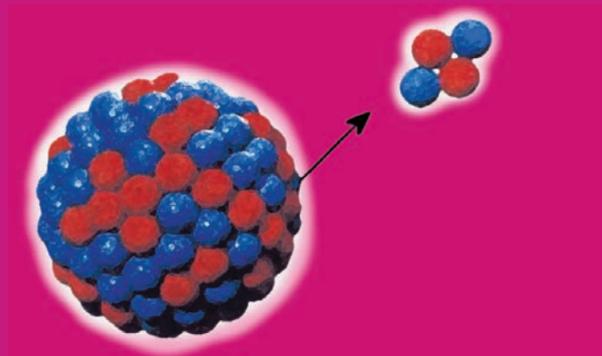


# Radioactivity

Matter is made of atoms. Some of these atoms are unstable and disintegrate while emitting different types of radiation : they are radioactive.

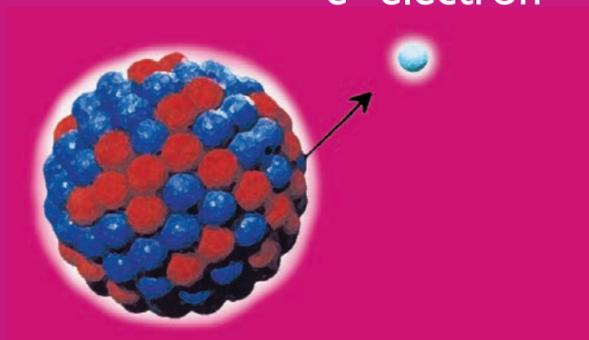
**Alpha decay ( $\alpha$ )**  
ex : uranium-238 atom

helium nucleus

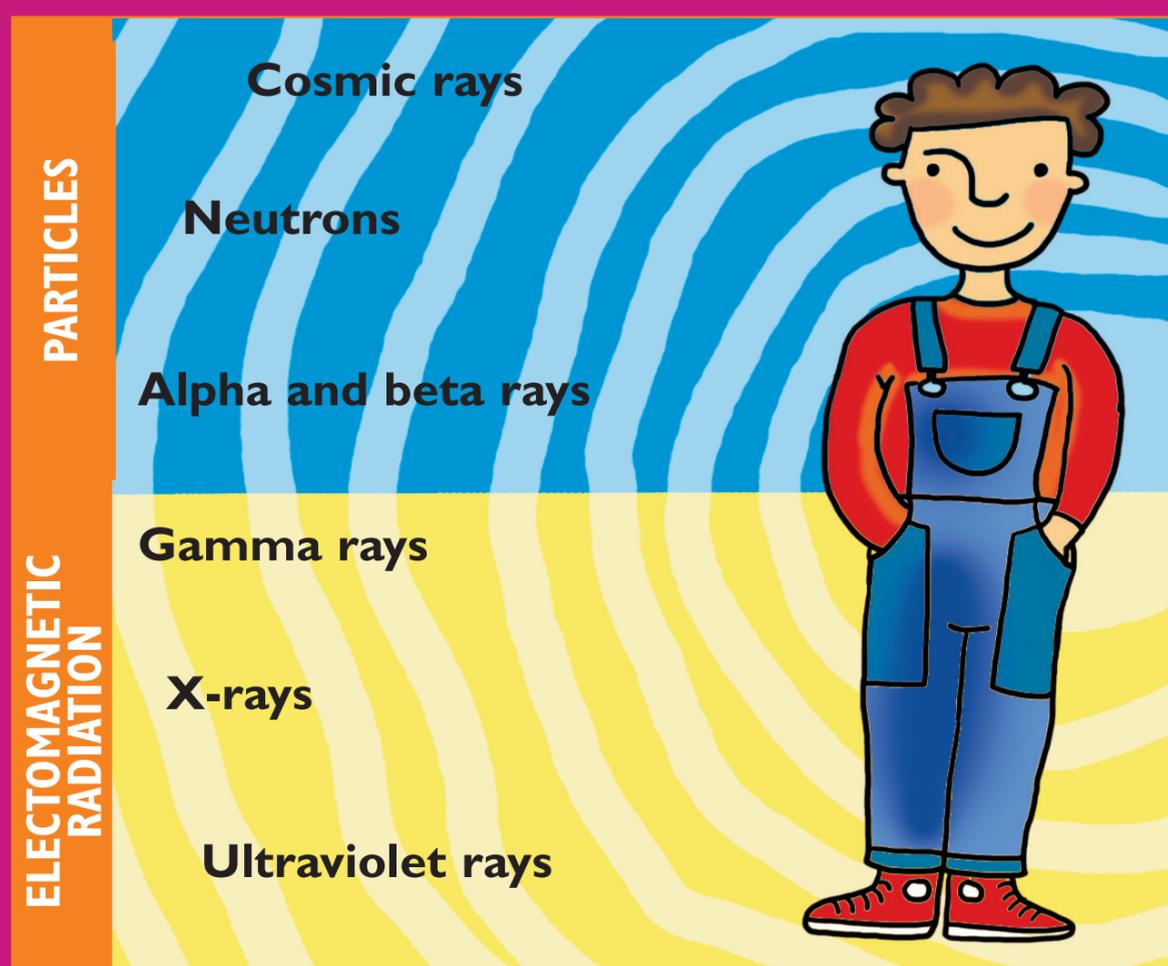


**Beta decay ( $\beta$ )**  
ex : carbon-14 atom

e- electron



This radiation can be accompanied by a gamma decay ( $\gamma$ ).



Human beings have always been exposed to radiation in their environment.



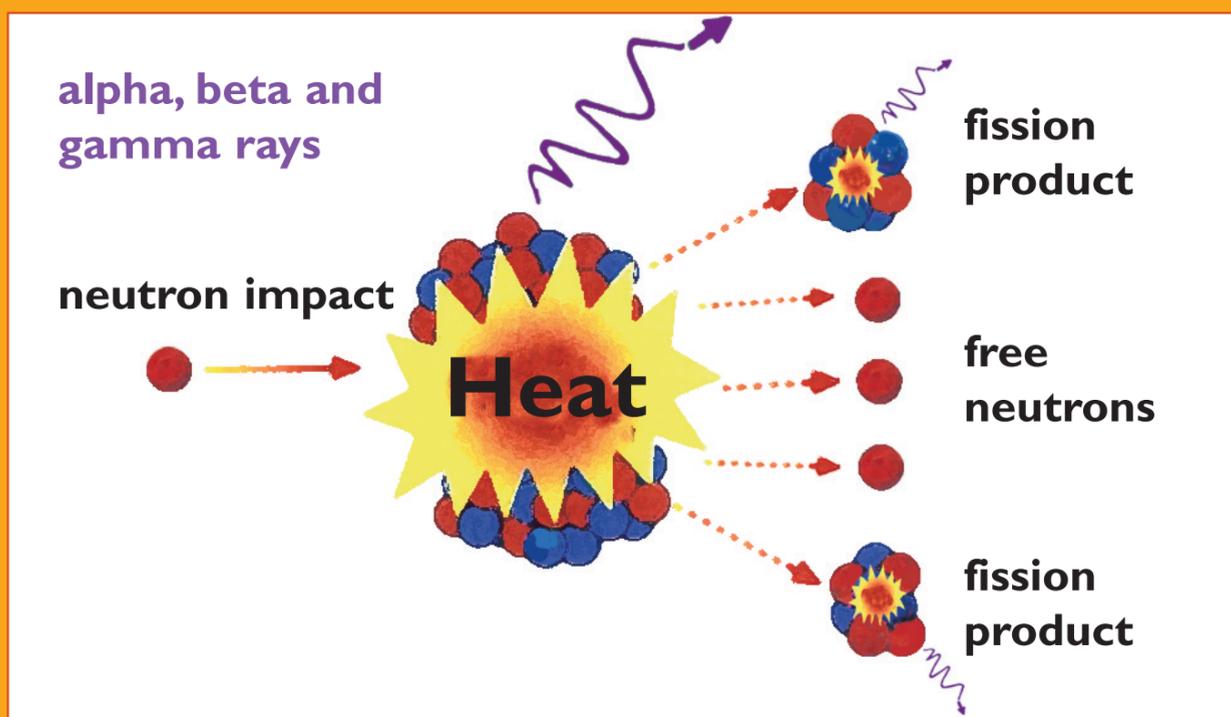
In 4.5 billion years, natural background radiation has been divided by 4. As of today, it is still significant.



Since the beginning of the 20th century, human beings have created radioactive elements for various applications. It is the artificial radioactivity.

# From radioactivity to nuclear energy

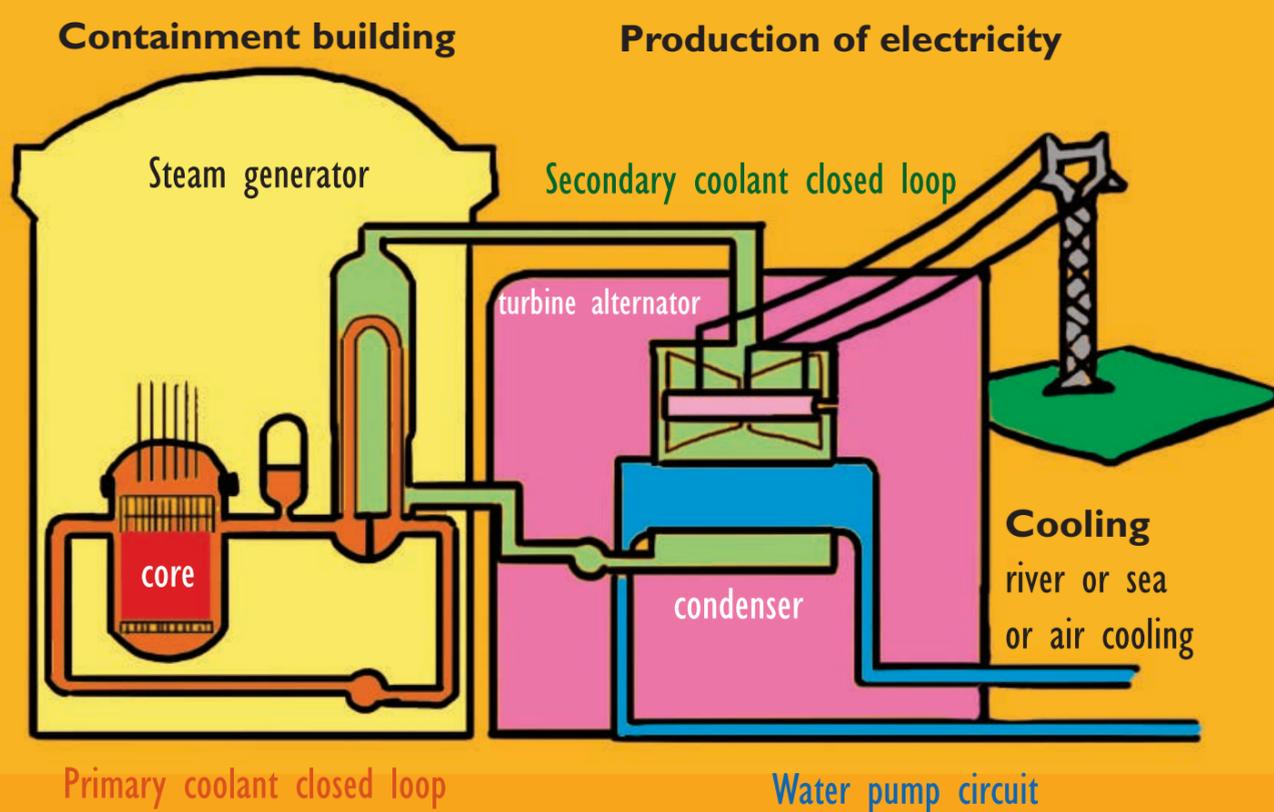
7% of the electricity in the world is produced by 400 nuclear reactors. 80% of the electricity in France is produced by 58 nuclear reactors spread over 19 different sites.



The nuclear fission reaction is induced by the bombardment of the atoms with neutrons. It subsequently generates heat energy.



Fission products, such as cesium, iodine and strontium are highly radioactive waste which can contaminate the environment. They are stored temporarily, waiting to be sent to final disposal facilities.



In the nuclear reactor core, the fission of uranium 235 is under control thanks to control rods able to absorb the neutrons. The heat liberated by the fission must be constantly removed by the coolant loops. A long loss of heat removal will lead to a major accident. The containment building must always remain leakproof.

# Irradiation and contamination



By a major nuclear accident, fission products are released and spread in the air. They form a radioactive cloud composed of gas, drops and dust.



When the radioactive cloud, caused by the nuclear accident, is above me, I'm irradiated by ionising radiation.

When the radioactive cloud is gone, the fallout (dust and drops) remains and fission products are all over my body, my clothes and the environment. Everything is contaminated.



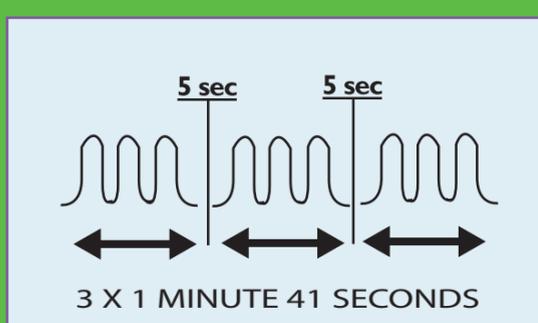
Contamination occurs through inhalation, ingestion or contact.

# Safe and sheltered

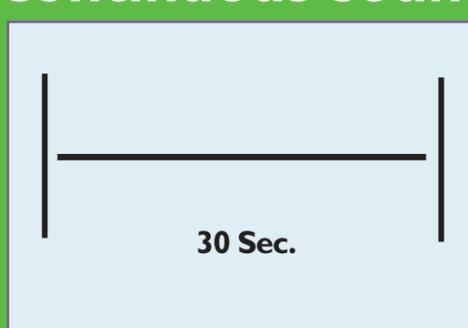
When there is a radioactive cloud, the National Alert System (NAS) will warn you. It means that you have to take shelter inside a building.



**ALERT**  
discontinuous sound



**END OF ALERT**  
continuous sound



In France you can listen to the NAS sound on this website : [www.iff-rme.fr](http://www.iff-rme.fr)



Vehicles equipped with a siren relay the alert.

By a nuclear accident always listen to the instructions given by the authorities on the Radio.

Use a battery-powered radio in case of a blackout.



The local authority at department level decides when the iodine pills or syrup are to be taken.

He can also issue an evacuation order for the population or keep them at home and give them specific instructions.

# Fukushima : Chaos

## From a natural disaster ...



March 11, 2011, the northeast coast of Japan is shaken by an earthquake of magnitude 9. It causes a tsunami that ravages the seafront with waves sometimes higher than 10 meters. Many aftershocks follow for weeks.

## ... to a nuclear accident ...

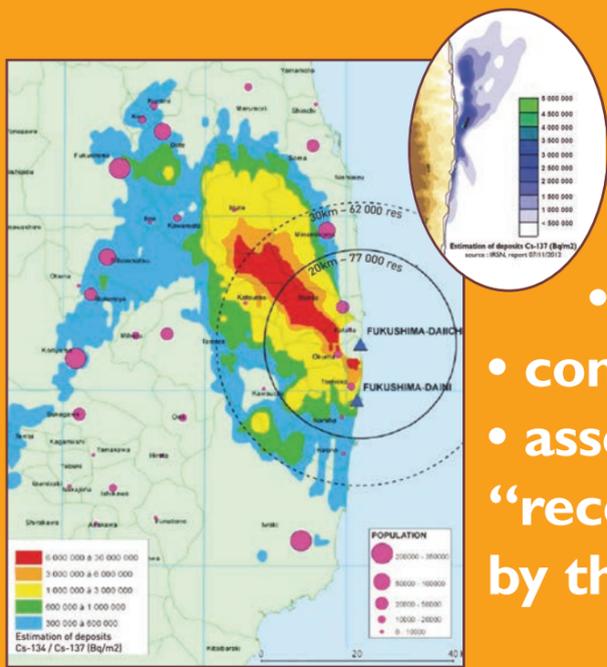


The protective dyke of the Fukushima Daiichi nuclear power plant is flooded. Cooling systems of reactors are destroyed. 3 out of 6 cores melt.



The population is evacuated up to 30 km around the plant, due to radioactive releases.

## ...and to contamination



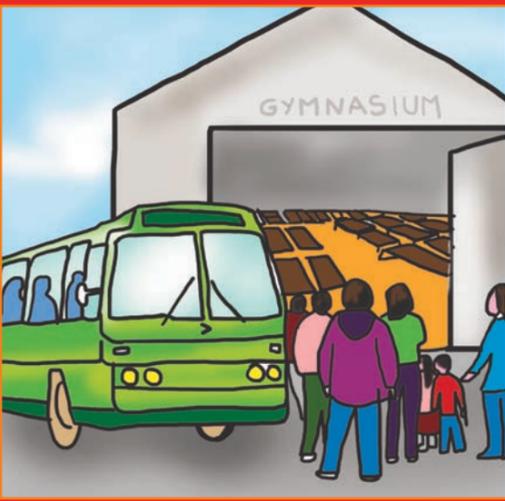
Assumptions, calculations and field measurements define :

- the radioactive plume,
- contamination,
- assessment of “received and future” doses by the population.



The Operator, the Japanese authorities and the population will have to manage long-term site, contamination and health risks.

# Fukushima : Consequences



## Human

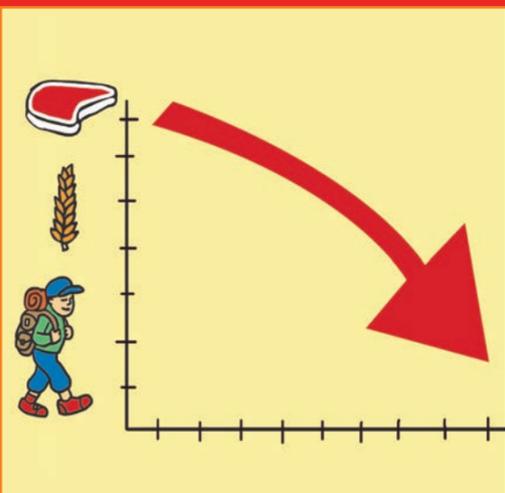
Thousands of people were evacuated and relocated. Others are forced to adapt to live in contaminated areas. Health effects will be revealed in the future.



## Environment

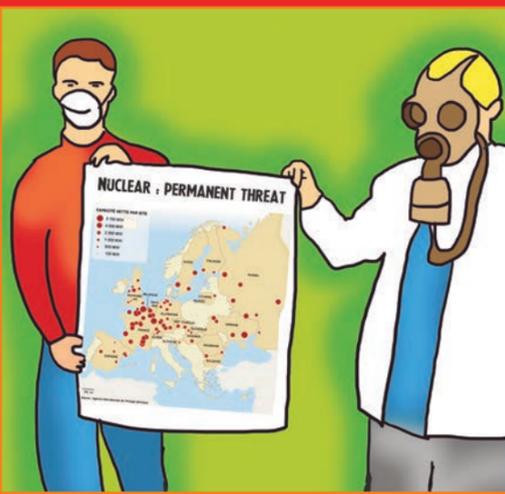
Soils and marine ecosystems are contaminated. Vegetables, fruits and animals are unfit for human consumption.

Many consumers start to boycott products from the contaminated area (rice, tea, fish, oysters ...).



## Economy

The local economy disappears around the nuclear power plant. The country's financial growth stops for several months.



## Politics

Nuclear energy, safety, emergency response management, risk prevention and public information are subject to debate in many nuclear nations.



Air is monitored on all continents to alert the population in case of significant radioactivity.