BETAVOLTAIC NUCLEAR BATTERIES

Dark Red Group

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WHAT ARE BETAVOLTAIC DEVICES?

- Gaining stability
- Converting beta particles into electrical current

\[ \beta^- _{\text{He}} \rightarrow \text{He}^+ + e^- + \bar{\nu}_e \]

- Similar to photovoltaic devices
  - Excess helium
- Build up of electron pairs
- Longevity

http://www.nuclear-power.net/glossary/tritium/

http://large.stanford.edu/courses/2013/ph241/harrison2/
WHERE WE FIND THEM

- Medical applications
- Spacecrafts
- Future potential
  - Micropower ideas
- Naval applications
APPLICATIONS IN DEFENSE

- 1954
- Nuclear subs and aircraft carriers
- 83 nuclear ships: 101 naval reactors
- Trident missiles

https://uk.wikipedia.org/wiki/%D0%9A-222
EXPERIMENT 1 (PHOTOVOLTAIC CELL TESTING)

How distance and angle affect photovoltaics

- Extended distance from light source
- Parallel to a desk and 45° angle from the desk
- Measured the voltage and current produced by a photovoltaic cell
DATA 1 (PHOTOVOLTAIC CELL TESTING)

Current of Photovoltaic Cells vs. Distance from Light

Voltage of Photovoltaic Cells vs. Distance from Light
EXPERIMENT 2 (BETAVOLTAIC CELL TESTING)

How temperature affects betavoltaics

- Cooled a betavoltaic to -30°C
- Alkaline batteries vs. Nuclear batteries
- Nuclear batteries are better at colder temperatures
As temperature decreases, potential difference across the battery increases.

As temperature increases, short circuit current decreases, internal conversion efficiency decreases, and maximum power decreases.
POLICY

- Governmental Policy
  - Fairly recent technology (7 years old)
  - Regulated limit on annual radiation exposure

- Economics
  - Makes certain consumer and military goods cheaper
  - Cost-effective
  - Medical Applications
ENVIRONMENTAL/HEALTH EFFECTS

● Environmental
  ○ Radioactive Waste, though in small quantities
  ○ Longer battery life
  ○ Helium emissions

● Potential Health Concerns
  ○ Half-lives - 12.3 years
  ○ Human exposure
  ○ Nuclear waste
OUTLOOK

Sustainable

Reliable

Practical


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