

## REVIEW OF OVEREXPOSURE EVENTS

Given the significant potential consequences of overexposures, staff performed a special study of the overexposure events that have occurred in the 4-year period from FYs 2002-2005.

### Frequency of Occurrence:

Only a small percentage of events per year are overexposures.

- Only 3% of total events (56 overexposure events out of a total 2038 events reported for a 4-year period from FYs 2002-2005).

Few overexposure events per year meet AO criteria (i.e., significant events).

- Zero AO overexposures in FY 2005.
- Only 6 out of 56 total overexposure events for FYs 2002-2005 were AOs (an average of 1.5 per year).
- Less than 0.3% of total events are AO overexposures.
- About 10% of the overexposure events are AOs.

Few overexposures per number of individuals involved in work with radioactive materials.

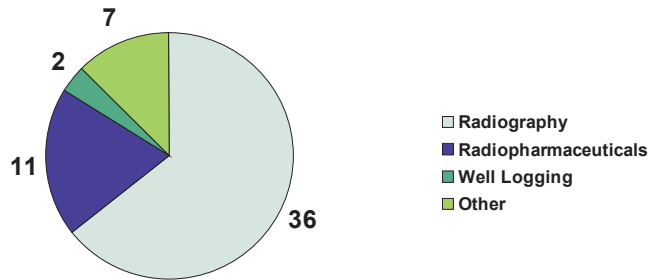
- Perspective: compare to the total number of opportunities for an overexposure to occur.
- Per NUREG-0713, vol. 26, it is estimated that there are over 13,000 monitored occupational workers at over 120 materials licensees.
- Per NUREG-1350, vol. 17, there are over 21,000 materials licensees.
- Some types of activities involving radioactive sources are conducted in environments where members of the public are nearby, such as in hospitals, in radiography or portable gauge field work, or during transportation. This is a normal part of the nature of these activities. Although the material and areas are controlled, the proximity of the public presents the possibility of inadvertent opportunities for members of the public to be in close proximity to sources (e.g., medical, radiography, well logging, portable gauges, transportation).
- Given these high numbers, it is significant that there are so few overexposures per number of individuals involved in work with radioactive materials, or that could possibly come in proximity to work involving these materials.

### Type of Licensee:

Overexposure events primarily involved three type of licensees.

- 88% involved radiography, well logging, and radiopharmaceuticals (49 out of 56).
- Remaining 12% involved a brachytherapy source, two fixed gauges, and three events involving unsealed material (7 out of 56).

Enclosure 4



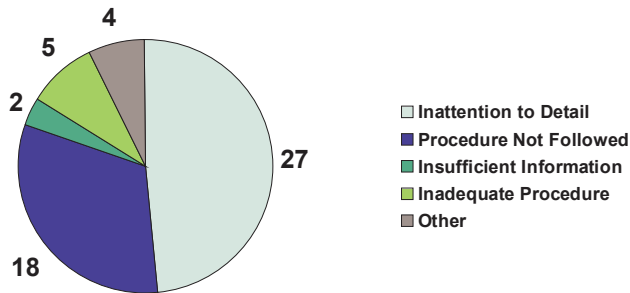
There are certain patterns within the three primary types of licensees involved.

- Radiography overexposure events typically involve whole body doses less than 10 rem to occupational workers and only involve one person.
  - 92%, 33 of the 36 radiography events, only 3 of these involved more than one person.
  - 82% did not exceed 10 rem (27 out of 33). Of the 6 exceeding 10 rem, the highest was 152 rem, and the next highest was 31.4 rem.
  - Only one event involved a dose to the public (doses to 2 FedEx package handlers from handling a damaged shipping package containing Ir-192 wafers for radiography sources).
- Well logging overexposure events typically involve non-radiation rig workers in the area and involve more than one person.
  - 2 events out of the 56 total overexposure events for FYs 2002-2005.
- Overexposure events involving radiopharmaceuticals typically involve extremity doses to occupational workers and involve only one person.
  - 11 events out of the 56 total overexposure events for FYs 2002-2005 involved radiopharmaceuticals.
    - 9 of these 11 events involved extremity doses to workers. Only 1 event of the 9 involved more than one person.
    - 2 events involved whole body doses to family caring for or visiting patients that were receiving therapeutic radiopharmaceutical doses, and where the family member did not adhere to directions/controls provided by hospital to minimize dose received (e.g., moved lead shield to be closer to the patient).
- The patterns seen are not unexpected given the types of work being performed in these areas, and the typical environments in which they are conducted.
  - Radiography: field work, fast moving, temporary setups, coordination with other types of non-rad work, large sources increasing the potential to (and more likely than users of small sources to) exceed the annual whole body doses by small amounts), handling source connections by hand (increasing potential for extremity doses to fingers in cases where sources are mishandled)

- Well logging: field work, fast moving, temporary setups, doses to public possible if source is left behind
- Radiopharmaceuticals: handling doses with hands increasing the potential for doses to extremities, unsealed material increasing the potential for contamination events, most handling done in restricted area increasing likelihood that any doses would be to only rad workers (and not to non-rad workers). Doses to family members not unexpected given family members more focused on comforting patient than in abiding by restrictions placed to minimize dose.

Cause:

Human error was the primary cause (80% of the events, 45 out of 56).



Summary:

Awareness of workers regarding the need for attention to procedures and detail is important in reducing the potential for overexposures.

No regulatory changes are recommended.

- There is a very low rate already and most of the errors could not easily have been foreseen (e.g., the equipment was well-designed, the procedure was adequate, the training was adequate, but the worker just did not follow the procedure or was inattentive).
- NRC is already engaged in raising awareness.
  - Issuing Information Notices to make licensees aware of potential problems or weaknesses
  - Sharing of examples of overexposures in NMSS Quarterly Newsletter (which goes to all licensees)
  - Communicating the importance that NRC places on avoiding overexposure by issuing enforcement (which also provides incentive for other licensees to avoid actions which could cause them to receive enforcement)
  - Conducting inspections (to allow NRC to identify pre-cursor issues that may lead to overexposures)
  - Starting human reliability studies with RES to explore whether there are ways to further reduce potential for human errors.