An Introduction to Nuclear Realism

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Outline

• The big picture
• Nuclear fission: a primer
• Nuclear power plant: how it works
• What happened in Japan?
• Nuclear realism
The Atom

Size of atom: $10^{-10}$ m
Size of nucleus: $10^{-15}$ m

Nuclear Fission

+ Energy

\[(E = mc^2)\]

http://www.atomicarchive.com/Fission/Fission1.shtml
Nuclear Chain Reaction

Controlled chain reaction → Nuclear power plant

Uncontrolled chain reaction → Nuclear weapon

http://upload.wikimedia.org/wikipedia/commons/thumb/9/9a/Fission_chain_reaction.svg/500px-Fission_chain_reaction.svg.png
Nuclear Power Plant

Boiling water reactor

http://www.nrc.gov/reading-rm/basic-ref/students/animated-bwr.html
Fukushima I Nuclear Power Plant (part 1)

Six reactors producing about 2.5% of Japan’s electricity (2008).

After earthquake: reactors 1, 2 and 3 shut down automatically (nuclear chain reaction stopped).

Reactors 4, 5 and 6 were already shut down for maintenance.

After the earthquake and tsunami, the backup diesel generators for running the cooling systems failed.

Fukushima I Nuclear Power Plant (part 3)

Biggest danger: release of radioactive materials

Iodine-131: half-life of 8 days; absorbed in thyroid.

Cesium-137: half-life of 30 years; gets widely distributed in body.

Current levels (March 19):

50-mile radius around Fukushima is at risk.

Radiation reaching U.S. West Coast is 100,000 times less than background.
Fear

At least five merchants on Amazon.com were selling packages of potassium iodide tablets for between $300 and $400, far above the usual list price of $10. Two big online sellers said on their websites they were sold out.

Health officials warn potassium iodide can pose its own risks if misused.

The British Columbia Center for Disease Control warned people not to confuse iodide with iodine and told them not to take iodine solutions thinking they provide any protection against radiation.

Perry Kendall, the Canadian province's chief medical officer, believes most people will heed warnings not to overreact, but acknowledges his office has received calls alleging the government is engaging in a cover-up.
Respect

“We concluded that any earthquake strong enough to damage the reactor, and thus expose the public to harmful radiation, would be much more dangerous to the public in its direct effects, and that it would be more beneficial to devote efforts and resources to general preparedness.”

---Michael W. Golay
professor of nuclear science and engineering at MIT

Nuclear Realism

• 1 kg of natural uranium can power a 100W light bulb for 180 years; 1 kg of coal/oil can power the same light bulb for 4-5 days.

• No greenhouse gases, but have radioactive waste.

• Other factors: cost, availability, self-sufficiency.

Respect, not fear

http://www.whatisnuclear.com/articles/nucenergy.html