

# Radiation

As reported by Richard Warry, BBC News, “Japanese authorities say radiation levels from the Fukushima Daiichi nuclear plant climbed to potentially harmful levels for a brief interval on Tuesday,” March 14, 2011... with “a radiation level of up 400 millisieverts per hour at the Fukushima nuclear plant itself.”<sup>1</sup> Where does this fall on the continuum of radiation exposure?

## Dose Benchmarks (mSv = millisieverts)

### Radiation dose Effect

< 0.01 mSv/year	Living near a nuclear power station
0.24 mSv/year	Cosmic radiation (from sky) at sea level
0.28 mSv/year	Terrestrial radiation (from ground)
0.40 mSv/year	Natural radiation in the human body
2 mSv/year	Typical background radiation experienced by everyone
9 mSv/year	Exposure by airline crew flying New York-Tokyo polar route
20 mSv/year	Current limit (averaged) nuclear industry employees
100 mSv/year	Lowest clearly carcinogenic level
350 mSv/lifetime	Relocation criterion after Chernobyl accident
1,000 mSv single dose	Causes (temporary) radiation sickness such as nausea and decreased white blood cell count, but not death. Above this, severity of illness increases with dose.

Source: World Nuclear Association.

- Most experts agree even small doses of ionising radiation — as low as 100 millisieverts — can increase the risk of cancer, but by a very small amount.
- In general, the risk of cancer increases as the dose of radiation increases. Exposure to 1 Sv of radiation is estimated to increase the lifetime risk of fatal cancer by around 5%.
- The thyroid gland and bone marrow are particularly sensitive to ionising radiation.
- Leukemia, a type of cancer that arises in the bone marrow, is the most common radiation-induced cancer. Leukemias may appear as early as a few years after radiation exposure.
- Other cancers can also result from exposure to radiation, but may not develop for at least a decade. These include cancers of the lung, skin, thyroid, breast and stomach.<sup>1</sup>



## What is a Sievert?

The *sievert* (symbol: Sv) is the International System of Units (SI)<sup>3</sup> derived unit of dose equivalent. It attempts to quantitatively evaluate the biological effects of radiation as opposed to the physical aspects, which are characterised by the **absorbed dose**, measured in *gray*. The *millisievert* is commonly used to measure the **effective dose** in diagnostic medical procedures (e.g., X-rays, nuclear medicine, positron emission tomography, and computed tomography).

**microsievert (μSv)**      1 μSv = 10<sup>-6</sup> Sv or 0.000001 Sv

**millisievert (mSv)**      1 mSv = 10<sup>-3</sup> Sv or 0.001 Sv

**sievert (Sv)**              1 Sv = 1,000 mSv (millisieverts) or 1,000,000 μSv (microsieverts)

<sup>1</sup> <http://www.bbc.co.uk/news/health-12722435>

<sup>2</sup> <http://en.wikipedia.org/wiki/Sievert> - Comité international des poids et mesures (CIPM) 1984, Recommendation 1 (PV, 52, 31 and Metrologia, 1985, 21, 90). *Introduction to Quantities and Units for Ionising Radiation*, National Physical Laboratory.

<sup>3</sup> The International System of Units (SI) specifies a set of seven base units from which all other units of measurement are formed. These other units are called SI derived units and are also considered part of the standard. SI units [were patterned] after the French Le Système International d'Unités which opted for a universal, unified and self-consistent system of measurement units based on the MKS (metre-kilogram-second) system. The names of SI units are always written in lowercase. The symbols of units named after persons, however, are always spelled with an initial capital letter (e.g., the symbol of hertz is Hz; but meter becomes m). Source: [http://en.wikipedia.org/wiki/SI\\_derived\\_unit](http://en.wikipedia.org/wiki/SI_derived_unit)