

OFFSITE SHIPMENT OF RADIOACTIVE MATERIALS

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Radiation Practices Engineering
Manufacturing Engineering
Section

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Douglas United Nuclear, Inc.
Richland, Washington

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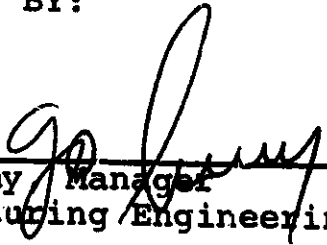
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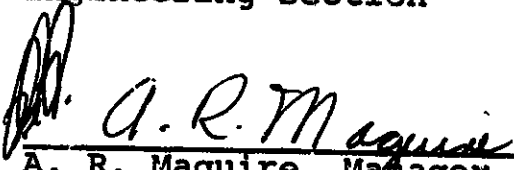
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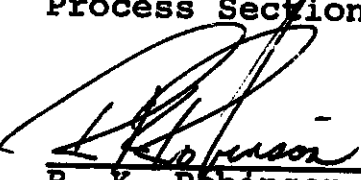
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INTRODUCTION

Offsite shipment is defined as the movement of material from DUN facilities to any receiver other than the Hanford contractors listed below:

- Douglas United Nuclear, Inc.
- Atlantic Richfield Hanford Company
- Battelle Northwest
- ITT/Federal Support Services
- J. A. Jones Company
- Hanford Environmental Health Foundation

The following procedures insure that material prepared by DUN for off-site shipment will comply with all applicable Department of Transportation and AEC Regulations. However, before making international shipments, contact Radiation Practices Engineering on 2-5360. This manual consists of:

1. The "Procedure for Offsite Shipment of Radioactive Materials", which describes proper packaging, labeling and administrative techniques. An appendix of containers normally used by DUN for offsite shipments is included.
2. The procedures needed for proper completion of the "Radioactive Shipment Authorization (RSA) Form" for offsite shipments.

It is the responsibility of the individual who prepares or directs the preparation of a package for offsite shipment to:

1. Insure that offsite shipments of radioactive material prepared by DUN are in compliance with all applicable DOT and AEC regulations by following the procedures in this manual.
2. Call Radiation Practices Engineering (RPE) for procedural or compliance interpretations.

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OFFSITE SHIPMENT OF RADIOACTIVE MATERIALS

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PROCEDURE FOR OFFSITE SHIPMENT OF RADIOACTIVE MATERIALS

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1.0 SHIPPER

The individual who prepares or directs the preparation of a package for offsite shipment by AEC-RL.

- 1.1 If the material to be shipped is fissile material (i.e., contains U-233, U-235, Pu-238 or Pu-241), contact the Process Standards Unit on 2-4395. They will specify the container to be used and the transport index of the loaded container.
- 1.2 Use Appendix B to determine the transport group for the shipment and the quantity category for each container. If a container falls into one of the following three categories, or if the contents are classified, contact RPE on 2-5360.

Categories

- "Large quantity," i.e., exceeds the "Type B" quantity limits
- Small quantity
- Low specific activity quantity

- 1.3 After determining which quantity category the container falls into (as specified in Appendix B), and if the material being shipped is non-fissile, select a proper container from Appendix A. Insure that all conditions listed for use of the container (such as allowable heat generation rate) are complied with. If a container which is not listed is to be used, contact RPE on 2-5360 before it is used. If the material being shipped is fissile material, contact the Process Standards Unit (see 1.1 above).

NOTE: Type B quantity shipments must be shipped in Type B packages only.

- 1.4 Advise Nuclear Materials Management on 3211 of the impending shipment.

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PROCEDURE FOR OFFSITE SHIPMENT OF RADIOACTIVE MATERIALS

- 1.5 Internal bracing or cushioning, where necessary, must be adequate to insure that the distance from the inner container or material to the outside wall of the package remains constant and that the transport index remains constant under conditions normally incident to transportation. If the shipment consists of or contains radioactive liquids, powder or gas, contact RPE on 2-5360 for packaging instructions.
 - 1.6 Have radiation monitoring survey the loaded container. RM will advise the shipper and RPE of any violation of AEC or DOT regulations pertaining to radiation dose rate or radioactive contamination levels.
 - 1.7 Determine the "transport index" for the loaded container. This will be the highest dose rate at three feet from any accessible external surface of the container. However, the dose rate must not exceed 10 mrem/hr. The transport index has no units. (Ex.: If the highest dose rate at 3 feet is 8 mrem/hr., the transport index will be 8).
- NOTE: The transport index for all fissile material shipments will be determined by the Process Standards Unit. (See 1.1).
- 1.8 The transport index for the total shipment (determined by summing the transport index for each package in the shipment) shall not exceed 50 per transport carrier, unless specifically authorized by RPE.
 - 1.9 Select and fill in completely the proper "Radioactive" label for each container, using Appendix C and the information from parts 1.6 and 1.7 above. Each container must be posted with two "Radioactive" labels (placed on opposite sides or faces of the container where they are plainly visible). "Radioactive" labels are available from RPE.
 - 1.10 If the container is to be shipped as an "empty" container, Radiation Monitoring must determine if it meets applicable radiation limits. If the container is released by RM as an

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internally contaminated empty, it must be securely closed and a standard "Empty" label available from RPE, must be attached completely covering the old "Radioactive" label. If the interior of the container is found to be uncontaminated, the old "Radioactive" label must be removed. An "Empty" label is not required.

- 1.11 Request a completed Address label (Form No. RL-451) from Nuclear Materials Management.

NOTE: Address labels are not required on containers shipped in exclusive use, sealed transport vehicles.

- 1.12 Complete and distribute a Radioactive Shipment Authorization (RSA: Form No. BC-5000-291) in accordance with Procedure II of this manual. Nuclear Materials Management (on 3211) will transmit the Government Bill of Lading (GBL) number, when applicable, to the shipper. This number must be recorded on the RSA and on the container shipping label.

NOTE: If radioactive materials are being shipped in exclusive use, sealed transport vehicles, it is not necessary to mark the GBL number on the containers or on the vehicle.

- 1.13 Prepare a "Shipping and Receiving Report" (Form No. BD-5000-264) on the day of shipment and distribute copies promptly. Contact Nuclear Materials Management on 3211 for assistance in obtaining and preparing this form.
- 1.14 Containers must be blocked and braced so that they cannot change positions in the conveyance when submitted to normal conditions of transit.
- 1.15 Placard the rail or motor freight carrier vehicle placing the proper "Dangerous-Radioactive Materials" placard (different placards are used for motor and rail freight - RPE will supply the proper type) on each of the two sides and the front and rear of the vehicle when:

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- A "Radioactive Yellow III" label is used on the container being shipped, or when
- A carload lot of radioactive material is being shipped.

2.0 NUCLEAR MATERIALS MANAGEMENT

- 2.1 Obtain the GBL number and transmit this number to the shipper. If the shipment will not be made on a Government Bill of Lading, so advise the shipper.
- 2.2 Prepare an Address label (Form number RL-451) and send it to the shipper.
- 2.3 Promptly forward copies of the Radioactive Shipment Authorization (RSA) as follows:
- 2.3.1 The Yellow copy to the receiver
- 2.3.2 The Goldenrod copy to AEC-RL Traffic Management
- 2.4 Comply with all other applicable provisions of DUN-M-4 (Rev 1) "Nuclear Materials Management Procedures Manual".

3.0 RADIATION MONITORING

- 3.1 Determine the radiation levels and insure that they are within the limits presented in DUN-M-3, 3.2. If they are not within the limits, advise both the shipper and RPE.
- 3.2 Complete the appropriate sections of the "Radioactive Shipment Authorization" (RSA).

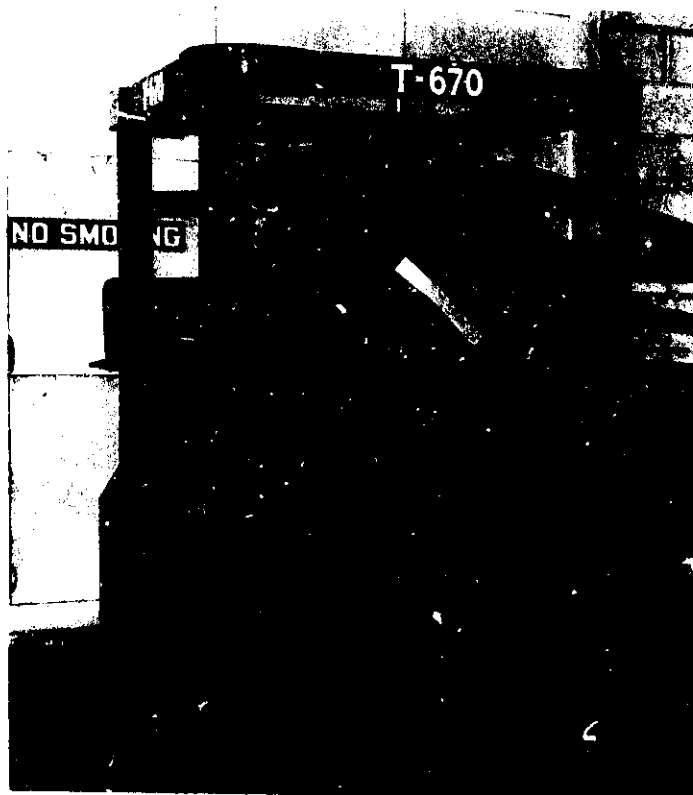
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APPENDIX A - SHIPPING CONTAINERS

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5 TON HOPPER

Type of Package: Exempt - low specific activity fissile material

Shielding: None

Permit: Exempt - low specific activity fissile material

Mode of Transport Authorized: Railcar (closed)

Special Conditions of Transport: Placard the railcar

Note: The 5 ton hopper is filled with UO_3 by Atlantic Richfield Hanford Company. DUN loads the hoppers onto the closed railcars (boxcars) for offsite shipment. This is the only authorized use of the 5 ton hoppers.

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OFFSITE SHIPMENT OF RADIOACTIVE MATERIALS

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APPENDIX A - SHIPPING CONTAINERS

NLO WOODEN BOX

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Type of Package: Type B - Fissile Material only
Dimensions: Several types are available
Capacity: Determined by Process Standards Unit
Shielding: None
Heat Generation Rate Limit: 0
Permit: DOT Special Permit 5467
Contents Authorized: Determined by Process Standards Unit
Mode of Transport Authorized: Railcar (closed)
Assigned to: National Lead Company of Ohio

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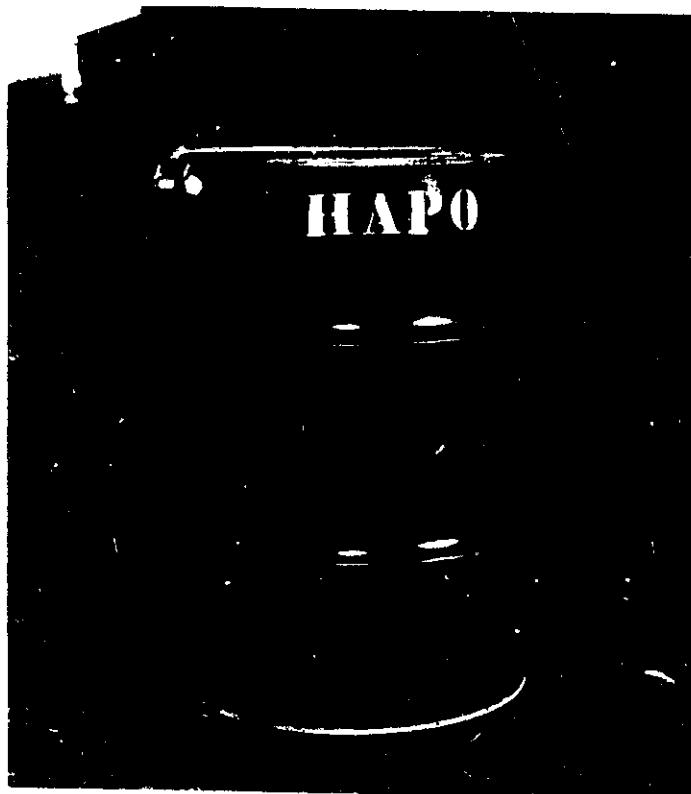
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JECT

APPENDIX A - SHIPPING CONTAINERS

MODEL 6B DRUM

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Type of Package: Type A
Shielding: None
Capacity: 30 gallons
Permit: DOT 6B Drum Specification Container
Heat Generation Rate Limit: 0
Mode of Transport Authorized: None specified
Special Conditions of Transport: None specified
Maximum Authorized Gross Weight: 480 pounds

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OFFSITE SHIPMENT OF RADIOACTIVE MATERIALS

APPENDIX A - SHIPPING CONTAINERS

MODEL 44 DRUM



Type of Package: Type B - Fissile Material only

Dimensions: Interior--Cavity - 16" ID x 28" long
Exterior--25 3/4" OD x 34" long

Weight: Varies with loading

Capacity: Determined by Process Standards Unit

Shielding: None

Heat Generation Rate Limit: 0

Permit: DOT Special Permit 5739

Contents Authorized: Determined by Process Standards Unit

Mode of Transport Authorized: Railcar or motor freight

Owner: RL

Home Location: Assigned to DUN, Fuels Section

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APPENDIX B-TRANSPORT GROUPS & QUANTITY CATEGORIES

- 1.0 Find the Transport Group of the radionuclide being shipped by using Table I of this Appendix. If the radionuclide is not listed in Table I, refer to Section 2.0. When the material being shipped consists of more than one radionuclide, use Section 3.0 of this Appendix to determine the Transport Group.

After the Transport Group has been established, determine which quantity category the proposed shipment falls into by using Table II of this Appendix.

- 2.0 The Transport Group of any radionuclide not listed in Table I shall be determined by using the following table:

<u>Radionuclide</u>	<u>Radioactive Half Life</u>		
	<u>0-1,000 Days</u>	<u>1,000 days to 10⁶ years</u>	<u>Over 10⁶ years</u>
Atomic No. 1-81	Group III	Group II	Group III
Atomic No. 82 and over	Group I	Group I	Group III

3.0 Mixtures of Radionuclides

- 3.1 If the identity and respective activity of each radionuclide in a mixture are known, use the following:

Divide the activity of each radionuclide by the activity allowed in its respective transport group (see Table II). Then add the results obtained for all radionuclides present. The sum must be less than 1.

- 3.2 If the transport groups of the radionuclides are known but the amount in each group cannot be reasonably determined, the mixture shall be assigned to the most restrictive transport group present in the mixture.
- 3.3 If the identity of all or some of the radionuclides cannot be reasonably determined, each of those unidentified radionuclides

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APPENDIX B-TRANSPORT GROUPS & QUANTITY CATEGORIES

shall be considered as belonging to the most restrictive transport group which cannot be positively excluded.

- 3.4 Mixtures consisting of a single radioactive decay chain where the radionuclides are in the naturally occurring proportions shall be considered as consisting of a single radionuclide. The transport group and activity shall be that of the first member present in the decay chain, except that if a radionuclide in the decay chain has a half life longer than that of the first member and an activity greater than that of any other member at any time during transportation, the transport group of the nuclide and the activity of the mixture shall be the maximum activity of that nuclide during transportation.

4.0 Special Form Material

To qualify as Special Form Material, the radioactive material must either be in massive solid form or encapsulated and must meet the criteria outlined in 173.398 of the Code of Federal Regulation (CFR) Title 49. Contact RPE on 2-5360 for assistance in determining if the material meets special form criteria.

5.0 Type A and Type F Quantities

Type A quantity shipments may be packaged in either a Type A or Type B container; however the Type A container should be used whenever possible. Type B quantity shipments must be packaged only in Type B containers. The package type is specified for each container listed in Appendix A.

TABLE I

Procedure I

Element	Radionuclide	Transport group						
		I	II	III	IV	V	VI	VII
Actinium (89)	Ac-227	X						
Americium (95)	Am-241	X						
Antimony (51)	Sb-122							
	Sb-124							
	Sb-125							
Argon (18)	Ar-41							
	Ar-41 (uncompressed)							
Arsenic (33)	As-73							
	As-74							
	As-76							
	As-77							
Astatine (85)	At-211							
Barium (56)	Ba-131							
	Ba-133							
	Ba-140							
Berkelium (97)	Bk-240							
Beryllium (4)	Be-7							
Bismuth (83)	Bi-208							
	Bi-209							
	Bi-210							
	Bi-212							
Bromine (35)	Br-82							
Cadmium (48)	Cd-109							
	Cd-115m							
	Cd-116							
Calcium (20)	Ca-48							
	Ca-47							
Californium (98)	Cf-250							
	Cf-251							
	Cf-252							
Carbon (6)	C-14							
Cerium (58)	Ce-141							
	Ce-142							
	Ce-144							
Cesium (55)	Cs-131							
	Cs-134m							
	Cs-134							
	Cs-135							
	Cs-137							
Chlorine (17)	Cl-36							
	Cl-38							
Chromium (24)	Cr-51							
Cobalt (27)	Co-56							
	Co-57							
	Co-58m							
	Co-58							
	Co-60							
Copper (29)	Cu-64							
Curium (96)	Cm-242							
	Cm-243							
	Cm-244							
	Cm-245							
	Cm-246							
Dysprosium (66)	Dy-164							
	Dy-165							
	Dy-167							
Erbium (68)	Er-169							
Europium (63)	Eu-150							
	Eu-152m							
	Eu-152							
	Eu-154							
	Eu-155							
Fluorine (9)	F-18							
Gadolinium (64)	Gd-153							
	Gd-155							
Gallium (31)	Ga-67							
	Ga-72							
Germanium (32)	Ge-71							
Gold (79)	Au-193							
	Au-194							
	Au-195							
	Au-196							
	Au-198							
	Au-199							
Hafnium (72)	Hf-181							
Hassium (108)	Hs-260							
Hydrogen (1)	H-3 (see tritium)							
Indium (49)	In-112m							
	In-114m							
	In-115m							
	In-116							
Iodine (53)	I-124							
	I-125							
	I-126							
	I-128							
	I-131							
	I-132							
	I-133							
	I-134							
	I-135							
Iridium (77)	Ir-190							
	Ir-192							
	Ir-194							
Iron (26)	Fe-55							
	Fe-59							
Krypton (36)	Kr-81m							
	Kr-81m (uncompressed)							
	Kr-86							
	Kr-86 (uncompressed)							
	Kr-87							
	Kr-87 (uncompressed)							

See footnotes at end of table.

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TABLE I
(Continued)

Radioisotope	Transport group							Element	Radioisotope	Transport group						
	I	II	III	IV	V	VI	VII			I	II	III	IV	V	VI	VII
Scandium (21)									Sc-46							
									Sc-47							
									Sc-44							
Scandium (34)									Sc-45							
Selenium (34)									Se-76							
Silver (47)									Ag-105							
									Ag-107m							
									Ag-111							
Sodium (11)									Na-22							
									Na-24							
Strontium (38)									Sr-83m							
									Sr-85							
									Sr-90							
									Sr-91							
									Sr-92							
									Sr-93							
Sulfur (16)									S-35							
Tantalum (73)									Ta-182							
Technetium (43)									Tc-99m							
									Tc-99							
									Tc-97m							
									Tc-97							
									Tc-96m							
									Tc-96							
									Tc-120m							
									Tc-120							
									Tc-127m							
									Tc-127							
									Tc-132m							
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TABLE I

Procedure I

(Continued)

Element ¹	Radionuclide ²	Transport group						
		I	II	III	IV	V	VI	VII
Yttrium (89)	Y-90				X			
	Y-91					X		
	Y-91m				X			
	Y-92				X			
	Y-93				X			
Zinc (66)	Zn-65				X			
	Zn-66m				X			
	Zn-67				X			
Zirconium (90)	Zr-90				X			
	Zr-91				X			
	Zr-91m				X			

- ¹ Atomic number shown in parentheses.
² Uncompressed means at a pressure not exceeding 14.7 p.s.i. (absolute).
³ Atomic weight shown after the radionuclide symbol.
⁴ Final radioactive material.

APPENDIX B

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TABLE II

DUN-M-22

Procedure I

TRANSPORT GROUP	LOW SPECIFIC ACTIVITY QUANTITY ¹	SMALL QUANTITY ²	TYPE A QUANTITY		TYPE B QUANTITY	
			(See 5.0)		(See 5.0)	
Group I	0^5 to < .0001 mCi/gm ³	0^5 to < .01 mCi	.01 mCi to < .001 Ci	.001 to < 20 Ci		
Group II	0 to < .005 mCi/gm	0 to < .1 mCi	.1 mCi to < .05 Ci	.05 to < 20 Ci		
Group III	0 to < .3 mCi/gm	0 to < 1 mCi	1 mCi to < 3 Ci	3 to < 200 Ci		
Group IV	0 to < .3 mCi/gm	0 to < 1 mCi	1 mCi to < 20 Ci	20 to < 200 Ci		
Group V		0 to < 1 mCi	1 mCi to < 20 Ci	20 to < 5,000		
Group VI		0 to < 1 mCi	1 mCi to < 1,000 Ci	1,000 to < 50,000		
Group VII		0 to < 25 Ci	25 to < 1,000 Ci	1,000 to < 50,000		
Special Form ⁴		0 to < 1 mCi	1 mCi to < 20 Ci	20 to < 5,000		

¹To be classified as low specific activity material, the activity must be uniformly distributed in the material and the limits above (given in millicuries per gram of material) must be complied with.

²Shipments of manufactured articles containing radioactive components (such as incense fission chambers) may be classified as small quantity shipments even though they exceed the limits above. Contact RPE on 2-5360 for instructions when shipping devices with radioactive components.

³mCi = millicuries = 10^{-3} curies.

⁴Special Form is defined in Section 4.0 of this Appendix.

⁵Although the lower limit is given as zero, material which does not contain more than 2×10^{-9} Curies per gram of material, and in which the radioactivity is essentially uniformly distributed, is not considered radioactive.

DOUGLAS UNITED NUCLEAR, INC.

OFFSITE SHIPMENT OF RADIOACTIVE MATERIALS

SUBJECT
APPENDIX C - RADIOACTIVE LABELS

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DATE ISSUED 2/1/69	PAGE NO. 1 of 1
SUPERSEDES ISSUE DATED NEW	
ISSUED BY RADIATION PRACTICES ENGINEERING	

RADIOACTIVE WHITE I LABEL

Use When:

- Dose rate on any external surface of shipping container does not exceed .5 millirem/hr

Do Not Use When:

- Fissile Class II or III material is being shipped

RADIOACTIVE YELLOW II LABEL

Use When:

- The limits for Radioactive White I Label are exceeded
- And dose rate on any external surface of shipping container does not exceed 10 millirem/hr
- And dose rate 3 feet from any external surface of shipping container does not exceed .5 millirem/hr
- And the transport index does not exceed .5

Do Not Use When:

- Fissile Class III materials are being shipped in the container

RADIOACTIVE YELLOW III LABEL

Use When:

- The limits for the two preceding labels are exceeded
- Fissile Class III materials are being shipped in the container
- "Large Quantity" shipment is being made



OFFSITE SHIPMENT OF RADIOACTIVE MATERIALS

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ISSUED BY RADIATION PRACTICES ENGINEERING	

SUBJECT

RADIOACTIVE SHIPMENT AUTHORIZATION (RSA) FORM

1.0 APPLICABILITY OF THE RSA FORM

An RSA form (Form No. BC-5000-291) is to be completed in accordance with the following procedure for all offsite shipments. This form is readily available from any Radiation Monitoring office. If the shipment is classified, contact RPE on 2-5360 before filling out the RSA.

2.0 SHIPPER

2.1 Complete the "To, From and Carrier" boxes in the "Shipping Data" Section.

2.2 Fill in "Type of Material and Container" block in the "Shipping Data" Section:

- List each radionuclide in the shipment where practicable. If the contents of the shipment are unknown, the fact should be so stated. If large numbers of different radionuclides are present, so state and identify those present in large relative quantities.
- List the Transport Group classification and the quantity category for the shipment as determined by the "Procedure for Offsite Shipment of Radioactive Material," Appendix B.
- List the total curies of each radionuclide where practicable. If more than one container is used, list the total number of curies of each radionuclide for each container where practicable. Describe the form (normal or special).
- Describe internal packaging (i.e., encapsulation).
- List the number of pieces or the weight of the radioactive material being shipped, whichever is more practical.
- List the type, name and DOT special permit number or a specification container number for each type of container being used in the shipment.
- List the total shipment weight.
- List the "Radioactive" label type used.

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OFFSITE SHIPMENT OF RADIOACTIVE MATERIALS

SUBJECT

RADIOACTIVE SHIPMENT AUTHORIZATION (RSA) FORM

- 2.3 Check the "Offsite" box.
- 2.4 Obtain the Government Bill of Lading (GBL) number from Nuclear Materials Management and record it in the GBL box.
- 2.5 Have Radiation Monitoring survey the loaded container. Insure that RM records the results of the survey on the RSA and completes all other applicable sections of the form.
- 2.6 Complete the "Special Instruction" Section when fissile material is being shipped or when any other special instructions are needed.
- 2.7 Obtain a fissile material criticality analysis if:
 - The fissile material exceeds 15 grams of contained fissile material (uranium containing U-235 which does not exceed 0.72 w/o is exempted).
- 2.8 Contact the Process Standards Unit on 2-4395 if the fissile material being shipped falls into the category in 2.7 above.
- 2.9 The shipper shall insure that the "Special Instructions" Section of the RSA form contains, when applicable, the actual criticality control instructions or that a copy of the instructions is attached to each copy of the RSA.
- 2.10 Check the "Classified" or "Not Classified" box, whichever is applicable.
- 2.11 Assure that shipment preparation has been in accord with procedures established in this manual and the RSA form has been completed in full in all sections excluding the "Patrol" Section and that all material recorded in the RSA is accurate and legible.

DOUGLAS UNITED NUCLEAR, INC.

OFFSITE SHIPMENT OF RADIOACTIVE MATERIALS

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RADIOACTIVE SHIPMENT AUTHORIZATION (RSA) FORM		SUPERSEDES ISSUE DATED NEW
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Then sign in the "Authorized Signature" category and fill in the date in the "Shipping Date" category. If the "Classified" box is checked (2.10 above), the signator must be registered in the patrol specimen signature book. The RSA replaces the C&R Pass.

- 2.12 Distribute the completed RSA promptly and in accordance with the following:

Send the Yellow and Goldenrod copies to Nuclear Materials Management for distribution and send the White copy to the Radiation Monitoring group which surveyed the shipment. Give the Pink copy to the carrier who will surrender it to Patrol at the last barricade to be passed. Attach the Buff copy to the container being shipped. If there is more than one container in the shipment, the RSA should be attached to the most conspicuous one. If the container is too small to allow the RSA to be attached, fold it, place it in a plainly marked envelope and attach the envelope to the container.

3.0 RADIATION MONITOR

- 3.1 Perform the following operations in accordance with DUN-M-3, Practice 3.2 and record the results in the "Monitoring Data" Section:

- Determine the maximum surface dose rate in mrem/hr
- Determine the maximum dose rate in mrem/hr at 3 feet from the container
- Determine the surface contamination on the container in d/m/100 cm² for alpha, beta, and gamma.
- Insure that each reading is in accordance with the limits presented in DUN-M-3, Practice 3.2. If the limits are exceeded, inform the shipper and RPE.

DOUGLAS UNITED NUCLEAR, INC.

OFFSITE SHIPMENT OF RADIOACTIVE MATERIALS

SUBJECT

RADIOACTIVE SHIPMENT AUTHORIZATION (RSA) FORM

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- 3.2 Check either the "Patrol Inspection Not Permitted" Box or the "Normal Inspection Permitted" Box based on observed radiation levels.
- 3.3 Determine if any special instructions concerning handling of the shipment are needed due to radiation levels. If special instructions are needed, record them in the "Special Instruction" Section.
- 3.4 Print name and date of survey in the "Monitored By" and "Date" spaces respectively.

4.0 PATROL

The "Patrol" Section will be completed by the patrol officer in accordance with ITT/FSS procedures. The RSA will act as a property pass for the shipment after it has been completed by the patrol officer. If the "Classified" Box has been checked (2.10 above), the signator must be registered in the patrol specimen signature book. A C&R pass is not required.