Public Health England

OTHEA: review of industrial radiography incidents

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EAN 16th Workshop
"ALARA in industrial radiography: how can it be improved?"
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Started in 2010 by France and UK (CEPN and PHE)

- 5 main sectors, 21 sub-sectors
- 100+ incidents reports in total
- 10,000 Visitors, 130 countries

OTHEA is a TRAINING RESOURCE

- Incidents are anonymous, free to use
- Not all incidents are included - only those with interesting lessons learned

OTHEA is NOT a database, however:

- Includes 36 industrial radiography incidents
  - 6,000 visits in total
- This presentation presents an analysis of these incidents


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Non-destructive testing
Reports
Country of origin
Available languages
Incident involving radiation injury from gamma NDT source exchange
France
Incident during the retraction of a gamma NDT source
France
Detached source with automated gamma NDT exposure equipment
France
Persons exposed due to failing to wind in NDT source between shots
France
Iridium-192 source stuck outside container due to equipment misuse
France
Industrial radiography: collection of incidents involving unauthorised persons in the controlled area
France
Exposure to persons during gamma radiography of a barge
France
Exposure to persons in poorly defined radiography controlled area
France
People entered radiography controlled area
France
Lost radiography source leading to exposure of many personnel
United Kingdom
Deterministic injuries to radiographers hand
United Kingdom
Industrial radiography guide tube damaged during use led to high exposure
United Kingdom
Gamma NDT overexposure from non-retracted source
United Kingdom
Drilling through a thulium-170 gamma NDT source producing widespread contamination
United Kingdom
Unauthorised gamma radiography exposes site welders
United Kingdom
Recovery of gamma NDT sources - 3 examples
United Kingdom
Entry in cobalt-60 radiography compound with source exposed
United Kingdom
Radiographer exposed due to poor communication between teams working at same time
United Kingdom
Poorly maintained radiography container - workers exposed
United Kingdom
Gamma radiography source stolen and dumped in canal
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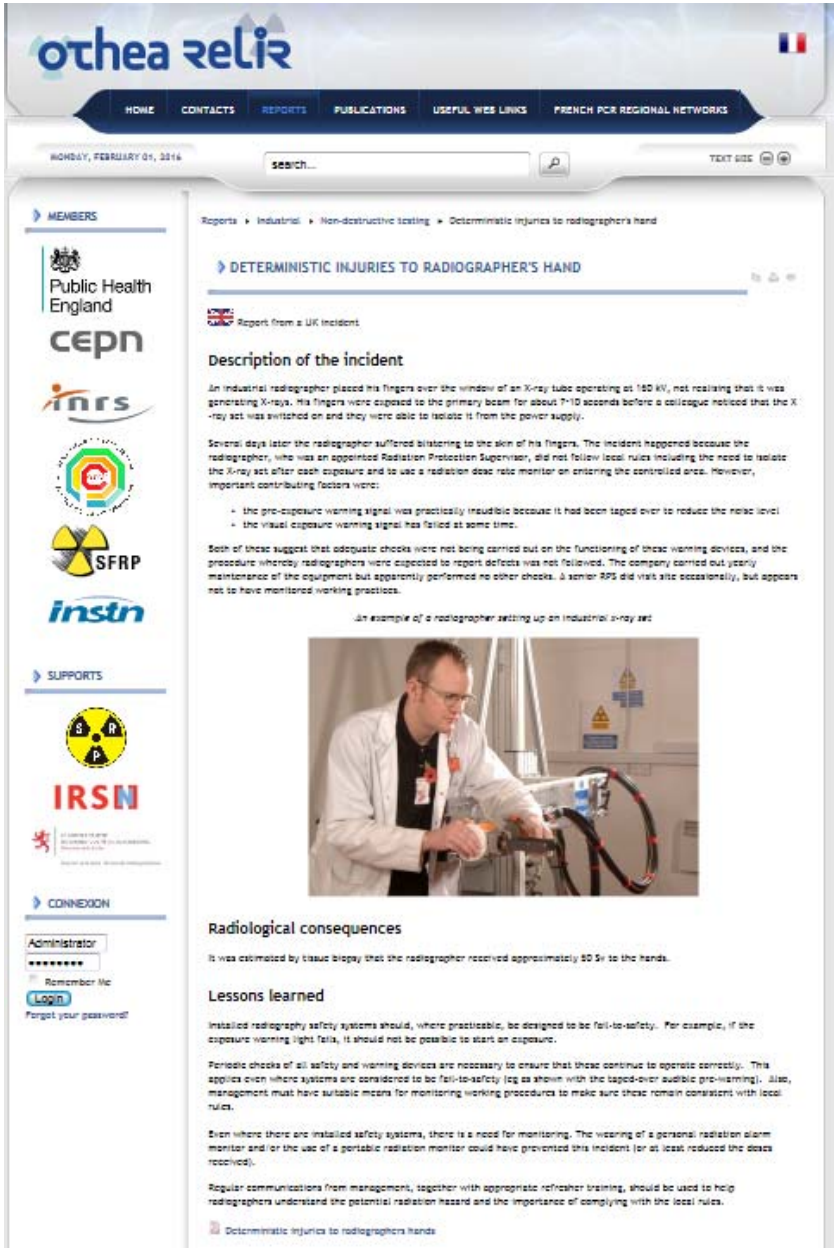
Gamma NDT source disconnected - radiographers exposed between radiographs
United Kingdom
Industrial radiography enclosure - failure of door interlock
United Kingdom
Failure of automated wind-out system in gamma radiography enclosure: 3 examples
United Kingdom
Unusually high recorded doses - 4 examples from industrial radiography
United Kingdom
Incident involving premature lock out of Techops 880 container
United Kingdom
Incident in x-ray NDT enclosure due to disabled safety systems
Slovenia
Incident during gamma radiography - exposure of a worker
France
Industrial radiography: hand injury from exposure to X-ray beam
United Kingdom
Overexposure of welders due to temporary loss of ytterbium-169 (Yb-169) source
United Kingdom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DETERMINISTIC INJURIES TO RADIOGRAPHER'S HAND
Report from a UK incident
Description of the incident
An industrial radiographer placed his fingers over the window of an X-ray tube operating at 160 kV, not realising that it was generating X-rays. His fingers were exposed to the primary beam for about 7-10 seconds before a colleague noticed that the X-ray set was switched on and they were able to isolate it from the power supply.
Several days later the radiographer suffered blistering to the skin of his fingers. The incident happened because the radiographer, who was an appointed Radiation Protection Supervisor, did not follow local rules including the need to isolate the X-ray set after each exposure and to use a radiation dose rate monitor on entering the controlled area. However, important contributing factors were:
the pre-exposure warning signal was practically inaudible because it had been taped over to reduce the noise level
the visual exposure warning signal has failed at some time.
Both of these suggest that adequate checks were not being carried out on the functioning of these warning devices, and the procedure whereby radiographers were expected to report defects was not followed. The company carried out yearly maintenance of the equipment but apparently performed no other checks. A senior RPS did visit site occasionally, but appears not to have monitored working practices.
An example of a radiographer setting up an industrial x-ray set
Radiological consequences
It was estimated by tissue biopsy that the radiographer received approximately 80 Sv to the hands.
Lessons learned
Installed radiography safety systems should, where practicable, be designed to be fail-to-safety. For example, if the exposure warning light fails, it should not be possible to start an exposure.
Periodic checks of all safety and warning devices are necessary to ensure that these continue to operate correctly. This applies even where systems are considered to be fail-to-safety (eg as shown with the taped-over audible pre-warning). Also, management must have suitable means for monitoring working procedures to make sure these remain consistent with local rules.
Even where there are installed safety systems, there is a need for monitoring. The wearing of a personal radiation alarm monitor and/or the use of a portable radiation monitor could have prevented this incident (or at least reduced the doses received).
Regular communications from management, together with appropriate refresher training, should be used to help radiographers understand the potential radiation hazard and the importance of complying with the local rules.
Deterministic injuries to radiographers hands

Incidents and doses

36 incidents:

- 80% gamma radiography (Ir-192 plus Co-60, Tm-170, Yt-169)
- 20% X-ray radiography
- 60% site radiography, 40% in radiography enclosures

Radiological consequences:

- 135 exposed persons (60 from one lost source incident)
- Individual effective doses: 0 to 370 mSv
- 21 overexposures (>20 mSv)
- Collective dose = 2.6 man Sv
- Hand doses: 0.2 to 60 Sv
- 3 reported hand injuries
  - 2 X-ray, 1 gamma

Categorisation of causes of incidents

- Each OTHEA incident reviewed
- Causes of incidents identified and categorised as one or more of the following:

Equipment failures	Procedural failures
Source (capsule and connector)	Lack of training
Source container	Lack of supervision
Exposure control (wind-out)	Poor equipment maintenance
Safety and warning system	Equipment used incorrectly
Dose rate monitor	Inadequate dose rate monitoring
Personal alarm	Failure to control the area
	Unsafe working procedures
	Lack of emergency plans
	Badly executed emergency plans
	Communication between Companies

Results of analysis…

Total equipment failures = 27

For example, personal alarm dosemeters:

- In 7 incidents it was reported that wearing an alarm would have either prevented the accident, or else significantly reduced the doses received.
- Plus…
  - 1 broken personal alarm
  - 1 worn underneath clothing
    - with no audible alarm
  - 1 alarm activated but ignored

Total procedural failures = 85

27 equipment failures…

Category	Number of incidents
Exposure system (gamma wind-out)	9
Safety system (or lack of)	9
Source (capsule and connector)	4
Container	3
Dose rate monitor faulty	2
Personal alarm faulty	1

85 procedural failures…

Category	Number of incidents
Unsafe working procedures	15
Poor equipment maintenance	12
Equipment used incorrectly	12
Lack of training specifically identified	10
Inadequate dose rate monitoring	10
Poor communication between Companies	8
Failure to control the radiography area	7
Lack of emergency plans	4
Badly executed emergency plans	4
Lack of supervision	3

“Unsafe working procedures”

The most generic category

- probably why it is at number 1

Examples:

- Forgetting equipment assembly steps
- Not repairing/reporting faults
- Poor communication between radiographers
- Ignoring warning signals
- Not properly isolating the source between exposures
- Continuing the work even when a problem arises
- Not reporting incidents

All examples of poor ALARA Culture?

plus

- Two examples of malicious action?

Observations…

- ALL incidents include an element of procedural failure
  - eg equipment failure caused by poor maintenance
- Lack of training was specifically identified in 10 incidents, but is implied in almost all incidents
- There is a need to think about the underlying causes of procedural failures, for example:
  - Money (lowest bidder contracts, radiographer pay)
  - Time (money, need to fit into clients schedule)
  - Working conditions (at night, poor access, lighting etc.)
  - The human factor (tiredness, stress, job dissatisfaction)

Public Health England

Thank you for your attention
danke, merci, grazie, grazcha

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