# Using Becquerel's method to harvest the energy of nuclear waste

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### Abstract

When Becquerel discovered radioactivity it was via the effect on fluorescent materials. This article describes applying that technique to harvest the energy of highly radioactive nuclear waste.

# History

In 1896 Becquerel<sup>2</sup> discovered radioactivity by its effect on fluorescent materials. The radioactive material emits radiation which is degraded by the fluorescent material into visible light. This in turn affected photographic plates.

## Main Article

The primary objection to the use of nuclear energy has been the waste products produced. While trivial in amount<sup>3</sup> when compared to fossil fuel waste products, the highly toxic nature makes them unpopular. Instead of treating them as waste, they can instead be viewed as a useful intermediary in secondary energy production.

Historically, a tiny fraction of this material has been used by SNAP<sup>1</sup> systems, where the material heats a thermocouple generating electricity. A more useful technique for harvesting the latent energy of these materials involves transforming the radiation from dangerous gamma radiation to visible light via fluorescent materials.

Take a small amount of highly radioactive waste, place in the center of a containment vessel (cube, sphere, tetrahedron, or octahedron) whose inner surface is coated with solar cells, and between them filling the void place a fluorescent material. Zinc salts are recommended, since they are more stable in the presence of any stray neutrons the radioactive material may emit than Beryllium salts. This structure is then placed within a lead car battery<sup>4</sup>, acting to charge it. The lead plates of the battery also absorb any stray radiation that is not transformed by the central mechanism. As it will be exposed to both radiation and battery acid, the containment vessel needs to be of particularly sturdy material. It is also desirable the vessel remain intact after accidents or fire.

This power supply generates significant stray heat, so that it should not be used in tropical settings, but is just the ticket for arctic applications where solar power is not readily available (and stray heat is welcome).

No statistics on the power production from this method are presently available, but the less efficient SNAP 8<sup>1</sup> produced 1 megawatt with 18 pounds (8.5 kg) of fuel. As car batteries are typically around 200 watt ongoing charge/discharge capacity, a few grams should suffice to charge a car battery in 2 hours with fresh fuel, or less than a day after several years of decay.

#### References

- 1) Aerojet General Corporation (November 1971). *SNAP-8 Electrical generating system development program.* NASA Lewis Research Center, Cleveland, Ohio. NASA CR-1907.
- 2) Henri Becquerel (1896). <u>"Sur les radiations émises par phosphorescence"</u>. *Comptes Rendus* **122**: 420–421. <u>http://gallica.bnf.fr/ark:/12148/bpt6k30780/f422.chemindefer</u>.
- "Waste Form Release Calculations for the 2005 Integrated Disposal Facility Performance <u>Assessment</u>" (PDF). *PNNL-15198*. Pacific Northwest National Laboratory. July 2005. <u>http://www.pnl.gov/main/publications/external/technical\_reports/PNNL-15198.pdf</u>.
- David Linden (ed), *Handbook of Batteries Third Edition*, McGraw Hill, New York, 2002 <u>ISBN</u> 0-07-135978-8, chapter 23