
Transportation of Radioactive Material in Illinois

June 1978 - June 1979

POOR ORIGINAL

State of Illinois
Department of Public Health

Prepared for
U. S. Nuclear Regulatory
Commission

8004170341

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Springfield, Virginia 22161

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Manuscript Completed: March 1980
Date Published: March 1980

State of Illinois
Division of Radiological Health
Dept. of Public Health
Springfield, IL 62761

Prepared for
Office of State Programs
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
NRC 06-78-358

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INTRODUCTION:

The second year surveillance program was performed for the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Transportation (DOT) under Loan Agreement No. NRC-06-78-358. The purpose of the agreement was to continue the establishment of a collaborative program between the State of Illinois, the NRC and the DOT for the surveillance of radioactive material in surface transport within the State. Information related to the condition of packages, handling practices related thereto, adherence to transportation regulations, and other pertinent data was acquired from vehicle inspections.

Maury Neuweg, Chief, Division of Radiological Health, acted as the State supervisor for the program along with Corporal Harold Diveley, coordination supervisor, Department of Law Enforcement. Ten Illinois State Police troopers, well versed in hazardous materials, and trained in the use of radiation detection equipment and pertinent DOT regulations were the investigators and inspectors for the surveillance program. The data in this report consists of the information supplied by the State troopers, as a result of their activities in this program.

OBJECTIVES:

The objectives of the surveillance program performed under the agreement were the following:

1. Evaluate a mechanism whereby law enforcement officers equipped with radiation detection instrumentation can monitor the surface transportation of radioactive materials in the State of Illinois and enforce the applicable regulations governing such transport.
2. Determine the level of compliance with the transportation system as relating to the carriage of radioactive materials.
3. Categorize transportation data by type of carrier (i.e. common, contract, or private).
4. Correlate the level of compliance with the level of surveillance.

OVERVIEW:

The actual data collection for the surveillance program covered the period of June 6, 1978, to June 6, 1979. The monitoring period differs from the NRC contract period of June 1 to May 30, in order to prevent redundancy of information in the last annual report as well as providing 365 days of surveillance. Surveillance personnel were located at the following

districts throughout the State near major interstate highways:

(a) Rock Island, (b) Elgin, (c) Blue Island, (d) Des Plaines, (e) Joliet, (f) Oak Brook, (g) Peoria, (h) Springfield, (i) DuQuoin, and (j) Maryville - Des Plaines personnel relocated to district during the month of August, 1978. The troopers utilized surveillance instrumentation (i.e. ionization chamber "cutie pie" and gamma scintillation detector with portable radiation monitor). Due to problems associated with the equipment components (i.e. batteries, cables, etc.), the "down time" averaged 10% for all instruments in the districts.

Upon identifying a vehicle transporting radioactive material by the State troopers, the vehicle was stopped and the following pertinent information was determined:

1. Type of vehicle was identified, such as (i.e. van, pickup, passenger car, semi) and the name of the carrier.
2. Vehicle was surveyed for radiation levels in the cab and outside surface of the vehicle.
3. Carrier documents were checked for shipper's certification, shipping papers and transport index. Placarding was observed and evaluated in accordance with applicable DOT regulations.
4. Package placement was examined for close proximity to occupied areas in the vehicle.

5. Package surveys were performed whenever possible reporting package marking, labels, shipping documents, isotope and source activity.

Forms were not sufficiently completed by the State troopers 20% of the time due to other enforcement action being designated, other duties assigned, or instruments not functioning properly.

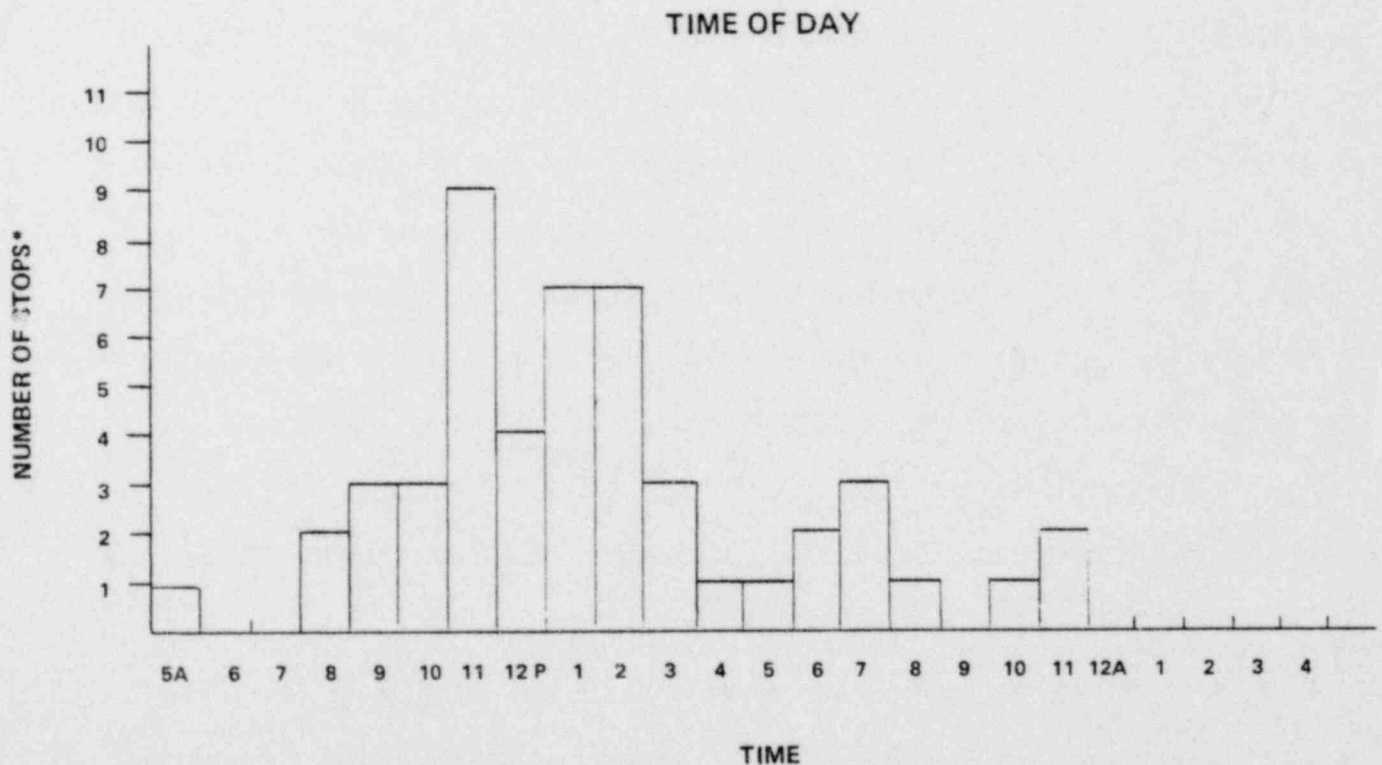
INSTRUMENTATION AND CALIBRATION:

The following instruments were used in the surveillance program: (1) Eight Eberline Instrument Company "Cutie Pie" portable low-medium range ionization chambers, Model RO-3- calibrated January 30, 1979, and March 5, 1979; (2) One Searle Analytic "radiation survey instrument", Model #2595 - calibrated January 30, 1979, and March 5, 1979; (3) One Eberline instrument Company "Cutie Pie" portable low-medium range ionization chamber, Model RO-1, calibrated March 5, 1979. This instrument is the property of the Illinois Department of Public Health and was used as a replacement since one trooper in the Joliet District had his assigned RO-3 stolen on March 16 while at the Peotone truck scale; (4) Eleven Eberline Instrument Company radiation detectors, Model RM-19 with SPA-3 gamma 2" x 2" sodium iodide thallium activated scintillation probes calibrated by Eberline Instrument Company May, 1977.

SURVEY RESULTS:

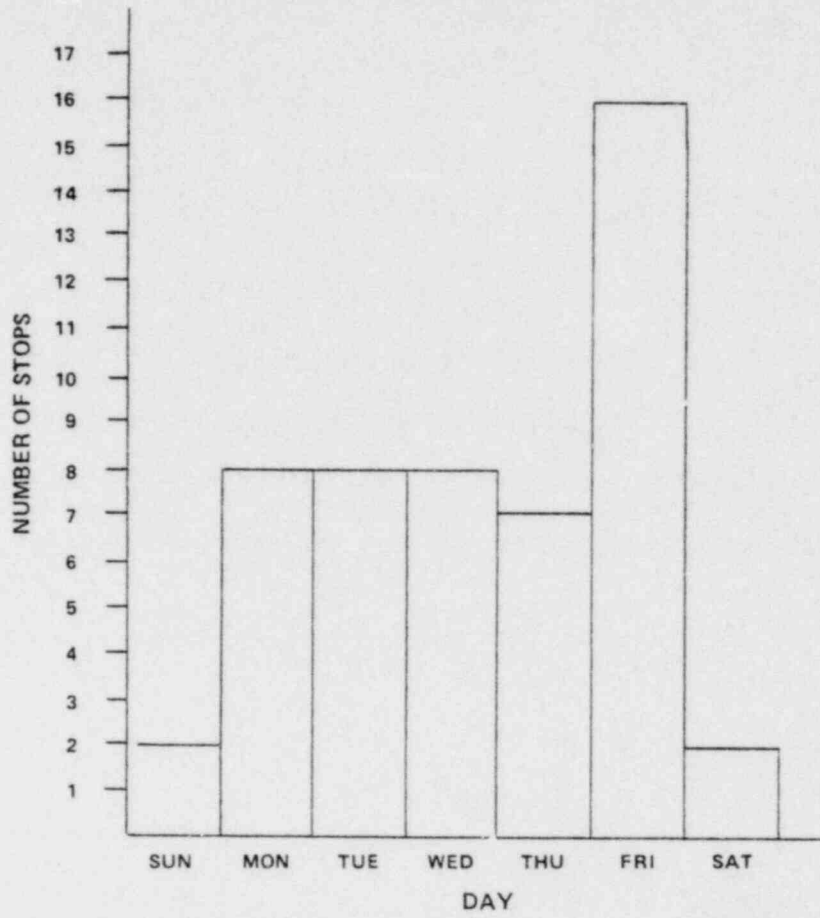
During the surveillance period from June 6, 1978, to June 6, 1979, 51 stops were made by the State troopers. The troopers began issuing citations to vehicles transporting hazardous materials February 1, 1979, since the Illinois Department of Transportation adopted 49 CFR 170-189 in its entirety. From February 1 to June 7, six (6) "Notice of Apparent Violations" were issued to vehicles transporting radioactive material for lack of proper placarding, no shipping papers, drums containing LSA radioactive material not properly marked, and no proper label on an industrial radiography gamma camera. Thirty-five percent of all stops occurred in the morning with 18% around 11:00 A.M.

The following graphs show the time of day the stops occurred, the day of the week, and the number of stops during each month.

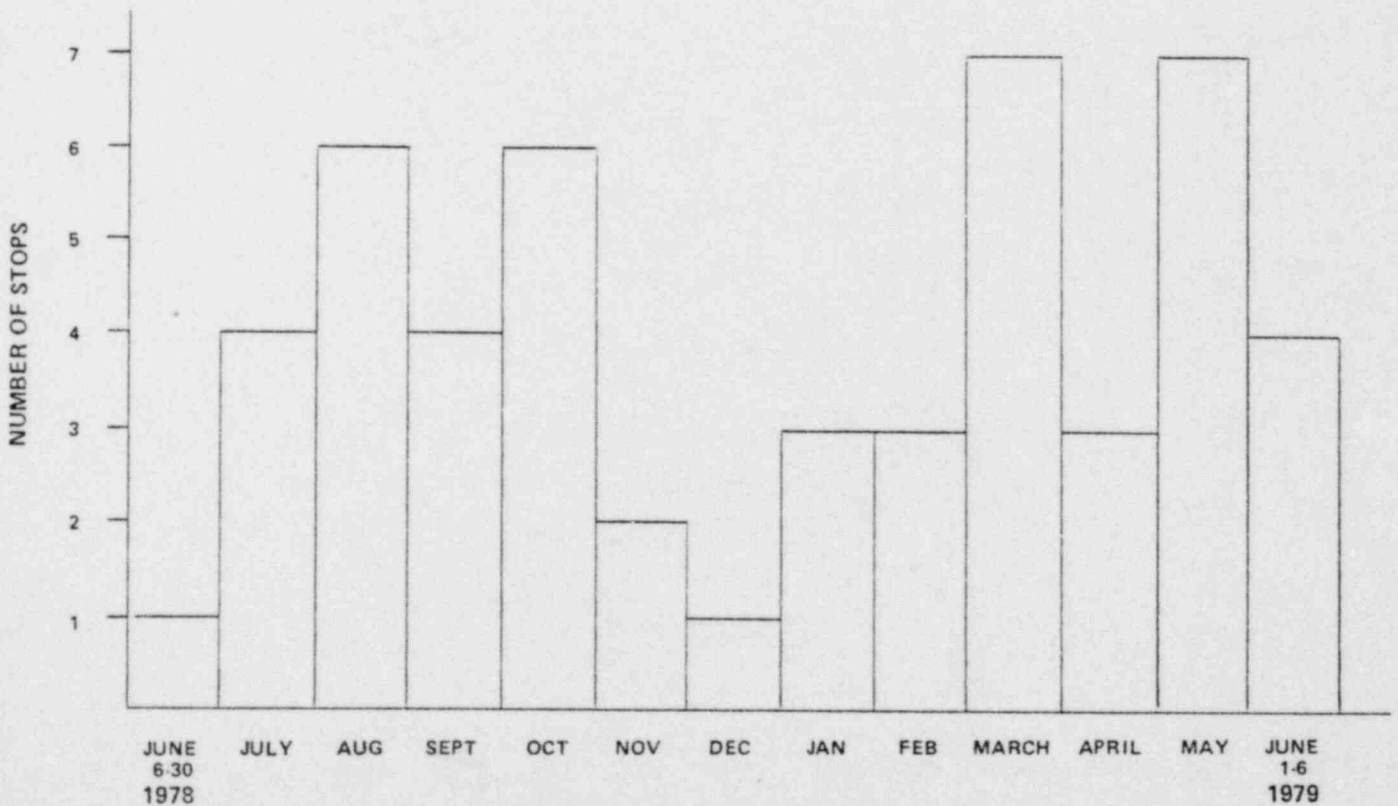


*During one surveillance stop, the time was not indicated

DAY OF WEEK

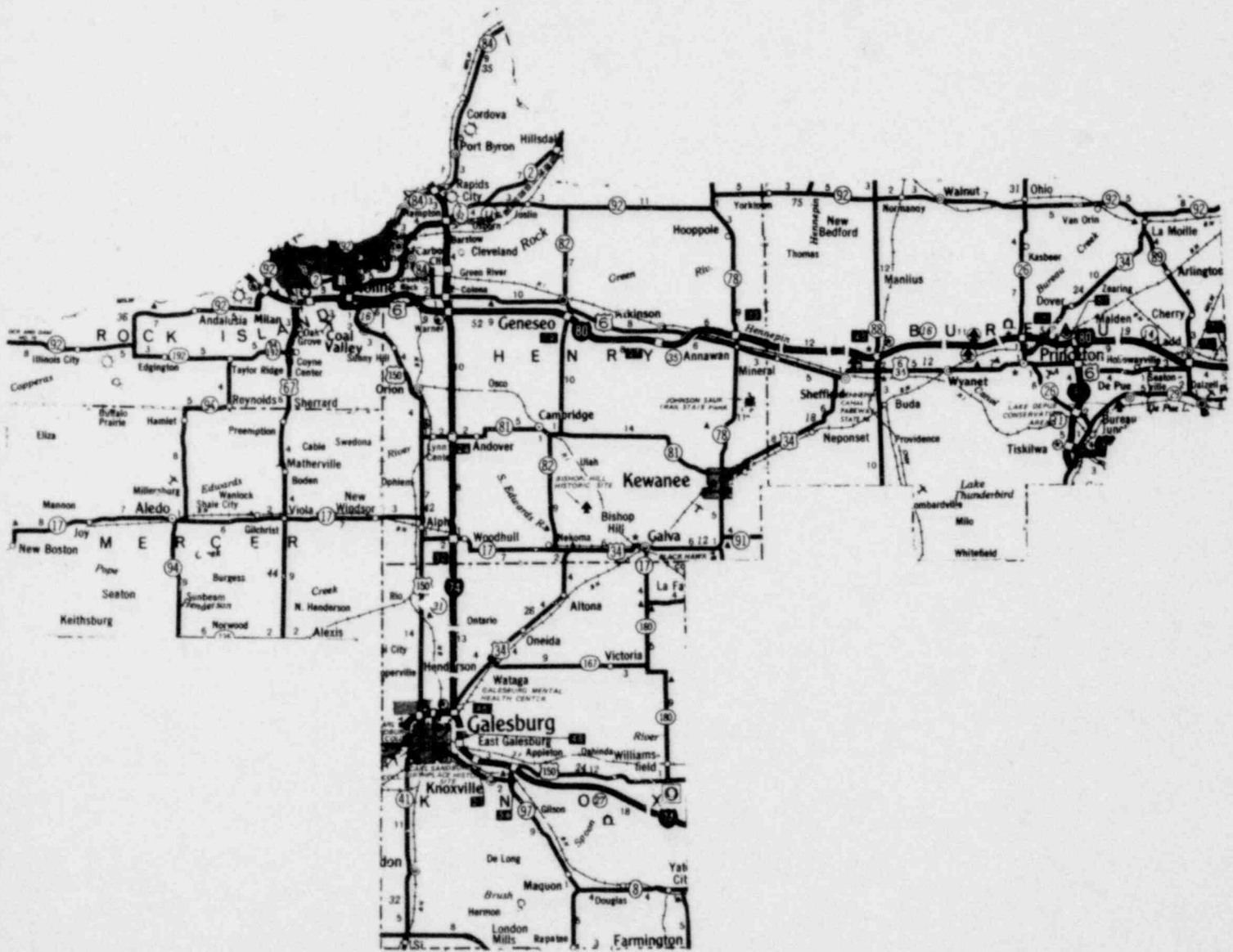


MONTH OF YEAR



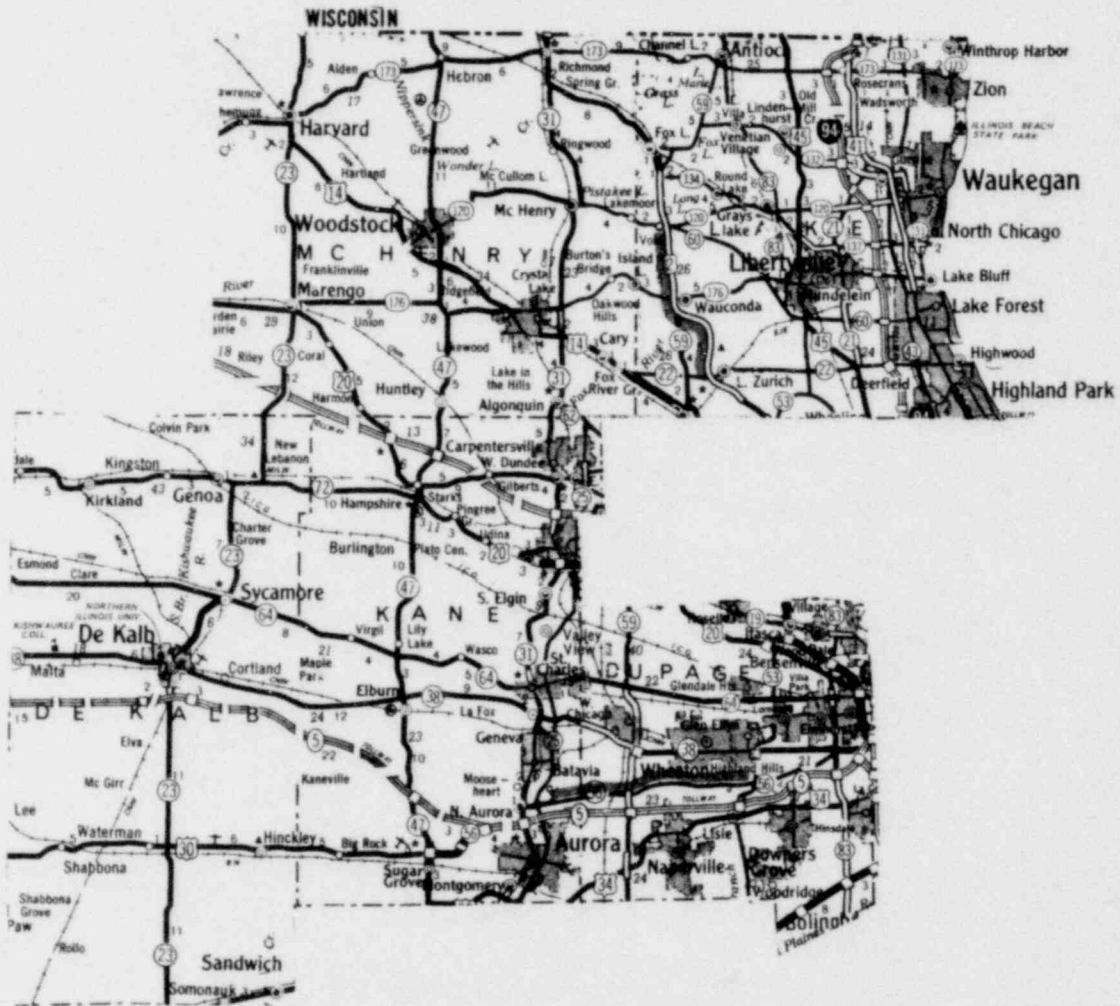
LOCATION OF SURVEILLANCE PERSONNEL:

The State troopers have normally only patrolled the interstate highways. The following is a description of the surveillance activities and a graphic indication of the geographical area included in each designated district. Each district has one trooper involved in surveillance activities except Joliet, which has two individuals.



ROCK ISLAND DISTRICT

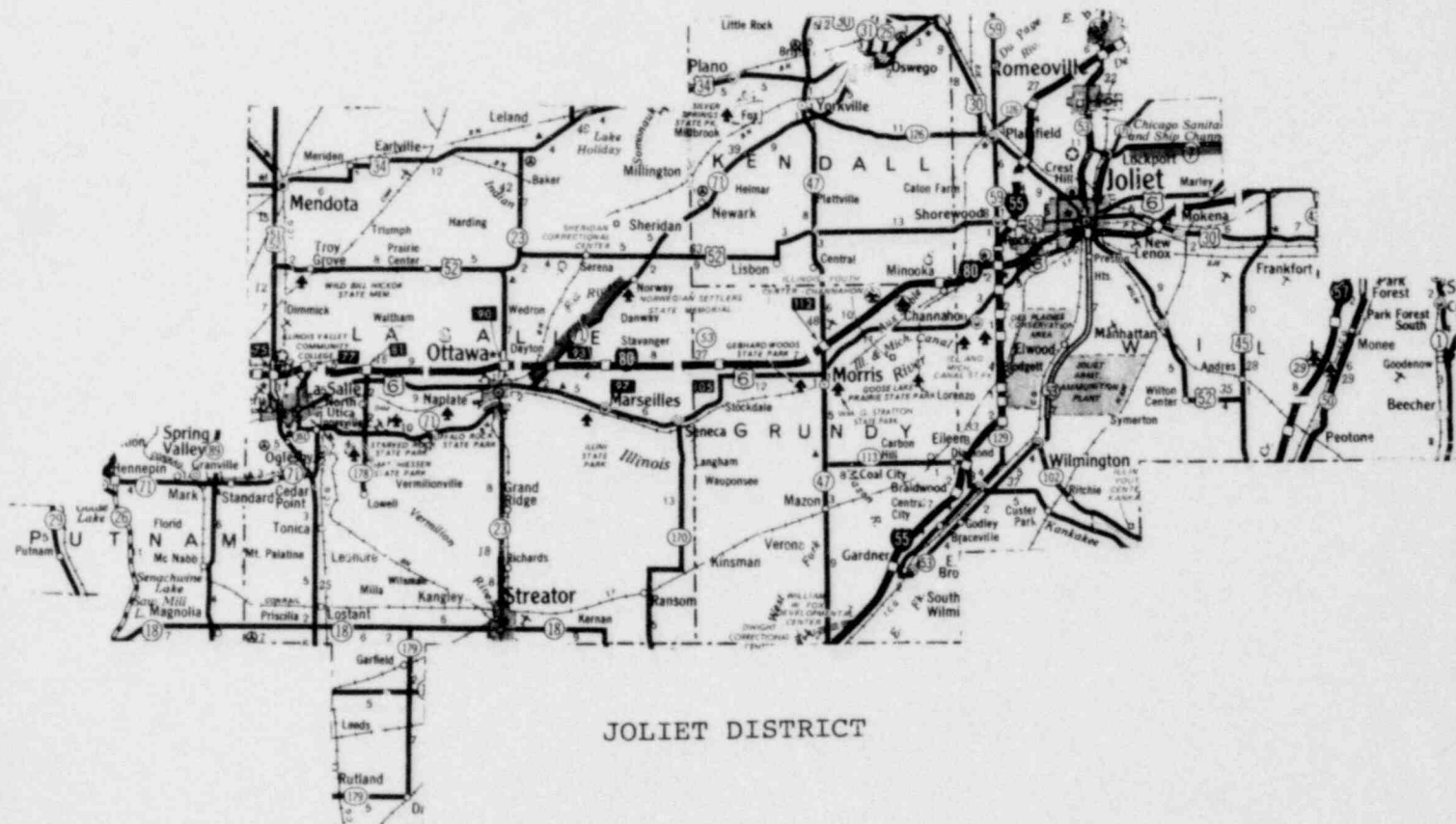
Rock Island District patrols I-80 and I-70. Two surveillance stops occurred in which both shipments were LSA waste-fuel cycle. The number of stops made is significantly lower than last year's report due to the Sheffield low-level burial site in Illinois being closed.



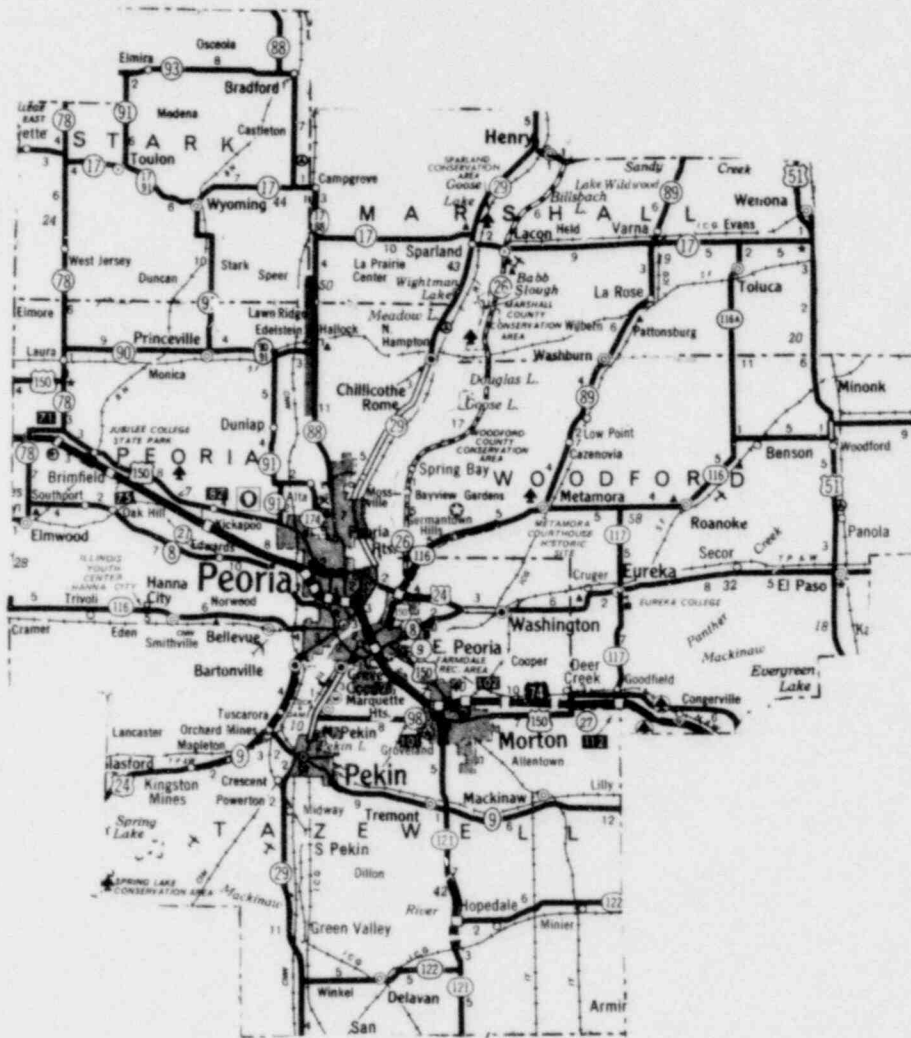
ELGIN AND OAK BROOK DISTRICTS

Elgin and Oak Brook Districts had a decrease in the number of stops compared to the last contract year. Elgin District had one surveillance stop which was a LSA waste-fuel cycle shipment.

Oak Brook District patrols strictly the three tollways I-5, I-90, and I-94. Two (2) surveillance stops occurred in which one shipment contained radiopharmaceuticals. The other was an empty cask, resulting in a citation being issued due to the fact the surface reading was 3mR/hr and no health physics survey was performed because of inclement weather.

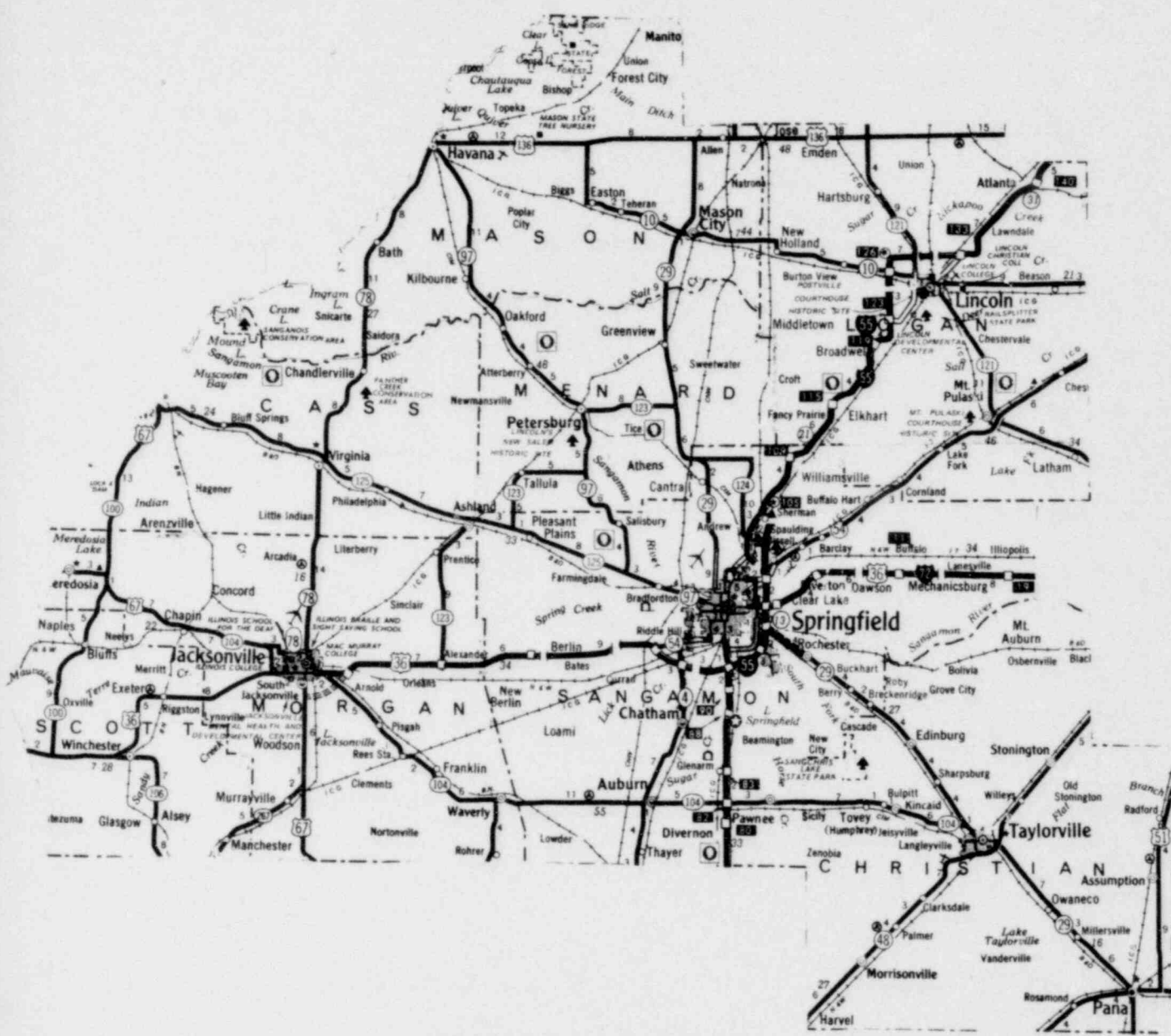


Joliet District has two State troopers actively involved in the surveillance study where 53% of all stops occurred, predominantly performed by one trooper. Twenty-six stops consisted of the following



PEORIA DISTRICT

Peoria District had two surveillance stops in which one involved industrial waste of I-125 and the other was a LSA waste fuel-cycle shipment.



SPRINGFIELD DISTRICT

Springfield District had 5 surveillance stops involving one radiopharmaceutical shipment, 2 industrial shipments where one was a radioactive isotope gauge and the other a 0.1 mCi Radium-226 check source, and 2 LSA waste fuel-cycle shipments.

DU QUOIN DISTRICT

DuQuoin District had 12 stops involving the following application classes: 9 fuel cycle LSA which were depleted uranium and uranium yellow cake; 2 LSA waste fuel cycle and 1 industrial isotope gauge. The number of stops would have been greater, but the trooper involved in the study was transferred to Springfield during the latter part of March and his replacement was not trained until June.

MARYVILLE DISTRICT

Maryville District did not have any surveillance stops even though the district is located nearby a large radiopharmaceutical company in St. Louis, Missouri. The primary duty of the trooper was law enforcement.



VEHICLE RESULTS:

The following vehicle types were noted during the surveillance stops; 3 passenger cars were stopped where in two instances they were used for transporting industrial radiography gamma sources and the other was the patient with the thyroid scan; 33 semi-trailer vehicles for waste disposal and LSA fuel cycle material; 4 straight trucks transporting radioactive waste, industrial type of sources (i.e. tracers for oil well exploration and survey instrument check sources) and isotope gauges for well logging; 8 pickup vehicles used by industrial radiographers and one oil well logger; 2 van type vehicles used for transporting radiopharmaceuticals; and 1 double bottom vehicle used for the shipment of a moisture-density gauge.

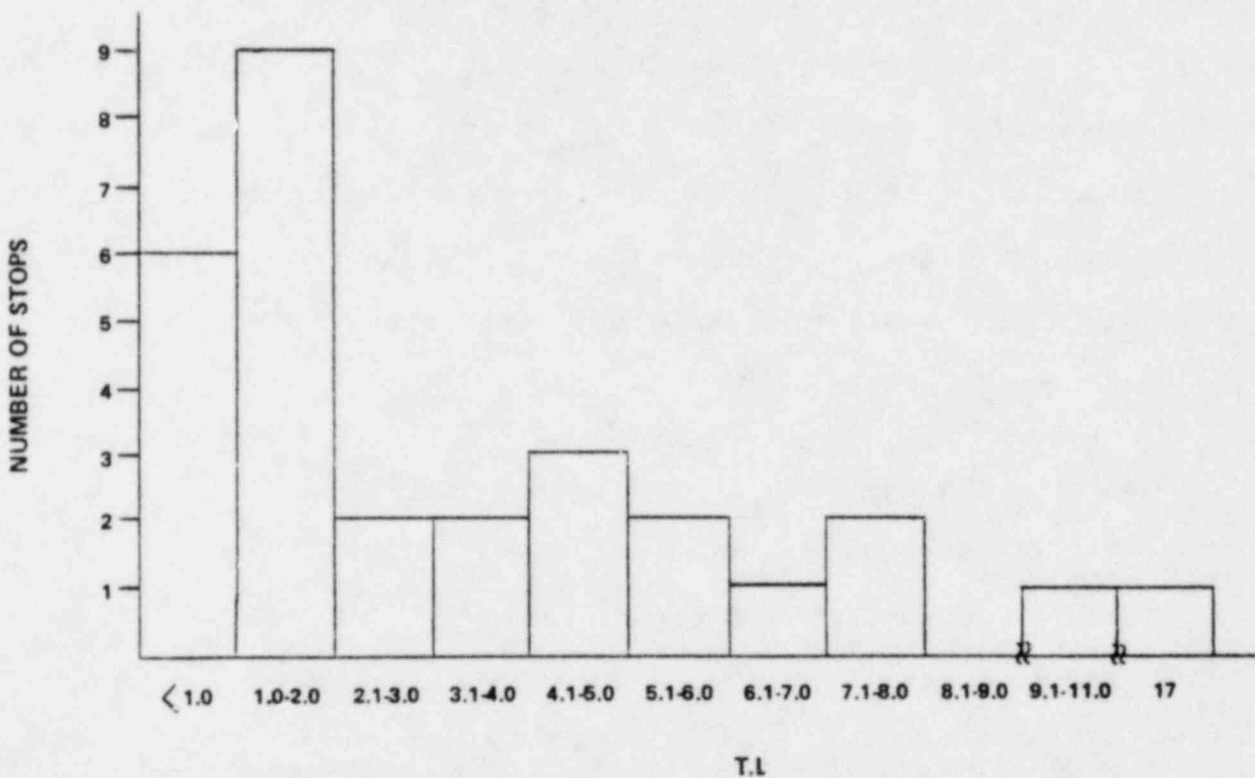
The carriers involved in the surveillance stops were of the following categories; 17 contract, 17 private, and 17 common. Thirty-two of the carriers' vehicles were of the exclusive use type.

The normal form (i.e. gas, liquid, solid) in which the radioactive material shipments occurred was solid for 47 surveillance stops. There were 3 liquid shipments consisting of two radiopharmaceutical shipments, and 1 industrial shipment of Iodine-131 used for injecting into pipe lines.

There were 9 industrial radiography sources classified as special-form radioactive material shipments.

The average Transport Index indicated on shipping papers and/or determined by the state troopers was 3.4 for 28 surveillance stops, ranging from 0.2 to 17.0.

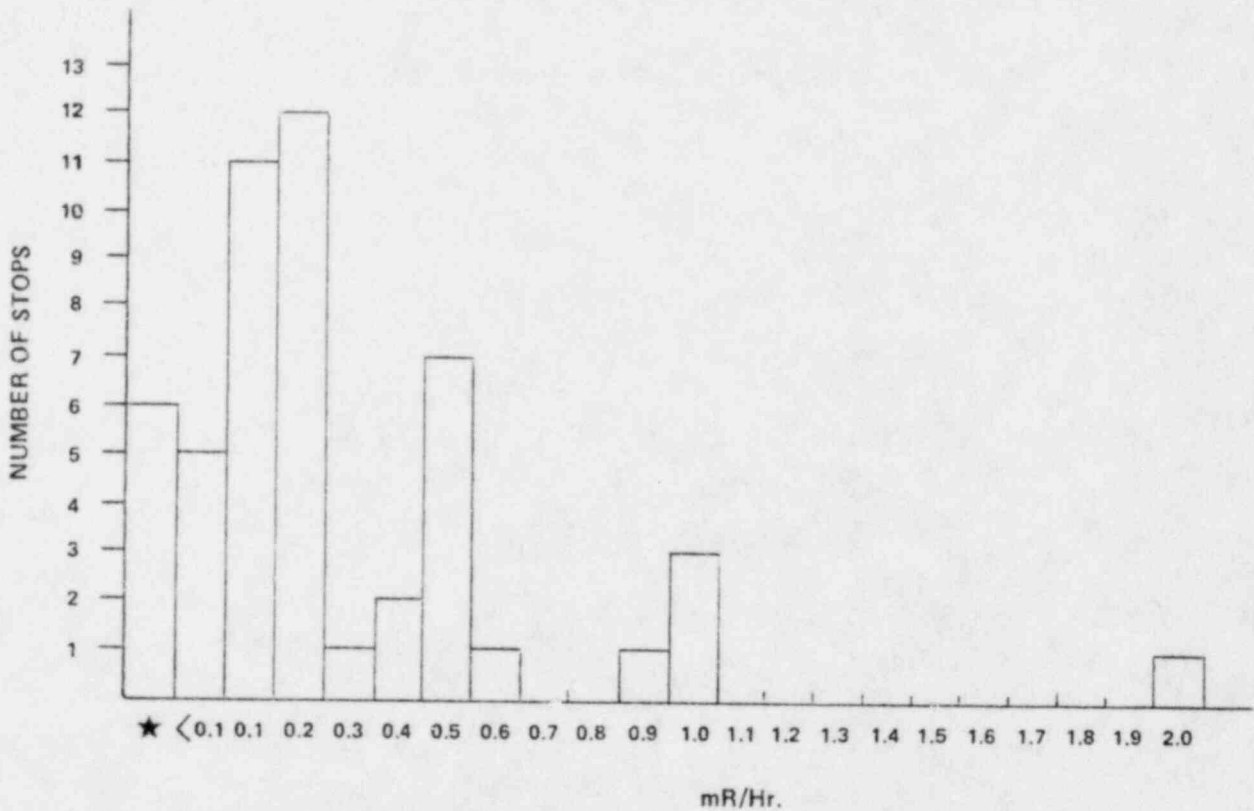
TOTAL TRANSPORT INDEX IN A SHIPMENT



MONITORING RESULTS:

The cab areas of the vehicles were monitored with ionization chamber survey instruments. The average result for the normally occupied area within the vehicles was 0.33 mR/hr for 44 of the vehicles stopped.

EXPOSURE RATE IN VEHICLE CAB

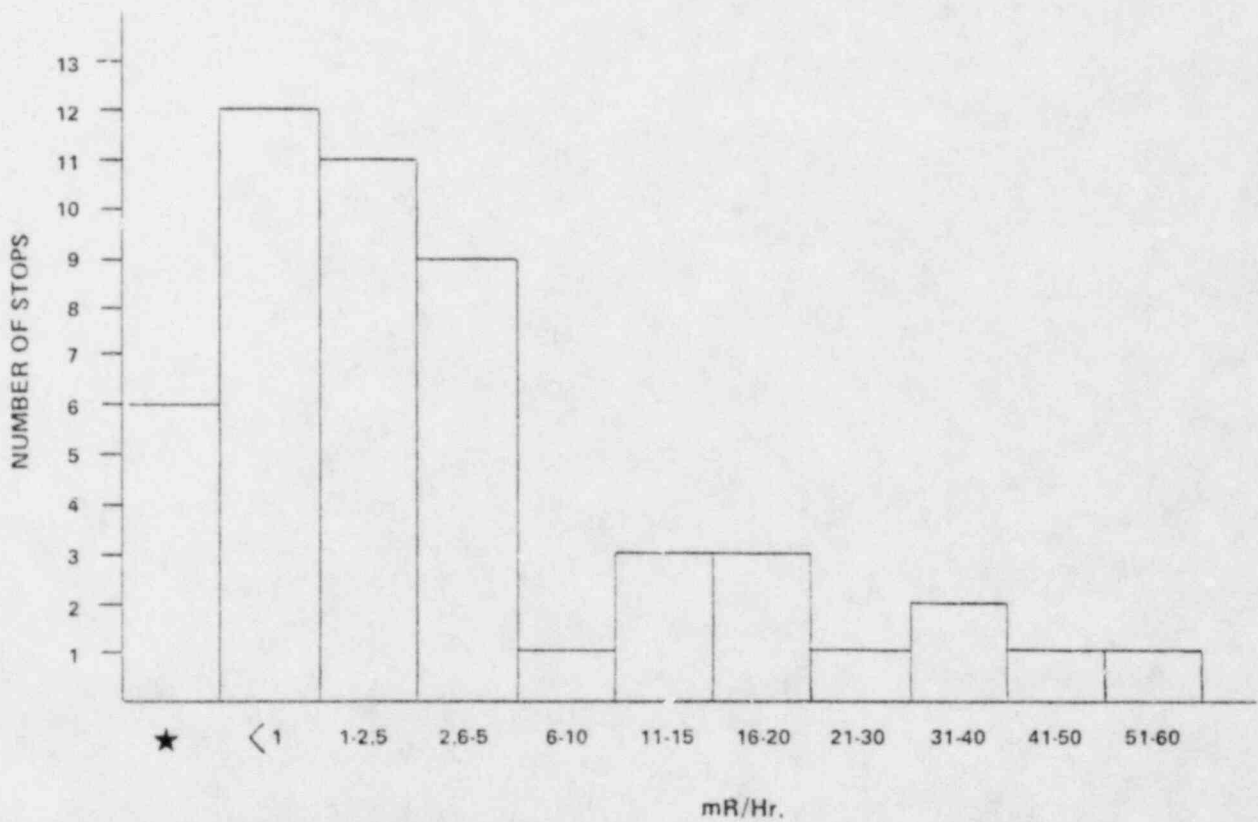


\star No reading indicated on report form

In total, there were only two vehicle stops involving medical radioactive materials being transported in vans where the driver's position within the vehicle was 2.0 mR/hr and 0.2 mR/hr.

The outside surfaces of the 44 vehicles stopped were monitored and resulted in a maximum average level of 8.24 mR/hr with a range from 0.1 to 55 mR/hr. The 55 mR/hr surface reading was obtained from the shipping papers on a LSA waste shipment of 1.7 Curies in the Joliet District and was not confirmed by the trooper's survey instrument.

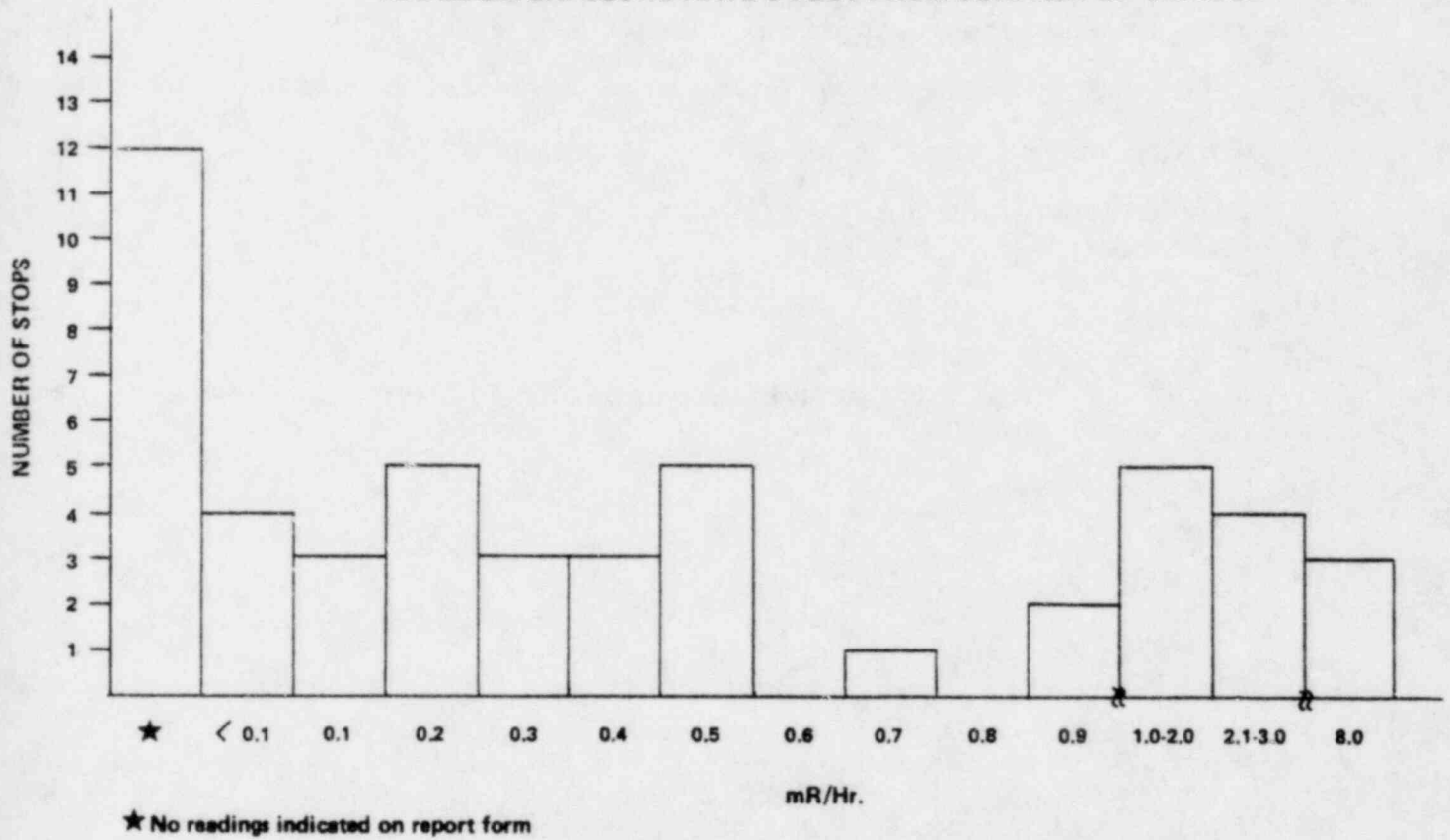
MAXIMUM EXPOSURE RATE ON OUTSIDE SURFACE OF VEHICLE



★ No reading indicated on report form

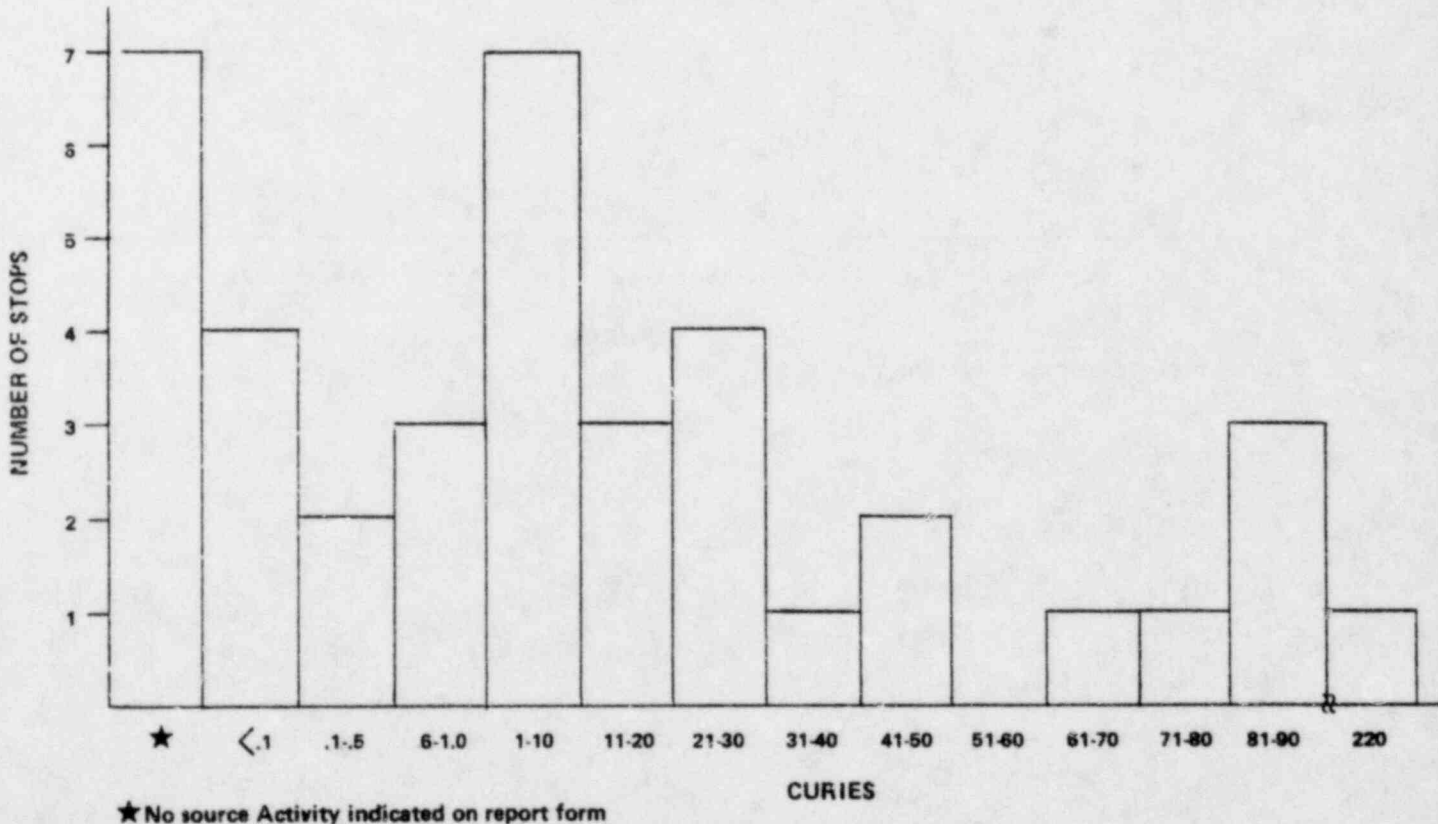
The average maximum radiation level at six feet from the surface of the vehicle was 1.33 mR/hr for 38 vehicles, ranging from background to 8.0 mR/hr.

MAXIMUM EXPOSURE RATE 6 FEET FROM SURFACE OF VEHICLE



The average total activity for the radioactive materials in transit was 29.27 Curies per shipment for 32 trucks. The troopers were not able to determine the total radioactive source activity on the other 19 vehicles. The total radioactive source activity on each vehicle ranged from 0.1 millicurie to 200 Curies, the later being an industrial radiography gamma source. The gross weight indicated for 12 shipments of LSA radioactive material averaged 38,642 lbs per shipment. The other seven surveillance shipment stops had neither gross weight nor source activity indicated in which two vehicles were transporting isotope gauges, one vehicle was an empty cask, one vehicle was the individual with the thyroid scan, and 3 vehicles were transporting depleted uranium in projectiles.

TOTAL RADIOACTIVE MATERIAL SOURCE ACTIVITY IN A SHIPMENT



R A D I O A C T I V E M A T E R I A L M O V E M E N T

	<u>Total No. Stops</u>	<u>Total Activity (Ci) No. Stops</u>	<u>Activity</u>	<u>Total Weight (K lbs) No. Stops</u>	<u>Weight</u>	<u>Avg. Activity Per Shipment (Ci)</u>	<u>Avg. Weight Per Shipment (K lbs)</u>
Medical	2	2	0.291			0.1455	
Limited	2	2	0.0001			0.00005	
Waste (LSA)	19	16	354.531	3	131.5	22.16	43.83
Fuel Cycle (LSA)	15	3	25.8	12	332.2	8.6	27.68
Industrial	13	13	556.10			42.78	

SURVEILLANCE STOPS

DATE	ROUTE	DISTRICT	ISOTOPE	QUANTITY	PACKAGE INSPEC-TION	TI	DESTI-NATION	VEHICLE TYPE	PACKAGE PLACE-MENT*	SHIPPING PAPERS	PLAC-ARDED	D.O.T. NON-COMP. ITEMS
06/09/78	I-57	DuQuoin	---	---	---	---	IL	Pickup	mid-rear	none	no	(1)
07/16/78	I-80	Joliet	Ir-192	74 Ci	---	---	IA	Auto	right rear	none	yes	
07/17/78	I-55	Spfld.	I-131 Se-75	5 mCi 3 mCi	yes	6.4	IL	Van	mid-center	yes	not re-quired	
07/27/78	I-57	DuQuoin	LSA Waste	3.9 Ci	---	---	SC	Semi	all	yes	yes	(2)
07/28/78	I-57	DuQuoin	U-Yellow Cake	43 K lbs	---	---	IL	Semi	all	yes	yes	
08/09/78	I-57	Joliet	LSA Waste	9.0 Ci	---	6.0	SC	Semi	all	yes	yes	
08/10/78	I-57	Joliet	Ir-192	29.0 Ci	yes	1.5	IL	Pickup	right rear	none	yes	(3)
08/11/78	I-57	Joliet	LSA Waste	18.1 Ci	yes	3.5	SC	Semi	all	yes	yes	
08/18/78	I-57	Joliet	Not (A) Listed RAM-LSA	13.3 K lbs	---	---	IL	Semi	mid-rear	yes	yes	
08/28/78	I-80	Joliet	Ir-192	82 Ci	yes	2.0	IL	Pickup	right rear	none	yes	
08/31/78	Ill. 50	Joliet	Ir-192	50 Ci	yes	0.6	IN	Pickup	left rear	none	yes	(4)
09/01/78	I-64	DuQuoin	U-Yellow Cake	38 K lbs	---	---	IL	Semi	all	yes	yes	
09/07/78	I-57	DuQuoin	U- Depleted (B)	33 K lbs	---	---	NY	Semi	all	yes	not re-quired	
09/12/78	I-57	Joliet	Ir-192	50 Ci	yes	6.0	IL	Pickup	right rear	none	yes	(5)
09/15/78	I-55	Spfld.	Ra-226	0.1 mCi	---	---	IL	Straight truck	left rear	none	yes	(6)

(A) Depleted Uranium

(B) U-Depleted and Class A Explosive, no individual weight

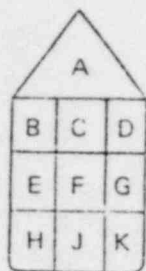
DATE	ROUTE	DISTRICT	ISOTOPE	QUANTITY	PACKAGE INSPEC- TION	TI	DESTI- NATION	VEHICLE TYPE	PACKAGE PLACE- MENT*	SHIPPING PAPERS	PLAC- ARDED	D.O.T. NON-COMP. ITEMS
10/07/78	I-57	Joliet	Cs-137 Am-241 Be	10 mCi 40 mCi	yes	1.0	WI	Double Bottom	right center	none	not re- quired	(7)
10/09/78	I-194	Oak Brook	Co-57 H-3 I-131	283 mCi	yes	10.6	IA	Van	all	yes	yes	(8)
10/24/78	I-57	DuQuoin	U-Yellow Cake	42.5 K lbs	---	---	IL	Semi	all	yes	yes	
10/26/78	I-57	DuQuoin	U-Yellow Cake	38 K lbs	---	---	IL	Semi	all	yes	yes	
10/27/78	I-57	DuQuoin	U-Yellow Cake	41.8 K lbs	---	---	IL	Semi	all	yes	yes	
10/28/78	Dresden Road	Joliet	LSA Waste	2.4 Ci	yes	---	SC	Semi	center	yes	yes	(9)
11/01/78	I-57	Joliet	Ir-192	65 Ci	yes	1.0	IL	Pickup	middle right	none	yes	(10)
11/19/78	I-80	Joliet	LSA Waste	23.7 Ci	yes	5.0	SC	Semi	all	yes	yes	
12/06/78	I-64	DuQuoin	LSA Waste	60 K lbs	---	2.0	SC	Semi	all	yes	yes	(11)
01/03/79	I-57	Joliet	LSA Waste	1.7 Ci	---	---	SC	Semi	all	yes	yes	(12)
01/10/79	I-90	Oak Brook	---	---	yes	---	MN	Semi	cask	none	no	(13)
01/12/79	I-57	Joliet	LSA Waste	11.5 Ci	---	4.3	SC	Semi	all	yes	yes	(14)
02/13/79	I-57	Joliet	LSA Waste	220.0 Ci	yes	17.0	SC	Semi	all	yes	yes	(15)
02/20/79	I-55	Spfld.	LSA Waste	683 mCi	---	---	NV	Semi	center	yes	yes	(16)
02/20/79	I-74	Peoria	LSA Waste	11.9 Ci	---	1.6	SC	Semi	all	yes	yes	
03/06/79	I-57	DuQuoin	U- Depleted	---	---	---	NY	Semi	all	yes	not re- quired	
03/09/79	Ill. 13	DuQuoin	U- Depleted	---	---	---	NY	Semi	all	yes	not re- quired	
03/09/79	Ill.13	DuQuoin	U- Depleted	---	---	---	NY	Semi	all	yes	not re- quired	

<u>DATE</u>	<u>ROUTE</u>	<u>DISTRICT</u>	<u>ISOTOPE</u>	<u>QUANTITY</u>	<u>PACKAGE INSPEC- TION</u>	<u>TI</u>	<u>DESTI- NATION</u>	<u>VEHICLE TYPE</u>	<u>PACKAGE PLACE- MENT*</u>	<u>SHIPPING PAPERS</u>	<u>PLAC- ARDED</u>	<u>D.O.T. NON-COMP. ITEMS</u>
03/16/79	I-57	Joliet	U-Yellow Cake	38 K lbs	yes	3.0	IL	Semi	all	yes	yes	(17)
03/23/79	I-57	Joliet	I-131	50 mCi	yes	1.0	TX	Straight Truck	left middle	none	yes	
03/26/79	I-55	Spfld.	LSA Waste	172.2 mCi	---	---	GA	Semi	center & rear	yes	yes	
03/30/79	I-55	Joliet	I-131	---	---	---		Auto				(18)
04/02/79	U.S. 6	Rock Island	LSA Waste	27.2 Ci	---	3.5	SC	Semi	middle center	yes	yes	
04/25/79	Ill. 29	Peoria	I-125 Waste	780 mCi	---	0.3	IL	Straight Truck	center	yes	yes	
04/30/79	I-55	Spfld.	---	---	yes	0.2	OK	Straight Truck	center	none	yes	(19)
05/01/79	I-57	Joliet	U-Yellow Cake	5.8 Ci	---	5.0	IL	Semi	all	yes	yes	
05/03/79	I-57	Joliet	U-Yellow Cake	10.0 Ci	---	7.5	IL	Semi	all	yes	yes	
05/04/79	I-57	Joliet	U-Yellow Cake	10.0 Ci	---	7.5	IL	Semi	all	yes	yes	(20)
05/09/79	I-80	Joliet	Ir-192	82 Ci	yes	1.0	IN	Pickup	center	none	yes	(21)
05/14/79	I-80	Rock Island	LSA Waste	22.9 Ci	---	2.5	Sc	Semi	center	yes	yes	
05/17/79	I-80	Elgin	LSA Waste	596 mCi	---	---	SC	Semi	center	yes	yes	
05/29/79	I-80	Joliet	LSA Waste (C)	37.8 K lbs	---	---	SC	Semi	front & center	yes	yes	
06/01/79	I-55	Joliet	Ir-192	88 Ci	yes	0.5	IL	Auto	rear center	yes	yes	
06/01/79	I-55	Joliet	U- Depleted	44.6 K lbs	---	---	CA	Semi	all	yes	yes	
06/04/79	I-55	Joliet	LSA Waste	33.7 K lbs	---	1.0	WA	Semi	all	yes	yes	
06/07/79	U.S. 6	Joliet	Ir-192	36 Ci	yes	0.3	IL	Pickup	rear right	yes	yes	

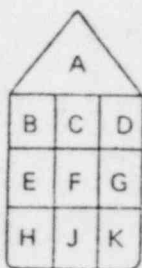
24.

(C) Animal Carcasses

* Package Placement. The following diagrams appear on the State trooper's report in which he marks the respective blocks on the drawing indicating the placement of radioactive material shipments. Whenever the package placement is stated on the above surveillance stops to be "all," all area is occupied except the cab or driver's position. Most semis transporting LSA material were using the entire trailer area, and one van carrying radiopharmaceuticals utilized all areas of the van except the area near the driver.



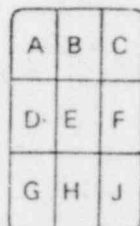
PASSENGER
CAR



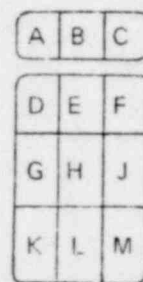
PICKUP



VAN



STRAIGHT
TRUCK



SEMI



DOUBLE
BOTTOM

D.O.T. NON-COMPLIANCE ITEMS

Shipping papers and a shipper's certification¹ were the frequent items found in non-compliance with DOT regulations, along with an occasional transport index omitted from the shipping papers and/or shipping labels. There were 20 vehicles, 39% of all stops, with improper shipping papers and/or shipper's certification, placarding, Yellow III labels, radioactive material label², etc.

Improper placarding involved 7 vehicles which were issued warning citations by the troopers. In these instances, 6 vehicles did not have the sufficient number of placards or proper placarding and one vehicle did not warrant placarding.

The following data were listed on the Surveillance Stops by number, explaining the D.O.T. non-compliance items and unique circumstances found during the trooper's investigation:

- (1) No placard, driver placed placards on vehicle at time.
No papers identifying isotope in two gauges used for testing oil wells.
- (2) Placarded with old rectangular placards.

1 Appendix A

2 Appendix B

- (3) No Yellow III label, label present was not readable, nor T.I. indicated.
- (4) No Yellow III label, label present was not readable, nor T.I. indicated.
- (5) One radioactive placard missing, Yellow III label not readable, nor T.I. indicated.
- (6) Vehicle was placarded according to report, does not need to be.
- (7) Papers did not indicate proper shipping name, hazard class, nor label required.
- (8) No placard on front.
- (9) No markings on shipping containers "Radioactive LSA"
- (10) No label on package, or T.I.
- (11) Shipping papers did not list shipping name, hazard class, or isotope. The radioactive shipment record indicated mixed isotopes, total of 35.6 Ci.

- (12) T.I. not listed on shipping papers.
- (13) Empty cask, 3 mR/hr on surface, no health physics survey release performed on the empty spent fuel cask.
- (14) No placards on both sides.
- (15) T.I. not listed on shipping papers.
- (16) Citation given for overweight on gross weight of shipment.
- (17) Drums were not marked "Radioactive LSA", T.I. not indicated on shipping papers.
- (18) Driver of auto had recently undergone a thyroid scan.
- (19) No label on gauge to indicate isotope or activity, no shipping papers.
- (20) Placard not on rear of vehicle.
- (21) No T.I. source activity, or isotope listed on label.

PACKAGE INSPECTION:

Package inspections occurred during 19 surveillance stops, (37% of all stops) producing the following information:

<u>TYPE</u>	<u>SURFACE</u> <u>mR/hr</u>	<u>3'</u> <u>mR/hr</u>	<u>6'</u> <u>mR/hr</u>	<u>ISOTOPE</u>	<u>QUANTITY</u>	<u>LABEL</u>
A	13.0	5.5	0.1	I-131	5 mCi	Yellow II
B	20.0	1.5	---	Ir-192	29 Ci	-----
A	25.0	5.0	2.0	Waste LSA	18.1 Ci	-----
B	75.0	2.0	0.5	Ir-192	82 Ci	Yellow III
B	29.0	0.6	0.0	Ir-192	50 Ci	None
B	45.0	6.0	0.0	Ir-192	50 Ci	Yellow III
B	3.0	0.3	0.0	Cs-Am	50 mCi	None
A	15.0	10.0	2.5	Radiopharma- ceuticals	254 mCi	Yellow III
B	15.0	4.0	2.0	Waste LSA	2.4 Ci	-----
B	45.0	1.0	---	Ir-192	65 Ci	None
A	18.0	5.0	2.0	Waste LSA	23.7 Ci	-----
Large Quantity	3.0	----	---	Empty Cask	-----	-----
Large Quantity	40.0	17.0	8.0	Waste LSA	220 Ci	-----
A	3.6	3.0	0.9	U-Yellow LSA	38 K lbs	-----
A	15.0	0.8	---	I-131	50 mCi	Yellow II
B	2.0	0.2	0.1	Unknown	-----	None
B	4.0	1.0	0.0	Ir-192	82 Ci	Yellow III
B	11.0	0.5	0.0	Ir-192	88 Ci	Yellow III
B	38.0	----	---	Ir-192	36 Ci	Yellow III

All package inspections revealed no surface radioactive contamination present on wipes performed. During the inspection, only the package with the largest quantity of radioactive material was inspected, as indicated in the 2 radiopharmaceutical stops, which will be changed upon the implementation of the new report form. Most industrial radiography sources were inspected since proper shipping papers were not available.

In the future, any time the vehicle driver does not have proper shipping papers, or there is an accident involving a carrier transporting radioactive materials, or excessive radiation levels are present, package inspections will be performed even though the vehicle's trailer may be sealed.

OBSERVATIONS:

The work accomplished under the second surveillance contract period indicates that, by the number of reports submitted by State troopers, the surface transit flow of radioactive materials in this State is low. Yet, it is still estimated that less than 1% of all shipments were surveyed due to the following: (a) manpower availability - only ten troopers were involved who perform various tasks within their districts; (b) work hours for the personnel involved in the study vary since they are on a rotational or "swing shift"; (c) location of personnel is sparse, and the interstate highways within this State are not continuously monitored due to other duties constantly assigned to the troopers.

The primary duty of the State troopers in the study has been law enforcement, with the secondary duty of serving as hazardous materials experts, including, involvement in the surveillance program. This situation has been changed whereas July 1, 1979, the troopers primary duty will be hazardous materials, and will be patrolling their entire district; (d) the carriers of radioactive materials shipments realize that a transportation study is occurring within this State and may be avoiding entry into Illinois; (e) the portable radiation detection monitors, being battery operated, were not remaining charged after 2 to 3 hours of constant use. This problem has been rectified since the RM-19's were modified so that they can be charged by connecting them to a DC converter within the vehicles; (f) most stops have occurred on interstate highways. However, there were numerous instances in which the trooper's radiation monitor would alarm, but due to the highway design, the trooper was unable to change his direction of travel. Also, during several instances the trooper was unable to determine the specific vehicle transporting radioactive material whenever the vehicle was not placarded on a congested six lane highway. The new report form used by the troopers will indicate whenever their radiation monitor alarms and they are unable to pursue.

RECOMMENDATIONS:

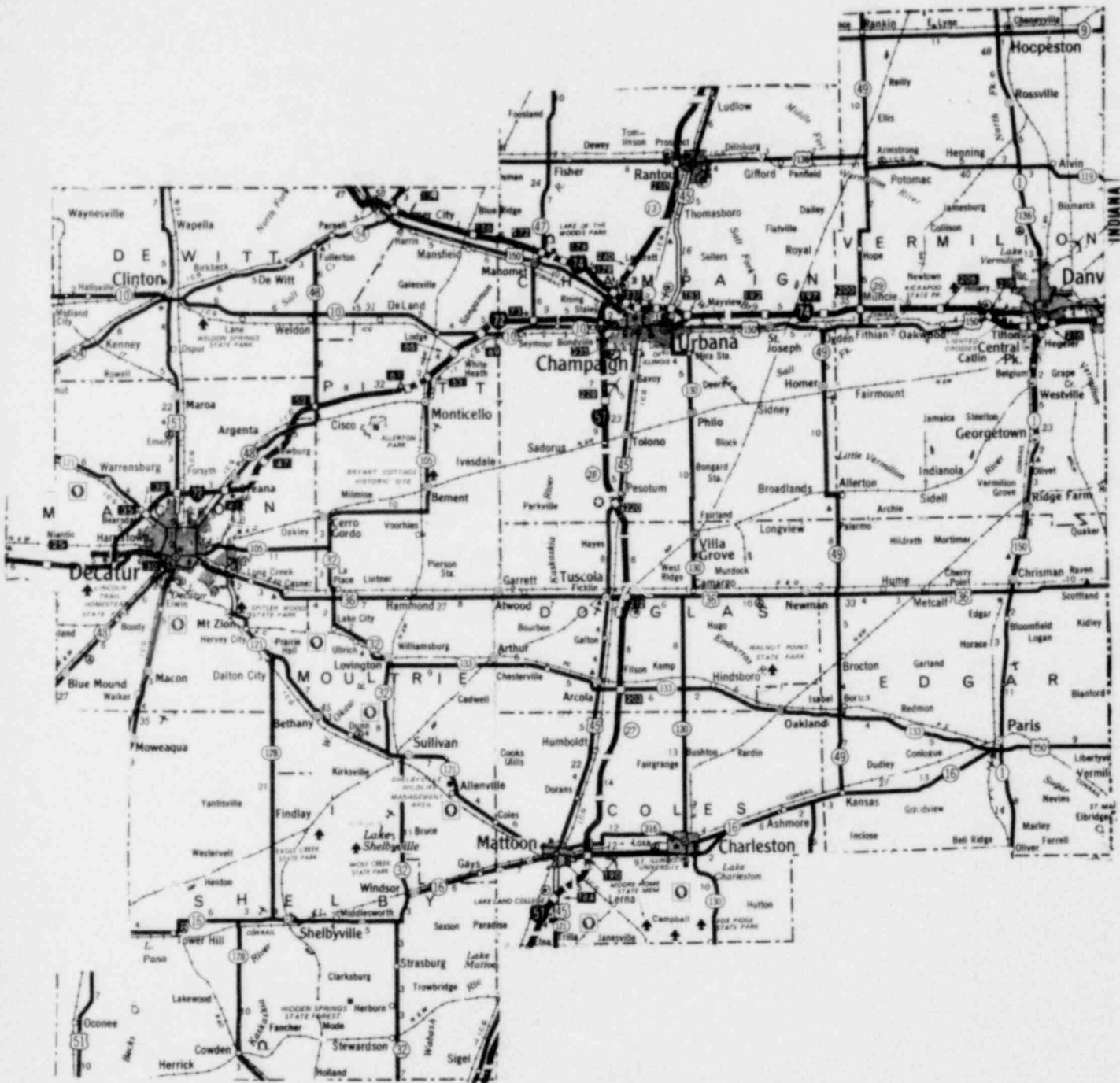
The following recommendations are being made to improve the efficiency and effectiveness of this transportation study:

1. Relocation of surveillance instruments is needed in areas that are not productive to anticipated areas of radioactive material shipments.

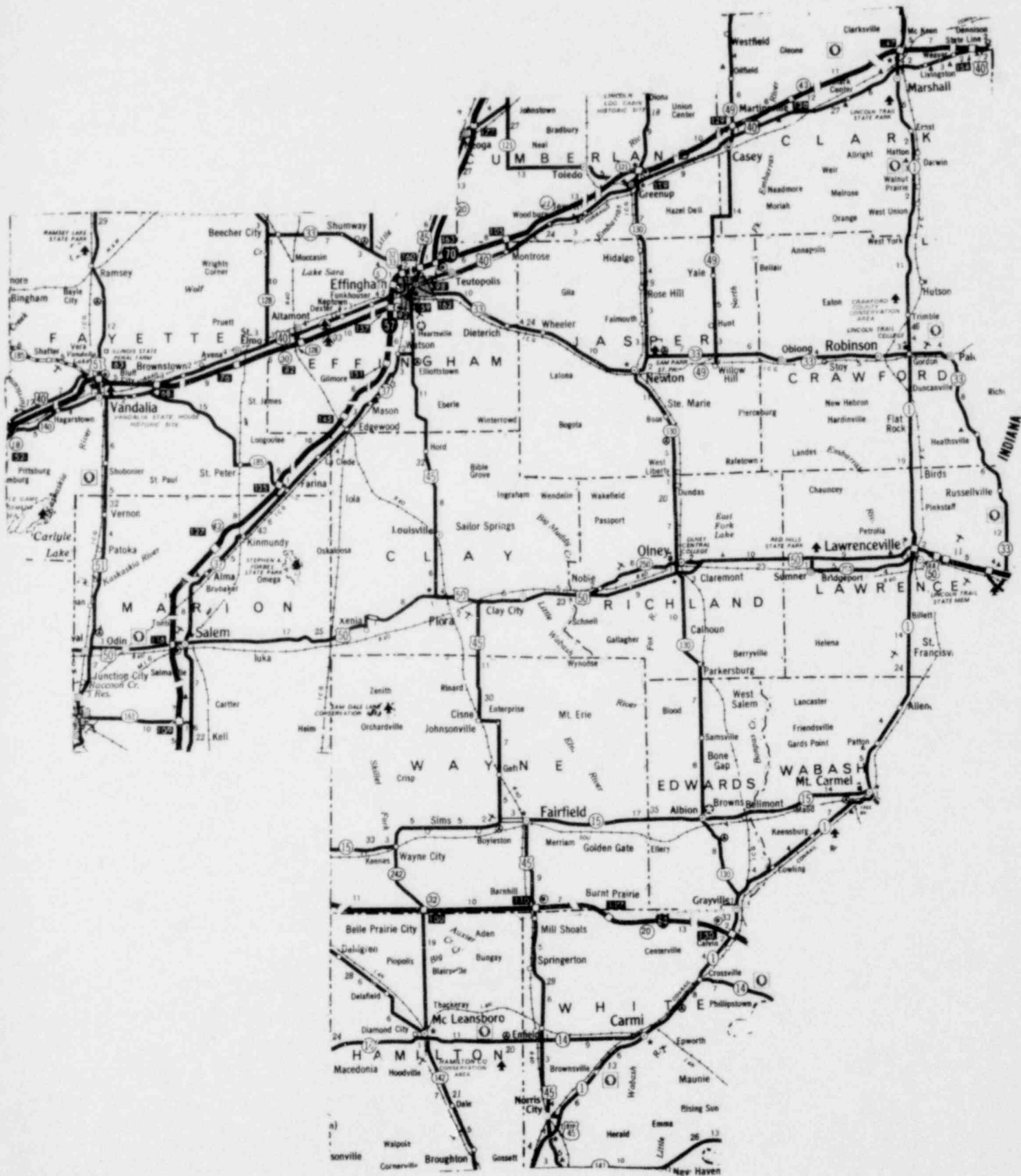
2. Surveillance of medical radioactive material shipments needs to be intensified since only 2 surveillance stops in this category occurred during the past year. Since most hospitals receive their shipments of radioactive material over the weekend, more effort should be placed on surveillance of these shipments.

3. Strip chart recorders need to be provided that will connect to 2 additional RM-19's with scintillation probes and placed near O'Hare airport area and I-55 bridge near East St. Louis as well as other major highways entering the State. This will determine the exact number of radioactive material shipments traversing the area on a 24-hour basis. The strip chart recorder and instruments could be placed at a location for a one-month period with at least weekly checks being performed by the State troopers, replacing the strip chart and sending it in for evaluation. From evaluation of the strip chart, patterns of radioactive material in transit can be determined. The indication of a significant number of vehicles will result in the relocation of a complete set of instruments to that geographical area.

The following districts will be involved in the surveillance study beginning June 7, 1979, since 6 additional Eberline Instrument Company portable radiation detectors Model RM-19 with Model SPA-3 gamma 2 inch by 2 inch sodium iodide thallium activated scintillation probes have been received and hazardous materials troopers trained. Also, 6 Eberline Instrument Company "Cutie Pie" portable low-medium range ionization chamber, Model RO-3 were received and distributed to the troopers.



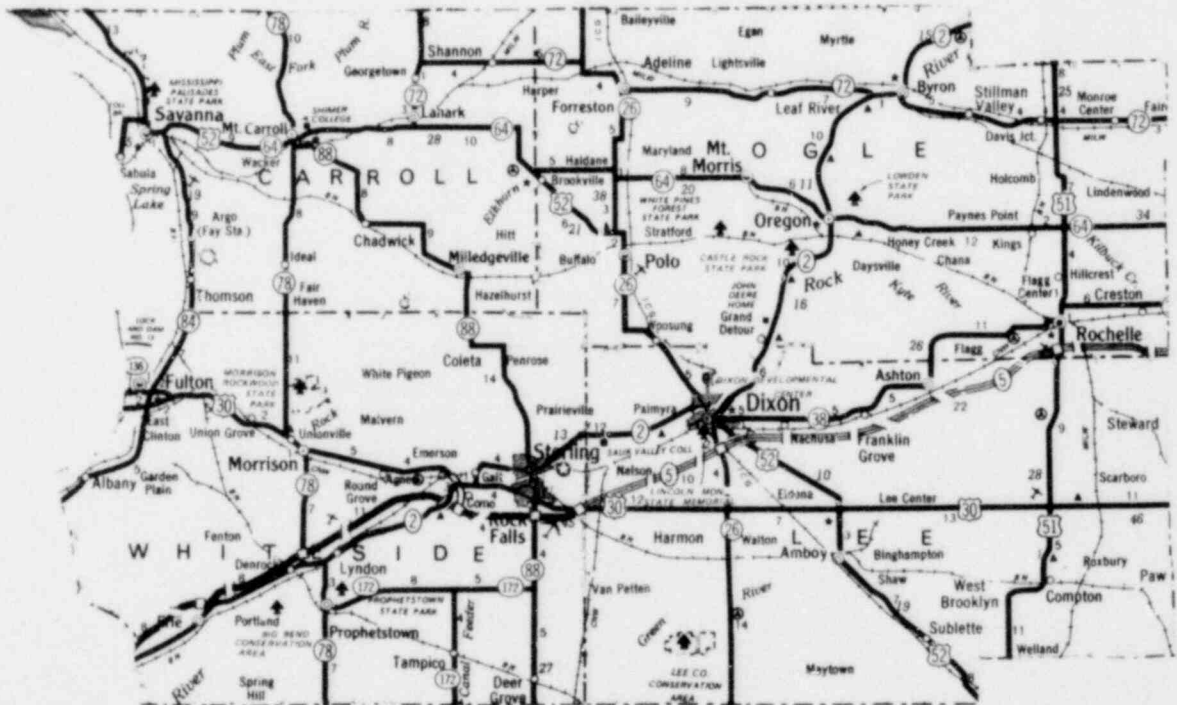
PESOTUM DISTRICT



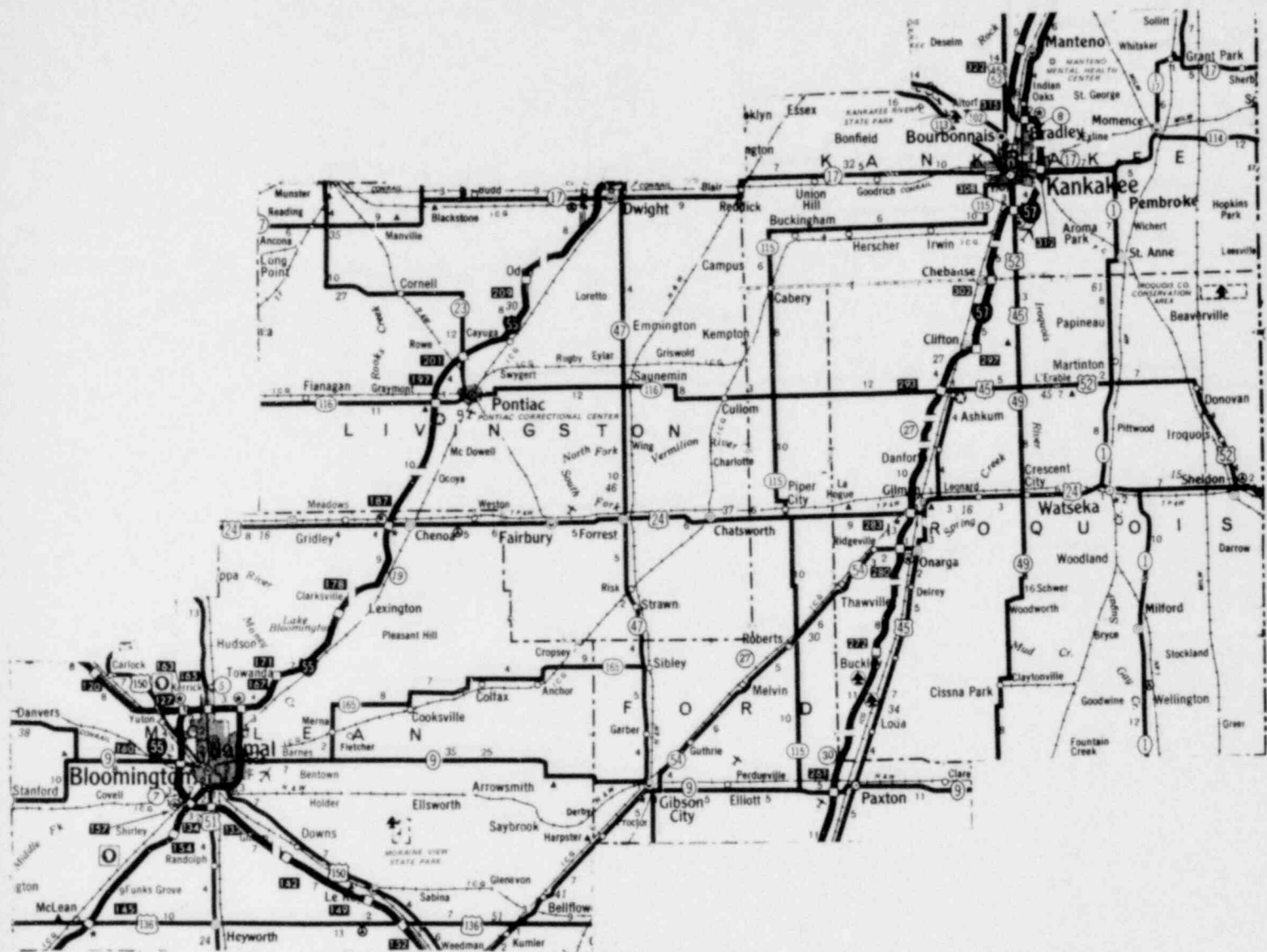
EFFINGHAM DISTRICT



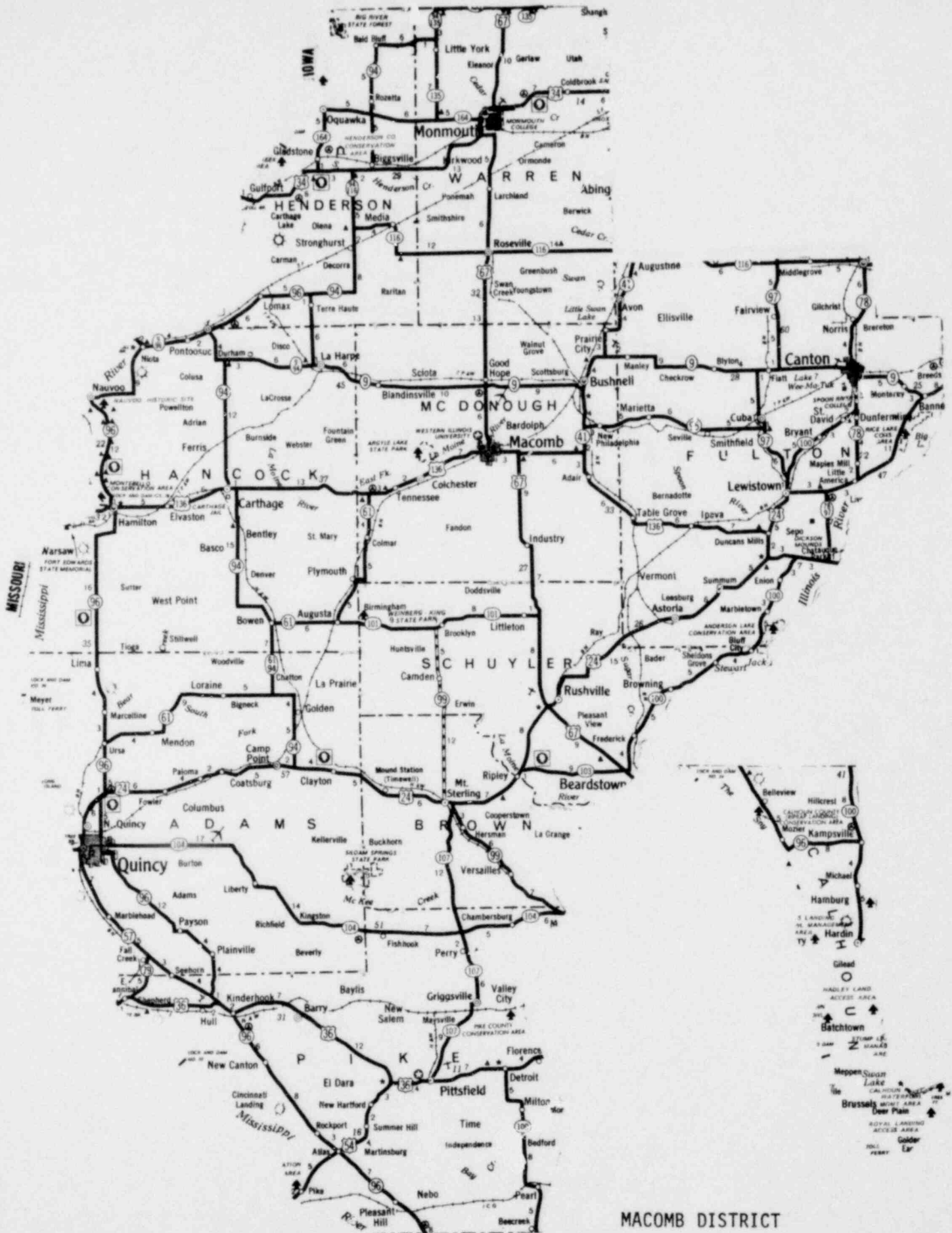
PECATONICA DISTRICT



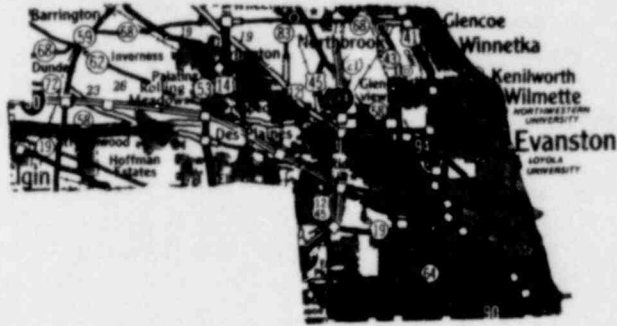
STERLING DISTRICT



PONTIAC DISTRICT



MACOMB DISTRICT



*Lake
Michigan*

AREA NOT COVERED

The only area not covered by troopers in this surveillance study, after June 7, 1979, is the northern part of Cook County where the world's busiest airport, O'Hare, is located. The O'Hare airport located near Des Plaines will have a concentrated, one week, surveillance study conducted during the month of October utilizing one trooper from each of the following district offices: Rock Island; Blue Island; Oak Brook; and Joliet. This will determine the magnitude of radiopharmaceutical and other radioactive material shipments entering and departing from the O'Hare area. If this study indicates a significant number of vehicles are transporting radioactive material in the area, a trooper will be assigned to patrol the area during the remainder of the new contract period.

4. All RO-3 survey instruments will be calibrated every three months since they are being used to enforce DOT regulations. The calibration will be performed by the Illinois

Department of Public Health and all instrument ranges will be within $\pm 10\%$ of the actual value. The RM-19's will be checked daily by the troopers to determine if their instrument is properly working through the use of 2 Coleman gas mantles placed 4 inches from the SPA-3 scintillation probe, which will trigger the RM-19 alarm.

5. The establishment of a new State trooper's report form* by October, 1979, should improve the cooperation of the troopers since it will be less confusing and complicated whenever completing the form. Also more information will be on the report form such as package type indicated on shipping documents, Notice of Apparent Violation (NAV) citation issued, package information (i.e. gross weight with instructions provided in case of an accident, package marked "Radioactive-LSA", number of packages inspected, individual package information, etc.). Along with the new form, a detailed explanation on completion of the form will be issued to each trooper involved in the study.

6. The number of complete sets of surveillance radiation detection instruments (i.e. RM-19 with scintillation probe and RO-3) should be increased by at least five more instruments since the Department of Law Enforcement has committed their manpower to this study. This would allow at least two troopers in each Northern district to have surveillance instruments making the surveillance study more comprehensive. This recommendation is justifiable, at least

* See Appendix C

in the northern portion of the state since Joliet District with two troopers accounted for 53% of all surveillance stops made during this second contract period. Also, when there are two troopers operating on different work hours, this will allow surveillance stops to be made of those radioactive shipments traversing this state during the early morning and late evening hours.

In summary, the surveillance study appears to be beneficial in verifying that most vehicles surveyed have radiation levels below the DOT limits. However, other DOT regulations are not always being followed by certain carriers, especially regarding placarding and required shipping papers.

Information received as a result of this year's study continues to provide baseline data regarding the surface movement of radioactive material within the State. It is suggested that this study be continued by implementing the recommendations outlined above, which should result in a significant increase in the amount of documented information available for future analysis and evaluation

APPENDIX A
PROPER SHIPPING PAPERS

U.S. DEPARTMENT OF TRANSPORTATION
OFFICE OF REGULATORY AND SAFETY ADMINISTRATION
SAFETY REGULATIONS FOR THE TRANSPORTATION OF RADIOACTIVE MATERIALS

TO: General Electric
SA: General Electric
ATTN: Radioactive Material
Origin: General Electric

Radioactive Mat'l Description: _____
Principal Radionuclide: Co-60
Physical Form: Solid Liquid Gas

Normal Special Placable

Radioactive Mat'l	Quantity	Weight	Volume	Activity
<u>NA</u>	<u>NA</u>	<u>NA</u>		

Shipping - Plastic Pails (See Remarks) - Plastic Pails and Shielding Gamma Seal Equip.
Gross Weight of Shipment: 200 Gross Volume of Shipment: 22.65 cu ft
Type Package: Except Type A Type B Large Quantity U.S.G. Spec. 2 or 3 or 4 Special Permit 2, Co-60 Industrial Use

Direct Radiation Survey

Package: 44 area/hr @ Contact
Package: 2 area/hr @ 3 ft. (Transport Index)
Vehicle: 13 area/hr @ Contact (Auto Use Only)
Vehicle: 2 area/hr @ 3 ft. (Auto Use Only)
Tot: 62 area/hr maximum (Auto Use Only)

Containerization Requirements

Package: Area 0.1 to 0.2 mSv/hr and less than 0.1 to 0.2 mSv/hr
Package: Area 0.2 to 0.5 mSv/hr and less than 0.5 mSv/hr
Vehicle (General Carrier): No significant accessible surface
Vehicle (Auto Use): Area 0.1 to 0.2 mSv/hr @ Contact
Tot: 0.2 mSv/hr @ 3 ft.

Signature of Shipper: Ray Johnson
Comments: Open crates are a radioactive material controlled area.

Certification

This is to certify that the above named articles 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.

This is to certify that the contents of this consignment are properly described by name and are packed, marked and labeled and are in proper condition for carriage by air according to all applicable carrier and governmental regulations. This consignment is within the limitations prescribed for:

Passenger Aircraft Only
 Cargo Aircraft Only

Approved By: Paul W. Sipes JR. Date: 26 Mar 79

PROPER SHIPPER'S CERTIFICATION

DRUM #3 HAS 36 CANS OF SECTION K-1 THROUGH K-8,
 DRUM #4 HAS 38 CANS OF SECTION K-1 THROUGH L-9
 10,032 GETTERS.
 DRUM #5, HAS 42 CANS OF SECTION L-1 THROUGH M-8,
 11,088 GETTERS.
 DRUM # 6, HAS 42 CANS OF SECTION M-1 THROUGH M-8,
 11,088 GETTERS
 264 GETTER INSERTS IN EACH CAN TOTAL 61,776

0A25682

THIS SHIPPING ORDER

is subject to the conditions and terms of the contract of sale of goods to which it is attached. It is not to be used as a receipt for the goods unless it is so used by the carrier.

Carrier's No. **Carrier** Shipper's No. **0A25682**

G. E. MIL TUBE **1-2-79** **19** **(CALCITE 880, FLEETING, G. 9450)**

From **GENERAL ELECTRIC COMPANY** To **GENERAL ELECTRIC COMPANY**

Consigned to **GENERAL ELECTRIC COMPANY**

Address **GENERAL ELECTRIC COMPANY, 1230 N. MICHIGAN ST., CHICAGO, ILL. 60606**

City **CHICAGO, ILL.**

State **ILL.**

Country **U.S.A.**

Special Instructions **PLEASE USE OF VESSEL'S PROPER CONNECTIONS OF THE REGULATIONS OF THE INTERNATIONAL MARITIME ORGANIZATION**

Remarks **264 GETTER INSERTS**

Weight **264**

Volume **264**

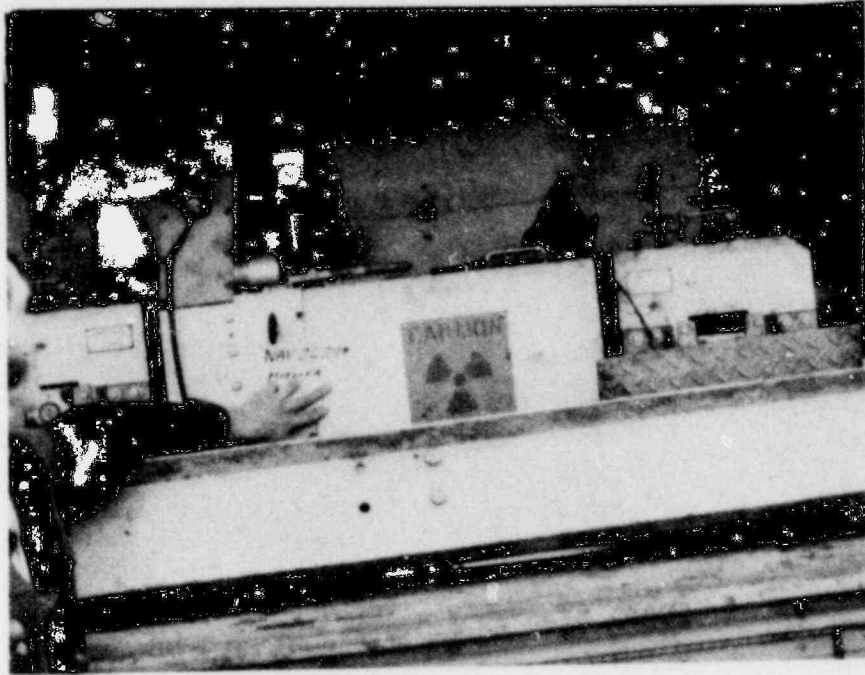
Number of Packages **264**

Number of Pieces **264**

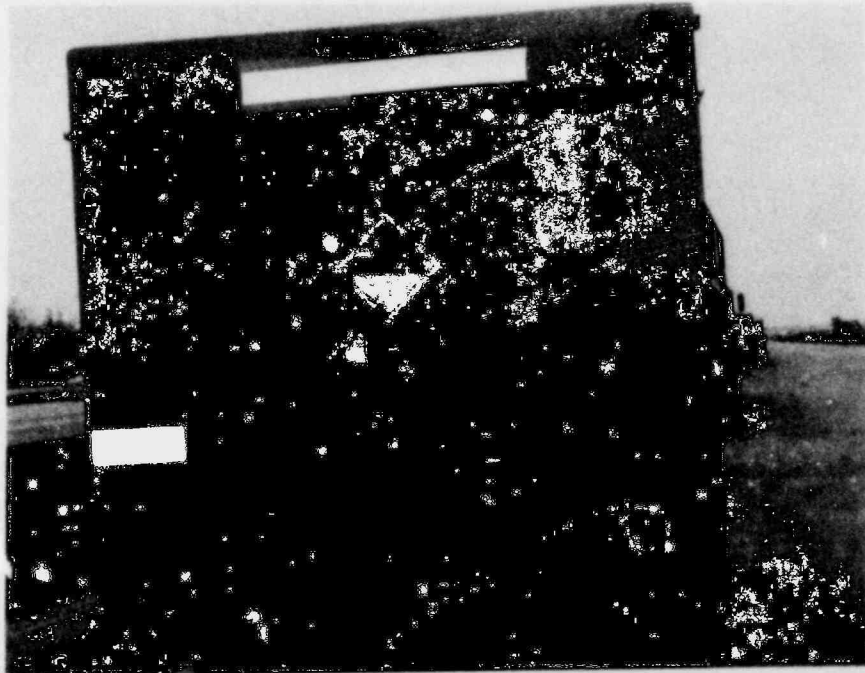
Number of Units **264**

9

APPENDIX B



ISOTOPE GAUGE WHERE ISOTOPE AND SOURCE
ACTIVITY WERE NOT INDICATED



NO SHIPPING PAPERS

DIVISION OF STATE POLICE
HAZARDOUS MATERIALS
SECTION

RADIOACTIVE MATERIALS
VEHICLE INSPECTION
DATA SHEET

Office Use Only:

District _____

Year & Sequential Number: _____

APPENDIX C

I. VEHICLE INFORMATION STATE POLICE REPORT FORM

Location _____ County Code No. _____

Date _____ Time _____ License No. _____ Year _____ State _____

Vehicle Type ____ (1. Passenger Car 2. Pick-up 3. Van 4. Straight Truck 5. Semi 6. Double Bottom 7. Other _____)

Carrier Type _____ (1. Common 2. Contract 3. Private) Properly Placarded ____ Yes ____ No

Carrier Name _____

Carrier Address _____

Drivers Name _____ Drivers Lic. No. & State _____

II. SHIPPING DOCUMENTS

Shipping Papers ____ Yes ____ No Shipping Name _____

Hazard Class _____ Isotope _____

Total Quantity _____ [1. Curies (Ci) 2. Millicuries (m Ci) 3. Microcuries (u Ci) 4. Pounds 5. Kilograms]

Package Type _____ (1. A 2. B 3. Other _____)

Special Form ____ Yes ____ No Normal Form _____ (1. Gas 2. Liquid 3. Solid or Powder)

Transport Index (Total for Vehicle) _____ MR/HR.

Labels _____ (1. No Label Required 2. White I 3. Yellow II 4. Yellow III 5. Other _____)

Fissile Class _____ (1. Fissile I 2. Fissile II 3. Fissile III 4. Fissile Exempt)

Exclusive Use ____ Yes ____ No Exclusive Use Instructions With Vehicle ____ Yes ____ No

Shipper Name _____

Shipper Address _____

Consignee Name _____

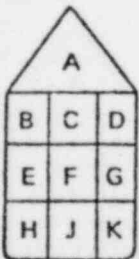
Consignee Address _____

III. VEHICLE SURVEY

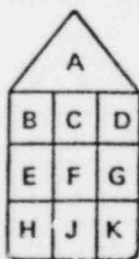
Radiation Levels _____ MR/HR Cab Seat (Private Carrier Exempt) _____ MR/HR Outside Surface (Highest Reading)

_____ MR/HR Six Feet From Outside Surface (Exclusive Use Only)

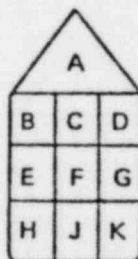
Package Placement (1. Passenger Car 2. Pick-up 3. Van 4. Straight Truck 5. Semi 6. Double Bottom 7. Other _____)



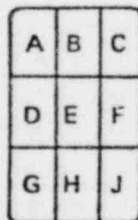
1.



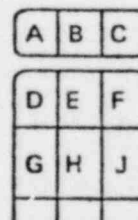
2.



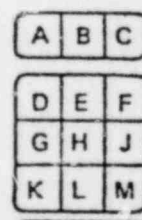
3.



4.



5.



6.

Office Use Only

District _____ Year & Sequential Number _____

IV. OTHER HAZARDOUS MATERIALS ON VEHICLE Yes No

Shipping Name _____

Hazard Class _____ Quantity _____

V. SURVEY RESULTS No Irregularities Detected

Enforcement Action Yes No NAV Issued Yes _____ Number No

5800.1 Yes No Illinois Department of Public Health Notified Yes No

VI. PACKAGE INFORMATION -- OPTIONAL DATA

To be obtained when obvious discrepancies are present ie., radiation readings in excess of regulatory limits, indication of radioactive material on board and shipping papers are missing or show no radioactive material and where shipping papers do not provide required information and such information is essential to proper enforcement action.

Pack No.	Pack Type	Pack Spec. No.	Pack Seal	Label	Isotope	Quantity	Transport Group	Surface Reading	T. I. Label	T. I. inst. Reading	Gross Weight
1.											
2.											
3.											
4.											
5.											
6.											
7.											
8.											
9.											
10.											
11.											
12.											

Total Packages in Shipment _____ Number of Packages Inspected _____

Removable Contamination Yes No

Package Labeled for Additional Hazard Yes No

L.S.A. Packages Marked or Stenciled (Radioactive - LSA) Yes No

Name _____ Rank _____ ID _____ District _____

NRC FORM 335 (7-77)		U.S. NUCLEAR REGULATORY COMMISSION BIBLIOGRAPHIC DATA SHEET		1. REPORT NUMBER (Assigned by DDC) NUREG/CR-1193	
4. TITLE AND SUBTITLE (Add Volume No., if appropriate) TRANSPORTATION OF RADIOACTIVE MATERIAL IN ILLINOIS				2. (Leave blank)	
7. AUTHOR(S)				3. RECIPIENT'S ACCESSION NO.	
9. PERFORMING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code) Division of Radiological Health Department of Public Health State of Illinois Springfield, Ill. 62761				5. DATE REPORT COMPLETED MONTH YEAR March 1980	
12. SPONSORING ORGANIZATION NAME AND MAILING ADDRESS (Include Zip Code) Office of State Programs U. S. Nuclear Regulatory Commission Washington, D. C. 20555 (Sponsored jointly with Department of Transportation)				6. (Leave blank)	
13. TYPE OF REPORT Report of data collected during surveillance of radioactive material in transport in Illinois				PERIOD COVERED (Inclusive dates) June 6, 1978 to June 6, 1979	
15. SUPPLEMENTARY NOTES				10. PROJECT/TASK/WORK UNIT NO.	
16. ABSTRACT (200 words or less) This report describes the second-year study conducted by the State of Illinois on the transportation of radioactive material into, within and through the State from June 6, 1978 to June 6, 1979. During this period, sixteen State Police troopers monitored from time to time the main highways in vehicles equipped with radiation detection instrumentation. The data collected during the monitoring process are contained in this report. The data relate to personnel radiation exposures, condition of packages, handling practices, and general adherence to regulations governing the safe transport of radioactive materials. The results of the first year's study, covering the period, June 6, 1977 to June 6, 1978, are contained in NUREG/CR-0756.				11. CONTRACT NO. NRC-06-78-358	
17. KEY WORDS AND DOCUMENT ANALYSIS				14. (Leave blank)	
17a. DESCRIPTORS				17b. IDENTIFIERS/OPEN-ENDED TERMS	
18. AVAILABILITY STATEMENT Unlimited Availability				19. SECURITY CLASS (This report) Unclassified	
20. SECURITY CLASS (This page) Unclassified				21. NO. OF PAGES 46	
22. PRICE S					

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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