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# Transportation of Low-Level Radioactive Waste Into South Carolina

October 1978 - September 1979

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Bureau of Radiological Health  
Department of Health & Environmental Control  
State of South Carolina

Prepared for  
U. S. Nuclear Regulatory  
Commission

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Prepared by  
Bureau of Radiological Health  
Department of Health & Environmental Control  
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## ABSTRACT

Shipments of low-level radioactive waste into the Chem-Nuclear Systems, Inc site near Barnwell, SC were surveyed to determine the origin of such wastes, types and condition of packages or containers and compliance with existing regulations. Type A shipping casks were given special attention during the survey. Area monitors (TLD) were used around transportation terminals. Most violations in packaging, placarding, labeling and shipping documents appeared to be the fault of the shipper (originator) and not the carrier or consignee.



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# Transportation of Low Level Radioactive Waste Into South Carolina

## Introduction

The Chem-Nuclear Systems, Inc. low-level radioactive waste burial site located in Barnwell County, South Carolina was receiving approximately 80% of this type waste generated in the United States. Under a contract with the U. S. Nuclear Regulatory Commission (NRC) and the Department of Transportation (DOT) the state of South Carolina undertook a surveillance and inspection program directed solely at the transportation of low-level radioactive waste by highway mode into the Chem-Nuclear Systems, Inc. site. (Figure 1 - map showing location Chem-Nuclear)

The transportation surveillance contract covered the period from October 1, 1978 thru September 30, 1979 and was carried out by the Bureau of Radiological Health, South Carolina Department of Health and Environmental Control, Columbia, S. C.

The origin and types of low level radioactive waste shipments were identified as follows:

1. Nuclear Power Plants, U. S. Navy Nuclear Powered Vessels and Research Reactors
  - a. Spent resins and filters used to remove radioactive contaminants and corrosion products from primary cooling systems.
  - b. Concentrated solidified sludges.
  - c. Contaminated or irradiated metal components and equipment. (Pumps, fuel racks, piping, etc.)
  - d. Contaminated water solidified with a media such as concrete.
  - e. Contaminated paper, protective clothing, wood, building rubble, and other general trash.
2. Academic, Commercial and Government Research Laboratories and Hospitals
  - a. Radioactive contaminated general laboratory trash such as glassware, paper, lab clothing, gloves, culture dishes, syringes, etc.
  - b. Animal carcasses containing residual radioactive tracers.
  - c. Sealed radioactive sources used in cancer therapy, instrument calibration and research.
  - d. Solidified aqueous solution containing radioactive contaminants.
3. General Industrial, Irradiator Facilities, Research Laboratories, and Nuclear Fuel Processing Facilities
  - a. Sealed radioactive sources from gauging devices.
  - b. Large radioactive sealed sources used in irradiators for sterilization of products or in industrial radiography.

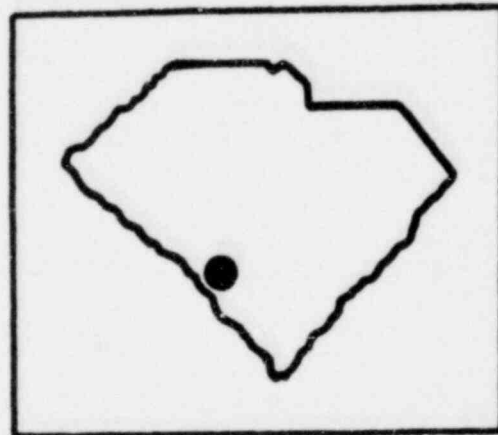


Figure 1

Location of Chem-Nuclear

- c. Depleted Uranium slag resulting from the manufacture of shielding devices and weapon's projectiles.
  - d. Uranium slags and slurries generated as the result of nuclear fuel fabrication and processing.
  - e. Piping, wiring, metals, and other hardware with induced radioactivity from particle accelerators.
4. Department of Defense
- a. Aviation gauges, luminous dials, compasses, and electron tubes containing radioactive material.

Some types of packages and containers used to ship and transport low level radioactive waste were identified as follows:

1. Small cardboard or small wooden boxes
2. 5 gallon metal pails with crimp tops
3. 30 or 55 gallon metal drums with rim lock bands
4. Mild steel cask liners (100 - 300 cubic feet)
5. Large reinforced wooden crates
6. Type A or Type B shipping casks
7. Transfer "pigs" (various sizes and shapes)
8. Fiber drums with PVC liners or bags
9. Large metal tanks or large steel containers
10. Items wrapped in heavy polyethylene or herculon
11. Large concrete blocks
12. Bulk material in covered dump truck (not requiring packages)

The types of motor transport vehicles identified were as follows:

1. Tractor/trailer, enclosed vans (hard or canvas top)
2. Flat bed trailers with large crates, metal tanks, or with shipping casks
3. Step deck trailers with shipping casks permanently or temporarily mounted
4. Low boy trailers with shipping casks permanently or temporarily mounted
5. Straight trucks and delivery vans
6. Pickup trucks and automobiles

#### Procedures

The inspections were performed at the Chem-Nuclear Systems, Inc. site near Barnwell by trained inspectors of the Bureau of Radiological Health (BRH), South Carolina Department of Health and Environmental Control (DHEC).

Arriving shipments were inspected prior to their moving on to the trench site area for off-loading. A normal sequence for inspection by BRH involved the following procedure:

1. Inspect vehicle for DOT placards.
2. Inspect security seals on closed vans or casks.
3. Inspect packages and containers for labels, markings, seals, specification packaging, damage or leakage.
4. Inspect shipping cask for labels, markings, seals, lid bolts, tie-downs, mounting bolts, damage or leakage.
5. Inspect tractor and trailer for obvious defects such as tires, lights and structural failure of trailer.

6. Survey vehicle with portable GM instrument to determine radiation levels at surface, six feet and at driver's position.
7. Take smears on outside of closed vehicle and on flat beds, low boys, etc. Take smears on inside of trailer vans when possible.
8. Take smears from casks, containers, and representative packages.
9. Inspect all shipping papers.
10. Follow truck to trench site for inspection and surveillance of packages, containers, and cask during off-loading.
11. Note any discrepancies during and following off-loading of packages.

Often during radiation monitoring of trucks, a vehicle would have to be pulled out of line, due to close proximity to other vehicles, and spotted in a remote monitoring area to confirm radiation levels. (Figure 2)

During the first few weeks of the contract work it became evident that the condition of many of the NRC Certified Type A shielded shipping casks appeared to be in very poor condition. In May of 1979 another element was added to the inspection and surveillance program and that was a detailed inspection of Type A shielded casks used for shipping low level radioactive waste. A Cask Inspection History sheet (Figure 3) was developed as a record of every cask arriving at Chem-Nuclear Systems, Inc. in Barnwell.

One publication which proved to be of great value was the Directory of Certificates of Compliance for Radioactive Materials Packages (NUREG-0383) Vol. 1 & 2, issued by the Office of Nuclear Material Safety and Safeguards, U. S. Nuclear Regulatory Commission.

Each cask was photographed for the record and inspected each time it arrived at the Chem-Nuclear Systems, Inc. site. Items checked and information obtained on each cask were:

1. Date inspected and where shipped from. This information gave information on the "turn-around time" of a specific cask.
2. Lid bolts and threads; missing, loose, stripped, etc.
3. Cask mounting flanges, bolts, or securing equipment
4. Cask tie-down cables, chains, ratchets, chaffing, etc.
5. Lid gaskets and rain cover
6. Special mechanical equipment on some casks
7. Dangerous rust spots and weak areas, deformation
8. Liquid in cask
9. Visible cracks or deformation of trailer

From October 1978 and up until April 10, 1979 all inspections at the Chem-Nuclear Systems site were unannounced. From April 10, 1979 through August 16, 1979 the Bureau of Radiological Health had an inspector on-site every weekday and all in coming vehicles were inspected and surveyed. During the remainder of the contract period (September 1979) the state had to resume unannounced inspections for only a few days each week. A total of 1,941 vehicles were inspected during the contract period of which 1,334 are included as part of this report.

A smaller percentage of individual packages were surveyed and monitored at Chem-Nuclear by the state inspector. In some instances a shielded cask with a resin liner could be considered as one package or container. Casks were also shipped



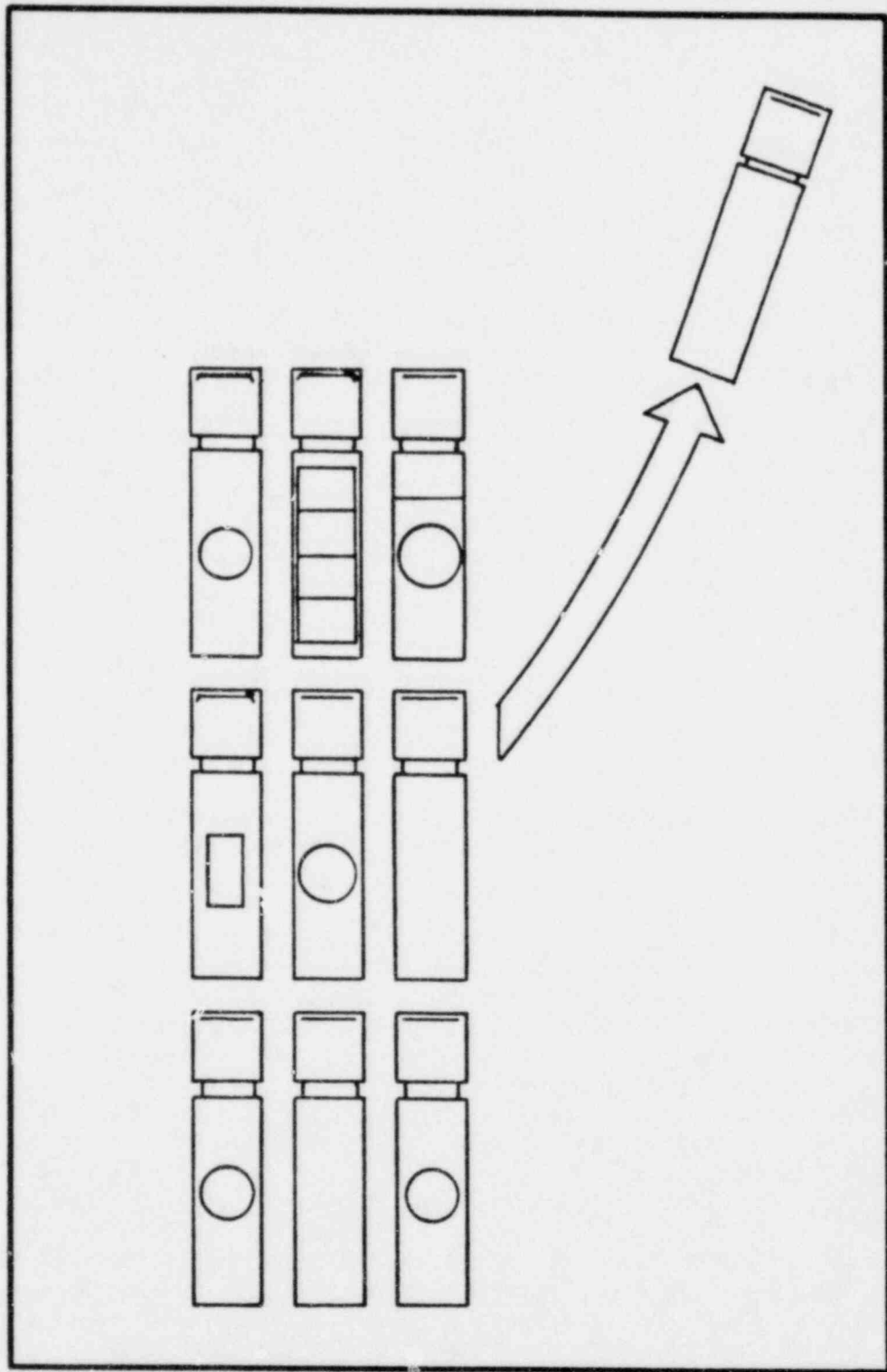


Figure 2  
Diagram of Vehicles Lined Up for Inspection.





with drums arranged inside, ranging from 1 to 20. Vans arrived with as many as 200 drums per load. In order to hold down the radiation exposure of the off-loaders only selected packages or containers would be isolated for inspection and survey. Packages would have to be moved away from the open trench area to obtain valid radiation readings. In all 1,797 packages or containers were inspected and surveyed.

Thermoluminescent dosimeters (TLD) were placed around the Chem-Nuclear Systems site and at the adjacent transportation terminals operated by Home Transportation Company and Tri-State Motor Transit. The location of these TLD monitors are shown in Figures 4 and 5.

### Results and Discussion

Major highway routes used by carriers of low-level radioactive waste shipments in South Carolina were identified during the study. (Figure 6) For the most part highway carriers utilized the interstate and major highways whenever possible. From personal observation and reports, truckers did not always observe the 55 mile per hour speed limit when transporting radioactive material shipments. Although the state inspector was not qualified or required to perform vehicle safety or mechanical inspections some trucks did arrive at the inspection point with faulty brakes, bald tires, tail lights damaged or missing, damaged or warped trailers, etc. These observations were made on perhaps no more than a dozen trucks out of the 1,334 inspected.

Drivers were interviewed whenever possible. Most were aware of the hazardous nature of their shipments. Although in most cases their knowledge was limited. Except for about three major carriers of low-level radioactive waste, drivers had not been informed or instructed regarding emergency notifications or procedures in the event of an accident on the highway. The majority of the drivers who had not had any emergency instructions indicated that in the event of an accident they would call "their dispatcher".

Vehicles hauling low-level radioactive waste were classified into three categories:

1. Courier or Freight Forwarders - which included United Parcel Service (UPS) and private vehicles.
2. Common Carriers (not sole use) - those trucks having a shipment of radioactive material as part of a general cargo on the same truck.
3. Exclusive Use (sole use) - those trucks having trailers containing only low-level radioactive waste. May have consisted of only one cask on a trailer, one or more crates, boxes, containers, or drums on a trailer or in a van, or a full-load of crates, boxes, containers, or drums on a trailer or in a van. In order to be classified as Exclusive Use, the entire shipment must have consisted of radioactive material only and no other commodity.

The number of vehicles inspected within these categories are shown in Table 1.

The tractor/trailer or vehicle was inspected for DOT placards. If a radioactive DOT placard was on the front of the trailer but not on the front of the tractor this method of placarding was acceptable and not recorded under "Inadequate Number of Placards".

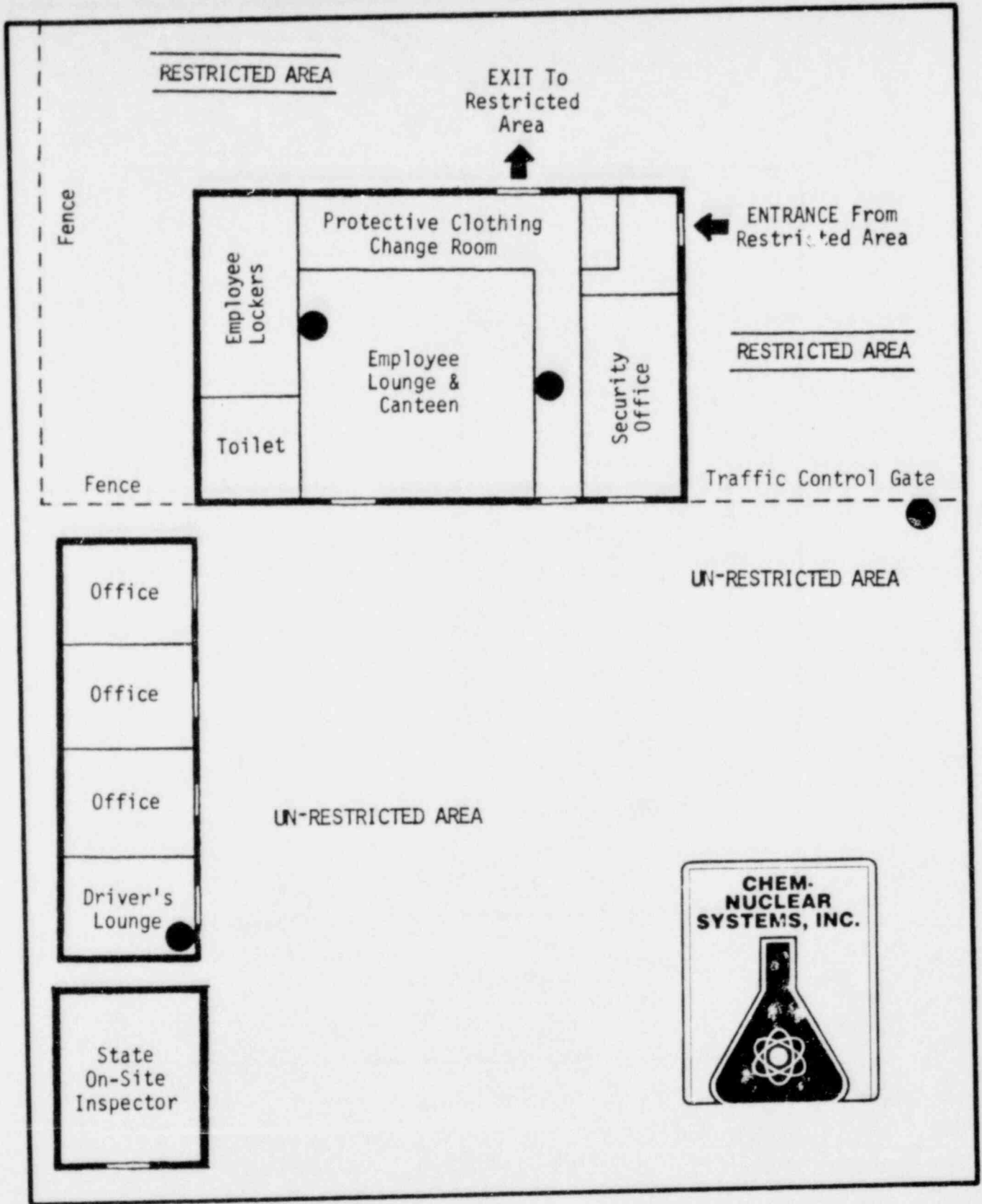


Figure 4

Location of TLD Area Monitors at site buildings.

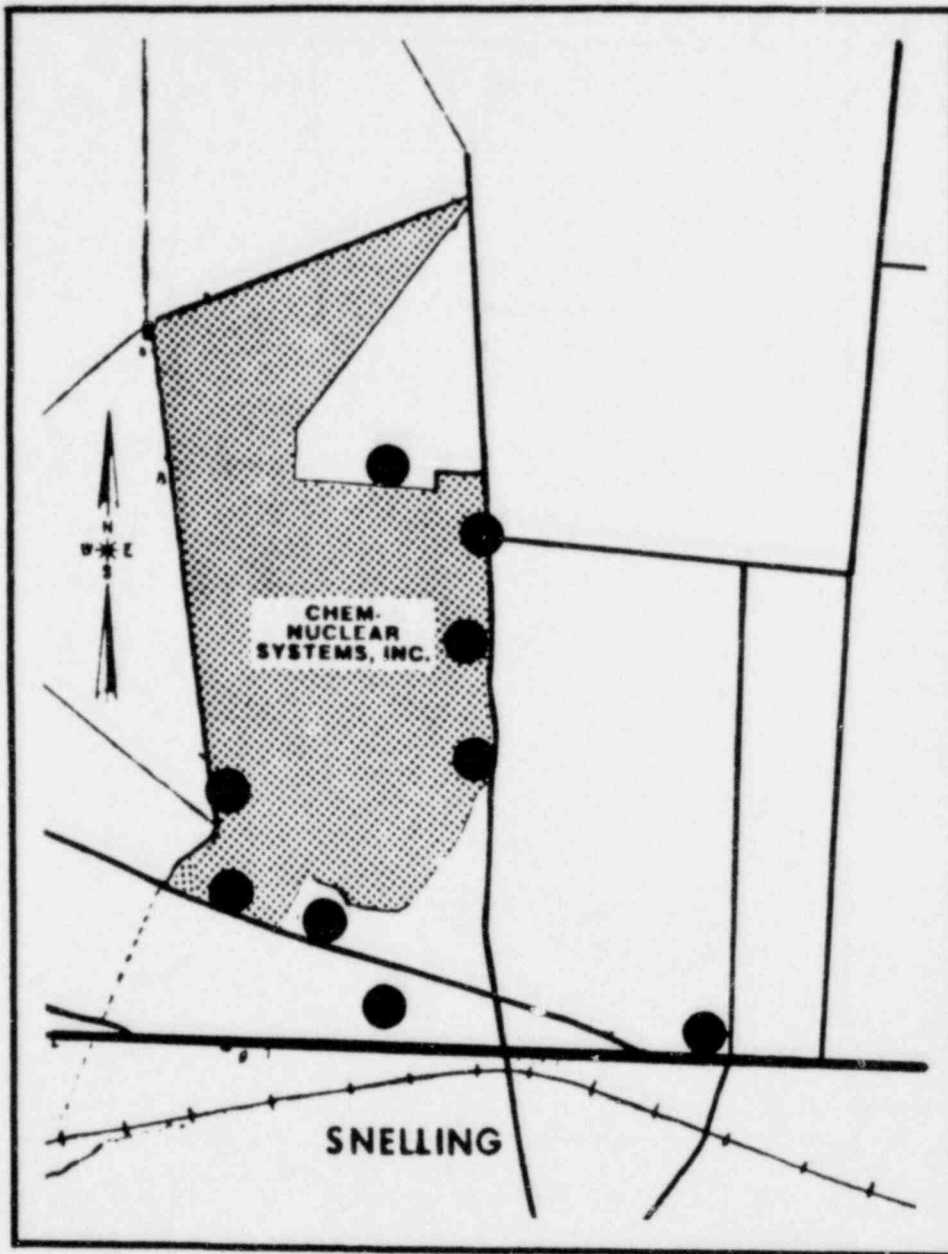


Figure 5

Location of TLD Area Monitors around Chem-Nuclear facility and adjacent transportation terminals.

Radiation measurements were made at the surface of closed transport vehicles and at six feet from surface. Radiation measurements on open vehicles were made at the vertical plane (surface reading) of the trailer and at six feet. Radiation readings were taken in the cab at the driver's position unless readings were 1.5 mR/hr or greater, then readings were made in the sleeper compartment if there was one.

Smears for possible contamination were taken with 2 inch smears inside vans and on the deck of flat bed or low boy trailers. Smears were also taken on the outside surfaces (around the cargo door) on vans. Contamination that was detected on trailers never exceeded the limits set forth in the DOT regulations. Table 2 shows the number of vehicle discrepancies noted.

An inspection was made of the packages or containers to determine if they were secure for transportation. Bracing and blocking, tie-downs, straps, and other restraints were checked. During the first half of the contract inspection period a high number of shipments were noted to be improperly braced or secured for shipment. It became somewhat of a safety hazard to open the rear doors of a van because of the possibility that several 55 gallon drums would fall out on top of an unwary inspector. Towards the latter part of the inspection program a vast improvement was noted regarding the securing of packages.

CATEGORIES	INSPECTIONS
Courier or Freight Forwarders.....	12
Common Carrier (not sole use).....	152
Exclusive Use (sole use).....	1170
TOTAL VEHICLES INSPECTED.....	1334

Table 1  
 Number of vehicles inspected Oct 1978 - Sept 1979

No Placards on vehicle when placards required.....	10
Inadequate number of Placards on vehicle.....	12
Exceeded 200 mR/hr at surface of vehicle or cask.....	6
Exceeded 10 mR/hr at 6-feet from vehicle.....	6
Exceeded 2 mR/hr in cab.....	1
Packages or Cask not secure in shipment.....	24
Contamination detected inside trailer.....	12
Contamination detected outside of trailer.....	2

Table 2  
Vehicle discrepancies

TYPE A PACKAGES & CASKS	WHITE I	YELLOW II	YELLOW III	LSA
Radioactive Waste.....	474	120	72	1123
TYPE B PACKAGES & CASKS				
Non-fuel bearing reactor components...	0	0	2	
Radioactive Waste.....	0	0	6	
TOTAL PACKAGES OR CASKS INSPECTED.....				1797

Table 3  
Package and Cask Inspections



	WHITE I	YELLOW II	YELLOW III	LSA
Package Seal Broken or non-existent				
Type A Package or Cask.....	6	2	1	42
Type B Package or Cask.....	0	0	0	0
Package Damaged.....	2	2	1	9
Package or Container Leaking.....	0	0	0	6
Non-specification package.....	0	1	6	28
Contamination detected on package.....	0	0	0	10
No Labels or Markings on Package.....	4	39	0	60
Only one Label on Package.....	0	0	0	
Isotope not shown on Label.....	66	2	5	
Quantity not shown on Label.....	68	1	5	
TI not shown on Label.....	--	0	1	
TI incorrect.....	--	2	4	

Table 4  
Package Violations or Discrepancies





The majority of the radioactive waste received at the Chem-Nuclear Systems, Inc. Barnwell site was described by the shipper as Radioactive-LSA (LSA) type material. Both Type A and Type B packages or casks were used as well as some non-specification packaging. Table 3 shows the number of package and container inspections.

Results of the package or cask inspections showing the number of violations or discrepancies are shown in Table 4. With regards to broken package seals on Type A packaging it should be noted that in most instances this involved the 17-H 55 gallon steel drum. Most of these violations were either no lids on drum, no rim lock bands, no securing bolt through rim lock band, or loose rim lock bands or lids.

Some damaged packages were seen. Only those packages with serious potential hazard conditions were recorded as "damaged". Again the 55 gallon drum represented the majority of damaged packages. Drums with large holes punched in the sides or ends, warped or bent with contents exposed, rusted or corroded areas, or boxes broken open at one corner or side, sides of boxes broken with contents visible, or metal bands broken loose.

Leaking packages or containers did not always refer to liquid. In 4 out of the 6 reports of leaking packages, this involved powdered, granular, or other solid material.

Thirty-five non-specification packages or containers were noted. The definition of "strong-tight-packages" could not be applied to these. Most were poorly constructed wooden crates and boxes, which, by the time they reached Chem-Nuclear Systems had failed to retain the contents to some degree.

Some contamination was detected on ten LSA drums but in no case did the removable contamination exceed the limits set forth in the DOT regulations.

Package labeling and marking appeared to be an area of misunderstanding on the part of the shipper. Review of the shipping papers was used in an attempt to determine package labeling and marking. Table 4 indicates some of the discrepancies noted in this area.

Shipping papers were reviewed as part of the inspection program. One of the most common discrepancies found on shipping papers was the failure to use the proper shipping name of the material as required by section 172.101 of CFR 49. Some typical descriptions were: WASTE, TRASH, DEBRIS, ATOMIC WASTE, RADIOACTIVE WASTE, RADIOACTIVE WASTE - NO VALUE, RADIOACTIVE MATERIAL WASTE, RADIOACTIVE WASTE FOR DISPOSAL, RADIATION DEVICES - NO VALUE, BULK WASTE - NON-RADIOACTIVE, or SOLID WASTE.

The Shipper's Certification was generally found to be executed properly for the majority of shipments.

In only about 10% of the shipments inspected were any written emergency instructions included with the shipping papers.

Only in a few instances did the inspector find on the shipping papers an indication that the shipment was Exclusive Use or Sole Use vehicle. (This documentation may have been available elsewhere such as carrier contracts, etc.)

The poorest shipping papers observed were those from the U. S. property disposal facilities (National Guard, U. S. Air Force, U. S. Army). These shipments seldom had adequate paper work or proper package labels.

Table 5 is a tabulation of the results of the TLD Area Monitors used as part of the survey. The Control TLD was posted outside the office in Columbia, 70 miles away from the Barnwell area, and the average mrem per day exposure was 0.24. This 0.24 mrem/day has not been subtracted from any of the results shown on Table 5.

#### Conclusions and Recommendations

In general it was found that low-level radioactive waste was being packaged and transported in a safe manner. It did become obvious that when discrepancies were found they usually were the fault of the shipper (originator) of the material. In most cases, during the period of this report, there was little evidence to indicate that an inspection of the shipment had been made by any government regulatory agency (NRC or DOT) prior to the material leaving the originator. Inspection for compliance with the regulations was performed by the shipper (originator).

Most violations and discrepancies were detected by the consignee at the point of destination. It should be noted that Chem-Nuclear Systems in Barnwell, South Carolina has their own inspection program for all vehicles and packages arriving at their site.

The condition of Type A shipping casks improved within a three month period when it became known to the owners of those casks that they were being inspected very closely by the State of South Carolina. Repairs, replacement of tie-downs, mounting flanges, rain covers, cleaning, painting, etc. became evident.

The following recommendations are offered:

1. The inspection and surveillance of radioactive waste shipments should be continued.
2. The NRC and/or DOT should make inspections of waste shipments at the originator's facility to assure that such shipments are in compliance with applicable regulations.

Table 5

DIRECT RADIATION EXPOSURE MEASUREMENTS  
USING LiF THERMOLUMINESCENT DOSIMETERS

Station Number, Location, & Sample Period	Days Exposed	Total mrem For Period	Aveg mrem Per Day
CHEM-NUCLEAR SYSTEMS, INC Barnwell, South Carolina			
80-6131 Driver's Lounge at Chem-Nuclear			
Apr. 23, 1979 - June 7, 1979	44	40	0.90
June 7, 1979 - Sept 13, 1979	98	64	0.65
Sept 13, 1979 - Dec. 13, 1979	91	35	0.38
80-6132 Site Building in Security Office			
Apr. 10, 1979 - June 7, 1979	58	33	0.56
June 7, 1979 - Sept 13, 1979	98	44	0.45
Sept 13, 1979 - Dec. 13, 1979	91	26	0.29
80-6133 Site Building in Lounge and Canteen			
Apr. 10, 1979 - June 7, 1979	58	31	0.53
June 7, 1979 - Sept 13, 1979	98	42	0.43
Sept 13, 1979 - Dec. 13, 1979	91	32	0.35
80-6134 Admin Building at Receptionist Desk			
Apr. 10, 1979 - June 7, 1979	58	20	0.35
June 7, 1979 - Sept 13, 1979	98	56	0.57
Sept 13, 1979 - Dec. 13, 1979	91	34	0.37
80-0644 Traffic Control Gate to Restricted Area			
Mar. 16, 1978 - June 15, 1978	91	129	1.4
June 15, 1978 - Sept 15, 1978	92	93	1.02
Sept 15, 1978 - Dec. 15, 1978	91	85	0.94
Dec. 15, 1978 - Mar. 16, 1979	91	135	1.49
Mar. 16, 1979 - June 21, 1979	97	146	1.51
June 21, 1979 - Sept 21, 1979	92	49	0.54
Sept 21, 1979 - Dec. 13, 1979	83	35	0.42

Table 5 - continued

TLD

DIRECT RADIATION EXPOSURE MEASUREMENTS  
USING LiF THERMOLUMINESCENT DOSIMETERS

Station Number, Location, & Sample Period	Days Exposed	Total mrem For Period	Aveg mrem Per Day
CHEM-NUCLEAR SYSTEMS, INC. Barnwell, South Carolina			
80-0603 On Osborn Rd near front entrance into Chem-Nuclear Systems, Inc.			
Mar. 16, 1978 - Jun. 15, 1978	91	27	0.30
Jun. 15, 1978 - Sept 15, 1978	92	16	0.17
Sept 15, 1978 - Dec. 15, 1978	91	15	0.17
Dec. 15, 1978 - Mar. 16, 1979	91	34	0.38
Mar. 16, 1979 - Jun. 21, 1979	97	20	0.21
Jun. 21, 1979 - Sept 21, 1979	92	12	0.14
Sept 21, 1979 - Dec. 13, 1979	83	14	0.17
80-0625 Across from main office bldg, on-site.			
Mar. 16, 1978 - Jun. 15, 1978	91	43	0.48
June 15, 1978 - Sept 15, 1978	92	26	0.28
Sept 15, 1978 - Dec. 15, 1978	91	34	0.37
Dec. 15, 1978 - Mar. 16, 1979	91	63	0.69
Mar. 16, 1979 - June 21, 1979	97	122	1.25
June 21, 1979 - Sept 21, 1979	92	261	2.85
Sept 21, 1979 - Dec. 13, 1979	83	157	1.90
80-0645 On fence, north side of property.			
Mar. 16, 1978 - June 15, 1978	91	413	4.5
June 15, 1978 - Sept 15, 1978	92	48	0.53
Sept 15, 1978 - Dec. 15, 1978	91	112	1.23
Dec. 15, 1978 - Mar. 16, 1979	91	77	0.85
Mar. 16, 1979 - June 21, 1979	97	77	0.80
June 21, 1979 - Sept 21, 1979	92	22	0.24
Sept 21, 1979 - Dec. 13, 1979	83	43	0.52

Table 5 - continued

 DIRECT RADIATION EXPOSURE MEASUREMENTS  
 USING LiF THERMOLUMINESCENT DOSIMETERS

Station Number, Location, & Sample Period	Days Exposed	Total mrem For Period	Aveg mrem Per Day
CHEM-NUCLEAR SYSTEMS, INC Barnwell, South Carolina			
80-0646 At fence, E side of property, road #585			
Mar. 16, 1978 - June 15, 1978	91	29	0.32
June 15, 1978 - Sept. 15, 1978	92	21	0.23
Sept 15, 1978 - Dec. 15, 1978	91	16	0.18
Dec. 15, 1978 - Mar. 16, 1979	91	41	0.45
Mar. 16, 1979 - June 21, 1979	97	25	0.26
June 21, 1979 - Sept 21, 1979	- - - -	-missing -	- - - -
Sept 21, 1979 - Dec. 13, 1979	83	14	0.17
80-1409 On-site Picnic Area.			
Dec. 20, 1977 - Mar. 16, 1978	86	348	3.5
Mar. 16, 1978 - June 15, 1978	- - - -	-missing -	- - - -
June 15, 1978 - Sept 15, 1978	92	140	1.5
Sept 15, 1978 - Dec. 15, 1978	91	34	0.38
Dec. 15, 1978 - Mar. 16, 1979	- - - -	-missing -	- - - -
Mar. 16, 1979 - June 21, 1979	97	279	2.9
June 21, 1979 - Sept 21, 1979	92	204	2.2
Sept 21, 1979 - Dec. 13, 1979	83	34	0.41
80-1452 At jct of roads 585 & 586, off-site.			
Mar. 16, 1978 - June 15, 1978	91	100	1.1
June 15, 1978 - Sept 15, 1978	92	65	0.71
Sept 15, 1978 - Dec. 15, 1978	91	47	0.51
Dec. 15, 1978 - Mar. 16, 1979	91	56	0.62
Mar. 16, 1979 - June 21, 1979	97	96	0.99
June 21, 1979 - Sept 21, 1979	92	104	1.14
Sept 21, 1979 - Dec. 13, 1979	83	82	1.0



Table 5 - continued

TLD

DIRECT RADIATION EXPOSURE MEASUREMENTS  
USING LiF THERMOLUMINESCENT DOSIMETERS

Station Number, Location, & Sample Period	Days Exposed	Total mrem For Period	Aveg mrem Per Day
HOME TRANSPORTATION CO. INC. Barnwell, South Carolina			
80-6118 Inside office trailer.			
Apr. 4, 1978 - Aug. 29, 1978	147	26	0.18
Aug. 29, 1978 - Dec. 12, 1978	105	23	0.22
Dec. 12, 1978 - Mar. 12, 1979	90	29	0.32
Mar. 12, 1979 - Sept 13, 1979	185	21	0.11
Sept 13, 1979 - Dec. 13, 1979	91	15	0.17
80-6119 Outside, in front of office trailer.			
Apr. 4, 1978 - Aug. 29, 1978	147	40	0.27
Aug. 29, 1978 - Dec. 12, 1978	105	31	0.29
Dec. 12, 1978 - Mar. 12, 1979	90	28	0.31
Mar. 12, 1979 - Sept 13, 1979	185	25	0.13
Sept 13, 1979 - Dec. 13, 1979	91	17	0.19
80-6130 East gate on Osborn Road.			
Apr. 4, 1978 - Aug. 29, 1978	147	31	0.21
Aug. 29, 1978 - Dec. 12, 1978	105	27	0.26
Dec. 12, 1978 - Mar. 12, 1979	90	33	0.37
Mar. 12, 1979 - Sept 13, 1979	185	31	0.16
Sept 13, 1979 - Dec. 13, 1979	91	17	0.19
80-1451 East side of terminal property.			
Mar. 16, 1978 - June 15, 1978	91	27	0.29
June 15, 1978 - Sept 15, 1978	92	13	0.15
Sept 15, 1978 - Dec. 15, 1978	91	35	0.39
Dec. 15, 1978 - Mar. 16, 1979	91	40	0.45
Mar. 16, 1979 - June 21, 1979	97	52	0.54
June 21, 1979 - Sept 21, 1979	92	14	0.16
Sept 21, 1979 - Dec. 13, 1979	83	23	0.28

Table 5 - continued

 DIRECT RADIATION EXPOSURE MEASUREMENTS  
 USING LIF THERMOLUMINESCENT DOSIMETERS

Station Number, Location, & Sample Period	Days Exposed	Total mrem For Period	Aveg mrem Per Day
TRI-STATE MOTOR TRANSIT CO. Barnwell, South Carolina			
80-5139 Outside of terminal office.			
Apr. 4, 1978 - Aug. 29, 1978	147	26	0.18
Aug. 29, 1978 - Dec. 12, 1978	105	28	0.26
Dec. 12, 1978 - Mar. 12, 1979	90	30	0.33
Sept 13, 1979 - Dec. 13, 1979	91	21	0.23
-----			
Area Monitors Along Highway Routes Used By Carriers of Radioactive Materials.			
80-1453 S.C. #64, Moore's Store, Snelling, SC			
Mar. 16, 1978 - June 15, 1978	91	18	0.20
June 15, 1978 - Sept 15, 1978	92	16	0.17
Sept 15, 1978 - Dec. 15, 1978	91	17	0.19
Dec. 15, 1978 - Mar. 16, 1979	91	28	0.31
Mar. 16, 1979 - June 21, 1979	97	28	0.29
June 21, 1979 - Sept 21, 1979	92	14	0.15
Sept 21, 1979 - Dec. 13, 1979	83	12	0.15
80-0617 S.C. #64 at Barnwell City Limits.			
Mar. 16, 1978 - June 15, 1978	91	23	0.25
June 15, 1978 - Sept 15, 1978	92	13	0.14
Sept 15, 1978 - Dec. 15, 1978	91	13	0.14
Dec. 15, 1978 - Mar. 16, 1979	91	42	0.46
Mar. 16, 1979 - June 21, 1979	97	18	0.19
June 21, 1979 - Sept 21, 1979	92	15	0.16
Sept 21, 1979 - Dec. 13, 1979	83	14	0.18

Table 5 - continued

DIRECT RADIATION EXPOSURE MEASUREMENTS  
USING LiF THERMOLUMINESCENT DOSIMETERS

Station Number, Location, & Sample Period	Days Exposed	Total mrem For Period	Aveg mrem Per Day
Area Monitors Along Highway Routes Used By Carriers of Radioactive Materials.			
80-6120 Amoco Station, US #78, Williston, SC			
June 22, 1978 - Sept 15, 1978	85	22	0.25
Sept 15, 1978 - Dec. 15, 1978	91	26	0.28
Dec. 15, 1978 - Mar. 12, 1979	87	46	0.53
Sept 13, 1979 - Dec. 13, 1979	91	34	0.37
80-6122 Jct SC #121 & US #76, Newberry, SC			
May 4, 1978 - Aug. 18, 1978	106	19	0.18
Aug. 18, 1978 - Jan. 16, 1979	151	46	0.31
Jan. 16, 1979 - May 23, 1979	135	31	0.23
80-6125 Jct of SC #70 & US #301, Denmark, SC			
May 4, 1978 - Aug. 14, 1978		-VANDALIZED-	
Aug. 14, 1978 - Jan. 9, 1979	148	36	0.24
Jan. 9, 1979 - May 24, 1979	127	29	0.23
80-0104 Jct of SC #19 & US #278, New Ellington.			
Mar. 17, 1978 - June 16, 1978	91	21	0.23
June 16, 1978 - Sept 15, 1978	91	15	0.16
Sept 15, 1978 - Dec. 14, 1978	90	14	0.16
Dec. 14, 1978 - Mar. 21, 1979	97	30	0.31
Mar. 21, 1979 - June 22, 1979	93	18	0.19
June 22, 1979 - Sept 14, 1979	84	14	0.17
Sept 14, 1979 - Dec. 11, 1979	88	13	0.14



JOB	TOTAL PERSONNEL MONITORED	TOTAL EXPOSURE (rem)	AVERAGE EXPOSURE (rem)
Health Physics	10	3.312	0.331
Off-loaders	26	11.745	0.452
Truck Drivers	8	0.221	0.028
Tech. Services	5	0.066	0.013
Equip. Operators	6	3.128	0.521
Maintenance	12	0	0
Admin. Personnel	40	1.405	0.035
Contract Personnel	5	0	0

Table 6 \*

Personnel Exposure (TLD) for the First Quarter 1979  
Chem-Nuclear Systems, Inc

\* This information obtained from Environmental Assessment For Barnwell Low-level Radioactive Waste Disposal Facility, January 1980, Chem-Nuclear Systems, Inc.

# **EMERGENCY PROCEDURE**

**this vehicle  
is carrying**

# **RADIOACTIVE MATERIALS**

**In case of an accident dial "0"  
for operator and notify the  
state police. Upon their  
arrival give police the  
attached papers.**

NAME OF SHIPPER

Subject: A detail of instructions issued to assure safety and unity in procedure in the transportation of Radioactive Material, as defined in Hazardous Materials Regulations of The Department of Transportation.

This instruction is issued to you, \_\_\_\_\_, to be  
Name of Carrier  
forwarded with the shipment for the information of all drivers, dispatchers and other operating personnel associated in the total handling of material to its destination.

The shipment you are transporting is classified under The Department of Transportation Regulations as a Dangerous Article. Every possible precaution has been exercised in its preparation and packaging for transportation.

The intent of this instruction:

1. To emphasize that experience and systematic procedures to assure attention to detail in preparing radioactive material, as required by law, make this type freight less dangerous than many other items moving in transportation, as long as these simple instructions are followed.
2. To provide a set of rules to be followed in the event of an accident or other serious problem occurring while shipment is in your custody. (To date there is no record of a serious accident involving radioactive material.)

Signed \_\_\_\_\_  
Shipper's Representative  
NAME OF COMPANY

EXAMPLE

NAME OF SHIPPER

EXAMPLE

DETAILED INSTRUCTIONS FOR  
HANDLING AND TRANSPORTING RADIOACTIVE MATERIAL

Packaging, Marking and Labeling

Each package has been prepared in accordance with the Department of Transportation (DOT) published requirements or is authorized under DOT special permits.

If a package has more than one dangerous characteristic, both labels are attached; i.e., yellow label (flammable solid) Radioactive White I or Radioactive Yellow II or III (Radioactive Material).

Radioactive material must be kept a minimum of three (3) feet from undeveloped film. No one may be permitted to tamper with or attempt to open this package in transit except the shipper or consignee. The package is sealed or wire strapped and must remain intact.

Equipment

Vehicles transporting radioactive material, yellow label III, must be properly placarded in such a way that they will remain intact during wind and rain. "Exclusive Use of Trucks" in addition, must be sealed by the shipper and broken by the consignee. Sealed vehicles are not to be opened while in terminals or enroute except under authorization of (The Shipper's Name) or its representative authorizing the shipments. The exception to this rule is covered under "Accidents".

Operations

Schedules and routes are extremely important for reasons of U. S. Government programs for security and safety. A vehicle handling a shipment of this nature in Exclusive Use or Truckload Service which becomes "off schedule" by more than two (2) hours for any reason must report immediately to (The Shipper's Name) and to those designated on the attached "Destination Contact Information" sheet.

Advance arrangements can be made to provide adequate protection for your vehicle at points of rest. Police parking lots and Government facilities are usually used for this purpose. (Required for special circumstances.)

Some shipments are "Security" shipments. A vehicle must not be left unattended or out of the driver's visibility during stops. Additional "special" instructions are provided on the bill of lading when required.

### Accidents or Other Emergencies

In the event of an accident, the driver should immediately seek State or Local Police assistance. The vehicle should be kept as isolated as possible; flares should be used; and spectators should be kept away from the vehicle. Police authorities generally have instructions in these matters. Then proceed to notify the listed parties as shown in the attached "Instructions for Immediate Emergency Action".

When fire results in an accident or for some other reason smoke is discovered escaping from the vehicle, the vehicle doors should be opened. (If Security shipment, a vigilance must be maintained.)

If the cargo, other than our special shipment is the cause of the fire, remove that material from the vehicle. If this is impractical or the vehicle itself is on fire, remove the special shipment.

The vehicle should be remotely placed whenever possible so that wind will blow smoke into an open area if the material cannot be removed from the vehicle.

### SUMMARY

Only under a most unforeseeable situation can a serious incident occur in the transporting of our shipment of radioactive material. This should in no way result in an attitude of complacency.

The above instructions should be familiar to everyone. Equally important is the use of common sense and good judgment in "on-the-spot" decisions.

These instructions and other paperwork should be kept in a conspicuous and readily available location inside the cab. This is important so that information is available if the driver is incapacitated. The police authorities would normally obtain information requested on the "Accident Data" sheet.

All rules of safety must be strictly complied with; i.e., speed, condition of equipment, proper lighting, and other well known "good driver habits".

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EXAMPLE

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INSTRUCTIONS FOR IMMEDIATE EMERGENCY ACTION IN INCIDENTS  
INVOLVING RADIOACTIVE MATERIALS

1. When incidents involve a nuclear radiation source, then spillage or release of radioactive material, or there are personal injuries in incidents involving radioactive materials, the following emergency actions and precautions should apply:

Notify Immediately

A. State Police

B. The Shipper:

C. The Carrier:

D. Destination Contact:  
(See Attachment)

**EXAMPLE**

2. If the incident involves wreckage and a person is believed to be alive and trapped, make every effort possible to rescue him.
3. Restrict the area involved as a result of the incident. Keep the public as far from the scene of the incident as practical. Souvenir collection and handling of debris by on-lookers should be prevented.
4. Segregate and detain for further examination those persons who have had possible contact with the radioactive material. Obtain the names and addresses of those involved.
5. Remove injured persons from the area affected by the incident with as little direct personal contact as possible and hold them at a transfer point. Until physicians familiar with radiological health procedures are present, limit first aid and medical procedures to those that must be done promptly. Whenever recommended by a doctor, an injured individual should be removed to a hospital or office for treatment, and the doctor or hospital should be informed when there is reason to suspect that the injured individual may have radioactive contamination on his body or on his clothing.
6. In incidents involving fire, fight fires from upwind whenever possible. Treat same as a fire involving toxic chemicals. Keep out of smoke, fumes, or dust resulting from the incident. Segregate clothings and tools used at the fire until they can be checked for radioactive contamination. Do not handle suspected material until it has been monitored and released by radiation monitoring personnel.
7. In the event of a vehicle accident involving radioactive materials, detour all traffic around the accident scene. If this is not possible, move the vehicle or vehicles involved the shortest distance necessary to clear the right of way. If radioactive material is spilled, prevent the passage of vehicles and people through the area unless absolutely necessary. If right of way must be cleared before the radiological assistance team arrives, wash spillage to the shoulders of the right of way with a minimum dispersal of wash water.
8. Do not eat, drink, or smoke in the incident area. Do not use food or drinking water that may have been in contact with material from area.



ACCIDENT DATA SHEET

1. Person reporting the accident:

Name:

Title:

Location:

Telephone contact:

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EXAMPLE

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2. Description of accident\*:

3. Time accident occurred:

4. Location of accident (including type of surroundings):

5. Location of nearest airport:

6. Fire or explosion involved:

7. Persons involved:

8. Responsible local officials advised:

9. Other information furnished:

10. Time call received:

\*Including as much of the following information as is available or can be obtained: kind, amount, and form of material involved; present physical condition of material; name of carrier, name of shipper and recipient.

DESTINATION CONTACT INFORMATION

The contact for notification of accident, change of instruction, delays or any other emergency during this shipment should be directed to the following representative at your destination:

Chem-Nuclear Systems, Inc.  
P. O. Box 726  
Barnwell, South Carolina 29812

Representative - ( name )

Phone: 803-259-1781

EXAMPLE



Low Level Radioactive  
Waste Shipment Accident

SUBJECT: Transportation Accident Involving a Shipment of Low-Level Radioactive Waste shipped from Quad-Cities Nuclear Station, Commonwealth Edison, Cordova, Illinois, to Chem-Nuclear Systems, Inc., Barnwell, S.C., License No. 097.

June 18, 1979

TYPE: Accident involved the possibilities of release of 21.82 Curies of low specific activity, mixed fission and corrosion products from a Hittman HN-100 Series 1, Unit 5, USA/9086/A, DOT 7A, Type A shipping cask.

Investigator: Virgil R. Autry  
Bureau of Radiological Health  
S. C. Department of Health  
and Environmental Control

APPENDIX C

#### A. Reason for Investigation

At approximately 2:55 a.m., Monday, June 18, 1979, Mr. Heyward Shealy, Chief, Bureau of Radiological Health, was notified by the State's Centrex Operator, that an accident involving a shipment of Radioactive material had occurred on Interstate 26 East, at mile marker No. 88 near the small town of Little Mountain, S.C.

At approximately 2:52 a.m., Mr. Emory Williams of the Bureau of Radiological Health, was notified by the S. C. Highway Patrol Dispatcher, Columbia, S.C., Office of the accident.

Two additional members of the Emergency Radiological Assistance Team were notified by Mr. Shealy and Mr. Williams.

#### B. Summary of Facts

On June 15, 1979, the low-level Radioactive Waste shipment departed the Quad-Cities Nuclear Station, Commonwealth Edison, Cordova, Illinois, enroute to the Chem-Nuclear System's burial facility, Barnwell, South Carolina. The shipment was being transported by Tri-State Motor Transit Company, Tractor No. 543, trailer no. 111109. The Radioactive material was contained within a Hittman HN-100 Series 1, Unit 5, NRC License No. USA/9086/A, DOT 7A, type A shipping cask, loaded on a Tri-State step-deck flatbed trailer. The cask was secured to the trailer with a deck mounted securing ring and four wire-cable tiedowns.

The principal Radioactive contingent was identified as Cesium-134, Cesium-137, Cobalt 60, Cobalt 58, etc., low specific activity, 21.819 curies, spent resins in cement, 6465 pounds. The solidified material was contained in 14 - 55 gallon drums, and loaded in the shipping cask.

At approximately 2:15 a.m., June 18, 1979, the driver of the transport vehicle, while trying to avoid hitting an automobile which had cut into his lane, ran off the road. The transport vehicle skidded on its right side in a shallow ditch for approximately 100 yards and came to rest on its right side. The shipping cask was torn from the support ring and came to rest beside the trailer with two of the four tiedowns remaining attached to the trailer. The cask rested on its side at a 10 degree angle, top up, with the bottom dug into the earth approximately one foot.

The driver suffered numerous lacerations and injuries, but was able to crawl from the tractor. It was learned later from the Tri-State terminal manager, that the driver had suffered several fractured vertebrae.

Radiological monitoring by the Bureau of Radiological Health's Emergency Radiological Assistance Team determined that there was no release of radioactive material and the accident posed no threat to the public nor the environment.

### C. Details of Investigation

At approximately 3:15 a.m., the first member of the Bureau's Emergency Radiological Assistance Team arrived at the accident scene. Immediately, radiation readings were taken of the area around and at the shipping cask. No radiation readings above normal background were detected at the accident scene within 15 feet of the cask. The ground surface in the area was monitored and no release was detected. By 3:30 a.m. three additional members of the Emergency Radiological Assistance Team had arrived at the accident scene. Radiation readings taken of the cask surface and around the lid were 30 m $\mu$ /hr. The cask was inspected for damage and none was found. All bolts securing the lid were in place. Smear samples were taken of the cask to determine spreadable contamination. None was detected.

Radiation readings were taken at the highway traffic lane with the highest reading detected of .3 m $\mu$ /hr. Due to the extent of damage to the transport vehicle and location of the accident, the right lane of the eastbound portion of the Interstate was blocked to traffic. However, the left lane remained opened allowing traffic to pass.

Emergency personnel, highway patrol, and local wrecker personnel were on the scene within minutes of the accident and assisted the driver.

At approximately 6:00 a.m. the wrecker company had removed the damaged transport vehicle and released the cask from the trailer.

At 8:00 a.m., a crane arrived to lift the 45,000 pound cask and load it on another transport vehicle which had been provided by Tri-State. Several attempts were made to lift the cask; however, the crane was unable to lift it. Another crane was summoned and arrived at approximately 3:30 p.m. The cask was lifted and placed on the transport vehicle. The accident was cleared by 4:00 p.m. and the low-level waste shipment continued to the burial facility.

Members of the Bureau's Emergency Radiological Assistance Team remained at the accident scene until the accident was completely cleared and the shipment enroute. As an added precaution, the shipment was escorted to the burial facility by a team member. The area of the accident scene was monitored again and no radioactive material was detected.

On June 19, 1979, the Bureau's on-site inspector observed the offloading of the waste shipment. No damage to the drums within the cask was noted and no Radioactive material was released within the cask.

### D. Conclusion

At no time did the accident pose any threat to the public or the environment. The wrecker crews and crane operators received minimal direct exposure from the shipping cask.

The driver of the transport vehicle was not cited for any violation.  
No violations of DOT regulations were noted nor cited.

It is recommended that all shippers and carriers of Radioactive material insure that all precautions are taken to prevent any release of Radioactive material by the use of proper packaging and securing of packages during transport.

No further action by the Bureau of Radiological Health is anticipated.

VRA:bo  
BRH/DHEC  
6-20-79



## BOARD

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# SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

Albert G. Randall, M.D., M.P.H.  
Commissioner

Sims-Aycock Buildings  
2600 Bull Street, Columbia, SC 29201

October 2, 1978

## CONTRACT FOR STATE TRANSPORTATION SURVEILLANCE PROGRAM

This is to inform you of a Contract entered into by and between the U. S. Nuclear Regulatory Commission (NRC), the U.S. Department of Transportation (DOT) and the S.C. Department of Health & Environmental Control (DHEC) in a program for the surveillance of radioactive materials in transport within the State of South Carolina. This program has Contract Number: NRC-06-78-357.

The principal objectives of the program are:

1. To obtain data on the physical condition of the packages.
2. To gather factual information and data concerning radiation levels in the transportation environment due to the presence of packages of radioactive materials,
3. To determine doses received by workers and others as a result of exposure to these packages,
4. To obtain information on the status of compliance with the packaging requirements and the regulations for transport of radioactive material shippers and carriers, and,
5. To obtain data on worker compliance with instructions for handling packages of radioactive material.

In connection with the foregoing and pursuant to this contract, the State may at times identify existing procedures, rules and regulations for the transportation of radioactive material that may not appear to be consistent with optimum practice. In this event, and while this contract is in force, the State will make its observations and suggestions, pursuant thereto, known to the NRC and/or DOT.

Information regarding the authority or activities under this Contract may be obtained by contacting:

Mr. Emory F. Williams  
Bureau of Radiological Health  
S.C. Dept of Health & Environmental Control  
2600 Bull Street  
Columbia, SC 29201

Telephone: (803) 758-5548



BUREAU of RADIOLOGICAL HEALTH  
S. C. DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL

# Shipment Inspection

## A. GENERAL INFORMATION

1. Name of Carrier: \_\_\_\_\_
2. Address of Terminal: \_\_\_\_\_
3. Location where inspection took place: \_\_\_\_\_
4. Shipment originated from: \_\_\_\_\_
5. Address of shipper: \_\_\_\_\_
6. Shipment consigned to: \_\_\_\_\_

## B. SHIPPING DOCUMENTS

1. Shipper's Certification: Executed \_\_\_\_\_ Appears on BOL \_\_\_\_\_ RSR \_\_\_\_\_
2. Description of material: \_\_\_\_\_
3. Bill of Lading Number: \_\_\_\_\_ Dated: \_\_\_\_\_
4. Labels required: \_\_\_\_\_ 5. Transport Group: \_\_\_\_\_ 6. Total TI: \_\_\_\_\_
7. Other information: \_\_\_\_\_

## C. VEHICLE INFORMATION

1. Designated Exclusive or Sole-Use Vehicle: \_\_\_\_\_
2. Shipment in Open or Closed Vehicle: \_\_\_\_\_
3. Complete vehicle inspection and survey on page 3.

## D. CARGO INFORMATION

1. Type Container(s) in Shipment (Record DOT Number and Specifications): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
2. DOT labels on containers or packages: \_\_\_\_\_
3. Contents shown on label: \_\_\_\_\_ 4. Highest TI shown: \_\_\_\_\_
5. Other information: \_\_\_\_\_

E. CONTAINER, CASK, OR PACKAGE INSPECTION

- 1. Container or Cask - Visible leakage: \_\_\_\_\_ Visible damage: \_\_\_\_\_
- 2. Tie-downs secure: \_\_\_\_\_ 3. Cargo covered: \_\_\_\_\_
- 4. Specification Container: \_\_\_\_\_ 5. Security Seals: \_\_\_\_\_
- 6. Other information: \_\_\_\_\_

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

USE RAM PACKAGE SURVEY FORM FOR MULTIPLE PACKAGES IN SHIPMENT

F. SPENT FUEL SHIPMENTS

- 1. Pressure gauge reading: \_\_\_\_\_ 2. Temperature gauge reading: \_\_\_\_\_
- 3. Record Date, Hour, and Readings from last two surveys made by drivers:  
 \_\_\_\_\_
- 4. Radiation Survey Meter on Vehicle: Make & Model: \_\_\_\_\_  
 Range: \_\_\_\_\_ Date Calibrated: \_\_\_\_\_

G. CONTAMINATION SMEARS

NO SMEARS TAKEN: \_\_\_\_\_

-Location Smear Made-

-Results-

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Attachments (copies of)

Inspector's Signature: \_\_\_\_\_

Bill of Lading  
RSR

Date of Inspection: \_\_\_\_\_



IDENTIFICATION

Tractor: \_\_\_\_\_

\_\_\_\_\_

Owned By: \_\_\_\_\_

\_\_\_\_\_

Tractor #: \_\_\_\_\_

License #: \_\_\_\_\_

\_\_\_\_\_

Trailer Type: \_\_\_\_\_

\_\_\_\_\_

Trailer #: \_\_\_\_\_

License #: \_\_\_\_\_

\_\_\_\_\_

RADIATION READINGS

Surface: \_\_\_\_\_

6 Feet: \_\_\_\_\_

INSTRUMENT USED

Make: \_\_\_\_\_

Model: \_\_\_\_\_

Detector: \_\_\_\_\_

Background: \_\_\_\_\_

RADIATION READINGS

Surface: \_\_\_\_\_

6 Feet: \_\_\_\_\_



RADIATION READINGS

Surface: \_\_\_\_\_

6 Feet: \_\_\_\_\_

FRONT

RADIATION READINGS

In Cab: \_\_\_\_\_

\_\_\_\_\_

RADIATION READINGS

Surface: \_\_\_\_\_

6 Feet: \_\_\_\_\_

PLACARDS

Front: Yes No

Rear: Yes No

Right: Yes No

Left: Yes No

REAR

Date: \_\_\_\_\_

Monitor: \_\_\_\_\_

<b>NRC FORM 335</b> (7-77)		<b>U.S. NUCLEAR REGULATORY COMMISSION</b> <b>BIBLIOGRAPHIC DATA SHEET</b>		<b>1. REPORT NUMBER (Assigned by DDC)</b> NUREG/CR-1434	
<b>4. TITLE AND SUBTITLE (Add Volume No., if appropriate)</b> TRANSPORTATION OF LOW-LEVEL RADIOACTIVE WASTE INTO SOUTH CAROLINA				<b>2. (Leave blank)</b>	
<b>7. AUTHOR(S)</b>				<b>3. RECIPIENT'S ACCESSION NO.</b>	
<b>9. PERFORMING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code)</b> Bureau of Radiological Health Department of Health & Environmental Control State of South Carolina Columbia, S. C. 29201				<b>5. DATE REPORT COMPLETED</b> MONTH March YEAR 1980	
<b>12. SPONSORING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code)</b> Office of State Programs U. S. Nuclear Regulatory Commission Washington, D. C. 20555 (Sponsored jointly with U. S. Department of Transportation)				<b>6. (Leave blank)</b>	
<b>13. TYPE OF REPORT</b> Data collection				<b>7. (Leave blank)</b>	
<b>15. SUPPLEMENTARY NOTES</b>				<b>8. (Leave blank)</b>	
<b>16. ABSTRACT (200 words or less)</b> <p>Shipments of low-level radioactive waste into the Chem-Nuclear Systems, Inc. site near Barnwell, S. C., were surveyed to determine the origin of such wastes, types and condition of packages or containers and compliance with existing regulations. Type A shipping casks were given special attention during the survey. Area monitors (TLD) were used around transportation terminals. Most violations in packaging, placarding, labeling and shipping documents appeared to be the fault of the shipper (originator) and not the carrier or consignee.</p> <p>This report describes the second-year study conducted by the State of South Carolina on the transportation of radioactive material. The results of the first year's study, covering the period, January 31, 1977 to January 31, 1978 are contained in NUREG/CR-0266, published in July 1978.</p>				<b>10. PROJECT/TASK/WORK UNIT NO.</b>	
<b>17. KEY WORDS AND DOCUMENT ANALYSIS</b>				<b>11. CONTRACT NO.</b> NRC-06-78-357	
<b>17b. IDENTIFIERS/OPEN-ENDED TERMS</b>				<b>13. PERIOD COVERED (Inclusive dates)</b> October 1978 thru September 1979	
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WASHINGTON, D. C. 20555

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