Disaster Preparedness Program for Health Facility's Technology Managers Radiation Safety Issues

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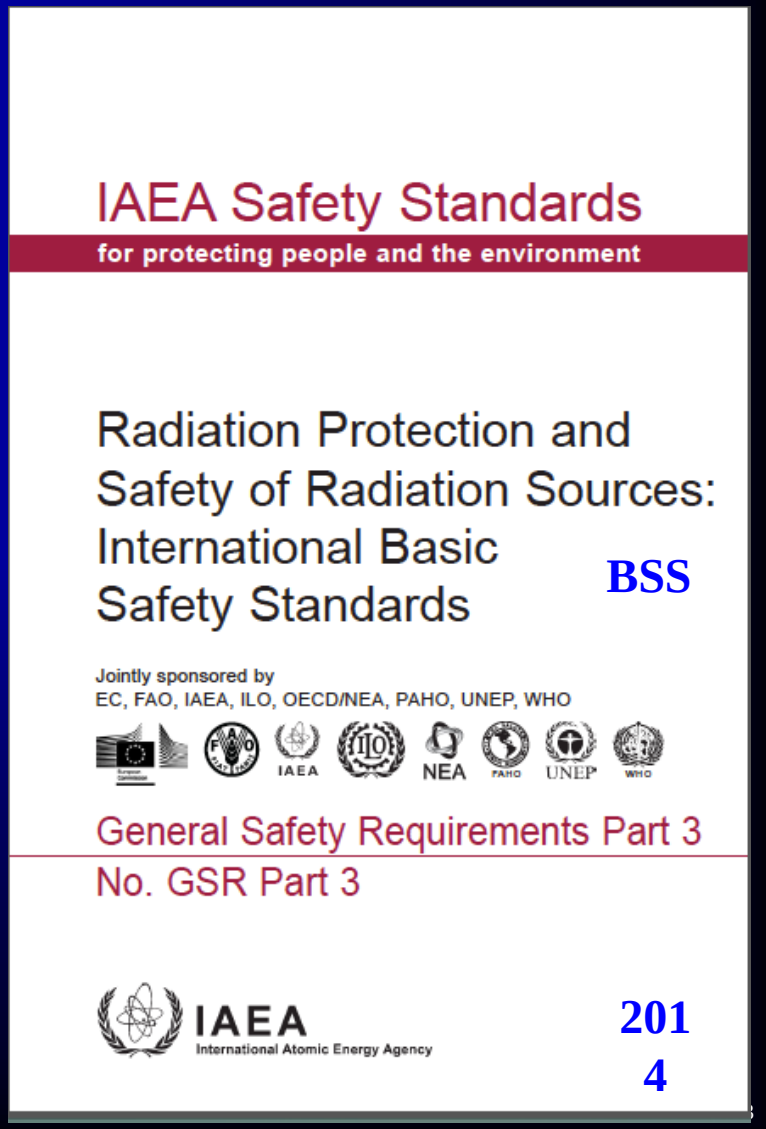
International Union for Physical and Engineering Sciences in Medicine

Disaster Types that Affect Hospitals

1. Loss of Radiation Source Control at the Hospital
2. Nuclear / Radiological Event
3. Natural Disasters
   a) Fires (do not have to be “natural”, they could be arson)
   b) Earthquakes
   c) Hurricanes / Typhoons
   d) Floods / Tsunamis

1. Loss of Radiation Source Control at the Hospital

- A BSS-based safety guide for medical applications considers this a contingency not an emergency
- Medical Physicists/Radiation Protection Officers need to have contingency plans and do periodic drills to test the appropriateness of the responses



1. Loss of Radiation Source Control at the Hospital

- Medical devices containing radioactive sources, to prevent patient / staff irradiation in case of a power failure (source would not retract), must have a manual retract assembly and/or a UPS

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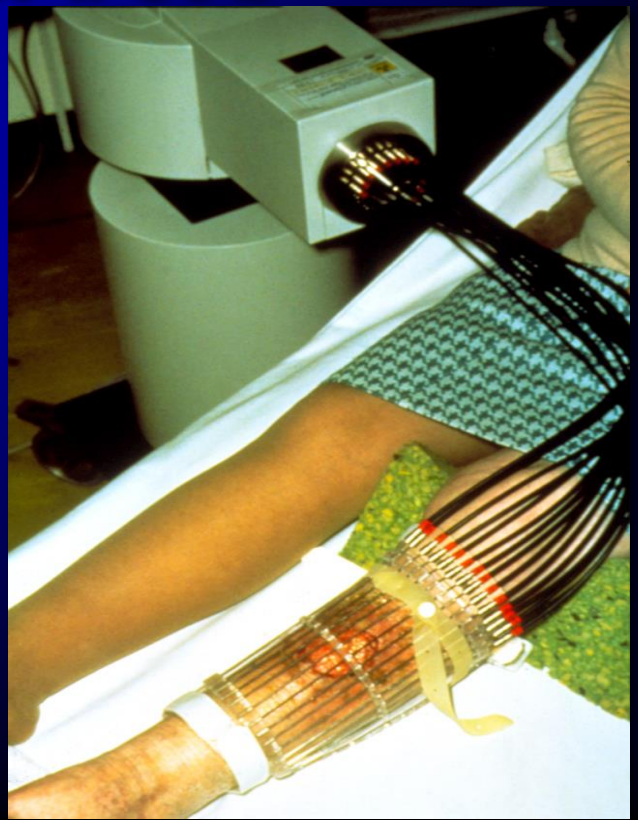
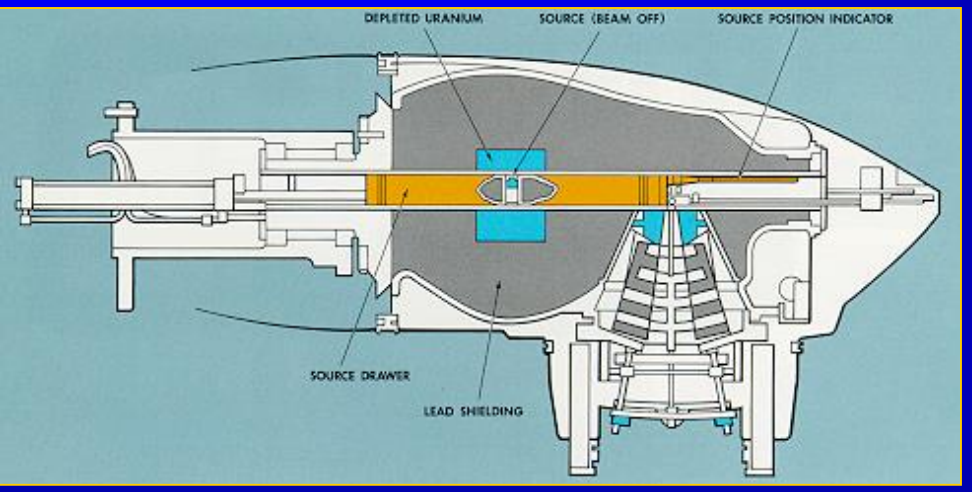
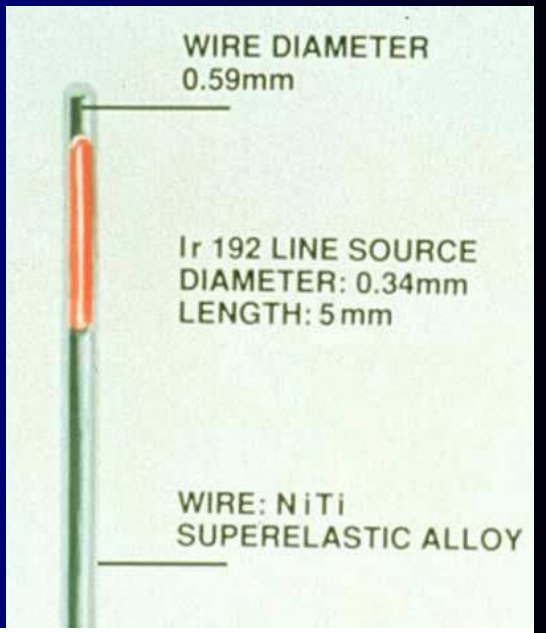


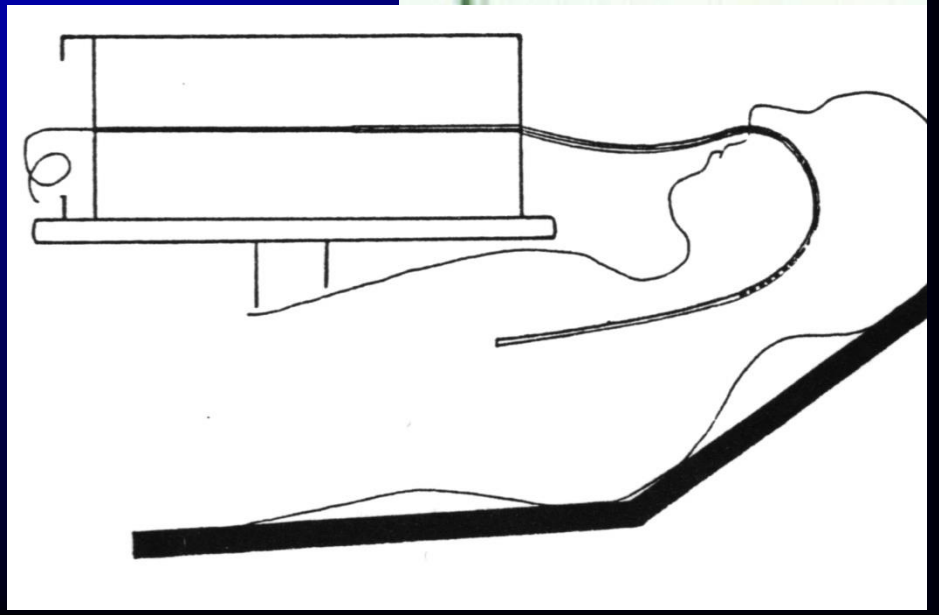
1. Loss of Radiation Source Control at the Hospital: Examples



Co-60 Source Stuck

Brachy Cable Broken





Safety

- Source safe key-lock
- Radiation warning light
- Emergency source-retract button
- Emergency source hand crank
- Dummy source positioning control

From a manufacturer of HDR units

2. Nuclear / Radiological Event

- Medical Services may be inoperable if radiation contamination is serious and both patients and staff may have to be relocated

- Hospital managers should request help from National Agency in charge of Disaster Response

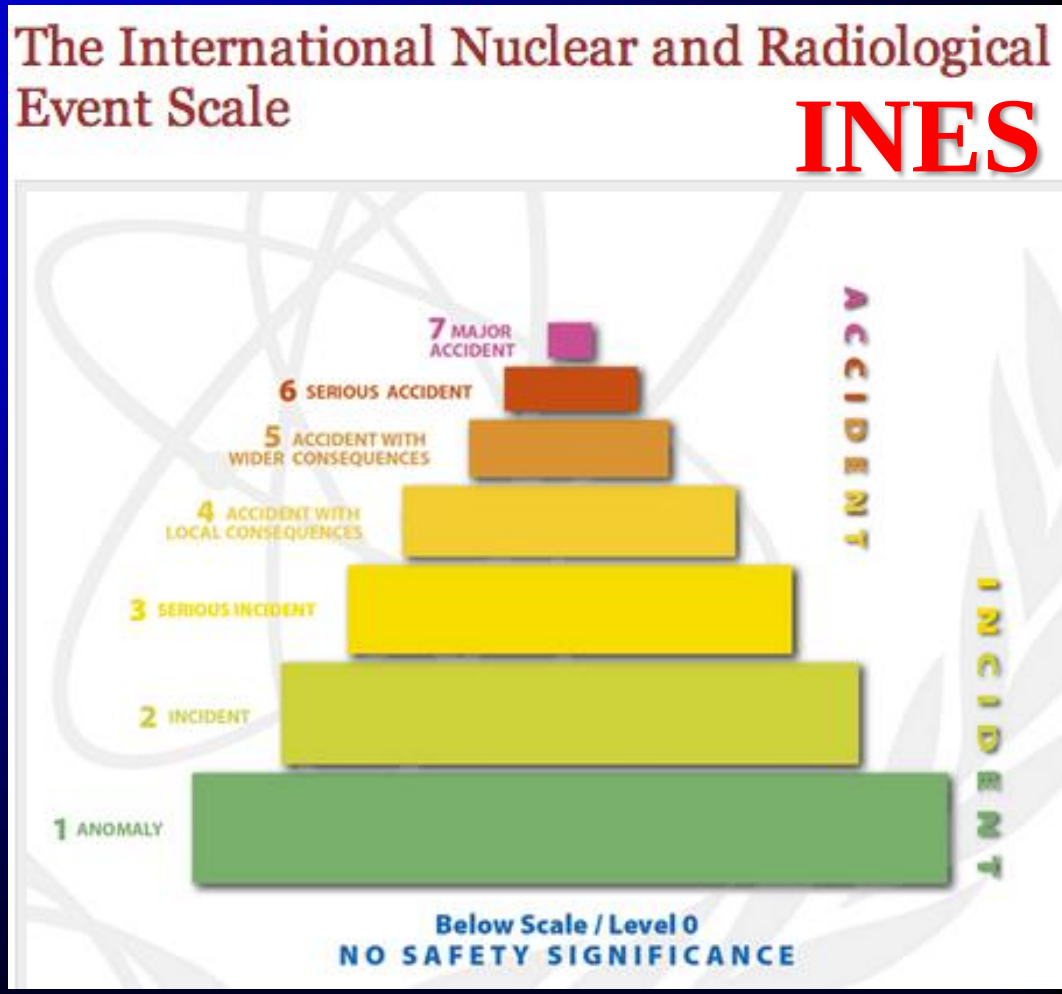
Abandoned Hospital near Chernobyl

http://www.theatlantic.com/health/archive/2013/01/inside-chernobyls-abandoned-hospital/266693/

2. Nuclear / Radiological Event

- **Country may need international assistance –**

  See *Joint Radiation Emergency Management Plan of the International Organizations EPR-JPLAN (2013)*, published by the IAEA



EPR-
JPLAN
2013

EMERGENCY PREPAREDNESS AND RESPONSE

Joint Radiation Emergency Management Plan

of the International Organizations

JOINTLY SPONSORED BY THE CTBTO, EADRCC, EC, EUROPOL, FAO, IAEA, ICAO, INTERPOL, IMO, OECD/NEA, PAHO, UNEP, UN/OCHA, UN/OOSA, WHO, WMO

IN CO-OPERATION WITH UNSCEAR

DATE EFFECTIVE: 1 JULY 2013

IAEA
International Atomic Energy Agency

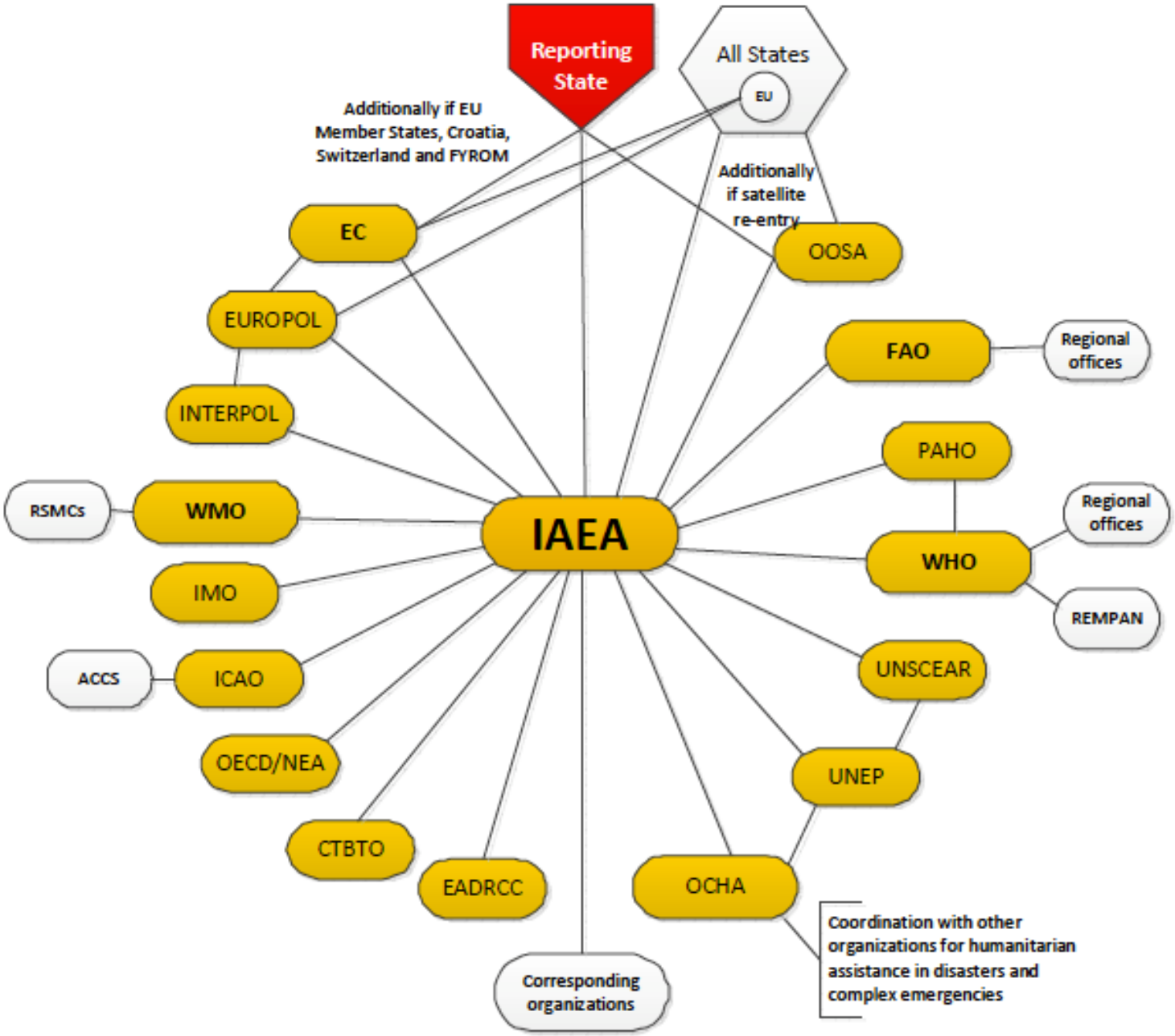
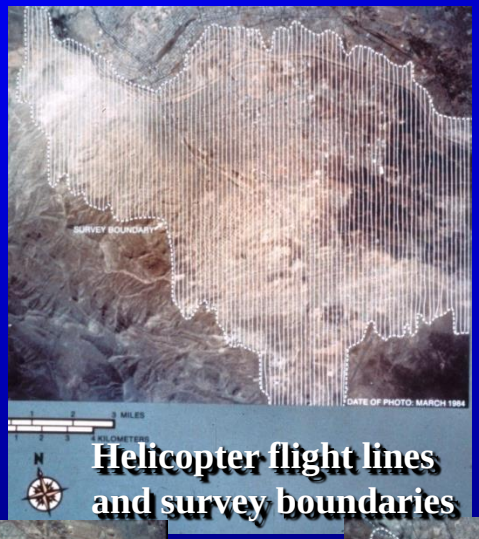


Figure 1: Framework for the inter-agency response coordination to radiation incidents or emergencies. Each international organization may have links with the relevant authorities in its own Member States for performing its usual functions.

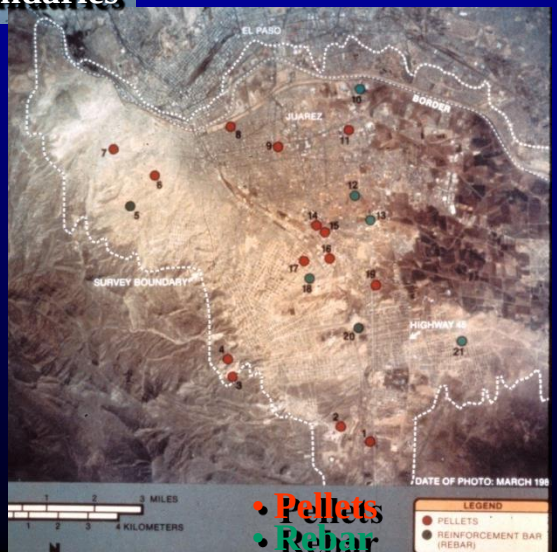
Radiological Accidents from Medical Sources

Ciudad Juarez (1984)



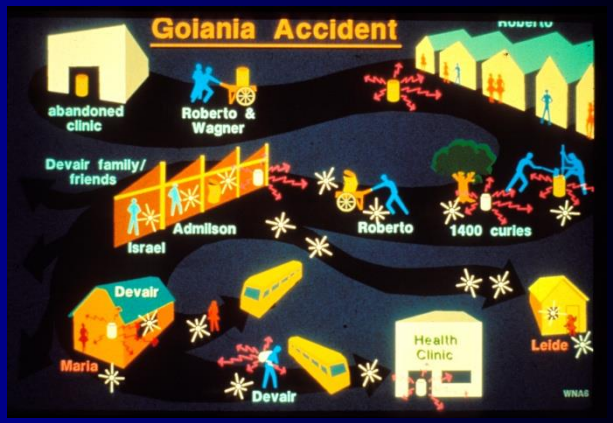
Helicopter flight lines and survey boundaries

• Significant Locations



• Pellets
• Rebar

Goiania (1987)



2. Nuclear / Radiological Event

If the hospital be part of the national / regional network of hospitals providing medical care to irradiated or contaminated patients in a nuclear/radiological emergency

- **Activate Emergency Plan, that should have been tested in practice drills periodically, and includes coordination with National Disaster Response Agency**
- **Assemble medical/technical/radiation experts team**
- **Prepare hospital to provide staff and rooms / areas for:**
  - **Irradiated patients in need of sterile conditions**
  - **Radioactivity detection in incoming patients & staff**
  - **Decontamination**

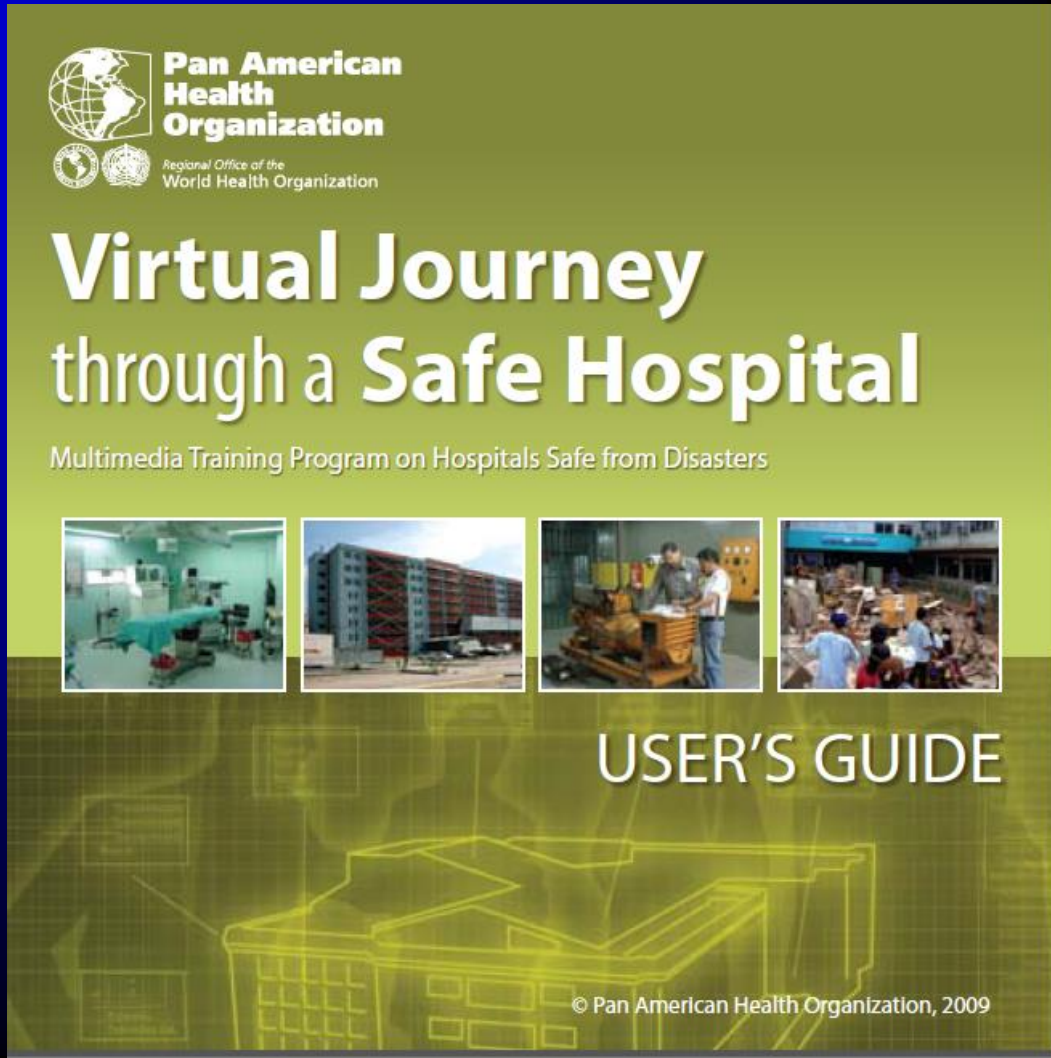
Medical treatment of a contaminated wound (*The medical aspects of radiation incidents*, REAC/TS)






3. Natural Disasters Common Recommendations

Device and building should be built to withstand major potential disasters in the area



Multimedia Training Program on Hospitals Safe from Disasters

PAHO/WHO has launched a new multimedia training program on disaster risk reduction and safe hospitals. The Virtual Journey through a Safe Hospital combines video, two- and 3-D animation, images and sound to make the learning experience much more versatile and easy to use. The program also includes presentations and technical publications to create a virtual learning environment on 'safe hospitals.'

The virtual tour is organized by modules, which can be used independently to explore specific aspects of the issue or which can be followed in sequence for a complete overview. A User's Guide accompanies the journey through the safe hospital, enabling the 'traveller' to adapt the route to his/her needs. A complete journey may take about three hours; on the other hand, the opening video—which gives a good overview of all the program's components—can be viewed in about 15 minutes.

Download the PowerPoint presentation on non-structural components.

In this section: a virtual 360° tour. Click on the green thumb tacks to learn about special safety measures to protect non-structural components.

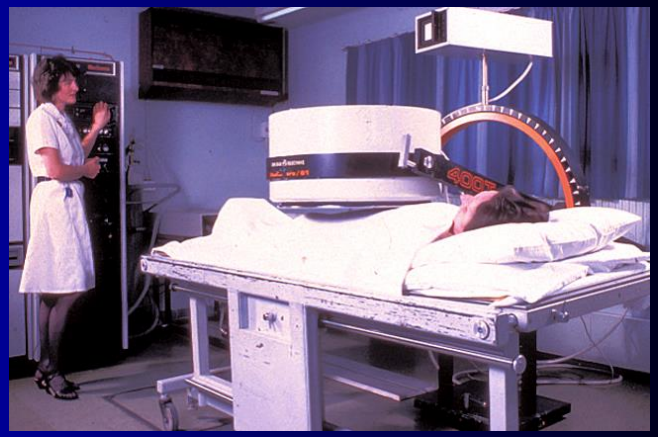
Text describing non-structural elements that must be evaluated to ensure the safety of hospitals.

The Guide discusses structural and non-structural components

3. Natural Disasters Common Recommendations

If event occurs when patients are undergoing radiological procedures:

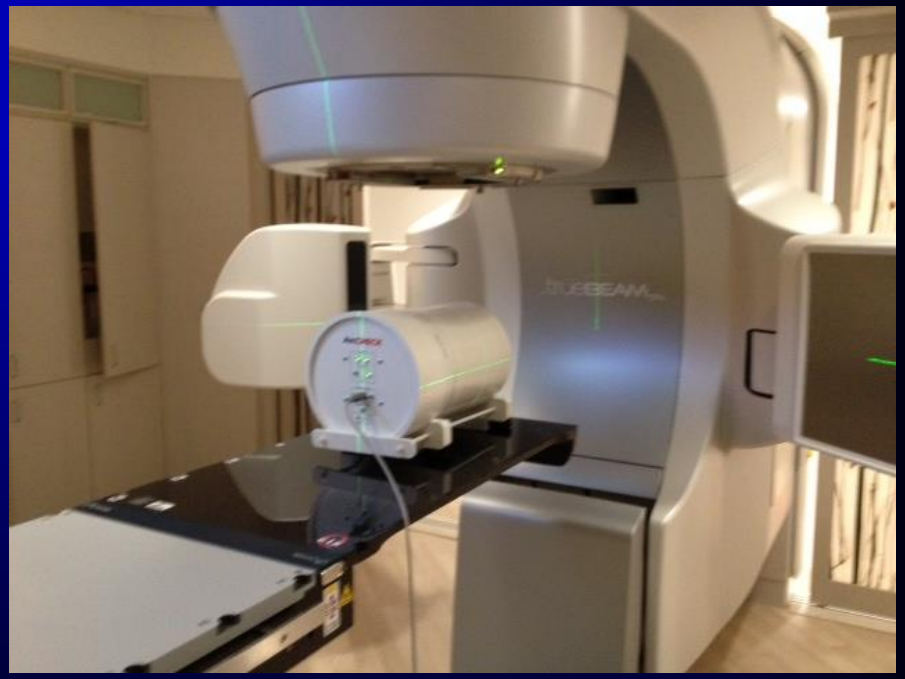
- Stop exams, interventions or treatments
- Move patients to safe location
- Record given doses (mu or time) in case of radiotherapy treatments



3. Natural Disasters Common Recommendations

After the event

- **Check and correct – if possible – the medical device's mechanical and electrical integrity**
  - **Components**
  - **Accessories, including patients' masks, immobilizers…**
  - **Dosimetry systems and QA phantoms**

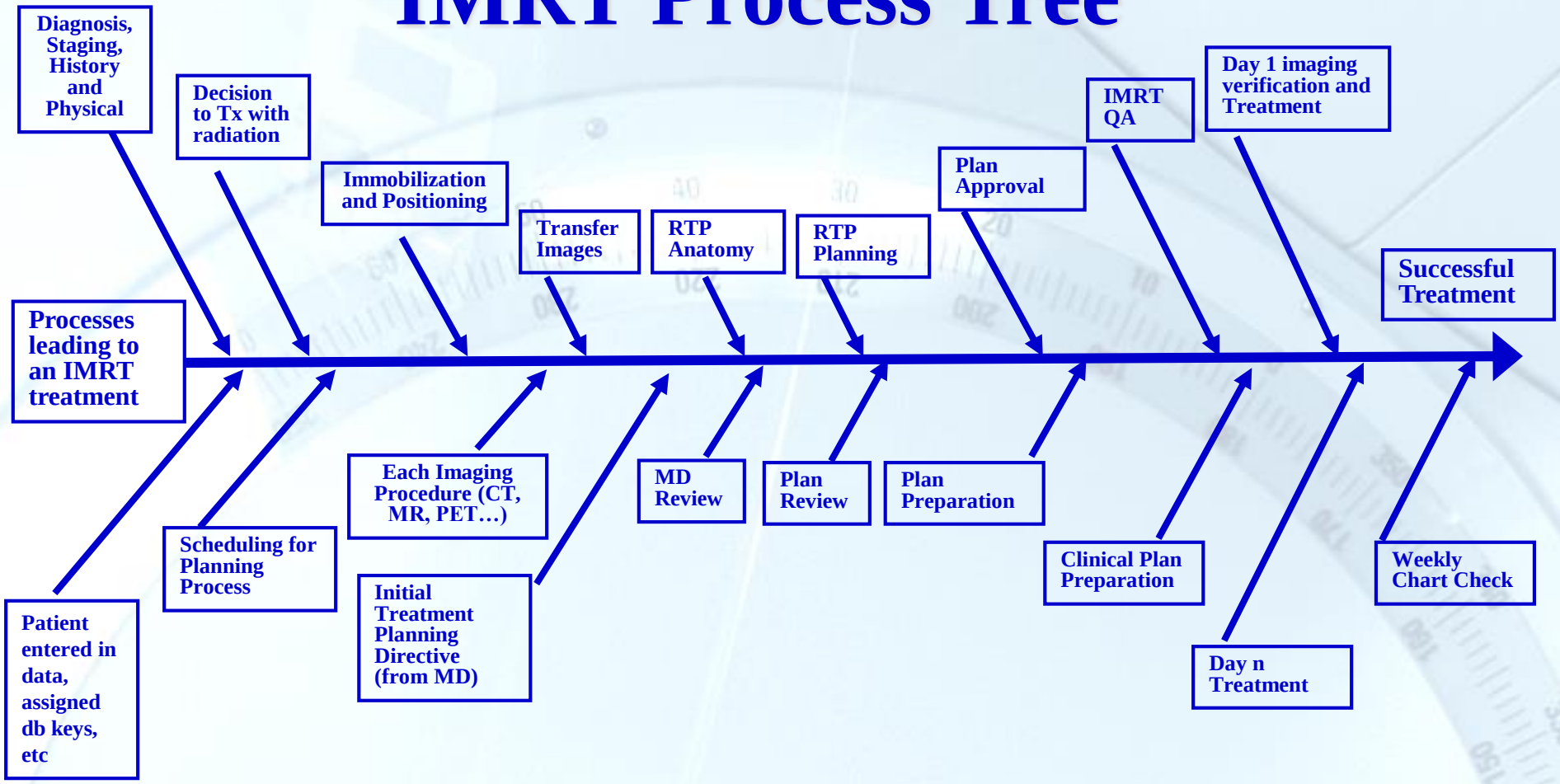


3. Natural Disasters Common Recommendations

After the event

- Assess/repair device's electrical & water supplies
- Assess/repair software and network operability
- Request medical physicist to perform a complete device evaluation before its return to clinical use

IMRT Process Tree



Saiful Huq, chair TG100

3. Natural Disasters Recommendations if Device Contains a Radioactive Source

After the event

- Seal room (prevent access) until radiation protection officer has verified that:
  - Source is still in the device or container
  - Sealed source encapsulation is intact
  - Either no contamination has occurred or
  - Contaminated areas have been decontaminated

Checking for Contamination

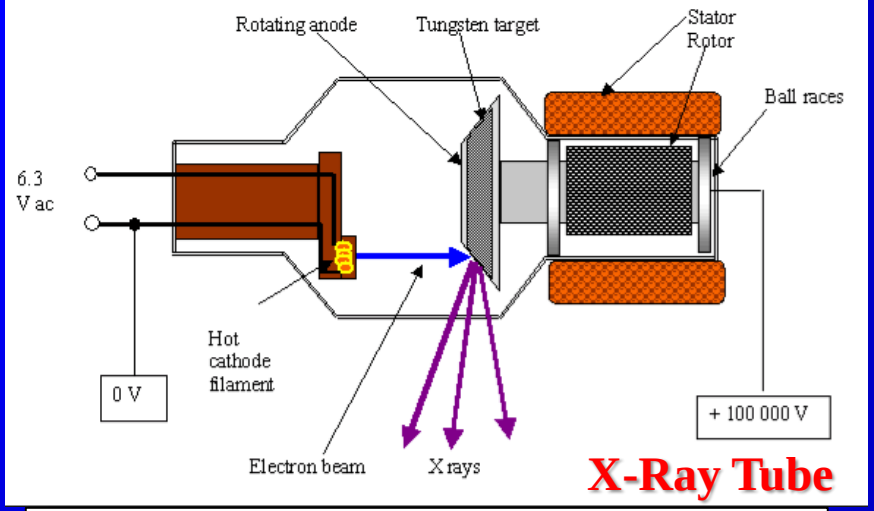
Additional Recommendations for Earthquakes

Depending on the magnitude, earthquakes may affect the alignment of the radiation beam

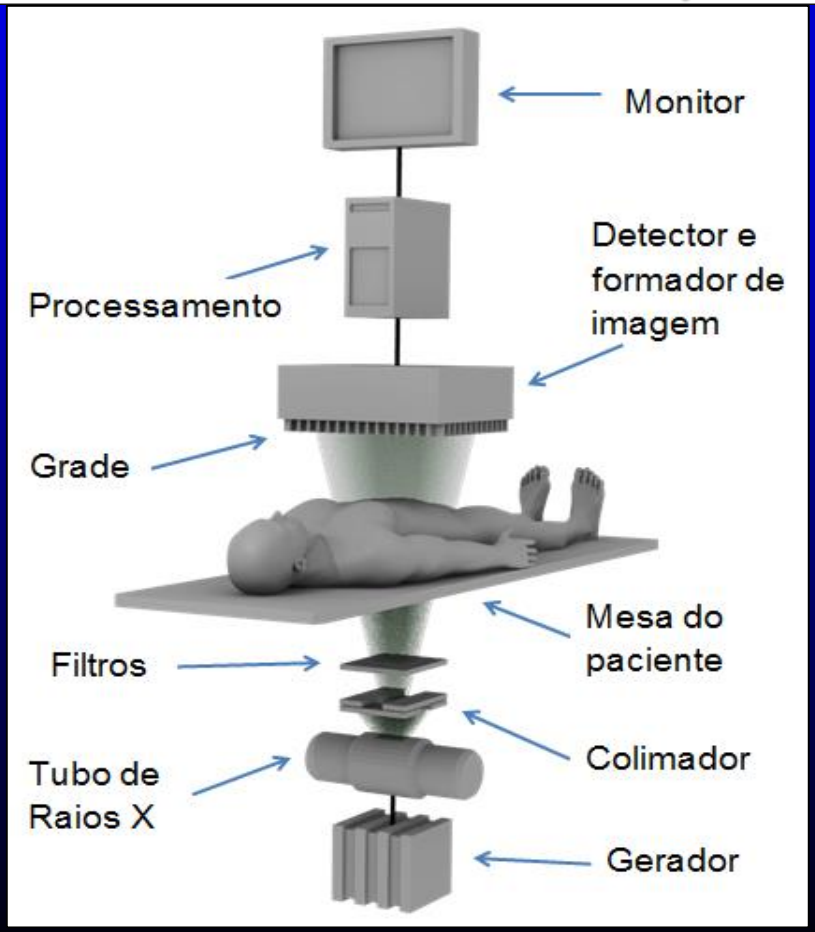
After the event

For medical imaging devices, check:

- **The congruence of the radiation and light fields**
- **The alignment of the whole imaging chain, including displays and networks (RIS, PACS)**



X-Ray Tube



Fluoroscope with Flat Panel Detector

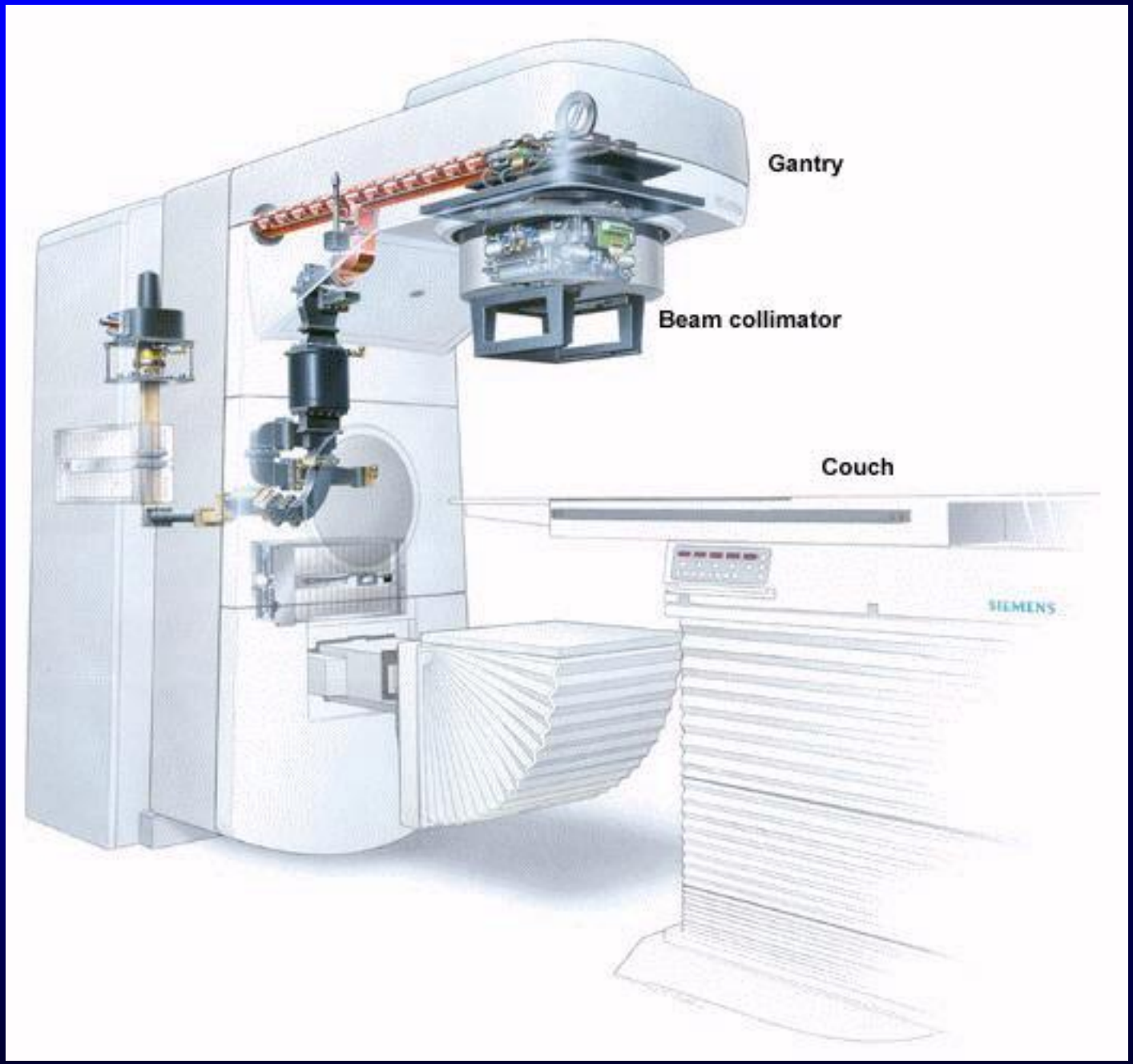
Fluoroscopic Imaging Chain

Additional Recommendations for Earthquakes

After the event

For external beam radiotherapy devices, especially linear accelerators, check:

- Position of collimator, gantry & table isocenters
- Field flatness and symmetry
- All dosimetry and treatment planning systems
- In-room imaging devices (IGRT)
- The record and verify network
- Patient accessories



Schematics of a medical linear accelerator (State University of Campinas, Brazil)

Conclusion

- Medical devices in medical imaging and radiation therapy are very vulnerable to disasters due to their design complexity.
- Prevention and response measures should take into account the medical device itself and its role in the whole radiological process.
- Hospital staff should be prepared to cope with disasters through frequent drills of a well-developed emergency plan which encompasses the phases before, during and after the disaster, and that includes radiation protection considerations.