Nuclear reactors—how they make our energy

[Editor's note: Construction of the Zimmer nuclear power station at Moscow, Ohio on the Ohio River will mean that Nicholas County will be within a 50-mile radius of a nuclear power station. The plant, which should begin operation next year, is located on the Ohio River across from Bracken County. This article from the National Geographic News Service details the operation and composition of a nuclear power reactor.]

by Donald J. Frederick
National Geographic News Service

WASHINGTON — Though one of the most awesome structures in the world, a nuclear power plant generates electricity in the same way as plants powered by fossil fuels such as coal.

Heated water produces steam; steam drives a turbine that spins a generator; a generator produces electricity.

But unlike its mundane fossil fuel counterpart, the heat source for a nuclear plant is the tremendous energy released from the fission, or splitting, of the nuclei of fissionable materials, principally uranium 235.

Surrounded by Water

Once operations begin in a typical pressurized water reactor — such as the Three Mile Island nuclear power plant near Middletown, Pa. — the reactor's core is surrounded and infiltrated with water. Thousands of tons of water circulate under high pressure to carry away the intense heat and keep the reactor temperature within limits. Any interference with this flow is potentially dangerous.

Even after the plant is shut down, radioactive decay from fission products in the fuel rods continues to produce substantial heat. Consequently, cooling water is still vitally necessary.

In a pressurized water reactor — the most common in the United States today — energy from the chain reaction of fissioning uranium in the reactor core (1) heats the surrounding water, which is pumped under pressure into the tubes of a steam generator (2) to heat the water already in the generator.

Heat from the tubes converts water in the generator to steam, whose energy turns the rotors of a high pressure turbine (3). Lower-energy steam proceeds to low-pressure turbines (4,5). An electric generator (6) converts the energy from the whirling turbine shaft into power for transmission to consumers through high-voltage lines (7).

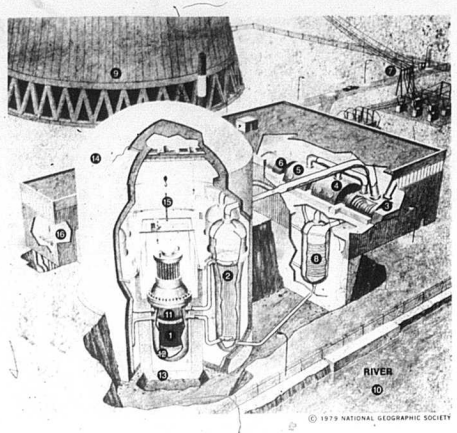
Depleted steam from the turbines passes over the cooling coils of a condenser (8) and is converted to water, which returns to the steam generator to be heated again. Water from the reactor's condenser coils is cooled by evaporation in an adjacent tower — only the base is shown (9) — and returned to the condenser for repeated use. Small amounts of river water (10) are piped to the condenser coils to replenish water lost by evaporation in the cooling tower.

Heart of the Matter

But the heart of a nuclear power plant and the thing that keeps everything ticking is the reactor core (1) surrounded by water and comprised of fuel assemblies containing about 100 tons of uranium dioxide. The rate of fission in the powerful packet is controlled by neutron-absorbing rods (11) that can be raised or lowered.

Core and water are contained in a heavy steel pressure vessel (12). It, in turn, is shielded by concrete walls five to ten feet thick (13), and the whole thing is topped off by a steel-and-concrete containment structure (14) to prevent radioactivity from escaping into the outside world.

From time to time, a reactor must be shut down for refueling. A bundle of fresh fuel rods holding uranium (15) is lowered into the reactor core. Spent fuel assemblies are immersed in water to dissipate heat and confine radiation in a separate facility on the site (16).



Inside a nuclear reactor power plant

Radiation is all around us

by Donald J. Frederick
National Geographic News Service

WASHINGTON — People are bathed in radiation all the time whether they know it or not, but barring a nuclear accident it's mostly natural radiation.

Cosmic rays from space, for example, give a person about 40 millirems a year at sea level, even more at higher altitudes. A millirem is a thousandth of a rem, the standard unit of radiation exposure.

More natural radiation comes from uranium, radium, and thorium in stone, concrete, and soil, as well as radioactive carbon and potassium in the body and in water and food. These sources give the average person a whole-body dose of about a hundred millirems a year.

Man Adds Radiation

Besides absorbing natural radiation, many people are exposed to man-made ionizing emissions. Medical diagnostic X-rays, for example, give the average person 70 millirems a year. TV sets and radium-dial wristwatches add perhaps a millirem a year.

From these natural and man-made sources, the average person gets close to 200 millirems of radiation annually, reports Kenneth F. Weaver in a major nuclear energy story in the April National Geographic.

A nuclear reactor, properly operated, adds little to this burden: no more than a few millirems a year for the exposed public. Coal-powered plants emit about the same amount of radioactivity because of radium and uranium in the coal.

But radioactive elements such as iodine 131, cesium 137, and strontium 90 — all produced in nuclear reactors — are especially hazardous to man if they get into the food chain, because of biological concentration.

How much radiation does it take to cause harm? Radiobiologists regard a single dose to the whole body of 600 rems — 600,000 millirems — as lethal to most people; 100 whole-body rems can cause radiation sickness; 10 can damage the lymph nodes and spleen and decrease the bone marrow and blood cells, although the symptoms are not felt.

Feared by Scientists

A few millirems or even a few rems seem small by comparison, especially spread over a period of time. However,

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Winners

Scholarship winners in the American Private Enterprise System program in Cynthiana last week included, from left, Cathy Mitchell, Martha Woosley, Mark Baker and Deanna Darrell. The four will participate in the Kentucky Youth Seminar this July at the University of Kentucky. — Mercury photo.

Quality important in hay

Kentucky farmers will harvest more than 1.5 million acres of hay in the upcoming hay making season. But quantity is not the main goal in producing the hay crop, remind Extension forage specialists in the University of Kentucky College of Agriculture.

"The goal of any hay making program should be to obtain maximum yield of digestible nutrients per acre," say Garry Lacefield and J. K. Evans, stressing the word "digestible".

They note that the most important factor in digestibility is the stage of plant maturity when harvested.

"The optimum stage for first harvest is always a compromise between quality, quantity and stand life," say the specialists. They report that research has shown the best compromise exists when plants are harvested at a stage when they are visibly changing from the vegetative to the reproductive stage.

"As forage plants advance from the vegetative to the reproductive stage, they become lower in protein, digestibility and acceptability to livestock," explain the specialists. They point out that the best indicator of forage quality is the animal, and forage intake decreases with delayed harvest.

Information on quality hay making, harvesting and feeding is available from county agricultural Extension agents.

Farm and Home

Nicholas County Extension Agents
Mike Phillips, Mrs. Sharon A. Wilson, Mrs. Margie Wilson

4-H TALENT SHOW

The 4-H Talent Show will be held April 27 and 28 at the Nicholas County Elementary School beginning at 7 p.m. April 27 will feature solo and small group acts. April 28 will feature the finalists for the TV Showcase and Club Acts. Admission will be 75 cents for adults and 25 cents for students. Make every effort to attend and watch Nicholas County's talented youth perform.

APES PROGRAM

A big thanks to those in the community who helped make the American Private Enterprise System program such a successful one. Nicholas County school personnel, discussion leaders, sponsors and selected students worked together, thus made the program both interesting and educational.

Congratulations to the four scholarship winners including Mark Baker, Deanna Darrell, Martha Woosley and Cathy Mitchell. These youths will participate in the Kentucky Youth Seminar held at University of Kentucky July 18-21.

4-H SUMMER ACTIVITIES

July 9-13 marks the time for 4-H Camp. The fee is $26.50 including 2 crafts. Interested youth should apply in the County Extension Office by June 1.

June 11-14 is an exciting time for Teen 4-H members. Kentucky 4-H Week will be held at University of Kentucky campus in Lexington. The fee for this event is $58. Included in this week will be a disco dance, a formal ball, election of Kentucky 4-H Officers and many leadership seminars and workshop. 4-H members who have completed the eighth grade and do not exceed 19 years of age are welcome to attend. Youth must apply for this event by May 5.

Sheep Day set

The University of Kentucky's Coldstream Farm will be the site of the 11th Annual Kentucky Sheeprofit Day set for May 24.

The program, scheduled for 4 p.m. to 8:30 p.m., will feature displays and demonstrations related to all aspects of the sheep industry. UK College of Agriculture faculty members and industry personnel will be available for consultation on production problems.

Presentations will be on working facilities, finance management, forage programs, junior sheep opportunities, sheep programs at UK and a new source of replacement ewes.

A sheepdog demonstration, complimentary lamburger supper and a meeting of Kentucky sheep and wool producers will conclude the late-afternoon program.

Branding could help retrieve stolen cattle

With cattle rustling reportedly on the increase in Kentucky, cattle producers are being urged to brand their animals.

"Branding may not stop a rustler from stealing cattle but it can help catch the thief and get the critters back to their owner," says Curtis Absher, Extension beef cattle specialist in the University of Kentucky College of Agriculture.

Kentucky has a brand law administered by the State Department of Agriculture. To serve as a legal mark of ownership the brand must be recorded with the state's agricultural department and properly applied.

Either the traditional hot iron branding or the newer freeze branding method may be used, according to Absher. Freeze branding, he says, was developed to reduce damage to the hide, and the method is believed to be more humane.

For freeze branding, the iron is super-chilled with dry ice or liquid nitrogen, then held in contact with the skin long enough to freeze the color-producing cells of the hair follicles. This takes 20 to 60 seconds, according to Absher, depending on the animal's age and type of coolant used. He adds that the hide must be clean, the hair clipped closely and alcohol or other suitable coolant applied to the skin before branding.

For hot branding, electrically heated irons are handy to use, but Absher says the iron can be heated over a gas burner or a wood or charcoal fire. The critical factor, he says, is heating the iron properly "so it barely glows when held in a shadow or down in a 5-gallon bucket." The hair is not clipped when fire branding. The specialist says the completed brand should be tan and look like new saddle leather.

Although proof of ownership is a major reason for branding cattle in the current flurry of rustling activity, Absher points out that there are other reasons for identifying cattle. He recommends a system that combines branding with tattoos and/or ear tags to identify cows within a herd by age and productivity. The system also should be useful for breed registration and disease eradication programs.

Tattoos are required by most breed associations for registration. But tattoos cannot be read unless the animal is confined, and for this reason an easy-to-read ear tag also should be used, according to Absher. The specialist says that the identification system is more useful if the ear tag, tattoo and/or brand carry the same individual cow number.

More information on the identification of cattle is available at county Extension offices.

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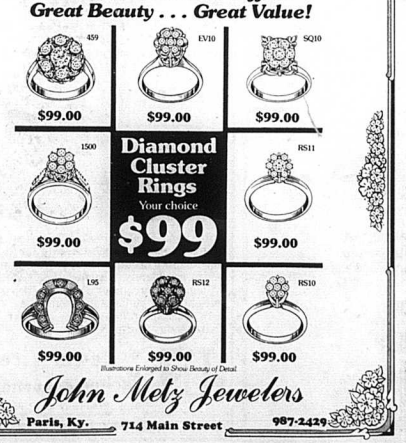

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