

# Three Selected Accidents

# Samut Prakarn

In 1981 a 5300 curie Co-60 source (5.7 year half-life) was installed in a teletherapy unit at a hospital in Bangkok, Thailand. It was purchased from Siemens who subsequently stopped producing these types of sources.

In 1994, the source was too weak to be useful – the treatment times became too long, and the source was taken out of service. Siemens would not take it back, so the hospital sold it to a small company KSE. KSE also had three similar sources.

Because of lack of storage space, the company moved the sources to a parking lot that they owned. The parking lot was fenced, but the local residents had made holes in it so that they could play football in the parking lot.

Part of the source, the source holder, was stolen:

The source holder and shield was 5 cm thick lead encased in stainless steel (42 cm by 20 cm).

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Teletherapy Head with Source Drawer Missing

The source holder went to a couple of scrap metal yards where it was opened up. The source was actually handled.

Some of these individuals experienced headaches, nausea, vomiting, weakness, some hair loss. One of the individuals said his hands felt itchy. One individual's hands became blackened and swollen.

When the exposed individuals went to the hospital for treatment, physicians suspected a radiation source and notified the police

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Parts of source assembly

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Damage to skin – desquamation  
Note swelling of fingers



Locating the source proved to be difficult because it was in a pile of scrap metal and the source was of so high an activity that it was inappropriate to get too close.

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Scrap metal yard

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Scrap metal/junk yard at night

Responders practiced retrieval techniques using dummy sources.

Used front loader to move a lead shield near the source.

Some workers insisted on lead aprons used in dentist's office. These aprons are so thin that they would not reduce exposures to the gamma rays from cobalt-60. Might actually increase exposure because the worker moves more slowly.

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Front loader used to move shield for operations

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Use of scintillation screen on the end of a pole to locate source at night.

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Putting recovered source into shielded container using two meter long tongs

# Istanbul



Cobalt-60 sources used in teletherapy have to be replaced every few years because of the short half-life of Co-60. Hospital personnel are generally not capable of changing the source. This is usually done by a company that specializes in this procedure.

One such company in Ankara shipped their old sources to an empty building in Istanbul. The building (with the sources) was later sold and the new owner did not recognize that these were highly radioactive sources. So the owner sold the sources to a scrap metal yard.

# Istanbul

Source Exchange Container



The scrap metal workers opened up the shielded container.

# Istanbul



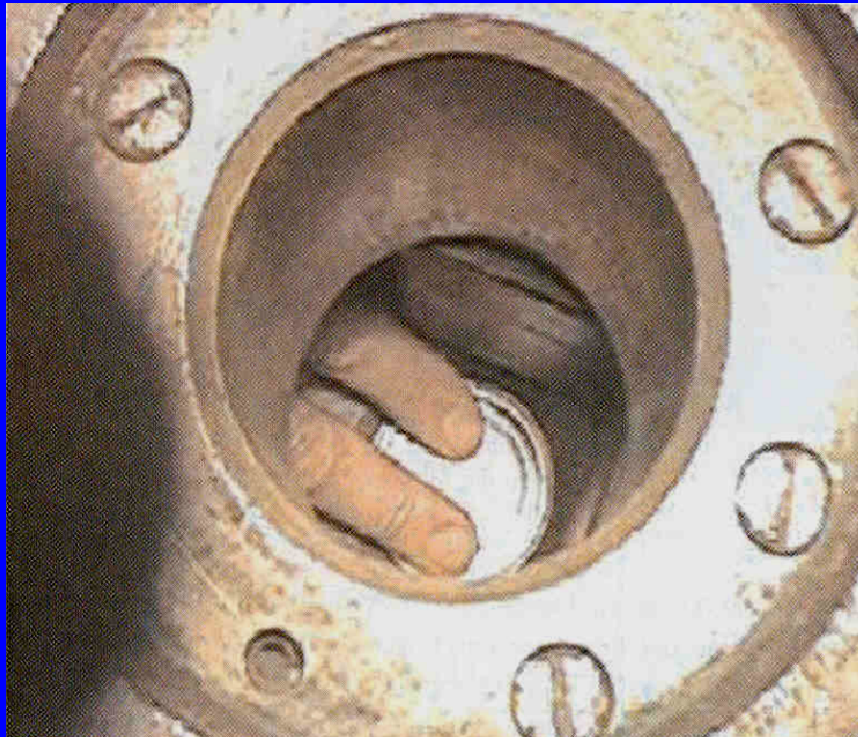
Source Exchange Container

# Istanbul



Source Inside Housing

# Istanbul



Source Removed from housing

# Istanbul



Damaged source exchange containers

# Istanbul

Within three days a number of the involved individuals became sick (nausea and vomiting).

They went to the hospital but were released. Doctors did not suspect radiation.

Some go later to a different hospital. Radiation is suspected.

# Istanbul

Physicians performed blood cell counts

Chromosomes analyzed, dicentric chromosomes counted

Patients isolated

Given blood transfusions and platelet transfusions

Colony stimulating factors used (CSFs)

Patients recovered



# Istanbul



Injury to hand 14 months after accident. Portion of one finger removed.

# Istanbul

High radiation levels detected at entrance to the scrap yard. The scrap yard was evacuated and the area cordoned off.

Recovery efforts planned carefully.

A dose limit of 2 mSv (200 mrem) was set for workers.

All personnel involved wore dosimeters.

# Istanbul



Scrapyard

# Istanbul



An empty shield was loaded on the back of a truck.

# Istanbul



Operators of mechanical grab at scrap yard asked to help. Their dose limit was set at 1 mSv (100 mrem).

# Istanbul

Bit by bit, pieces of metal were removed from the general area of the source (exact location not known). Pieces were then monitored for activity.

Having trouble, they decided to delay things for a day to plan what to do.

# Istanbul

A high dose rate detector was attached to the end of a long boom mounted on the end of a truck. This identified “suspicious objects.” The boom operator was behind a shield.

A long pole was used to spread scrap. Long shovel used to put suspicious objects into shielded bucket. This was done by many teams of two. Each team allows one try. Contents of bucket evaluated with detector at end of boom.

Source recovered.

# Istanbul



Surveying scrap at another scrap yard for other possible sources.



# Goiania

# Goiania



Two people removed the source assembly from a cesium-137 teletherapy unit left behind in an abandoned medical clinic. It contained 51 TBq of Cs-137.

# Goiania

These individuals were vomiting shortly thereafter but assumed it was bad food.

One felt dizzy, had diarrhea and a swollen hand.

He went to the hospital but the doctors concluded that it was an allergic reaction to some food.

The other person had the source under a mango tree at home and was trying to disassemble it. He punctured the source and removed some of the radioactive cesium.

The contamination resulted in over 1 Sv/hr at one meter.

# Goiania

The source capsule was sold to a scrap metal dealer.

He noticed that the punctured source capsule exhibited a mysterious blue glow.

Many people came to his house to see this, and a friend took some of the powder home and gave it to several people who spread it on their skin.

The scrap yard owner's wife received 5.7 Sv (5.7 gray). She went to the hospital but the doctors assumed it was an allergic reaction to food. She later died.

# Goiania

Two employees at the scrap yard worked on the source. They received 4.5 Sv (Gy) and 5.3 Sv (Gy). Both later died.

The brother of the scrap yard worker took fragments of the source to his home and put it on the kitchen table. Several family members handled the source while eating. His six year old daughter ingested a large amount of cesium and later died.

Convinced the source was bad luck, the scrap yard owner took the source to a doctor. Many people were going to hospitals with similar symptoms and eventually one suspected radiation sickness.

# Goiania

A medical physicist was asked to check out the bag. He took a NaI detector and turned it on long before he arrived at the doctors. The meter pegged but he assumed it was a bad meter. So he went back and got a replacement.

His new meter pegged so he caused the building to be evacuated.

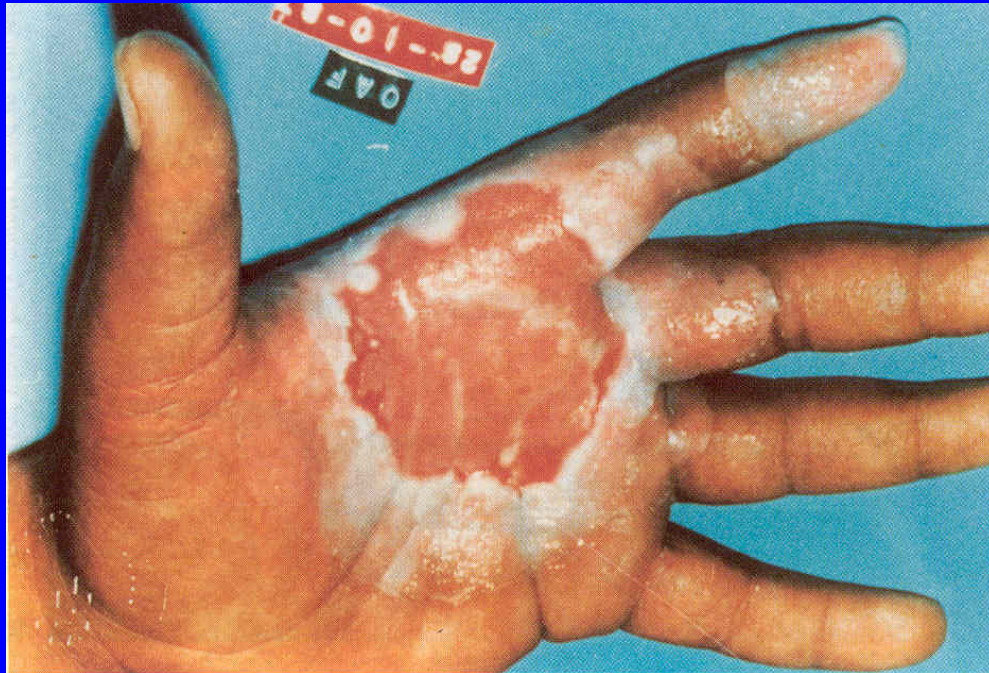
They also evacuated the home of the scrap yard worker.

# Goiania



Radiation lesion in thigh one month  
after the accident

# Goiania



Desquamation



# Goiania



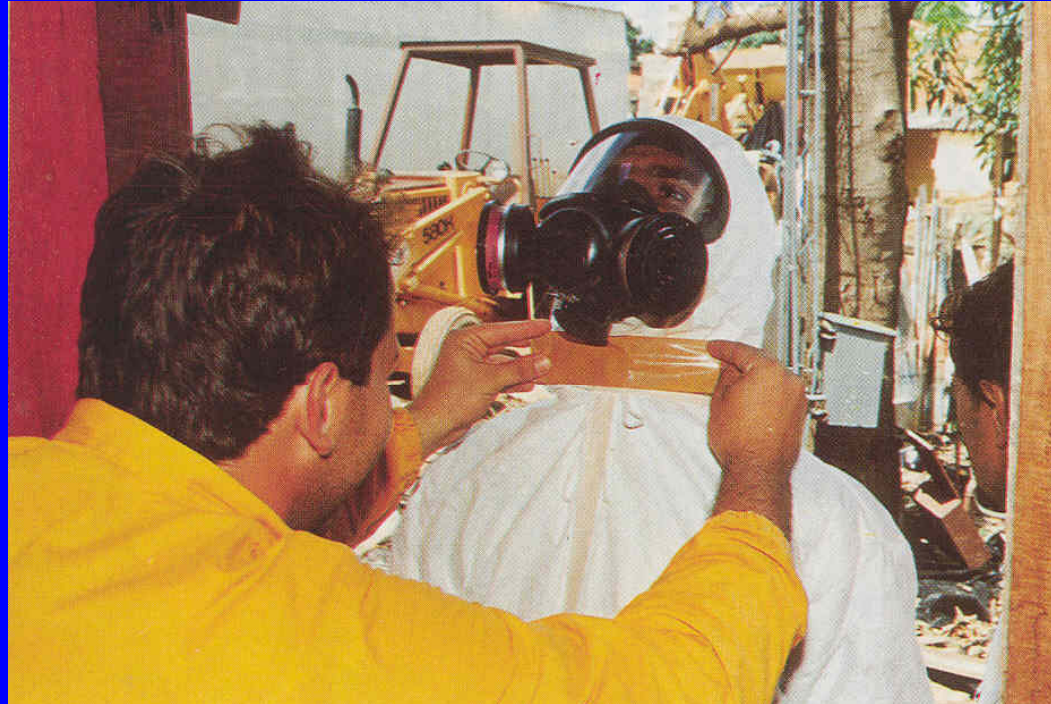
People being surveyed at football stadium. Of those surveyed, 249 had measurable contamination. Of these, 129 had internal contamination.

# Goiania



Hole being made in wall to remove a radiation hot spot of 0.5 Sv/hr (50 R/hr)

# Goiania



Preparing to demolish contaminated house

# Goiania



Demolished house

# Goiania



Surveying soil

# Goiania



Filling drums with contaminated soil

# Goiania



Waste containers at temporary storage site

# Goiania

## Annex I

### RADIOLOGICAL SURVEY EQUIPMENT

- (1) In order to protect monitors against the ambient environment, particularly radioactive contamination and rainwater, it was necessary to put them in plastic bags. This in itself caused some difficulty in taking readings and in general handling.
- (2) There were continual problems with the cables of instruments having remote probes. Often they could be repaired, but it was necessary to acquire a large stock of replacement cables.
- (3) Audible signals were found to be very useful in contamination monitoring, but in the presence of the public (such as in the monitoring of houses) it was necessary to mute the monitors, as the audible clicks gave rise to alarm.
- (4) The proportional counters and ionization chambers were found to be sensitive to the high humidities encountered and were therefore less useful. The ionization chambers were also sensitive to high temperatures.



# Goiania

(5) Equipment with digital readouts was found to be sensitive to temperature and was difficult to read in bright sunlight, particularly when the monitors were in plastic bags.

(8) A number of the monitors had slow response times; this became important in the later phases of the response to the accident when lower dose rates and contamination levels were prevalent.

(9) Subsequently, scintillation dose rate meters became available. These were designed for geological survey work. They could readily measure down to the level of background radiation and had a very fast response time. They were found very useful in quickly identifying small hot spots. As an indication of the usefulness of the speed of response,