NEWS, PEOPLE AND PRODUCTS

World's first isotope-powered weather station

THE WORLD'S FIRST isotope-powered automatic weather station is now in operation at Sheerwood Head on Axel Heiberg Island in the Canadian high Arctic. Ice and shoals prevented the apparatus being landed at the original site, Graham Island, 60 miles farther south.

The station and power source are housed in a cylindrical, insulated container, approximately 8 ft. long. The lower 5 ft. is buried in the permanently frozen ground. Readings from the anemometer, thermometer and barometer are fed into a data processing system and from there directly into the radio transmitter. This in turn relays them every three hours to receiving stations at Resolute and Alert.

Designed and built for the U. S. Atomic Energy Commission by nuclear division of The Martin Company, the unit will function unattended for up to two years.

The unmanned station is powered by pellets of a strontium-90 compound that generates heat spontaneously by radioactive decay. Using the principle of thermoelectric conversion, heat is transformed directly into a continuous flow of electricity by a series of thermoelectric couples. The thermoelectric assembly consists of 60 pairs of lead telluride elements, arranged like spokes around the cylindrical heat source and connected in series to a single outlet. Electrical energy is stored in rechargeable nickel-cadmium batteries to build up the power required to operate the long-range transmitters.

Fueling of the generator was carried out by AEC's Oak Ridge National Laboratory, but the generator was checked earlier using an electrical heater to simulate the fuel capsule. Under those conditions the converter operated continuously for about 6,000 hours without any decrease in efficiency or output.

In studies first begun in 1958 on the feasibility of using strontium-90 as a source of electrical power, The Martin Company concentrated on developing a safe fuel form and reliable shielding. The special biological problem raised by strontium becomes evident only if it is absorbed by some living organism. By using an insoluble compound this danger can be eliminated. Also, the fuel material must be dense enough to conserve space and be easy to produce.

Martin and AEC selected strontium titanate which remains stable even beyond its melting point of 3,000F. Its rate of solubility in fresh water is so low that it has never been measured. Even in sea water its solubility is measured in parts per billion.

In the operating generator, fuel pellets are encased in several layers of an alloy called Hastelloy-C, long under study by the U. S. Navy. It would take centuries to corrode, even if immersed in the ocean.

Radiation from strontium-90 is blocked by a variety of materials. In the first unit more than ¾ ton of lead is used and final protection for the whole generator is an outer cladding of stainless steel. It is claimed that the generator is so sturdily built that it could survive a plane crash or explosion without releasing its fuel.

An unmanned, automatic device capable of operating in climatic extremes helps to fill the hundreds of serious gaps that exist in the present worldwide network of weather reports.

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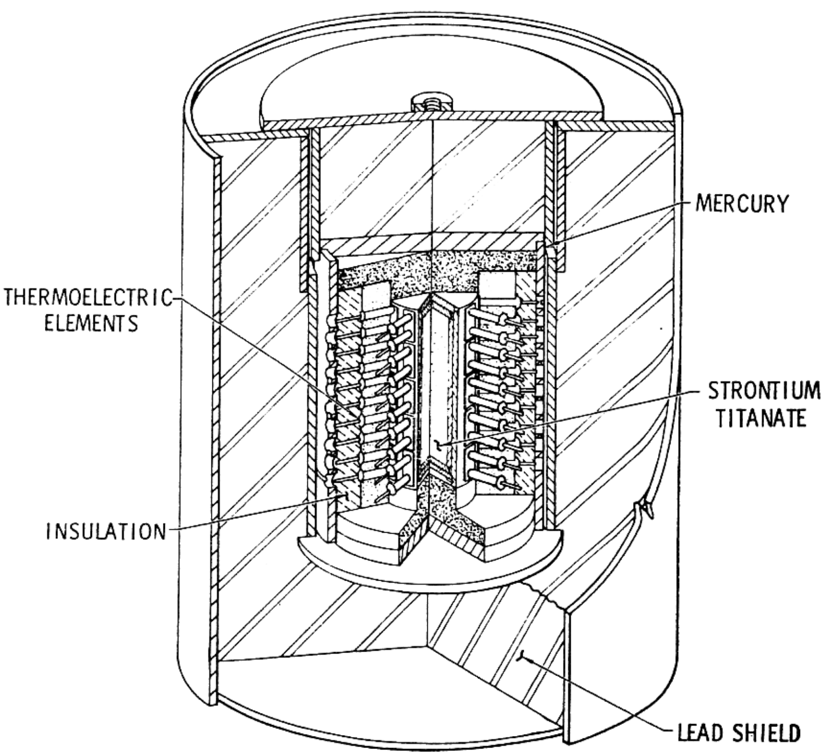
WEATHER STATION POWER SOURCE



Arctic weather station

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Many of these are in polar regions and accessible only during a brief portion of the year, yet all are important to long-range weather prediction. Also, long-term, maintenance-free reliability is possible because of the absence of moving parts in the radioisotope-fueled power system.

Strontium-90 generators of similar design may soon be used in Coast Guard navigational aids. In any application where frequent refueling or servicing is extremely difficult or expensive, isotope power promises economic advantages as well as increased reliability.

Design Details

Generator:

- Dimensions: 20 in. high, 18 in. diam (cylindrical).
- Fuel: 17,500 curies of strontium-90 in the form of strontium titanate pellets (about one pound).
- Fuel element dimensions: 5 in. high, 2.1 in. diam (cylindrical).
- Fuel containment: 3 layers — .250-in. thick Hastelloy-C (sea water corrosion rate .0001 in. per year).
- Shield: Lead 4.4 in. thick.
- Thermocouples: 60 pairs, 1¼ x-3/16-in. diam. "p" elements — lead telluride doped 1% sodium. "n" elements — lead telluride doped .03% lead iodide. Hot junction design temperature 800F. Cold junction design temperature 140F.
- Output: 5 watts @ 4.0 volts dc converted to 28 volts dc to supply trickle charge to nickel-cadmium batteries.
- Weight: 55 lb. plus 1,625 lb. of shielding.

Transmission:

- Transmitted data: Call letters and data measurements plus one repeat. Total of 9 seconds, simultaneously on both radio frequencies, once every three hours.
- Range: From 250 to 1,500 miles, depending on frequency.
- Radio transmitters: One at approximately 3.4 megacycles and one at approximately 5.0 megacycles, completely transistorized except for dual output tubes. Transmitters crystal controlled; turneable from 2.0 to 8.0 megacycles.
- Transmitter output: 250 watts on each frequency.
- Antennas: One 150-ft long, one 90-ft long.

Overall statistics:

- Dimensions: 8 ft tall, 26 in. diam (cylindrical).
- Housing: .250-in. thick steel.
- Total estimated weight: Somewhat over a ton, with shielding.
- Operating life: Minimum of two years, without refueling or servicing.

Instrumentation:

- Observations: Temperature: —75 to +120F ±1F. Barometer: 28 to 32 inches Hg. ± .02 in. Hg. Wind speed: 0 to 150 knots ± 1 knot (1 and 8 minute average). Wind direction to nearest 10 deg. heading.
- Data form: 8 bit binary digital.

Nuclear-powered ship

SUBJECT TO certain conditions, the U. S. Atomic Energy Commission has authorized fueling, start-up and operation of the reactor in the N. S. Savannah, for test and demonstration purposes, and for initial sea trials.

The world's first nuclear-powered, cargo-passenger ship is equipped with a pressurized water reactor manufactured by Babcock & Wilcox Co., New York. Its uranium oxide fuel, enriched to 4.4% in uranium 235, is expected to provide power for 3½ years, or 300,000 nautical miles, without replacement. The reactor's power rating is approximately 70 thermal megawatts.

After completion of the test program at Camden, N.J., at 10% of its reactor power, the Savannah will move to Yorktown under steam furnished by temporary oil-fired boilers located in one of the cargo holds.

A sheltered deck vessel, the Savannah will carry 60 passengers, a crew of approximately 110 and about 10,000 tons of dry cargo at a sustained sea speed of 20.25 knots. Basic ship costs, including nuclear propulsion system, were $35.6 million. Construction support, including first core cost, spare nucear parts, precritical tests and trials, crew training and administrative costs, total $11.3 million.