Nuclear Fallout

What is nuclear fallout?

Nuclear fallout is the residual radioactive material propelled into the upper atmosphere following a nuclear blast, so called because it falls out of the sky after the explosion and the shock wave have passed [1]. The amount and nature of the fall out will vary as to whether the nuclear detonation was airburst or ground burst and the nature of the material sucked up into the explosion cloud. The subsequent dispersion of fallout after explosion will be controlled by prevailing metrological conditions such as wind or rain

Fallout can also refer to radiation released after a nuclear accident although a nuclear reactor does not explode like a nuclear weapon. The isotopic signature is different, with bombs producing a much higher quantity of short-lived isotopes. Both, however, are equally dangerous.

Survival strategy

In simple terms:

- Time – limiting exposure time will limit the radiation dose
- Distance – the radiation dose reduces dramatically as you increase your distance from the source
- Shielding – proper shielding will also reduce the radiation dose

If a radiological emergency occurs general Government guidance is, **get inside, stay inside, and stay tuned [2]**.

If caught outside during an atomic blast, assuming of course one survives the initial shock and heat waves, one has roughly 15 to 20 minutes to get inside before the first fall out starts to return to earth. Fallout can continue for up to 30 days after an explosion and can not only contaminate humans but also all other animals, birds, plant life, soil, and water sources.

Survival kit

1. **Geiger Counter** – will allow one to measure how severe the risk is, what protective measures are needed and when one can end or relax a protective strategy.
2. **A Hideaway** – a place where you can physically isolate oneself (shield) from the fallout.
3. **Duct Tape and Plastic Sheeting** – to prevent any ingress of radioactive fallout into the hideaway.
4. **Face mask** – to protect oneself from breathing and even ingesting radioactive material (minimum P3 dust protection).
5. **Water** – for decontamination, personal hygiene and drinking - generally 4 to 5 liters per person per day (store beforehand as external sources of water may become contaminated).
6. **Water purification filter or tablets** – for safe drinking water
7. **Toiletries** – soap, other items of personal hygiene.
8. **Clothing** – a change of clothes, shoes. underwear **e**tc., in case of contamination.
9. **Sleeping apparel** – mattress, sleeping bag, blankets etc.
10. **Food** – minimum of 2000 kcal per day, per person in tins, survival ready meals – which may probably have to be eaten cold.
11. **Medical kit** – in case of sickness or injury (include potassium iodine).
12. **Medication** – a supply of one's normal daily medications.
13. **Sanitation** – toilet paper, plastic bin bags for waste disposal etc.

14. **Emergency Radio** – to keep track of authorities/government advice or other announcements.
15. **Lighting** – a torch or lamp to provide lighting, note electricity supply might be disrupted.
16. **Batteries** – spare batteries for electrical appliances (alternatively go with wind-up or solar powered devices).

Measuring radioactivity

Most modern Geiger counters, measure radioactive dose (rather than the actual level of radioactivity) expressed as micro sieverts per hour (µSv/hr).

1000 micro (µ) sieverts = 1 milli (m)sievert, 1000 milli (m)sieverts = 1 Sievert

Typical Geiger Counter Readings (assumed free air readings 1 meter above ground level):

Counts per Minute CPM	Micro Sieverts per hour µSv/hr	Milli Sieverts per year mSv/y	Comments
10	0.09	0.8	Very Low
25	0.24	2.06	Normal background, world average is 0.23 µSv/hr
40	0.38	3.3	High background
60	0.56	4.94	
100	0.94	8.23	Readings of ≥ 1 µSv/hr are starting to encroach on the danger zone. Shield or leave the area
200	1.88	16.47	Shield or leave the area immediately

Radiation doses and effects

Risk Levels	Radiation Effects	Dose in mSv	
1. HIGH RISK	Potentially fatal radiation sickness. Very high risk of cancer in later life	10,000	Fatal within days
		5,000	Dose which would kill half of those exposed within a month. Chernobyl workers who died within a month received a typical dose of 6,000 mSv
		2,000	Acute radiation sickness, but not death
2. MODERATE RISK	Mild or no immediate symptoms. Increased risk of serious illness in later life	1,000	Mild to moderate radiation sickness. 5% higher risk of cancer.
		400	Maximum radiation levels recorded at Fukushima (per hour). Total exposure of Chernobyl residents who were relocated.
		100	Lowest dosage level linked to increased cancer risk.
3. LOW RISK	No symptoms. No detectable increased risk of cancer.	10	Full-body CT scan.
		9	Yearly average exposure for airline crews.
		2.4	Yearly background radiation level UK.
		0.1	Chest x-ray
		0.01	Dental x-ray

Medical effects of radiation

Major body parts especially susceptible to radiation are:

- Eyes – high doses can trigger cataracts
- Thyroid – radioactive iodine rapidly builds up leading to cancer
- Lungs – potential DNA damage
- Stomach – vulnerable if one swallows irradiated food
- Reproductive organs – high doses cause sterility
- Skin – high doses cause redness and burning
- Bone marrow – red and white blood cells can be damaged leading to leukemia and other immune system diseases

Potassium Iodine (KI)

Nuclear explosions and reactor meltdowns can release large quantities of radioactive iodine (I131). This radioactive iodine, if breathed in or ingested via contaminated food products, can then be easily absorbed by the thyroid gland potentially causing thyroid cancer. Particularly vulnerable are those

adults with an iodine deficiency or growing children. However, if one pre doses with potassium iodine you can fill the thyroid gland with stable iodine and effectively block any further absorption (blockage effect).

Age	Dosage
Up to 1 month	16.25 mg
1 month to 3 years	32.5 mg
4 to 12 years	65 mg
13 to 45 years	130 mg
Over 45	nil

Dosage levels for Potassium Iodine [3]

Generally, one dose should be sufficient as the half-life of radioactive iodine is only 8 days. Over 45 years blockage is generally not required.

Best time to dose, of course, is before contamination (up to 24 hours) but up to two hours after initial contamination would also be acceptable. [4]

References:

1. https://en.wikipedia.org/wiki/Nuclear_fallout
2. https://www.epa.gov/radiation/protecting-yourself-radiation
3. https://tekdeeps.com/iodine-tablets-potassium-iodide-as-radiation-protection/
4. https://www.who.int/publications/i/item/9789241550185