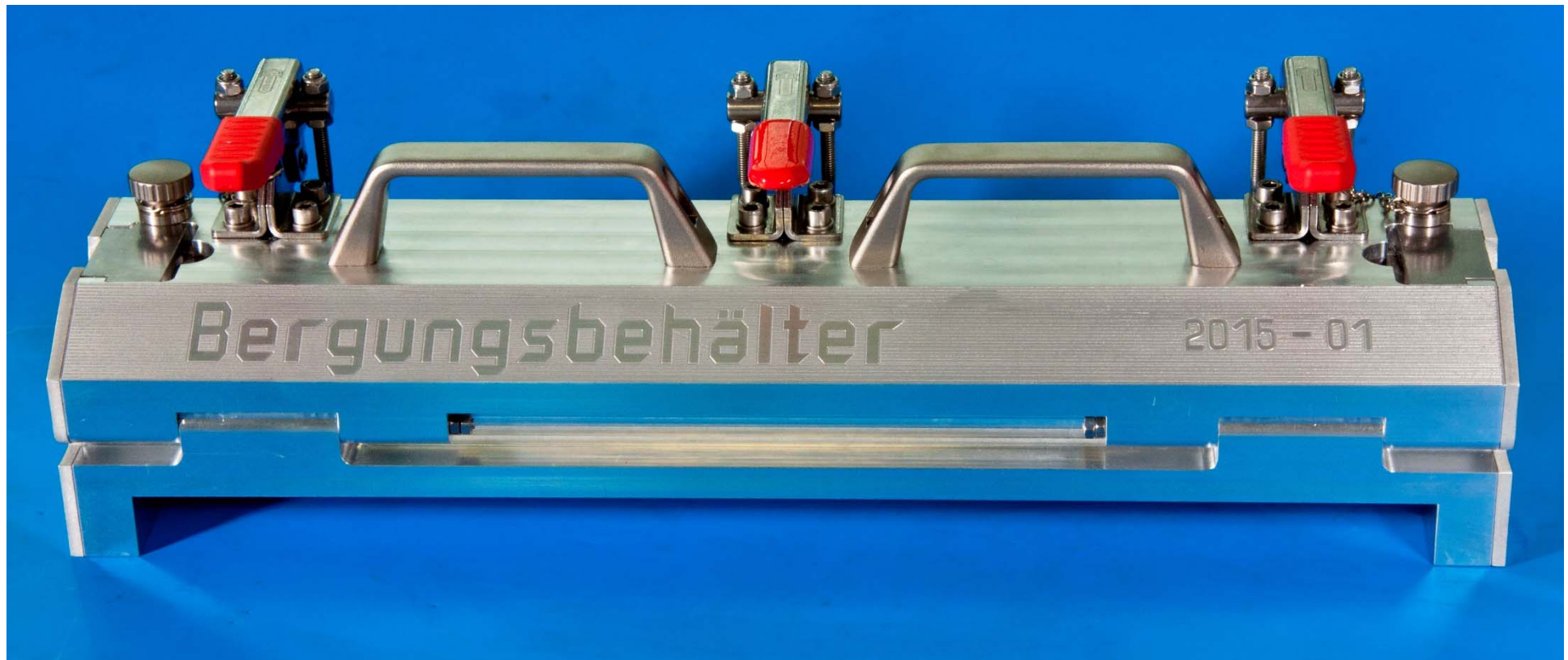


Gamma radiography source recovery equipment



suvapro

Sicher arbeiten

16th European ALARA Network Workshop

Stefan Büchi, Suva, Bereich Physik

15.03.2016

Agenda

- ◆ Initial situation.
- ◆ Radioactive source stuck in the guide tube — possible causes.
- ◆ Description of the source recovery container, constructed by Qualitech AG
- ◆ Source recovery process.
- ◆ Transport and further steps.

History

The following question was raised in the radiation protection commission of the Swiss society for nondestructive testing:

- ◆ "What will be done, if a source sticks in the guide tube of a gammagraphy projector?"

Answer:

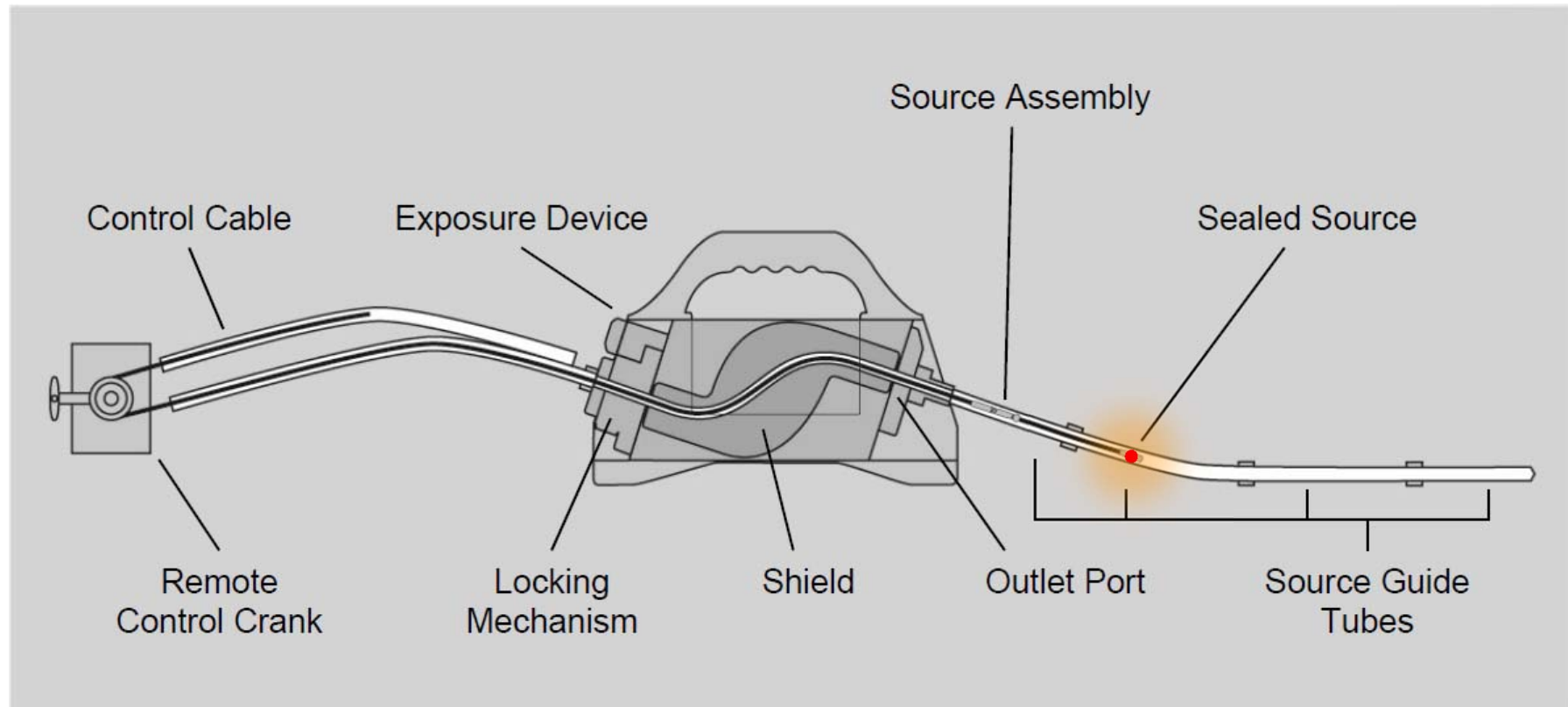
- ◆ "The PSI radiation protection guys will remove it." —
- ◆ "How exactly? How will they protect themselves?"

It was concluded, that a shielding container, tailored for that purpose, should be constructed.

Situation in which a source recovery container can be used

- ◆ The radioactive source is stuck in the guide tube of a gamma projector.
- ◆ All attempts to retract the source into the shielding container failed.
- ◆ The source may be located in a place with poor accessibility (e.g. on a construction site).
- ◆ The source must be recovered and moved to a safe place.
- ◆ The doses of all involved persons must be ALARA.

Radioactive source stuck in the guide tube — overview of the situation



Source: www.qsa-global.com Model 880 Series Source Projector Manual

Radioactive source stuck in the guide tube — possible causes

- ◆ Lost connection between source assembly and control cable: Source can be pushed forward but not retracted.



- ◆ Malfunction of the remote control assembly.
 - In this case, the cable can be pulled by hand.
- ◆ Mechanical damage at the projector (exposure device).

Radioactive source stuck in the guide tube — possible causes

- ◆ Guide tube squeezed or buckled (hit by the fallen gamma projector or any other object):
 - Source can neither be moved forward nor backward.
 - Source can be retracted no further than to the point where the source assembly reaches the squeezed or buckled part of the guide tube.



Attempts of moving the source back into the container

- ◆ **Before considering cutting the guide tube**, alternative ways of moving the source back into the projector must be examined.
- ◆ Advice must be sought from:
 - The operation manual.
 - The supplier or the manufacturer.

"Do not under any circumstances attempt to retrieve the source. Performing source retrieval is a licensed activity that allows only specially trained RSOs to respond to an emergency. This regulatory requirement is the result of overexposures to radiographers attempting to handle emergency retrievals by themselves." (from [Model 880 Series Source Projector Manual](#))

- ◆ These attempts must be planned and, if possible, tested in advance with non radioactive test equipment. The planning includes dose estimations.
- ◆ Unusual source recovery attempts must be performed under the supervision of the radiation protection authority.

Source remains stuck ☹️

— Use of a source recovery container 😊

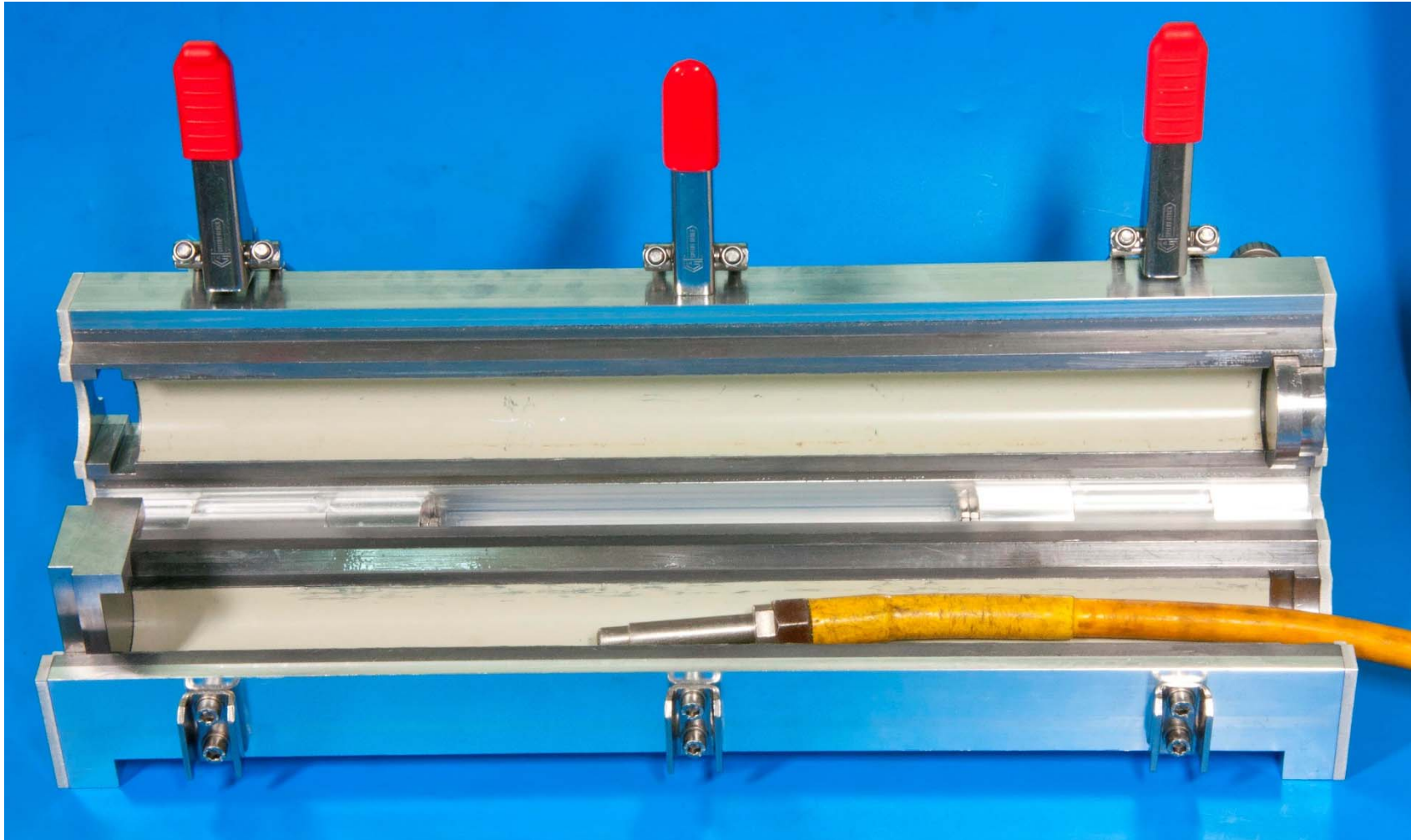
◆ Requirements specification:

- 150 Ci Ir-192 @ 50 cm during 2 min: shielding to 6 mSv
 - Attenuation factor: 16
 - 4 half value layers
 - 20 mm lead
- Less than 40 kg
- Rugged design
- Easy handling

Prototype source recovery container, constructed by Qualitech AG

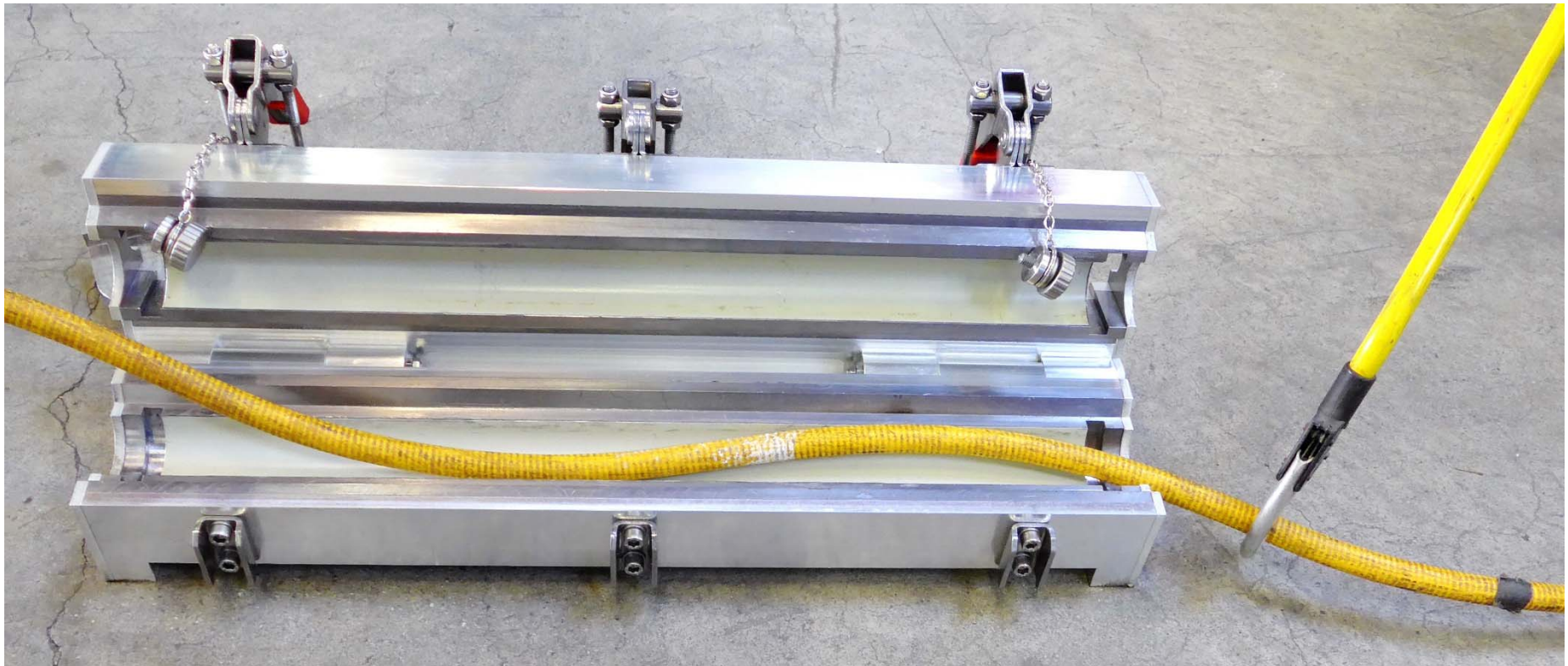
- ◆ Qualitech AG, a Swiss NDT company, constructed a prototype.
- ◆ Actual figures of the prototype:
 - Attenuation factor: Se-75: **500** Ir-192: **30** Co-60: **~3**
 - Weight: 33 kg
 - Lead shielding: 20 mm
- ◆ Rugged design:
 - Lead shielding in the shape of two halves of a cylinder, each embedded in an aluminium block for mechanical stability and hinged together.
- ◆ Easy handling:
 - Because the two parts are hinged together, the container can easily be closed.

Prototype source recovery container, constructed by Qualitech AG



Source recovery process

1. Place the open container parallel to the guide tube (not close to the stuck source).
2. Place the guide tube into the lower half cylinder using gripping pliers.



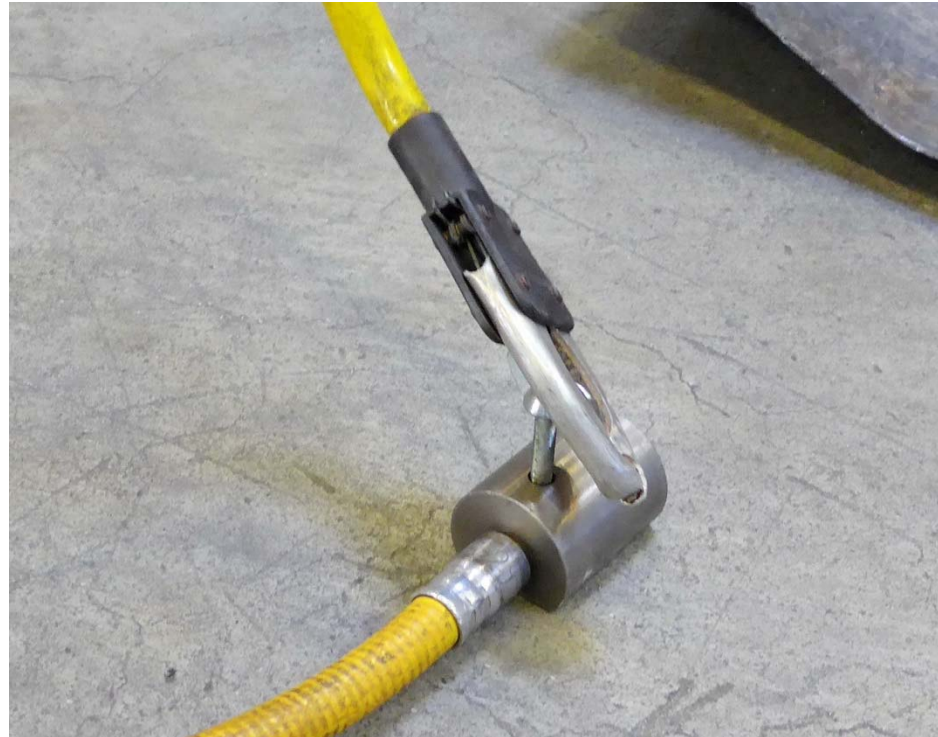
Source recovery process

3. Close the container.



Source recovery process

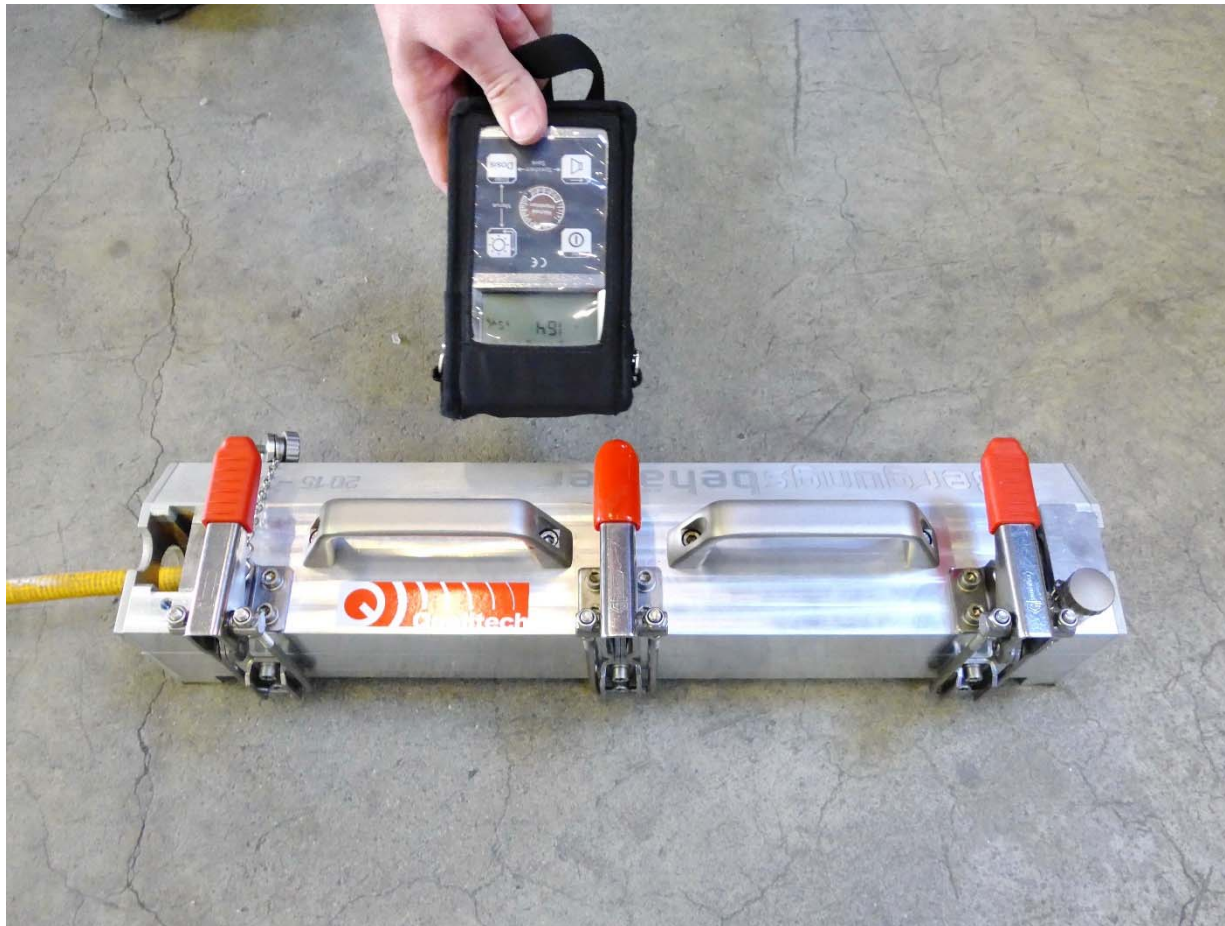
4. Remove the collimator, if necessary.



5. Pull at the guide tube in order to move the source into the container.

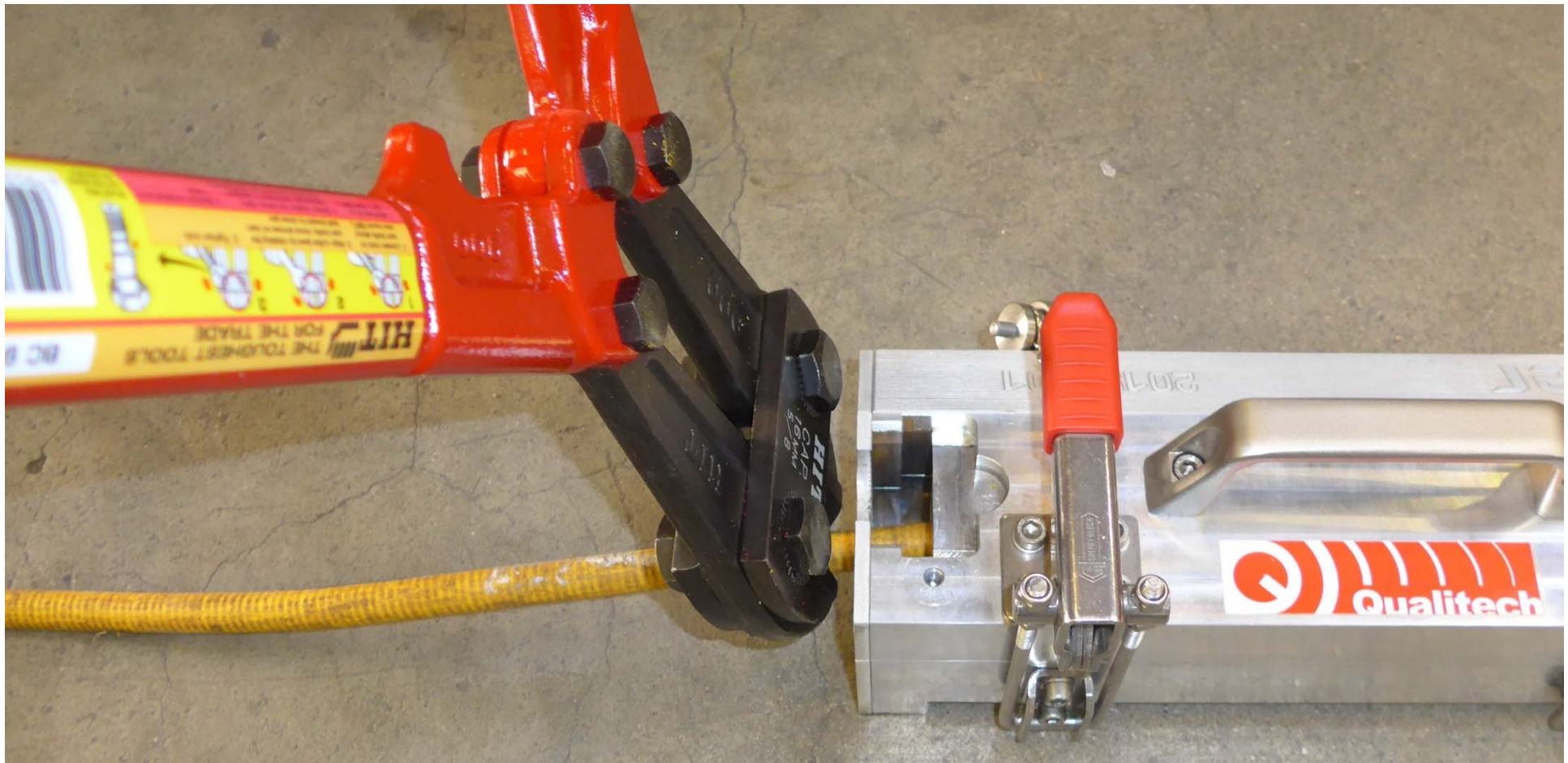
Source recovery process

6. Verify the position of the source by measurement. Use a telescope measurement device, if dose rate is high.



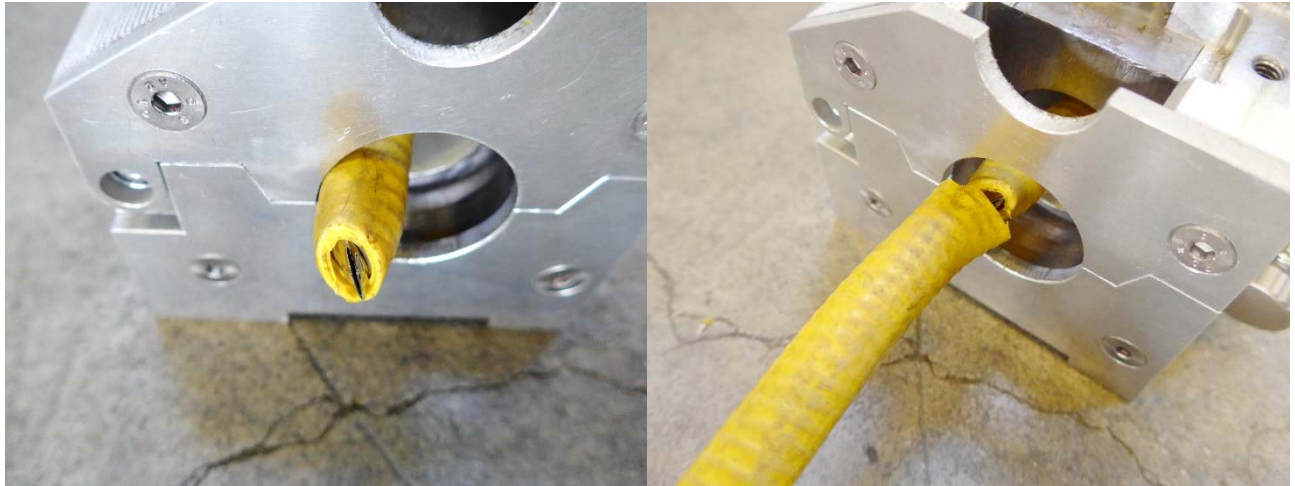
Source recovery process

7. Cut the guide tube with a bolt cutter.
Reconsider: Is this unavoidable?

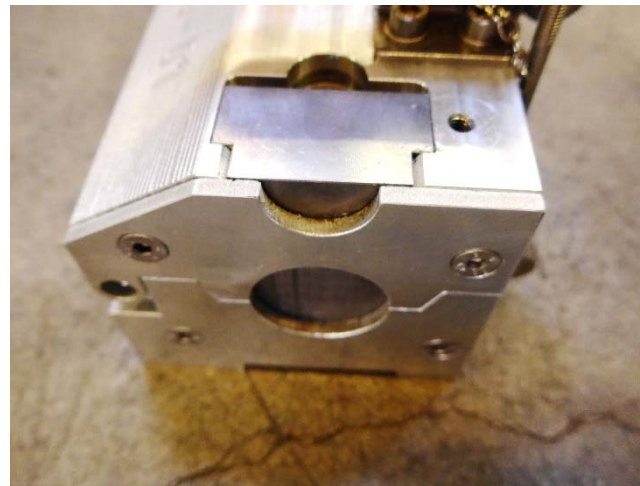


Source recovery process

8. Push the cut end of the guide tube into the container.



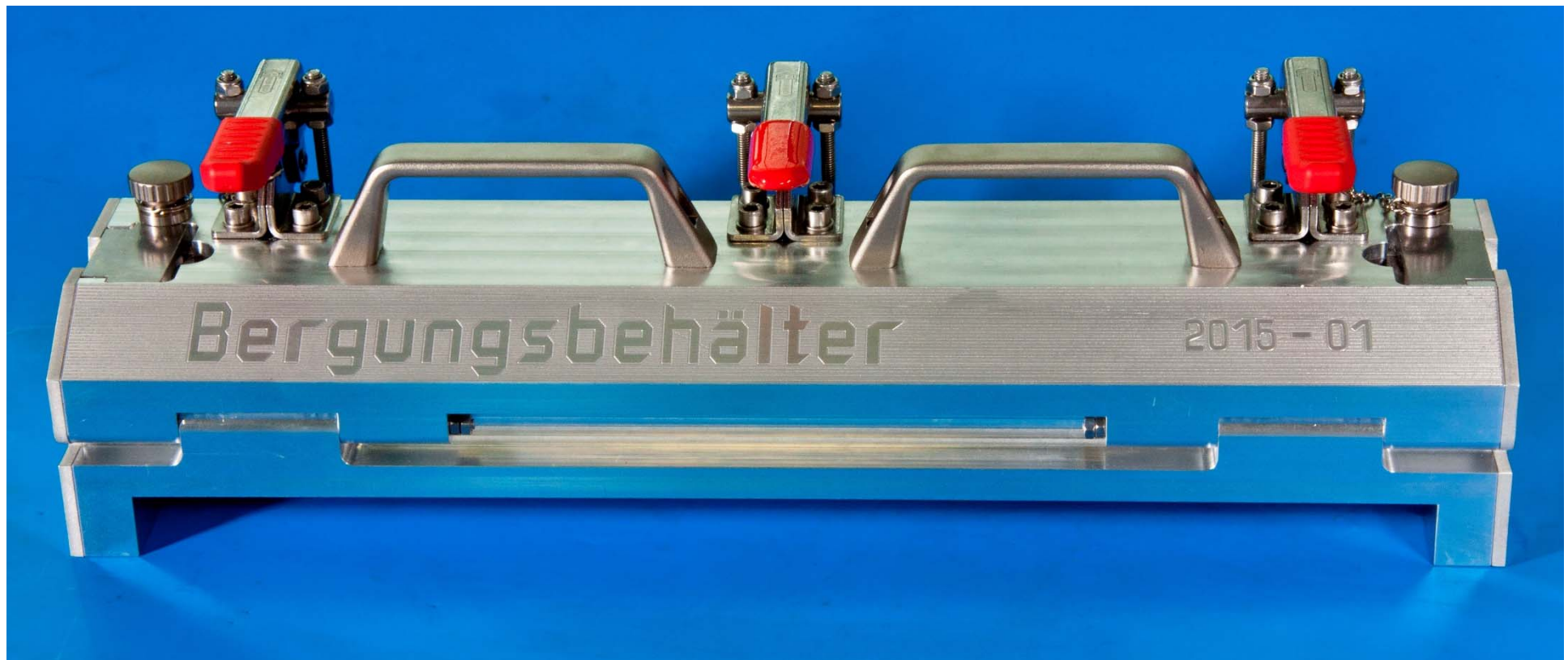
9. Insert the lead shield piece.



Source recovery process

10. Verify that the container is closed and the lead shield pieces at the front end and at the back end are fixed.

The container is ready for transport.



Transport within the inspection site

- ◆ The source may be stuck in a place with poor accessibility.
- ◆ Attach straps, a rod or other suitable lifting accessories to the handles.
- ◆ Distance of the involved persons from the source — Consider use of a crane or other auxiliary equipment.

Carriage by road to a facility for further treatment

- ◆ Place the source recovery container in a type A container.
- ◆ Perform dose calculations for the driver and accompanying personnel.
- ◆ If necessary, use additional shielding material.

Compliance with ADR

- ◆ Emergency response
→ ADR not applicable (section 1.1.3.1 d)).
- ◆ However, compliance with ADR should be ensured as far as reasonably achievable.
- ◆ Only deviation from ADR:
Activity exceeding A1 is carried in a type A package instead of type B(U).
- ◆ Dose rates according to ADR should not be exceeded:
 - 2 mSv/h outside the vehicle
 - 10 mSv/h outside the type A package

Further treatment at Paul Scherrer Institute (PSI)

Dependent on the condition of the source assembly and the remaining activity:

- ◆ Remove the source assembly into an intact gammagraphy container or source exchange container for further use. This process could be performed within a hot cell.
- ◆ Decay storage until the source assembly can safely be handled outside a hot cell.

Conclusions

- ◆ A source recovery container for gammagraphy emergency response involving Se-75 or Ir-192 was constructed.
- ◆ If a source remains stuck in the guide tube, doses of emergency response personnel can be kept ALARA.
- ◆ However, before the decision to cut the guide tube is made, all possibilities to retract the source assembly into the gammagraphy projector must be examined.
- ◆ The shielding of the presented source recovery container is very good for Se-75, sufficient for Ir-192 but poor for Co-60.
- ◆ The container is included in the emergency preparedness plans of the Suva.

Acknowledgements

- ◆ Qualitech AG:
 - Armin Weber, Günther Heiler, Reto Grundbacher
- ◆ Paul Scherrer Institute, radiation protection:
 - Beat Amrein
- ◆ Radiation protection commission of the Swiss society for nondestructive testing

Swiss NDT Smartphone-App

- ◆ Search for "Swiss NDT" in App Store or for Android



●●●○ Swisscom 4G 08:10


ABSPERRUNG CHECKLISTE **NOTFALL**

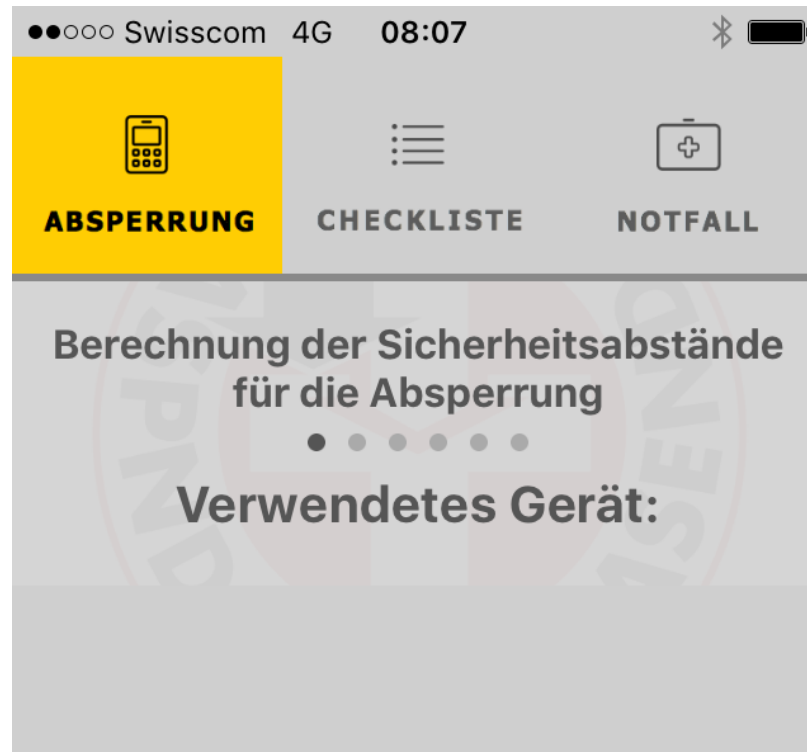
Vorgehen im Notfall:

- Strahlenquelle in den Behälter zurückziehen
- Personen in Sicherheit bringen
- Absperrung vergrössern (Dosisleistung < 10 μ Sv/h)
- Notruf

Wichtige Telefonnummern:

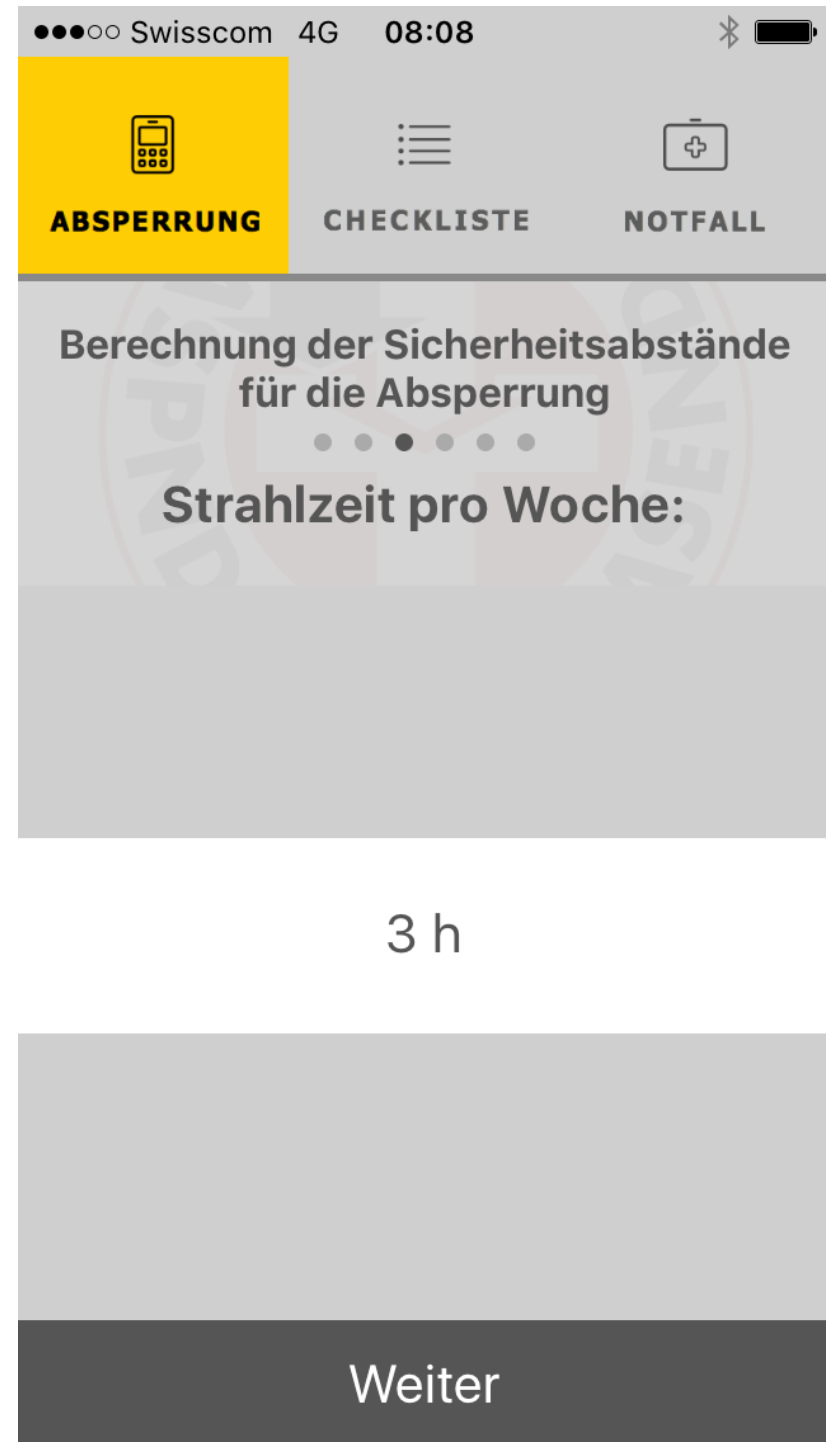
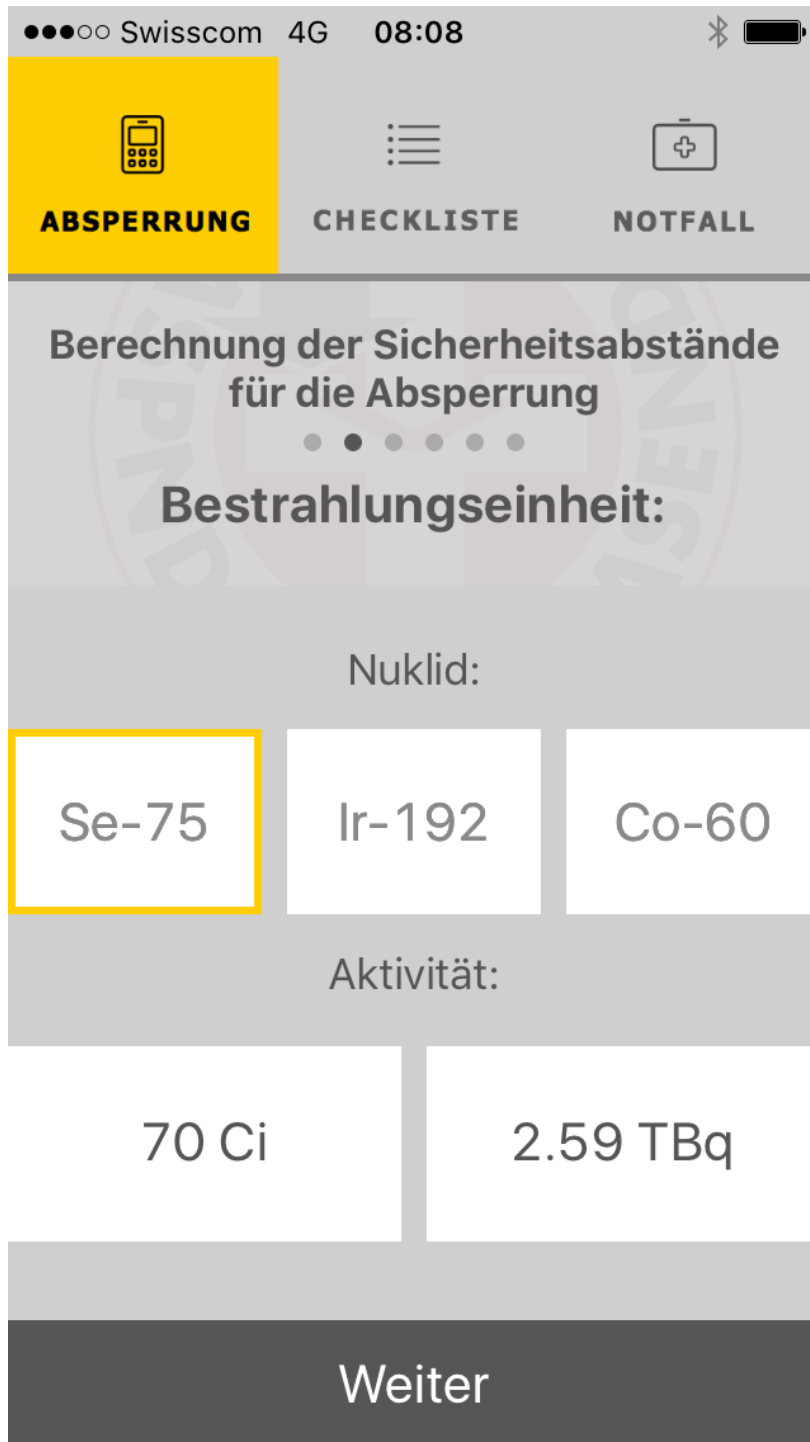
TD Suva
Tel: 6133

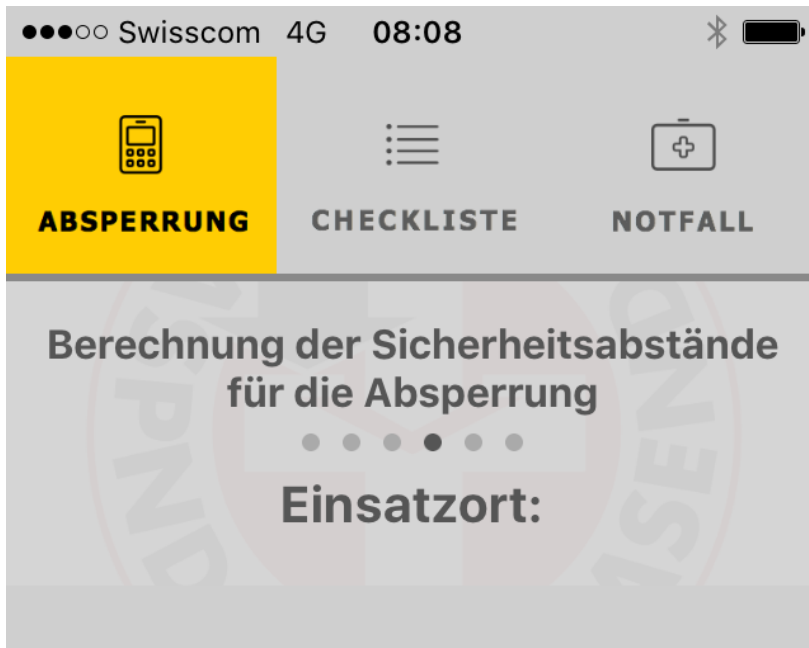
 > anrufen



Röntgenanlage >

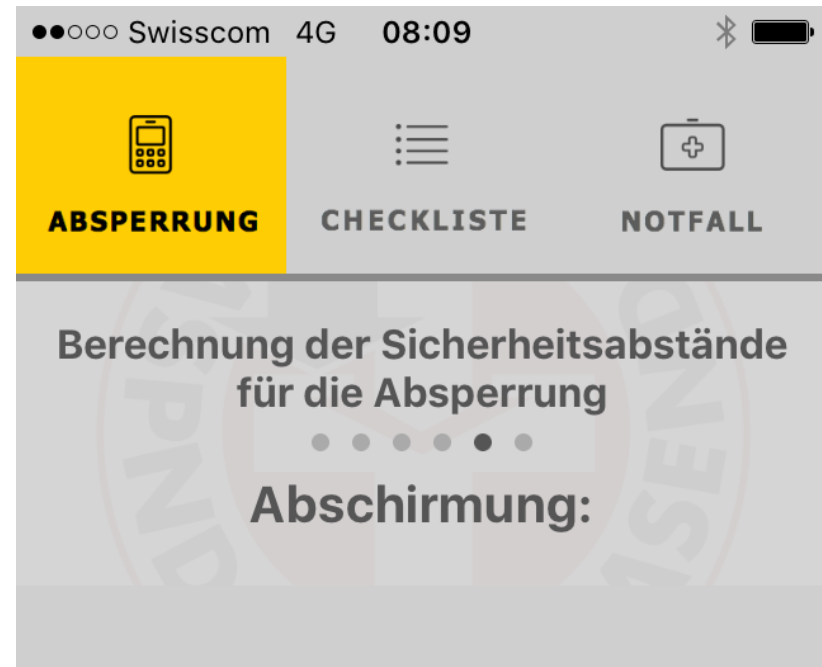
Bestrahlungseinheit >





Ausserhalb eines Gebäudes >

Innerhalb eines Gebäudes >

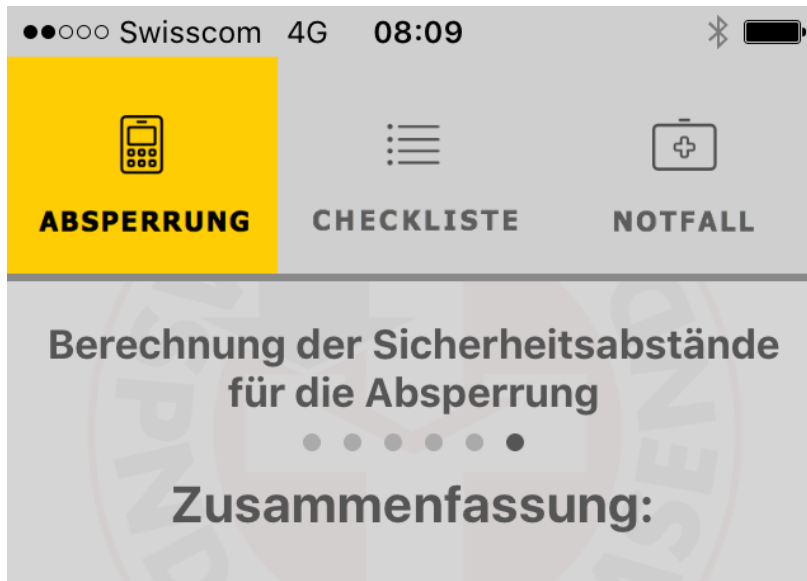


Eisen, Stahl (HWS = 7.1 mm)

20 mm

Schwächungsfaktor = 7.046

Weiter



Gerät: Bestrahlungseinheit

Nuklid: Se-75

Aktivität: 70 Ci / 2.59 TBq

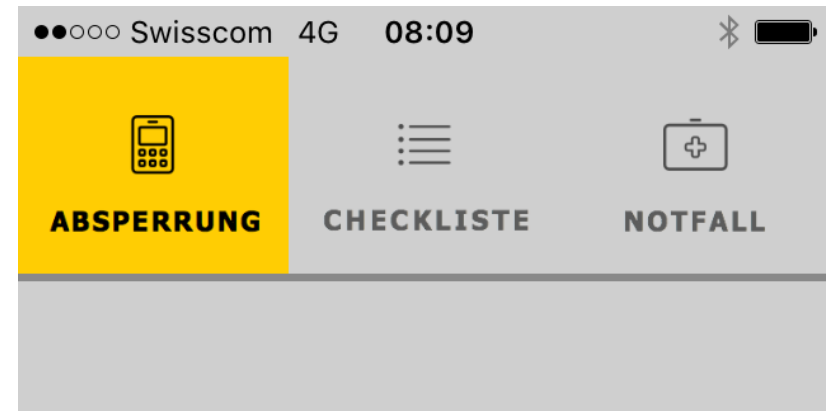
Strahlzeit pro Woche: 3 h

Innerhalb des Gebäudes: Nein

Abschirmung: Eisen, Stahl

Dicke: 20 mm

Weiter



max. Dosisleistung an der Absperrung
(mit Messgerät verifizieren!)

33 $\mu\text{Sv/h}$

Zusammenfassung:

Direktstrahlung

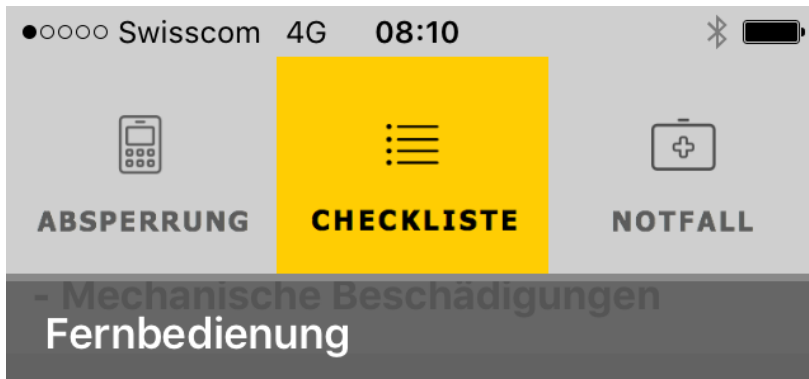
71 m

Direktstrahlung abgeschwächt

27 m

Streustrahlung

15 m



Kabelführung

- Schnitte
- Brüche
- Deformationen

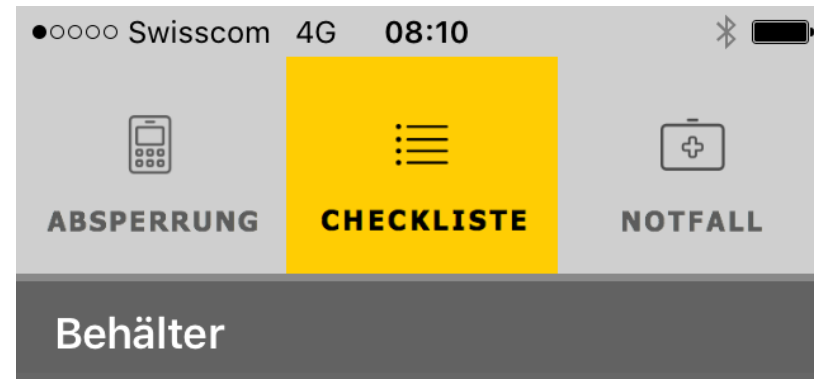
Behälter

Anschlusssteile Behälter beidseitig

- Mechanische Beschädigungen
- Sauberkeit

Strahlerhalter

- Herstellerlehre
- Mechanische Beschädigungen



Anschlusssteile Behälter beidseitig

- Mechanische Beschädigungen
- Sauberkeit

Strahlerhalter

- Herstellerlehre
- Mechanische Beschädigungen
- Sauberkeit

Beschriftung

- Vollständig
- Gut lesbar