AUG 31 1970

J. M. Allan, Senior Radiation Specialist
Region III, Division of Compliance

INFORMATION OBTAINED IN CHARLESTON, WEST VIRGINIA, RELATING TO SHIPMENT OF CESIUM 137 SEALED SOURCES FROM MINNESOTA MINING AND MANUFACTURING COMPANY (3M) TO UNION CARBIDE CORPORATION

At 1:30 p.m. on August 13, 1970, H. W. Young, arrived in Charleston, West Virginia, for the purpose of obtaining additional information in the subject case. During the afternoon of August 13, 1970, and on August 14, 1970, Young, accompanied by B. D. DeBord, Assistant Radiation Health Specialist, West Virginia State Department of Health, visited the terminal office for Cook Motor Lines, Inc., Charleston, West Virginia, and the Technical Center, Union Carbide Corporation, South Charleston, West Virginia. The information in this report relates only to the activities in this case beginning with the departure from Cleveland, Ohio, at 2:30 a.m. on August 7, 1970, of the trailer carrying the sealed sources.

The following persons were interviewed during the visit:

Cook Motor Lines, Inc.

H. L. Cook, President, Cook Motor Lines, Inc.
C. L. Cook (brother of H. L. Cook), Terminal Manager, Charleston, West Virginia
Dempsey F. Scott, Truck Driver
Harry A. Atkins, Truck Driver
Wayne A. Williams, Truck Driver

Technical Center, Union Carbide Corporation

R. V. Sealey, Senior Engineer (Nuclear) and Section Leader, Analytical Instrument Development Section, Engineering Department (Masters degree in physics and six years experience in the nuclear field)

B. W. DuVall, Research Physics, Analytical Instrument Development Section, Engineering Department (Ph.D. degree in physics and two years experience in the nuclear field)

R. D. Midkiff, Electronic Technician, Analytical Instrument Development Section, Engineering Department (two years experience in the nuclear field)

W. S. Kennedy, Electronic Technician, Analytical Instrument Development Section, Engineering Department (four years experience in the nuclear field)

Fred Williams, Radiation Safety Officer, Research and Development Department (twenty years experience in the nuclear field)

B. C. Petersen, Photographer and Circuit Board Designer Engineering Department (no experience in the nuclear field)

J. R. Patton, Receiving Clerk, Shipping and Receiving Department (no experience in the nuclear field)

W. E. Combs, Receiving Clerk, Shipping and Receiving Department (no experience in the nuclear field)

During the visit it was determined by interview that the following persons were directly involved in this case to the extent that they received some radiation exposure as a result of the shipment of sealed sources.

Cook Motor Lines, Inc.

Dempsey F. Scott, [redacted] exempt

Harry A. Atkins, [redacted] exempt

Wayne A. Williams [redacted] exempt

Warren G. Reed [redacted] exempt

Reed is also designated as a truck driver. He was on an overland trucking run at the time of the visit and not available for interview.

Technical Center, Union Carbide Corporation

J. R. Patton, [redacted] exempt

W. E. Combs, [redacted] exempt

(b)(6)

Fred Williams, [redacted]

C. R. Lanfried, [redacted] Lanfried is an Engineer and Supervisor of the Nucleonics Laboratory, Analytical Instrument Development Section, Engineering Department. He was on vacation at the time of this visit. (He has had 12 years experience in the nuclear field.)

R. O. Midkiff, [redacted] Midkiff is a Technician in the Research and Development Department. He was not interviewed during this visit due to other commitments.

R. V. Sealey [redacted]

B. W. DuVall [redacted]

W. S. Kennedy, [redacted]

None of the employees of Cook Motor Lines, Inc. wore personnel monitoring devices during the transfer of the sealed sources. The following personnel monitoring coverage was provided at Union Carbide: (PD - pocket dosimeter; FB - film badge)

J. R. Patton - None
W. E. Combs - None
Fred Williams - wore a PD on August 7, 1970 (after 3:30 p.m.) [redacted]
C. R. Lanfried - wore a PD and a FB on August 7, 1970 [redacted]
R. O. Midkiff - wore a PD on August 7, 1970 [redacted]
R. V. Sealey - wore a PD and FB on August 7, 1970 [redacted]
B. W. DuVall wore a PD and a FB on August 7, 1970 [redacted]
W. S. Kennedy wore a FB on August 7, 1970 [redacted]

(b)(6)

PD's used by Union Carbide personnel are the Bendix type with a range from 0 - 200 mr. PB services are provided to Union Carbide by Nuclear Chicago on a monthly rotational basis. PB's for the current quarter were distributed on July 15, 1970. Exposure records are kept on Forms AEC-4 and -5. The highest film badge result was 33 mrem. The film badge results are believed to be representative of actual exposures to personnel.

As determined by interview with persons associated with this case, the following sequence of events took place. On the evening of August 6, 1970, Scott drove a loaded tractor trailer rig from Cook's trucking terminal, 1708 Pennsylvania Avenue, Charleston, West Virginia, to Cook's trucking terminal, Cleveland, Ohio. Upon arrival at Cleveland Scott parked the trailer being delivered and using the same cab picked up a loaded trailer which contained the sealed sources. Scott then departed from the terminal in Cleveland at 2:30 a.m. on August 7, 1970. After making one 20-minute rest stop, Scott arrived at the terminal in Charleston at 8:30 a.m. Shortly after 8:30 a.m., Scott departed from the terminal and went to his residence. Scott maintains a log book which shows dates and times of all overland trips. This log book was referenced in order to substantiate times. The above one-way traveling period of five hours and 40 minutes was verified by C. L. Cook as being reasonable.

From 8:30 a.m. to 11:30 a.m. on August 7, 1970, the trailer containing the sealed sources was parked in the terminal yard, adjacent to other trailers. This was approximately 30 yards from the material handling dock and office areas. At 11:30 a.m. Atkins, Williams and Reed reported for work and were assigned to off-load the trailer containing the sealed sources. The trailer was backed up to the material handling dock. Reed drove a fork truck and with the assistance of Atkins and Williams proceeded to unload the trailer. The fork truck was used as much as possible in the unloading. The cargo consisted of a variety of items with the gauging devices containing the sealed sources positioned side by side on the floor, crosswise in the trailer and located in the forward third of the trailer. A measurement from the driver's position in the cab to the forward gauging device in the trailer showed the distance to be between 15 and 20 feet. The driver's seat was measured as being 20 inches above the level of the floor to the trailer. The trailer which was enclosed measured eight feet in width by 40 feet in length. As previously stated, the work crew reported for work at 11:30 a.m. The next time check was 1:50 p.m. (time of departure of gauging devices from terminal to Union Carbide). This period covers two hours and 20 minutes. During this period the work crew prepared the trailer for unloading at the material handling dock, entered and exited from the rear of the trailer many times, sorted shipments, put shipments aboard other trailers and at times stood around the dock. None of the members of the work crew which were interviewed could remember standing or sitting on the gauging devices which were actually in separate wooden

crates. Fifteen to twenty minutes was estimated as the maximum time anyone could have been within ten feet of the gauging devices. Each of the 12 source holders measured 6 inches in diameter by 68 inches in length and was crated in a wooden crate measuring on the outside 13-1/2 inches in width by 12-3/4 inches in height by 86-3/4 inches in length. Only eight of the source holders contained sealed sources (strip sources). Each sealed source (strip source) contained eight curies of cesium 137 as measured in January 1968.

Each crate had four-inch by four-inch blocks on the bottom to assist in handling by fork truck. Each gauging device weighed 870 pounds. The gauging devices were unloaded separately and immediately reloaded on another trailer similar to the one being unloaded. Both trailers were backed up to the material handling dock. The unloading and reloading by the fork truck driver required the assistance of Atkins and Williams since the gauging devices had to be positioned at an angle on the forks of the fork truck to assure clearance through to rear doorways of the trailers. The clearance through the rear doors was 92 inches as opposed to an overall length of 86-3/4 inches for the crates containing the gauging devices. As the gauging devices were being loaded on the new trailer they were positioned near the rear of the trailer since there was no other cargo involved and since it was being loaded for local delivery to Union Carbide.

At 1:50 p.m. Williams was logged out by the dispatcher to make what was considered to be a 20-minute trip to Union Carbide. A measurement from the driver's position in the cab to the forward gauging device showed the distance to be 35 feet. Due to a delay in route, Williams actually arrived at the receiving and shipping dock at Union Carbide at 2:30 p.m.

Upon arrival, Williams opened the rear doors to the trailer. Patton and Combs met Williams upon arrival, identified the shipment as gauging devices, notified the shipping and receiving office that radioactive material was involved and proceeded to unload the trailer. Patton drove a fork truck and, with the assistance of Combs to angle the crates on the forks to assure clearance, removed the gauging devices one by one. As they were removed they were stacked two high and positioned side by side and off to one side on the shipping and receiving dock. Patton and Combs estimated that 15 minutes was the maximum time required to unload the trailer. After unloading Williams closed the rear doors to the trailer and returned the trailer to the local terminal. Until Division of Compliance (Region III) personnel contacted Cook Motor Lines, Inc., their personnel had no knowledge of any radiation considerations in this case. Employees of Cook Motor Lines, Inc. did not wear any personnel monitoring devices and no radiation surveys were made in or around the Cook trailers involved in this case.

Upon arrival of the gauging devices at Union Carbide, Fred Williams, RSO, was notified by telephone. This is a matter of routine procedure when radioactive material is received. At 3:00 p.m., five minutes after the trailer had departed, Fred Williams arrived at the shipping and receiving dock. Fred Williams was accompanied by Lanfried and R. O. Midkiff. Using a Tracerlab, Model SU-14, GMSM, with a range from 0-25 mr/hr over three scales, a survey was made of the gauging devices. (The SU-14 instrument was last calibrated by Fred Williams in June 1970 using a cobalt 60 source of one curie. Source authorized by Union Carbide License No. 47-260-2.) This was the highest range instrument at the Technical Center, Union Carbide. At the time of this survey it was noted that an abnormally high radiation level was present. At 20 feet from the temporary arrangement, the radiation level was 25 mr/hr. Fred Williams noted that something was wrong and decided the crates had to be opened before the exact problem could be determined. After a quick calculation using the inverse square law, Fred Williams decided that the gauging devices could be carried two at a time by fork trucks to a fenced area designated the Radiation Storage Area. Patton and Combs, using separate fork trucks, proceeded to transport the gauging devices the 200-300 yard distance to the Radiation Storage Area. The movement involved three trips each for Patton and Combs of five minutes carrying time for each trip (one way). By 4:00 p.m. the gauging devices were inside the Radiation Storage Area, which is also designated as a restricted area. At 4:00 p.m. Sealey and DuVall who had been notified of the situation arrived at the Radiation Storage Area and with the assistance of Lanfried proceeded to maneuver as best they could within a 25 mr/hr radiation field and remove the tops to the crates containing the gauging devices. From past experience with similar type devices Sealey recognized that the handles and padlocks to secure the shutter mechanisms were not installed and that in one case, the shutter was in the closed position, in two cases they were almost completely in the open position and in five cases they were at different degrees of an open position. By means of pliers the ends of the shafts controlling the shutters were easily rotated to return the shutters to the closed positions. During the process of removing the tops to the crates, Sealey found the handles and padlocks packaged and stored in one of the crates containing a gauging device which did not contain a strip source. Sealey installed the handles on the shafts and locked each by means of a padlock. Sealey demonstrated during the visit that when a hasp on a handle mates with a hasp on a gauging device the shutter is closed, when a handle is rotated 180° the shutter is open and can be held open by means of a thumb screw and that the handle on the shaft is attached by means of a pin which is inserted through a hole in the handle and through a groove on the respective shaft. After closing the shutters, installing and locking the handles so the shutters could not be opened, the Radiation Storage

Area was locked and Sealey returned to his office to report by telephone the circumstances in this case to Region II. Sealey contacted J. T. Sutherland by telephone at 5:30 p.m. on August 7, 1970 (same date).

The Radiation Storage Area measures 30 feet by 30 feet and is enclosed by a chain link fence extending six feet in height and capped by three strands of barbed wire. Inside the fence enclosure is a small storage shed which is being used for the storage of other licensed materials possessed by Union Carbide. The entire enclosure has been designated a restricted area with control of access maintained by locking the gate. The fence enclosure was posted "Caution Radioactive Materials" with the conventional radiation symbol. Each gauging device was labeled "Caution Radioactive Material" with the conventional radiation symbol. The labeling also stated "Cesium 137, 8 Ci" and gave a date of measurement of each quantity. A copy of Form AEC-3 was posted as required. A picture was taken of the Radiation Storage Area which was forwarded to Region III on August 17, 1970.

Young, with the help of Sealey and Kennedy, made several radiation surveys appropriate to this case. Instruments used in the surveys were the following:

AEC Instruments

1 Victoreen, Model 740 (Cutie Pie), 0-10 r/hr, 3 scales, calibrated on April 8, 1970

1 Eberline, Model E-500 B (GMSM), 0-2 r/hr, 5 scales

Union Carbide Instrument

1 Tracerlab, Model SU-14 (GMSM), 0-25 mr/hr, 3 scales, calibrated in June 1970

West Virginia State Department of Health

1 Eberline, Model E-500 B (GMSM), 0-2 r/hr, 5 scales

The first survey was made around the outside of the Radiation Storage Area (restricted area). The radiation level was less than 0.6 mr/hr. A second set of surveys was made at the surface of the gauging devices with the shutter mechanisms locked in the closed position. The highest radiation level noted was 100 mr/hr, the second highest was 50 mr/hr and the highest for the other six was 30 mr/hr. At one foot these respectively attenuated to 20 mr/hr, 12 mr/hr and 6 mr/hr. Sealey believed the first two sets of higher readings were the results of voids in the shielding and that they would probably be returned to the manufacturer in the near future. A third set of surveys was made

at the ends of the gauging devices where the handles operating the shutters are located. With the shutters both in the open and closed positions, the radiation levels at the handles varied from 10-25 mr/hr. These radiation levels which were low by comparison were attributed to the fact that at each end of the gauging devices there is approximately four inches of lead shielding. A fourth set of surveys was made of two of the gauging devices (at separate times) with the shutters in completely open positions, at right angles from the mid-points and in maximum exposure positions. This set of surveys was made at points outside the crates holding the gauging devices. The distances from the devices to their respective crates were three inches. Each crate measured 3/4-inch in thickness. The results of this set of surveys were as follows:

Victoreen, Model 740 (AEC) Gauging Devices	Crate Surface	3 Feet	6 Feet	7 Feet	25 Feet
Serial No. 1469	off scale	1.2 r/hr	420 mr/hr	320 mr/hr	-
Serial No. 1471	off scale	1.4 r/hr	520 mr/hr	420 mr/hr	33 mr/hr
Tracerlab, Model SU-14 (Union Carbide)					
Serial No. 1471					21 mr/hr
Eberline, Model E-500 B (West Virginia)					
Serial No. 1471					35 mr/hr

A fifth set of surveys was made to determine how far the handles had to be turned clockwise and counterclockwise from closed positions before a significant radiation level appeared. The results of this survey showed that the radiation level increased sharply when the handles were turned 45° either way, clockwise or counterclockwise.

An examination of the gauging devices in the crates showed that they were positioned in several different orientations. This is shown in pictures forwarded to Region III on August 17, 1970. With the shutters in fully closed positions the handles were pointing to the following o'clock positions:

Gauge Serial No.	O'Clock
1465	9:00
1466	6:00
1467	9:00
1468	9:00
1469	2:00
1470	6:00
1471	10:00
1472	9:30

The above shows, for example, that if the shutters of the gauging devices with Serial Nos. 1465, 1467, 1468 were completely open (this was not the case) the handles would be pointing to 3:00 o'clock. It should also be noted that if all the shutters had been fully open, it would mean one thing; if all the handles faced the left side of the trailers, it would mean another thing; if all the handles faced the right side, it would mean another thing; if they were mixed in their facings, it would mean another thing; and considering the fact that there were four gauging devices present which did not contain sealed sources and probably provided some shielding, this would mean still another thing.

The padlocks were removed and a test was made to determine the force required to turn the shutter mechanisms using the handles. Each could be rotated with about equal force to the open position by turning clockwise or counterclockwise. One hand could turn, with two exceptions, each handle but with difficulty. In the two exceptions a thumb from the second hand had to provide added strength to turn the handles.

In the source holders the shafts holding the strip sources were by design off-set in order to facilitate rotation from a closed position to an open position. A test of the rotation of this shaft was made by Young. The handles were each released while in motion to determine if there was an affinity to any particular position relative to open or closed. This test did not show that there was any tendency to seek a particular position. This test was prompted in part by C. L. Cook's statement that there was a great deal of vibration inside the trailers during transit.

Union Carbide has in the past processed through the Technical Center a variety of gauging devices containing sealed sources. Some of them have been similar but not exactly like the ones involved in this case. The Technical Center possesses a license entitled "Union Carbide Corporation, South Charleston, West Virginia" (License No. 47-260-2). Further transfers of gauging devices containing sealed sources have been to licenses held by

Union Carbide at other addresses. The sealed sources in this particular case are presently possessed under Amendment No. 23 to the -2 license which authorizes 130 curies of cesium 137 for storage only. The original order for these gauging devices was placed on April 4, 1967. It was intended that all 12 of the SMRH gauges would be used at a Union Carbide plant in Taft, Louisiana. Plans were changed before loading the sealed sources at St. Paul, Minnesota, and it was decided that only eight would be loaded and that these and the four empty source holders would be sent to the Technical Center, South Charleston, West Virginia, and that the loaded ones would be held for future installation in a new Union Carbide plant in Ponce, Puerto Rico. A license authorizing the gauging devices containing sealed sources at Ponce, Puerto Rico, has not been applied for as yet but it is expected that an application for a license will be submitted to DML in the near future.

Union Carbide ordered the gauging devices from the Ohmart Corporation and had Ohmart ship them to 3M in St. Paul for loading with sealed sources. Sealey stated that 3M normally loaded gauging devices for Ohmart and that Union Carbide found it a cost saving to have separate contracts with Ohmart and 3M. Therefore, the shipment in this case was from 3M to Union Carbide.

Sealey stated that Fred Williams telephoned Mr. R. Wissink, Senior Industrial Hygienist, 3M, following receipt of the gauging devices. Wissink was not able at the time of the call to provide any explanation except that "Somebody goofed." Sealey stated that he was of the opinion that 3M personnel did not realize there were handles and locks associated with the shutter mechanisms and had failed to secure the shutters in the closed positions prior to shipment. Sealey believed that the shutter mechanisms through vibrations in transit came open to the extent found at the time of receipt at Union Carbide.

Original Signed By
J. T. Sutherland

J. T. Sutherland
Radiation Specialist

CO:II:HWY

OFFICE ▶	CO:II	CO:II				
SURNAME ▶	HWYoung:djw	JTSutherland				
DATE ▶	8/31/70	8/31/70				