date

NOTE: Attach γ isotopic report, Water Content Determination Worksheet, Gross Analysis Results.

ATTACHMENT 3

WASTE CLASSIFICATION WORKSHEET - A
(SR, FS, CW)

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
61.55 Table 1	Nuclide μCi/ml	Class A	Class A Factor	Class C	Class C Factor	61.55 Table 2	Nuclide μCi/ml	Class A	Class A Factor	Class B	Class B Factor	Class C	Class C Factor
C-14		.8		8		H-3		40		N.L.	X	N.L.	X
C-14 ^a		8		80		Co-60		700		N.L.	X	N.L.	X
Ni-59 ^a		22		220		Ni-63		3.5		70		700	
Nb-94 ^a		.02		.2		Ni-63 ^a		35		700		7000	
Tc-99		.3		3		Sr-90		.04		150		7000	
I-129		.008		.08		Cs-137		1		44		4600	
Pu-241 ^b		350		3500		T 1/2 < 5y		700		N.L.	X	N.L.	X
Cm-242 ^b		2000		20000							X		X
TRU ^b		10 ^c		100 ^c							X		X
											X		X
											X		X
											X		X
											X		X
											X		X
											X		X

WASTE CLASS _____
 WASTE SHIPMENT NO. _____
 BATCH NO. _____
 DATE _____
 RSLs _____
 TECHNICIAN _____

NOTES:
 (a) activated metals only
 (b) express as nCi/gm
 (c) total of transuranics listed

No limit

ATTACHMENT 4

WASTE CLASSIFICATION WORKSHEET - B

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
61.55 Table 1	Nuclide mCi	DAW Conc μCi/ml	Class A Factor	Class A Factor	Class C Factor	Class C Factor	61.55 Table 2	Nuclide mCi	DAW Conc μCi/ml	Class A Factor	Class A Factor	Class B Factor	Class B Factor	Class C Factor	Class C Factor
C-14			.8		8		H-3			40		N.L.		N.L.	
C-14 ^a			8		80		Co-60			700		N.L.		N.L.	
Ni-59 ^a			22		220		Ni-63			3.5		70		700	
Nb-94 ^a			.02		.2		Ni-63 ^a			35		700		7000	
Tc-99			.3		3		Sr-90			.04		150		7000	
I-129			.008		.08		Cs-137			1		44		4600	
Pu-241 ^b			350		3500		T 1/2 < 5y			700		N.L.		N.L.	
Cm-242 ^b			2000		20000										
TRU ^b			10 ^c		100 ^c										

NOTES:

- (a) activated metals only
- (b) express as nCi/gm
- (c) total of transuranics listed

N.L. no limit

WASTE CLASS _____

WASTE SHIPMENT NO. _____

BATCH NO. _____

DATE _____

RSLs _____

TECHNICIAN _____

DATE _____
RSLs # _____

ATTACHMENT 5

RADIOACTIVE MATERIALS CLASSIFICATION WORKSHEET

1. Does the material qualify as fissile (Pu-238, Pu-239, Pu-241, U-233, U-235) (Section 6.13.1)

_____ exempt quantities per section 6.13.1.1, proceed Step 2
_____ no, proceed to Step 2
_____ yes and not exempt, contact supervision for further instruction

2. Does the material qualify as a limited quantity (section 6.13.2)

_____ yes, ship as limited quantity
_____ no, proceed to Step 3

NOTE: This calculation need not be performed for shipments obviously far above limited quantity (i.e. radwaste shipments).

3. Is the curie content (column 6, Shipment Preparation Worksheet) for each nuclide less than A_1 (special form only)?

_____ yes,

_____ a) ship as Type A (Section 6.13.3) or
_____ b) for mixed radionuclides, proceed to Step 5

_____ no, ship a Type B (Section 6.13.4) and evaluate as a Highway Route Controlled Quantity, step 7

_____ not applicable, proceed to Step 4

4. Is the curie content (column 6, Shipment Preparation Worksheet) of each radionuclide less than the A_2 (normal form only)?

_____ yes,

_____ a) single radionuclide, ship as Type A or
_____ b) single radionuclide, proceed to Step 6, LSA determination
_____ c) mixed radionuclide, proceed to Step 5

_____ no, proceed to Step 6

5. Summation of F values less than 1? (See Section 6.9.1)

_____ yes, determined in Section 6.9.1.1, ship as Type A or LSA
_____ no, proceed to Step 6.

RADIOACTIVE MATERIALS CLASSIFICATION WORKSHEET
(Continued)

6. Does the material qualify for LSA (Sections 6.11 and/or 6.13.5)

- yes, determined in section 6.11, ship LSA
 yes, 6.13.5.1 to 6.13.5.3 (specify _____), ship LSA
 yes, 6.13.5.5 (contaminated non-radioactive materials),
ship as LSA
 no, ship as Type B and evaluate for a Highway Control
Quantity, step 7

7. Does the material qualify as a Highway Route Controlled Quantity (Section, 6.13.6)?

- yes, contact supervision and follow the instructions of section
 no, ship as appropriate

8. Does the material qualify for advance notification, Section 6.13.7 (nuclear waste only)?

- yes, contact supervision and follow the instructions of section
 no, proceed with Procedure 6.14

Technician

Supervisor, Chemistry and Radiation Protection

