Irradiator Technology H-315

Session 17

Accidents

Can Happen Anywhere!

Overexposure

Irradiation Facility Fleurus, Belgium

On 11 March 2006, the employee noticed that a radiation monitor alarm was activated with no irradiation in progress and the cell door open. He reset the alarm and entered the cell for 20 seconds to close the cell door.

The worker was not carrying a Geiger counter as required by company procedures.

It was determined he suffered an exposure of 420 rem.

Overexposure

Irradiation Facility Fleurus, Belgium

Update: May 15, 2006

The man is back with his family in Belgium.

He has lost all of his hair and needs to go to IRE (hospital) once a week for blood work.

People believe that he survived because he is apparently a "super athlete" at 50 years of age. .

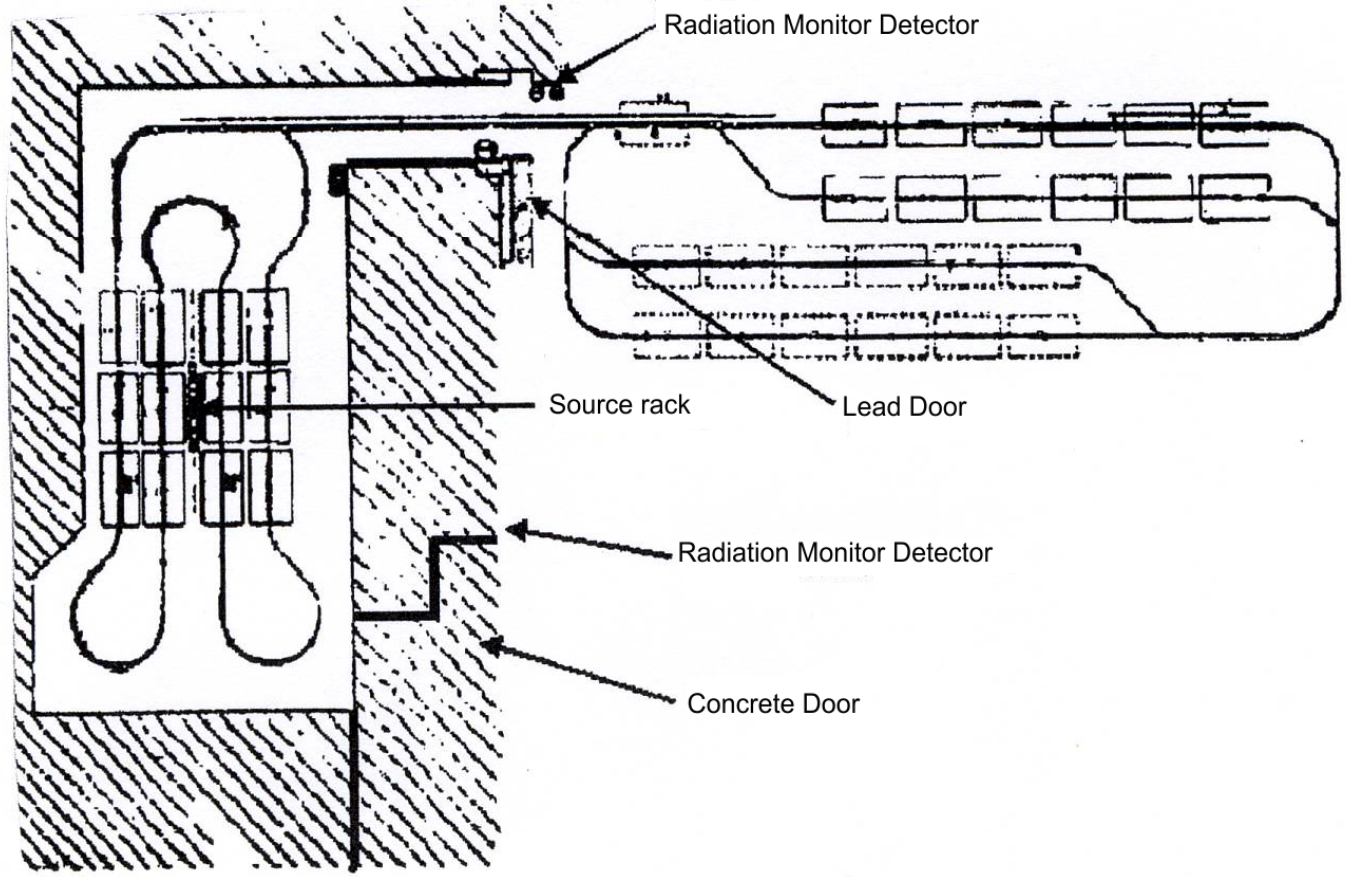
Overexposure

Irradiation Facility Fleurus, Belgium

Because the source hoist hydraulic system was shared with the product conveyor and the revolving door of the second irradiator, there was apparently some "known" back pressure problems. The day this man was overexposed, the rack was probably moving up and down much more than usual.

Overexposure

Irradiation Facility Fleurus, Belgium



Overexposure

Baxter Healthcare

HEADLINE: NRC PROPOSES $44,400 CIVIL PENALTY FOR BAXTER HEALTHCARE CORP. OVER IRRADIATOR EVENT AT PUERTO RICO FACILITY.

On April 21, 2004, interlocks were bypassed. Workers partially entered the room, were exposed to 4.4 and 2.8 Rem. They would have received a potentially lethal dose if they had entered the room completely. A step ladder left over the path of the source rack after changing a switch was the cause of the stuck source

Personnel Fatality at Steris Isomedix

On June 7, 2002 an incident occurred at the Spartanburg facility. A maintenance worker 41 years old died when a 12 foot tall metal carrier crushed his neck. The incident occurred when the conveyor jammed and he climbed a ladder to see what was causing the problem, the monorail system had not been locked out, the carrier moved towards him while he was trying to free it and he was hit.

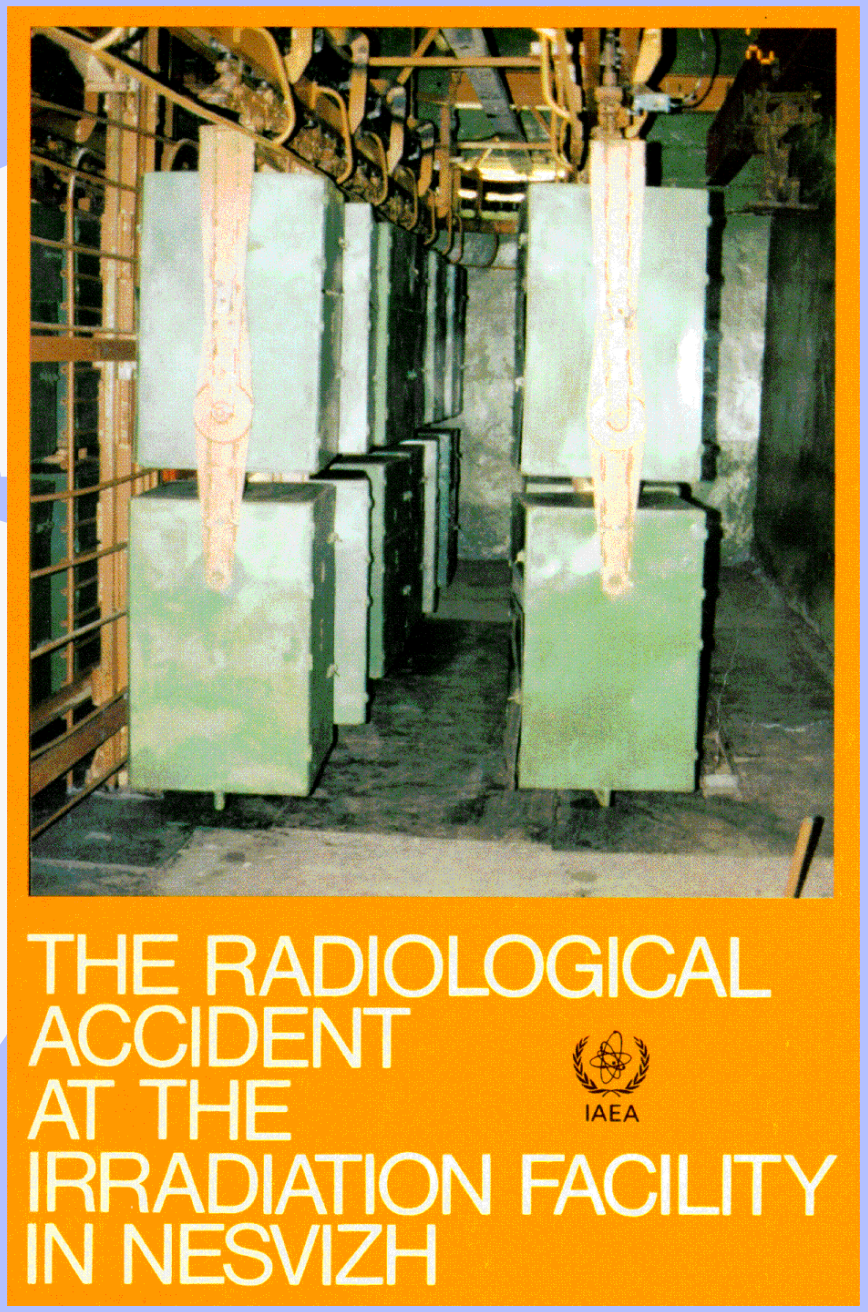
Personnel Fatality at Baxter Healthcare

Baxter Healthcare Corporation operates an irradiator facility for medical product sterilization in Aibonito, Puerto Rico. The licensee reported that a fatality occurred on July 31, 1998. The irradiator has shutdown following a carrier jam condition. An operator entered the irradiator room to troubleshoot the problem. While troubleshooting, there was some unexpected movement of the product carrier and the operator was trapped and killed. The accident did not involve any exposure from the radioactive source. The licensee is also obtaining assistance from the manufacturer, MDS Nordion, to determine any potential equipment problems.

October 1991

- Safe operating procedures were not followed

- Safety features were circumvented



Radiological Accident In Nesvizh

11Gy - 18Gy

Whole body dose

Died 113 days later

Radiological Accident In Nesvizh

Accelerator Accident

Maryland 1991

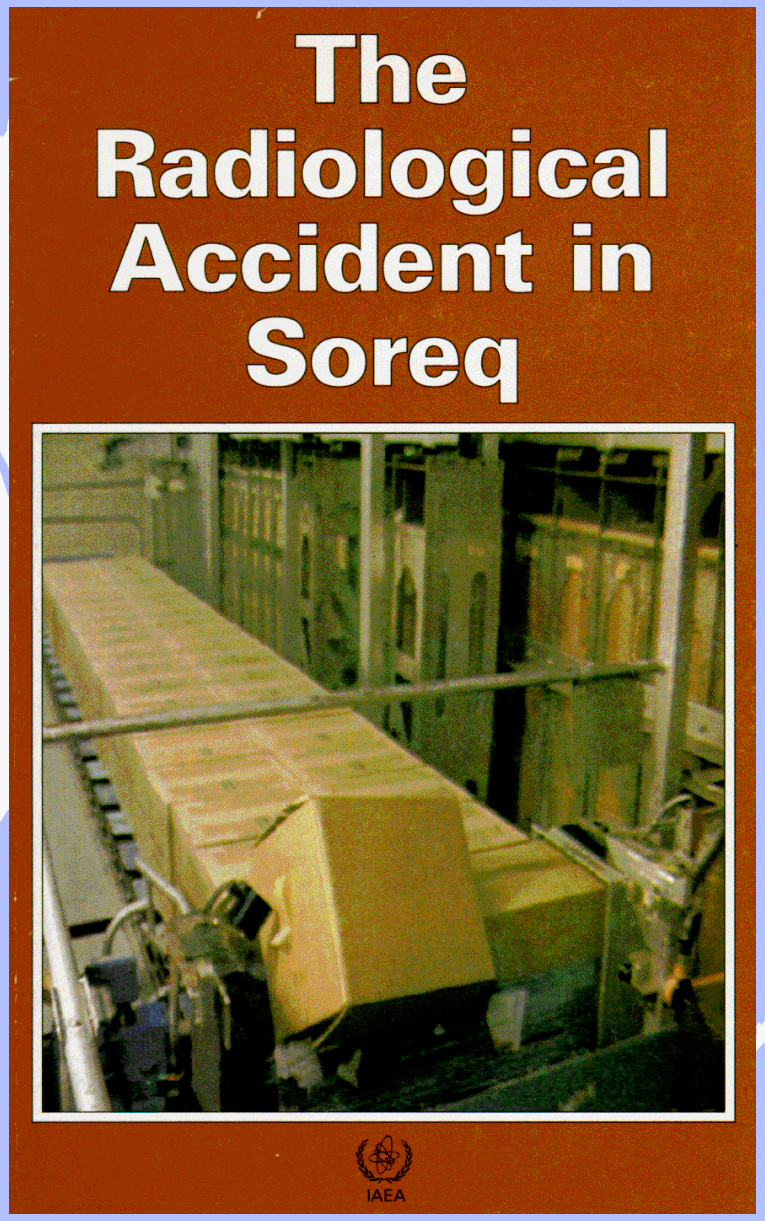
0.4 Gy/s - 13 Gy/s at various parts of body

Amputation of left and right hand digits 3 months later

… Also Hanoi Vietnam

June 1990

- Conflicting information on control console
- Safety systems bypassed
- Operating instructions not in local language
- Product boxes in poor quality
- Lack of shroud



Radiological Accident In Soreq

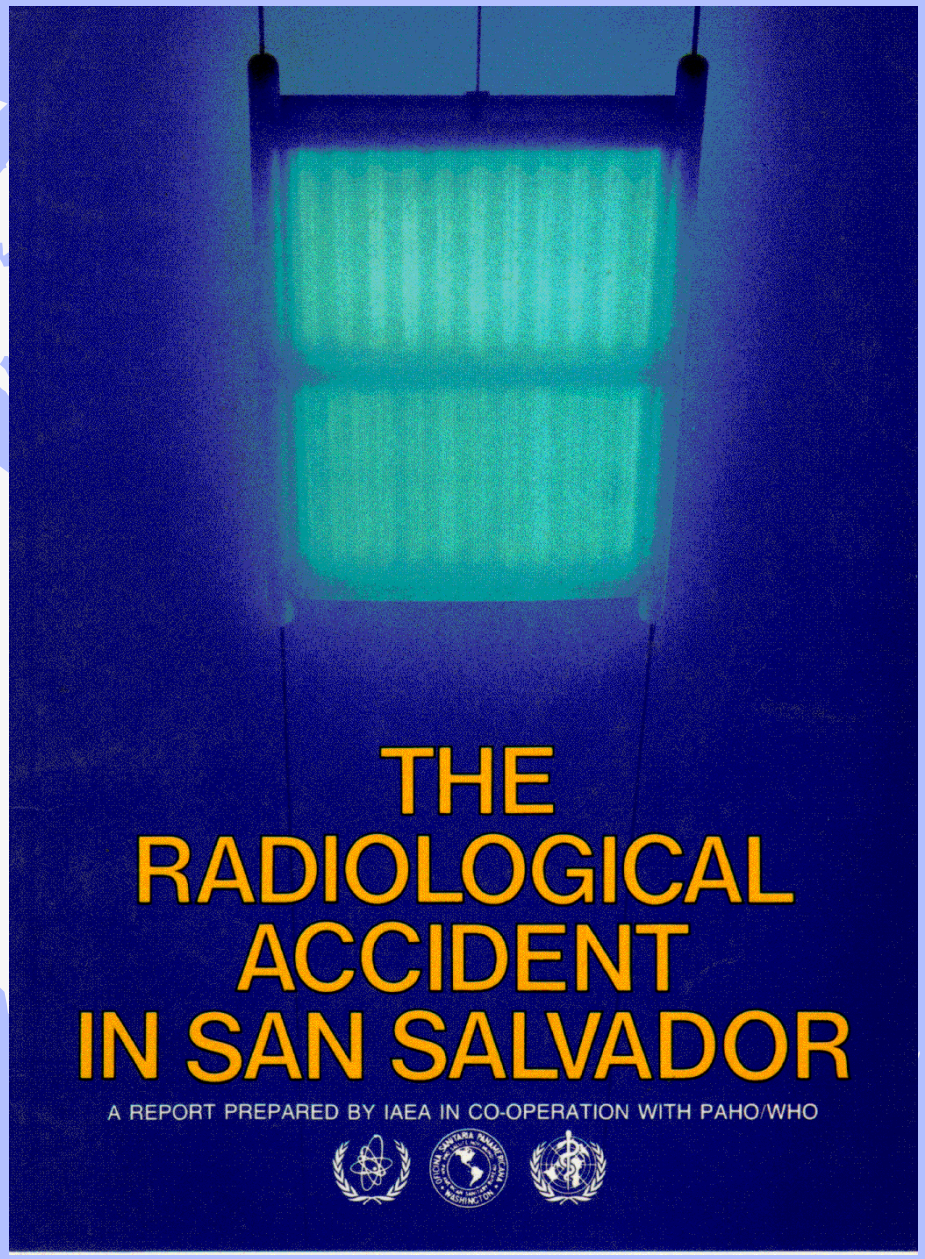
10 Gy - 15 Gy

whole body dose

Died 36 days after exposure

February 1989

- Lack of shroud
- Deformed source rack
- Product boxes in poor condition
- Degradation of safety procedures and systems
- Operators with informal training
- No relevant regulatory control



Radiological Accident in San Salvador

Worker 1: one leg amputated, died later

Worker 2: both legs amputated, prognosis good

Worker 3: residual effects

Other Incidents

- Kjeller, Norway, 1982
- RTI Rockaway N.J. 1977
- Stimos Italy 1975
- LINAC Illinois 1965
- USNRC Events at Large Irradiators (NUREG 1345)

Lessons to be Learned

- Safety Audits (meet recommendations)
- National Infrastructure??
- Manufacturer safety Upgrades
- Training ! Training ! Retraining !
- RSO
- Preventative maintenance
- Never bypass safety systems
- Follow proper entry procedures
- Survey meter works Ok!! Battery + test
- Emergency procedures

Lessons to be Learned

- Follow chain of command
- No disabling of safety systems
- No operation if safety system malfunctioning
- Redundancy in safety system
- Fix problem that can lead to source/product jam
- Operator's manual in local language
- Management commitment to safety
- Conflicting signal (assume the worst, prove it wrong

Where To Find The Info

- IAEA publications (many)
- ICRP Pub. 76 1997
- NUREG
  - Georgia leakage (1392)
  - Review of events (1345)
  - Working in Gamma Radiography (/BR-0024)

end

BIOLOGICAL EFFECTS OF RADIATION

Whole Body Exposure

Acute dose: (Massive dose in short time)

0-25 Rems: No serious injury

25-100 Rems: Blood cell changes, Possible injury

100-200 Rems: Nausea, possible disability

200-300 Rems: Nausea, Injury, disability, possible death, loss of hair…

300-600 Rems: **LD50, fatal to 50% of people**

600 Rems and up: Fatal

Note: Acute lethal dose can happen in seconds inside the source pass of a Production Irradiator

BIOLOGICAL EFFECTS OF RADIATION

Phase	Symptom	Exposure (Sv)				
		1–2 Sv	2–6 Sv	6–8 Sv	8–30 Sv	>30 Sv
Immediate	Nausea and vomiting	5–50%	50–100%	75–100%	90–100%	100%
	Time of onset	2–6h	1–2h	10–60m	<10m	immediate
	Duration	>24h	24–48h	<48h	<48h	48h–death
	Diarrhea	None	Slight (10%)	Heavy (10%)	Heavy (90%)	Heavy (100%)
	Time of onset	—	3–8h	1–2h	>1h	<30m
	Headache	Slight	Mild (50%)	Moderate (80%)	Severe (80–90%)	Severe (100%)
	Time of onset	—	4–24h	3–4h	1–2h	<1h
	Fever	Slight–None	Moderate (50%)	High (100%)	Severe (100%)	Severe (100%)
	Time of onset	—	1–3h	>1h	>1h	>30m
	CNS function	No impairment	Cognitive impairment 6–20 h	Cognitive impairment <20 h	Rapid incapacitation	Seizures, Tremor, Ataxia
Latent Period		28–31 days	7–28 days	>7 days	none	none
Overt illness		Mild Leukopenia; Fatigue; Weakness	Leukopenia; Purpura; Hemorrhage; Infections; Epilation	Severe leukopenia; High fever; Diarrhea; Vomiting; Dizziness and disorientation Hypotension; Electrolyte disturbance	Nausea; Vomiting; Severe diarrhea; High fever; Electrolyte disturbance; Shock	Death
	Mortality without medical care	0–5%	5–100%	95–100%	100%	100%
	Mortality with medical care	0–5%	5–50%	50–100%	100%	100%

Where To Find The Info

- USNRC web site
  - www.nrc/gov
- IAEA web site
  - www.iaea.org
- DOE web site
  - www.doe.gov
- Nuclear Material Events Database
  - http://nmed.inel.gov

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NMED

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Quarterly Reports

The Nuclear Materials Events Database (NMED) contains records of incidents involving radioactive material licensed under NRC regulations or compatible Agreement State regulations and reported to the NRC by the NRC licensees and the Agreement States. Event records are maintained in the NMED for the period of January 1990 through the present.

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Workers Undergo More Tests for Radiation Exposure

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North Korea Keeps World Guessing

Thought for the Day:

"The ear tends to be lazy, craves the familiar and is shocked by the unexpected; the eye, on the other hand, tends to be impatient, craves the novel and is bored by repetition."
- W. H. Auden

Electrostatic Measuring Monitoring & Test Equipment

Radiation burn

California 1979

28 Ci Iridium source

45 min exposure in back pocket

50 days after accident (photo)