The Response To Depleted Uranium Turnings Dumped In Northamptonshire

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INTRODUCTION

The discovery, by HM Inspectorate of Pollution (now part of the Environment Agency), of a substantial quantity of depleted Uranium Swarf scattered about derelict land on a farm in East Northamptonshire, UK, sparked a full scale emergency, where the National Arrangements for Incidents Involving Radioactivity (NAIR) Scheme were invoked.

Major users of radioactivity are required by UK law to have appropriate emergency plans.[1] The NAIR Scheme, co-ordinated by the National Radiological Protection Board (NRPB), provides advice to the Police on accidents involving radioactivity in cases where no emergency plan applies, or if such a plan fails. The Scheme envisages two stages of response - an initial response by local experts, usually from a hospital physics department; and a second stage, if the incident is large or requires specialists, from companies in the Nuclear Industry.[2] The Medical Physics Department at Northampton General Hospital was the local NAIR I contact.[3]

DISCUSSION

The first stage was an inter-agency meeting on Friday, the 13th of January, 1995, to discuss the discovery and its implications. The agencies present included the Police, Fire Service, Public Health, Ambulance, Mr. Denman as NAIR Stage 1, County Council, HMIP, District Council Environmental Health and a USAAF representative.

Discussion centred on whether, as the swarf was on private land, the farmer should be required to clean up the site, or whether the material was a sufficient public health risk that NAIR should be invoked. As the area had no gate, and was used as an adventure playground by children of nearby USAAF residents, and was a general illegal dump, it was decided that there was a public

risk, and, as there was no other obvious emergency plan, NAIR was invoked. Without visiting the site, NAIR Stage I decided that the clear-up was beyond their capabilities, and invoked Stage II directly.

The most at risk group were the children in USAAF Accommodation 100 metres away, and it became a priority to meet residents. Senior USAAF Staff were briefed at 15.00, and a residents meeting called for 18.00. Press were briefed at the site at 16.00. The Health Help-line was established by 18.00 with the twin aims of finding anyone who had been on the site and reassuring other members of the public. NAIR Stage II, AEA Technology, Harwell, arrived at 17.30. At the Meetings with USAAF staff and residents, and at the Press Conference, Dr Morgan and Mr Denman, together with the HMIP Inspector, Adrian Bush, provided expert comment.

The possibility of radioactive waste being on the farm had been raised when a consignment of metal waste set off a radiation alarm in a Sheffield scrap-yard. The company had only fitted the alarm recently in order to detect contaminated metal from sources such as Scandinavian steel with raised Caesium content following Chernobyl. Subsequently, a paper in Health Physics noted 38 incidents of radioactivity in scrap, worldwide, in the period 1983 to 1994 [4], and incidents continue at the rate of 3 each year.[5]

The passage of the waste had been tracked back by HMIP, via another scrap-yard in Northampton, to the farm. Originally suspected to contain Caesium, the material had, by the start of the NAIR incident, been identified as depleted Uranium Swarf, - that is metal turnings, 0.25 by 1 inches of almost pure Uranium-238, an α-emitter with half-life of $4.5 * 10^9$ years, decaying to radioactive daughters emitting α and β-radiation.[6] The Annual Limit of Intake is 0.5 MBq orally and 50 kBq for inhalation (minimum dependent on form).[7] It is pyrogenic, and should be stored under oil; otherwise oxidises to yellow\green oxide. It is also a chemical hazard with a daily limit 2.5 mgm, and a threshold limit in air equivalent to an ALI of 10 MBq. The risks are ingestion of oxide and inhalation of smoke if it burns. Additional information about depleted Uranium was obtained during the incident from the NRPB, British Nuclear Fuels (BNFL) and the NHS National Poisons Unit.

The swarf had been dumped in black unmarked drums; some had been opened and emptied and others had been knocked over, spilling the contents, so that most of the swarf was exposed. The initial assessment was that 50 kgm had been spilt.

AEA took several days to investigate the extent of the uranium and to plan the strategy to remove it. The swarf was spread over a sizable area on the ground amongst brambles and on the concrete roadway, pressed into the surface by vehicles. The estimate was revised upwards, and AEA eventually removed almost 1000 kgm of swarf from the site. AEA were concerned that the metal could catch fire when moved, and therefore proposed to make the piles safe with oil and transfer these piles to large oil-filled drums. The latter was the most hazardous operation. This required special protective suits and fire-fighting equipment.

This raised the possibility of a fire and radioactive plume, and consequent hazard to the public. A series of inter-agency meetings were held over the weekend to consider the implications, and Neil McColl, as NAIR Coordinator, ran computer simulations at NRPB to consider the risk from a plume in view of the current wind direction. The calculation assumed that 1% of the uranium would be sufficiently vaporised to be carried off-site. The projected radiation risk was low compared to NRPB Sheltering Limits [8], but it was decided that the USAAF personnel should be asked to stay away from their accommodation, or shelter in it throughout the 7 hour operation.

The Police set up road-blocks at convenient junctions half a mile away, and an ambulance, fire tender, and Mr Denman were on stand-by near the scene throughout. The operation was carried out safely, with the bulk of the uranium being removed that day. AEA took several months to completely clear the site, including scrubbing the concrete roadway, and removing a substantial amount of top-soil. This procedure was only completed in early 1996.

The Health Authority set up the telephone Help-line, 6 lines manned all week-end. Details were taken from callers, and these were prioritised following the guidelines in Table 1. This process was aided by a map of the site, initially cryptic, showing location of the swarf. Callers were reassured that they would be contacted again, starting with those of highest priority. 73 calls were received, and a further 21 were contacted as a result of these calls. The numbers of people (callers, USAAF residents, and people contacted) in each category is also shown in Table 1.

Table 1- Priorities used by Help-line

Priority	Definition	Numbers	of People
		Contacts	Physics Visits
5	Took swarf away. Ate it	0	0
4	Handled Swarf on site	3	3
3	Definitely saw and trod on swarf	3	3
2	Walked all over site, including drum area	22	20
1	Walked on site, not near drums	12	9
0	Never visited site (includes drive past)	134	17

A surprising number of people had been on the site as shown in Table 2.

Table 2 - People who visited the site

American Children Playing	American Resident jogging	Waste Regulators
Pigeon Shooters	Pheasant Shoot and Beaters	Fox Hunt Followers
Metal Sculptress	Aircraft memorabilia Group	Apple Scrumpers
Old bottle collector	Car scrap-dealer	Some-one dumping car
Farm Workers	Fly Tippers	Lovers

CONCLUSION

It was concluded that any contamination would be on outdoor shoes, door-mats, ground floor carpets, out-door clothing; and bike and car tyres, and so people were monitored in their own homes. The USAAF residents were monitored first, with the rest of the monitoring starting on Monday using three teams of two - one from the local Medical Physics Department, and two from NRPB. In total 52 people were monitored, (see Table 1), and all found to be negative. Eight people at greatest risk were offered whole body monitoring using the shielded germanium detector system at NRPB. Two took up this offer and were both found to be negative. Those not visited were advised by letter of the negative results for those at greater risk.

The only radioactivity found off-site was a small amount in the bottom of a drum - one of those used to transport the uranium. This had been removed from the site by a farm worker to a housing estate in a large town and used as a garden incinerator. Fortunately the area around the drum was clear, suggesting that the drum had been emptied before use.

From the quantity which was discovered on the site, it was surmised that a further empty drum must have been taken from site. This was no doubt an unmarked black drum like the others, of which there are many lying around the countryside. As the drum would be empty the risk to the public would be very low. It was concluded that there should be no public appeal to locate the drum.

The Police Press Office took charge of dealings with the Press. Their preference was to release the news as early as possible, to prevent speculation. This, of course, was prior to a full examination of the site by Stage II. At that time, the risk to people going on to the site was compared to a few chest X-Rays. The Press demanded pictures and hence access to the site, and had to be tested for contamination afterwards which sidetracked staff from public monitoring. The discussions about the fire risk to local communities did not excite the public greatly, even though news leaked out that this was being considered. Further, the Press missed the potential significance of the drum that was found off-site.

Public reaction to the incident was to a major extent determined by local, national and international press coverage Would the incident have had a higher profile without the on-going story of public demonstrations over live export of calves? The national press aided by spokesmen from pressure groups such as Friends of the Earth made much of the environmental concerns with subsequent comment developing a political dimension - "how could it happen?" - "could it happen again?" - rather than local health risks.

The Health Help-line number was carried by the national media, but given more prominence in the local press in Northamptonshire. The incident occurred 1 mile from the county border, but no one who lived outside Northamptonshire called the Help-line. Some callers were concerned that rats on the site could have carried the uranium off site to contaminate workers in an industrial complex half a mile away. Two ladies had scrumped apples, and made pies, and were concerned that the apples were contaminated.

By contrast, the American Residents had greater knowledge of the risk from uranium, because of health concerns over Uranium Mining. The residents were anxious for their children, but the concern dropped markedly once the site entrance and children's playground were found to be uncontaminated.

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Graded Decision Guidelines for Public Health Activities -- Lansdowne, Pennsylvania

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INTRODUCTION

In 1991, the Environmental Protection Agency (EPA) Region III office requested that the Agency for Toxic Substances and Disease Registry (ATSDR) initiate preliminary public health evaluations of radiologic hazards associated with several residential properties in Lansdowne, Pennsylvania. Because of the presence of radium, radon, and asbestos in the house at 133 Austin Avenue and an adjacent warehouse as reported by EPA, ATSDR determined an imminent public health hazard existed and both agencies expressed concern about the potential for structural fires, intrusion, or other unauthorized events. Because of ATSDR activities, and with concurrence of EPA, the site was included on the National Priorities List (NPL).

On June 13, 1991, EPA Region III contacted the EPA National Air and Radiation Environmental Laboratory (NAREL) to help in the initial site evaluation at 133 Austin Avenue. This two-family rental unit was believed to be contaminated with radium-226 (Ra-226) processed during the early 1900s at the adjacent warehouse at 36 S. Union Street. EPA Region III informed ATSDR that the rental house was occupied by two families, including a woman who was approximately 6 months pregnant. On the basis of limited sampling information, ATSDR concurred with the EPA Region III recommendation that all residents in the house be relocated. This relocation occurred during June 17 - 23. On June 19, NAREL collected radiologic data at the site, including external gamma radiation readings, levels of fixed and removable contamination, and radon levels in the house and adjacent warehouse.

DISCUSSION

NAREL released the results of this survey on June 28, 1991. The reported levels of external gamma radiation ranged from background levels (15 microroentgens/hour; μR/h) to 1.2 milliroentgens/hour (mR/h) in the master bedroom on the first floor. The maximum removable alpha contamination in the basement exceeded 30,000 disintegrations per minute (dpm). Radon measurements indicated that the highest levels in living areas were greater than 20 picocuries per liter (pCi/L), even with a relatively high rate of ventilation during the measurements. Because of this high rate of ventilation, NAREL requested that charcoal canisters be placed in the house. Results from the canister measurements showed that radon levels on the first floor ranged from approximately 49 pCi/L to 63 pCi/L. On the second and third floors, levels ranged from approximately 19 pCi/L to 29 pCi/L. NAREL also surveyed the warehouse and found elevated

levels of gamma radiation (190 μR/h to 1.2 mR/h) and radon (23 to 36 pCi/L); removable contamination on the first floor was 60 dpm.

EPA performed expanded site investigations and identified 40 residential properties contaminated with radium and/or radon in excess of levels thought to be safe for human exposure. ATSDR and EPA Region III collaborated to determine what, if any, actions should be taken to protect the public health of these residents. As a result of these guidelines, over 15 persons were relocated. The actions included a set of graded decision guidelines that would support actions ranging from no action to immediate relocation. The process used to develop these guidelines and the evaluation of standards as they existed in 1991 is discussed below.

The Uranium Mill Tailings (UMT) standards (40 CFR 192)[1] provided guidance for cleanup of properties contaminated with UMT. This established an action level at 4 pCi/L of radon and 20 μR/h gamma radiation above background in houses, which is similar to the situation at the Austin Avenue site. The UMT rule provided clear guidance for the decision to initiate cleanup action; however, the rule does not address the problem of relocating the occupants of the property in the interim.

For gamma radiation, several guidelines were available. In 1991, the Nuclear Regulatory Commission (NRC) allowed an exposure of 500 millirem (mrem) per year to members of the public.[2] The estimated annual cancer risk of such an exposure was about two extra cases in a population of 10,000 per year of exposure. The International Council on Radiation Protection (ICRP) and the National Council on Radiation Protection and Measurements (NCRP) currently recommend an annual exposure limit of 100 mrem per year above background.[3,4] The annual risk of 100 millirem is about 5 in 100,000. It is generally assumed that the limit of 100 mrem per year above background also is intended to apply to exposures that might be repeated for many years. The risks quoted above are calculated using an additive model that applies a linear-nonthreshold assumption and does not allow for the dependence of effects on dose rate.

At the other extreme, the standard for nuclear workers is 5.0 rem per year[2], but occupational exposures are kept as low as reasonably achievable (the ALARA principle). This level of risk is tolerable in an occupational exposure for which a commensurate benefit results from the exposure. A standard this high is inappropriate for an involuntary exposure to a member of the public, especially when no compensating benefit to society exists.

The final, and perhaps most relevant guidance, was EPA's Protective Action Guides (PAGs) for nuclear power plant accidents.[5] These guidelines focus on the relocation of persons from their residents after a nuclear accident and discuss risks and social and economic costs of relocation. The guidance allows a maximum of 2 rem the first year and a maximum of 500 mrem any other year. The 2 rem per year maximum in the first year is based on the typical radionuclide mix from a power plant accident and is intended to achieve 5 rem over 50 years because of decay. The 5 rem included the 2 rem in the first year and results in an average dose of 100 mrem per year over 50 years. Because radium has a 1,600 year half-life, it can be treated as if it does not

decay, and the 2 rem maximum would therefore not apply However, the 0.5 rem guide for any other year is designed to protect against hazards accrued over only a few years. Because the contaminated houses were to be cleaned up within a few years, the longest that nonrelocated persons will be exposed in the future is only a few years. Thus, the 0.5 rem guide fits well. It also should be noted that the PAGs do not consider past exposure. The guides are aimed specifically at preventing the effects of future exposures which is better explained in the PAG document. It also is intended that the relocation is based on exposures before cleanup measures are applied. Therefore, a person who is not relocated after a first-year dose of 1.9 rem would probably receive only 0.5 rem after rudimentary cleanup is performed.

Using these guidelines, ATSDR reviewed and categorized the addresses encompassed by the Austin Avenue site into three distinct categories: Category 1 – relocation if radiation exposure exceeds the 500 mrem action level (seven addresses); Category 2 – ATSDR and EPA discuss actions if radiation readings are greater than 200 mrem per year but below 500 mrem per year (four addresses); and Category 3 -- no actions necessary if expected annual exposures are less than 200 mrem per year (10 addresses). Table 1 lists each of the addresses and information regarding measurement levels, EPA actions, and categorization.

Radiation levels at addresses in Category 1 exceeded the ATSDR-recommended limits and relocation was offered to residents. Several elderly residents declined relocation despite elevated gamma radiation exposure rates and the elevated radon levels in their homes.

Addresses in Category 2 contained residences at which the expected external gamma radiation level was between 200 and 500 mrem per year. For each location, the demographic characteristics of the residents and the potential for additional exposure were considered. ATSDR met with EPA and discussed the four locations. EPA determined the annual gamma radiation exposure estimates after interviewing these residents. The estimates were time-weighted averages based on the estimated time, over a year, that residents would spend in each radioactively contaminated room. After reviewing the exposure estimates and the EPA rationale, ATSDR concurred with EPA's decision not to offer relocation.

Category 3 contained locations at which the expected external gamma radiation level was less than 200 mrem per year. As stated previously, when levels below 200 mrem were estimated, ATSDR recommended no EPA action. For each location, the demographic characteristics of the residents and the potential for additional exposure were considered. On the basis of annual gamma radiation exposure estimates, ATSDR concurred with EPA's decision not to offer relocation, except to one person, a medical radiologist who resided at 237 N. Lansdowne. This relocation was offered because of concern that the resident's cumulative occupational and residential exposures could exceed 500 mrem annually.

CONCLUSION

With the development of these graded decision guidelines, ATSDR and EPA were able to apply a uniform process to assist the on-scene coordinators and the remedial project managers in the performance of their duties. The guidelines also have been applied in Idaho (i.e., in conjunction with phosphate slag issues) and their use has been considered in Connecticut (i.e., in several contaminated buildings used previously in the watch manufacturing).

Table I. Location, estimated radiation levels, radon levels, and EPA actions

Location	Category	Gamma Radiation	Radon	EPA Actions
211 Penn Blvd.	1	Not Determined	34 pCi/L	Relocation offered but declined
25 Lexington Ave	1	0.7 rem/year	8	Relocation offered but declined
137 Lexington Ave	1	2.3	5	Relocation offered
25 Beverly	1	1.8	30	Relocation offered
216 Wayne Ave	1	0.67	ND	Relocation offered
218 Wayne Ave.	1	0.52	19	Relocation offered
500 Harper Ave.	1	0.47	50	Relocation offered
3723 Huev Ave	2	0.3 rem/vear	4.6	No offer
617 Pine St.	2	0.3	2	No offer
619 Pine St.	2	0.26	1.4	No offer
623 Pine St.	2	0.21	1.3	No offer
126 Owen Ave.	3	Background	5.7	No offer
237 N. Lansdowne Ave.	3	0.12	Not Determined	One relocated, occupational exposure
6 Plumstead Ave.	3	0.02	6.1	Radon reduction system installed
10 Plumstead Ave.	3	Background	8 in basement	No offer
310 Shadeland Ave.	3	0.07	ND	No offer
64 S. Clifton Ave.	3	Background	12.8	Unoccupied at time of measurement
621 Pine St.	3	0.1	3	Below action levels
346 Owen Ave.	3	Background	ND	Below action levels
151 Lexington Ave.	3	0.13	17	Radon reduction system installed
504 Harper Ave.	3	Background	ND	Below action levels

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