Date of Spill	Time of Spill	Area of Spill	Spill Involvement
19 May 2022	01:50	SPER Restricted area, Compounding area,	☑ Facility ☑ Equipment ☑Personnel

Radionuclide	Activity in mCi	Chem. & Physical Form
Tc99m	3 Ci	$TcO4^-$, liquid

Description:
Process: Preparation of radiopharmaceutical kits within biological safety cabinet.
Measurement of TcO4 activity obtained from Mo99 generator elution.

Description:

a) Pharmacy technician tried to deposit the elution vial containing the activity from the vial shield into the dose calibrator's chamber. The vial fell outside the chamber and onto the surface of the biological safety cabinet. At that moment, the tungsten vial shield slipped the technician's hand fell on top of the vial and shattered it, resulting in contamination of a small area limited to 50 cm2 of the operator's left arm.

b) The skin contamination was detected at approximately 02:00 while monitoring the operator. The contamination was likely from a small droplet deposited on the operator's gowning after a vial containing a solution of Tc-99m pertechnetate (TcO4) with an approximate concentration of 520 mCi per mL was broken inside the biological safety cabinet. A 20-microliter droplet of this solution was calculated to contain approximately 1 mCi of Tc-99m TcO4.

c) When the skin contamination was discovered, the area of contamination on the skin was decontaminated using a scrubbing sponge and Radiac-Wash. Two decontamination efforts removed most of the contamination, with only a small amount remaining non-removable contamination. After decontamination, the dose rate from residual skin contamination was measured at 7 mR/h = 24,000 CPM using a Ludlum model 14-C portable survey meter equipped with a Ludlum model 44-9 pancake GM probe.

d) Other contaminated inanimate areas included:

   i) Left side of the biological safety cabinet interior.

   ii) Stainless steel cart immediately in front of the biological safety cabinet, including computer monitor.

   iii) Floor 2 feet immediately in front of the biological safety cabinet.

   Initial fixed contamination readings were over 200 $mRh^{-1,}$ and no decontamination was performed. All these areas were shielded, and access was restricted to their immediacy.

   The area was released for use on Monday, May 23, 2022, after allowing for decay and background levels were achieved.

e) Only one person was contaminated in the event, and other adjacent areas were not cross-contaminated.

Root cause:

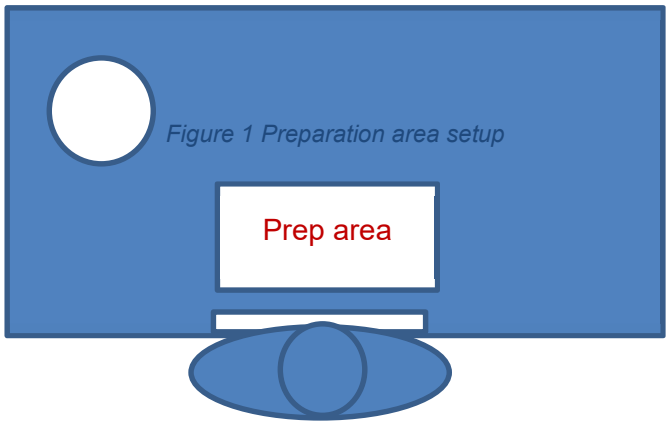

Figure 1 Preparation area setup

There are two failure modes: the vial fell outside the well, and the shielding slipped the operator's hand falling on top of the vial below.

The operator attempted to drop a vial containing material into the well for activity reading using the vial shielding. Reading of the vial's content is performed regularly to accurately measure the vial's activity in performing dilutions and during molly breakthrough testing.

Since the well is located to the rear and the left of the biological safety cabinet, the operator needs to extend his right hand over the preparation area to deposit vials into the well. The left-hand raises the well's dipper and then lowers it into the well. In general, the latter has effects: it increases the distance required to deposit the vial and overextends the arm beyond a more stable position for more control.

Trying to deposit the vial from the left side using the left hand is not feasible for two reasons: most operators are right-handed, the approach toward the well needs to occur from the sides, and there is not enough space on the left side of the well.

Corrective Actions:

- Replaced vial shield with a top-loading shield instead of a bottom-loading shield. The latter will allow for the glass vial to be handled from the top and withing the shielding using long forceps.
- Instructed operators to use long forceps to manipulate the vial to deposit it into the dose calibrator's well. This change will provide more reach while avoiding the manipulation of the shield using overextension of the arm, and second, it will prevent the shielding from falling onto the vial.

Conclusion:
An assessment of the dose received to the operator's skin was performed, see attachment. The dose to the skin was determined to be lower than the max extremity dose measured at the finger rings, and hence the reportable dose will be maintained as the one measured by the max extremity ring dose.

Because the dosimeter used during the event and during May was sent 10 days before the end of the month, and the dosimeters scheduled for June were used during the last days of May, a table using a normalized ratio between the dose measured at the rings and the activity handled by the operator was created.

Month 2022	Kit Prep Activity	Chest mRem	Left Finger mRem	The left-hand dose ratio	Right Finger mRem	The right-hand dose ratio
January	78,813	20	1,692	2.1E-02	1,206	1.5E-02
February	83,915	26	2,410	2.9E-02	2,150	2.6E-02
March	117,570	36	1,946	1.7E-02	1,718	1.5E-02
April	111,897	39	2,618	2.3E-02	3,434	3.1E-02
May*	82,721	26	1,851	2.2E-02	2,817	3.4E-02
June	105,339	32	2,562	2.4E-02	1,932	1.8E-02
			Average	**2.3E-02**		**2.3E-02**

The table showed an increase in the dose ratio during May when the event occurred. The increase is noted in the right finger dosimeter. Using a range between the highest ratio of 3.1 and the average, we may conclude that the event may have provided an additional dose between 25 to 91 mRem to the right ring dosimeter.

The frequency of the event is low. This is the first time the event has been recorded to have happened. The corrective actions are expected to reduce the two failure modes identified as the cause of the event.

Rolando Garcia	18-Aug-2022
Performed By	Date