Docket No. 030-34866
License No. 11-27610-01

To: Michael Vasquez, Region IV inspector

From: Michael Albanese, Qal-Tek Associates RSO
License # 11-27610-01, Docket # 030-34966

Subject: Maximally exposed member of the public from April 11, 2017 radioactive material shipment

Date: July 3rd, 2017

On June 7th, 2017 M. Albanese made contact with the Idaho Falls common carrier package distribution station manager that was the final handling station for this shipment. The manager and M. Albanese cooperatively agreed on the assumed handling times below and discussed the following detail related to how the radioactive package could have been handled at his distribution station.

A second conversation between the NRC inspector, Michael Vasquez, the Idaho Qal-Tek RSO and the Idaho Falls common carrier package distribution station manager on June 30th, 2017 revealed a misunderstanding in how the drum in question would be handled during deplaning. As a result, the original dose estimate was corrected with new information added to the assumptions section below and a different maximally exposed individual was identified.

> Plane configuration: Wing over plane, main door by cockpit, 6 zones (zone 1 by cockpit, zone 5-6 tail for Dangerous Goods), fixed floor conveyor down middle of plane.
>
> Common carrier reported a scan time from plane to truck of 2 minutes - from the time the 1st person scans in plane to when driver scanned it

The distribution station manager, communicated that the assumed handling times are probably the worst case along this packages transit route in the common carrier airport system as Idaho Falls has more manual conveyor systems that require individuals to physically push packages.

<u>Handling time Assumptions:</u>

The sequence of common carrier handling steps typically performed at Idaho Falls during airplane off-loading of packages to vans at distribution station:

1st person on plane

position package with hands for scanning and moved aside for person 2 on the plane to pick up – 5 seconds

2nd person on plane

carried package 20 feet from back to front of plane and place on belt or place on floor for the 3rd person to lift on the belt. - 25 seconds.

3rd person on plane

If 2nd person didn't place on belt then 3rd person performed a whole-body lift of package from plane floor to belt loader – 3 seconds

4th person on ground

escorts packages down belt loader descending from chest to waist height – potentially place hand on drum for < 20 seconds, belt travel time, not likely for this size drum relative to belt size

5th person on ground

pushes packages onto roller belt – 2 sec.

6th person in distribution station

scans and places tag on package at waist height, handling not required - 3 sec. process

7th person in distribution station

pushes packages to another belt A or B (it's called a transfer splitter belt that runs down the middle of transfer station to get it to trucks on each side of the station) – 2 seconds

8th person in distribution station

verifies split, hand pushes packages down rollers on top or side of package (may push multiple packages at once) - 2 seconds

9th – 11th persons in distribution station

van drivers waiting for packages on belt (since this package went to the 4th van station in line three drivers could have touch it) - 1 second

12th person in distribution station (she did not carry from back of truck to front for client removal from truck)

station 4 van driver, where this drum was picked up and place in the left rear of the van – 3 seconds

dragged the drum from the top from left rear of van to passenger door to stage for Qal-Tek receiver to remove from truck - 4 seconds

Assumptions:

- Worst Case: All 3 sources came out of pig during loading on truck destined for Newark, NJ airport and they remained as found upon receipt at Qal-Tek in Idaho Falls, ID.
- The Idaho Falls common carrier distribution station has more handling time of package due to more manual conveyors than other airport this package has visited (Newark, NJ – Memphis, TN – Salt Lake City, UT)
- Common carrier employees are members of the public
- Person 1 on the plane didn't place the drum on the plane floor rollers due to roller incompatibility nor on another package due to the drum weight, to deplane the drum.
- Person 2 on the plane lifted the drum to carry it the full length of the plane (20 ft.) and placed on the belt conveyor to remove the package from the plane.
- Drum was placed on the floor of the plane behind netting in the dangerous goods zone.
- The drum height coming off the plane to the sorting station building started at shoulder height and descended to waist height throughout the station until removed from the conveyor systems by the truck drivers.
- Detector volume = 349 cubic centimeter
- IAEA Specific Safety Guide # SSG-26 (see attached) dose rate correction factor only applies to on-contact and 1 foot drum measurement (see attached), The 1m measurements were considered to be accurate because the 3 sources would look like a point source at that distance (>11 detector diameters away from sources) with a uniform radiation field. This assumption is made because the 3 most significant sources contributing to the dose rate are positioned at different heights and distances from the drum wall such that the meter could see the radiation from each source along its vertical axis but was not a uniform field considering the small 19.4mCi Cs-137 source on the drum wall would not be considered a point source at such a close distance to the 349cc detector. By using a modified representation of IAEA Specific Safety Guide #SSG-26, the source area of the 3 unshielded sources were considered as the package size so a more realistic "half linear dimension of the package" could be applied to determine a more realistic correction factor. As a result, the distance of the 23mCi Cs-137 source to the drum wall, 12cm, was divided in half for the "half linear dimension of the package". With an "effective half linear package dimension" of 6cm and a "detector to package surface distance" of 7.5cm the interpolated correction factor was determined to be 1.95 from Table 1 for on-contact and 1 ft. measurements.

  Maximum On-Contact Dose Rate Measurement corrected to interpolation of IAEA Table 1 (see attachments)

Highest on-contact measurement was 1.45 R/hr

IAEA interpolated correction factor for large detector vs. 3 source "package" = 1.95

Corrected highest on-contact measurement: 2.83 R/hr

- WB distance when not on contact is 30cm or 1ft.
- Extremity when not on contact is 30 cm or 1 ft.
- Exposure times are estimates for each person's role performed smoothly with no significant delays

Maximally Exposures Common Carrier Individuals:

Person 2 : Total Estimated Dose: WB = 19.6mrem and extremity = 2.84mrem

25 sec. lift and carry from rear to front of plane and place on belt conveyor exiting plane - hand contact extremity exposure: 25 sec. x hr. /3600sec x (210x1.95)m R/hr. = 2.84mrem

25 sec. lift and carry from rear to front of plane and place on belt conveyor exiting plane – on contact WB exposure – 25 sec. x hr./3600sec. x (1.45x1.95)R/hr. = 0.0196R or 19.6mrem

Person 12: Total Estimated Dose: WB = 2.66mrem and extremity 0.42mrem

3 sec. lift and place – on contact WB exposure: 3 sec. x hr./3600 sec. x (1.45x1.95)R/hr = 0.0024rem or 2.4mR

3 sec. lift and place - on contact hand exposure: 3 sec. x hr./3600 sec. x (210X1.95)mR/hr = 0.34mrem

4 sec. drag using top of drum with hands on contact and body at 1ft for 4 sec.:

4 sec. x hr/3600 sec x (36x1.95) mR/hr = 0.078mrem to hands

4 sec. x hr/3600 sec x (118x1.95) mR/hr = 0.26mrem to body

Person 1: Total Estimated Dose: WB = 1.57mrem and extremity (foot) = 1.35mrem

5 sec. access, scan package and set aside for Person 2 to pick up – on contact hand extremity exposure : 5 sec. x hr/3600 sec. x (36x1.95) mR/hr. = 0.1mrem

5 sec. access, scan package and set aside for Person 2 to pick up – WB at 1 foot: 5 sec. x hr/3600 sec. x (118x1.95) mR/hr. = 0.32mrem

5 min. extremity exposure – foot at 1m residence time from hot spot during unloading adjacent packages: 5 min. x hr / 60 min. x 15 mR/hr. = 1.25mrem

5 min. WB at 1m residence time from hot spot during unloading adjacent packages: 5 min. x hr / 60 min. x 15 mR/hr. = 1.25mrem

Common carrier Employee training:

- Package distribution employees: General annual training (annual CBT - Dangerous good handling) on hazard identification, placement and handling (ALARA principles) what to look for, and what to do or not do for damaged or leaking packages.
- Package pickup employees: General annual training above, plus compliance training.
- Common carrier general lifting limit is 75 lbs. before using lifting/carrying devices

Sincerely,

Michael Albanese

Michael Albanese, RSO
Qal-Tek Associates