Nuclear reactor gives PSU research power

By STEVE SNYDER
Collegian Staff Writer

A blast of pressurized air is heard as a control rod, which regulates the rate of the nuclear fission reaction, is forced out of the reactor core. A bright flash of light follows as the reactor goes "super-critical." When the flash subsides, all that remains is the stereotypical Cerenkov radiation glow.

The event, which lasts about 0.003 seconds, is not the precursor to nuclear reactor disaster. Instead it is a "pulse" used to irradiate experimental samples or produce radioisotopes for research or tracing.

The pulse produces neutrons and gamma radiation used to irradiate experimental samples.

Joe Bonner, staff member at the University's Breazeale Nuclear Reactor, said the reactor is used in radioisotope production, neutron activation analysis, radiochemical analysis and radioactive and neutron activatible tracer techniques — experimental processes used in a wide spectrum of scientific research.

The reactor, located on campus near the Indoor Sports Complex, is incapable of producing a constant electrical flow because of its design. It operates at approximately 100 watts of power until a control rod is forced out of the reactor core by a blast of pressurized air, Bonner said.

The reactor goes super-critical during the pulse; this happens when excess neutrons are released. As a result, power jumps to about 300 megawatts, increased by a factor of three million. The reactor now is beyond the control of the operators, Bonner said.

A nuclear disaster does not result because the reactor has a built-in safety safety called a negative feedback mechanism, Bonner said. As the power increases, the temperature in both the fuel and the moderator — a substance used to slow the neutrons — rises.

The increased temperature causes molecules in the moderator to speed up, thus lessoning its slowing effect on neutrons, Bonner said.

The uranium 235, used as fuel within the reactor, refuses to accept these faster moving neutrons so the reactor shuts itself down.

This process is known as "prompt negative temperature coefficient," Bonner said.

"The government will not license a reactor without a negative temperature coefficient," he said.

The characteristic radioactive glow is a result of the fission products' emission of gamma rays, Bonner said.

Because the speed of light in water is 200,000 kilometers per second, neutrons released released from the uranium fuel rods are capable of exceeding it to create the glow, Bonner said.

Bonner said the glow was similar to a sonic boom created when an object exceeds the speed of sound. When electrons from the fission products exceed the speed of light in water, a "light boom" occurs, creating the glow.

The glow lasts for about ten minutes after the pulse.

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The building housing the reactor is not spectacular. Instead of being overshadowed by gleaming, monsterous cooling towers, Breazeale is modestly housed in what could easily be mistaken for a small office or classroom building.

The reactor is not as as large and impressive as a commercial nuclear reactor. The core is small and sits at the bottom of a pool of filtered, demineralized, distilled water. The pool is about 30 feet long, 14 feet wide and 24 feet deep, Bonner said.

Breazeale is a training, research, isotope production, General Atomics reactor. It does not produce any commercial electricity or even light the building in which it is housed, Bonner said.

The University has used the facility extensively in research and experimentation as well as providing a training ground for University nuclear engineers. Breazeale's annual report included 41 research projects last year.

The experimentation done at the reactor covered a broad range of topics.

For example, the anthropology department used the facility to determine the origin of prehistoric obsidian tools and chipping debris found in Ohio, said Robert Totenbier, operations supervisor at Breazeale. In a process called tracing, samples were irradiated to reveal their composition. Compositions can then be compared with the several volcanic flows in the Yellowstone National Park region — their most probable origin.

William Dunson and Joseph Freda of the biology department used the reactor to determine the effects of acid rain on amphibian larvae. They found that exposure to low pH, an effect of acid rain, accelerated the loss of sodium by the developing animals. The sodium loss was fatal to the subjects, Totenbier said.

William B. White and M. Y. Khalil of the geochemistry department irradiated two ceramic waste containers doped with urnaium to study the resulting damage. The containers, coated with uranium, were lowered into the reactor pool and subjected to a reactor pulse, Totenbier said.

Samples were irradiated to different degrees so that variable damage could be observed, he added.

In a related experiment, the researchers studied whether ceramics, exposed to radiation from fission products, would be more susceptible to attack and breakdown by aqueous solutions, Totenbier said.

They observed a substantial increases in the breakdown of perovskite but little change in the dissolution rate of zirconolite — two minerals used to produce ceramics, he added.

Richard Craig and Herbert Grossman of the horticulture department did extensive research on the effects gamma radiation on seed germination and physical changes in geraniums, Totenbier said.

They found that after an initial increase in plant height and branch length, overall the plants were significantly inferior to the plants which were not exposed to radiation.

Several members of the nuclear engineering department used the reactor to study damage in metals and semiconductors after they were exposed to neutron radiation, Totenbier said.

Researchers hope these experiments will lead to a better understanding of radiation damage to electrical circuits.

The physics department has been using Breazeale for trace element analysis of rain water. Through neutron activation analysis, contaminants in rain water can be identified, Totenbier said.

However, the University is not the only patron of the Breazeale facility. Industrial research is also conducted at the reactor, he said.

The Gas Spring Company, of Comar, Pa., which makes pneumatic springs, has used the reactor to locate oil inside sealed steel components. Through neutron radiography, the location of oil can be accurately photographed. The company has committed $57,000 to help improve the process so that they can, in turn, use it to improve their product. The Ben Franklin Partnership is also expected to support the project, Totenbier said.

The Lawrence Livermore National Laboratory, New Mexico, the nation's primary nuclear weapons developer and builder, has tested the sensitivity of their "Fission Foil Detectors" at Breazeale, Totenbier said.

These detectors are used to measure the "magnitude of the various nuclear devices tested at the Nevada Test Site," according to personnel in a report to the Breazeale facility. The report also claimed that staff members have applied the detectors with "outstanding success."

The Raytheon Company, of Sudbury, Mass., has also used the reactor to "predict the response of semiconductor devices and electronic circuits to neutron environments," a report prepared by the company for Breazeale said.

Bonner said the reactor is also used to evaluate forensic evidence.

A solution is spread on a shooting suspect's hand and allowed to dry. It is then peeled off and irradiated. Analysis of the samples can help police determine if the supect has recently fired a gun and in which hand it was held. By making similar imprints of objects at the crime scene, police can also determine the direction and distance of the shot, he said.

The Breazeale reactor was built in August, 1955 and has never had a radiation incident, Bonner said.

"If you treat the thing with respect and watch what you're doing, there are no problems," he said, speaking of the reactor.

Even the pool in which the reactor core is submerged is relatively radioactive free, Bonner said.

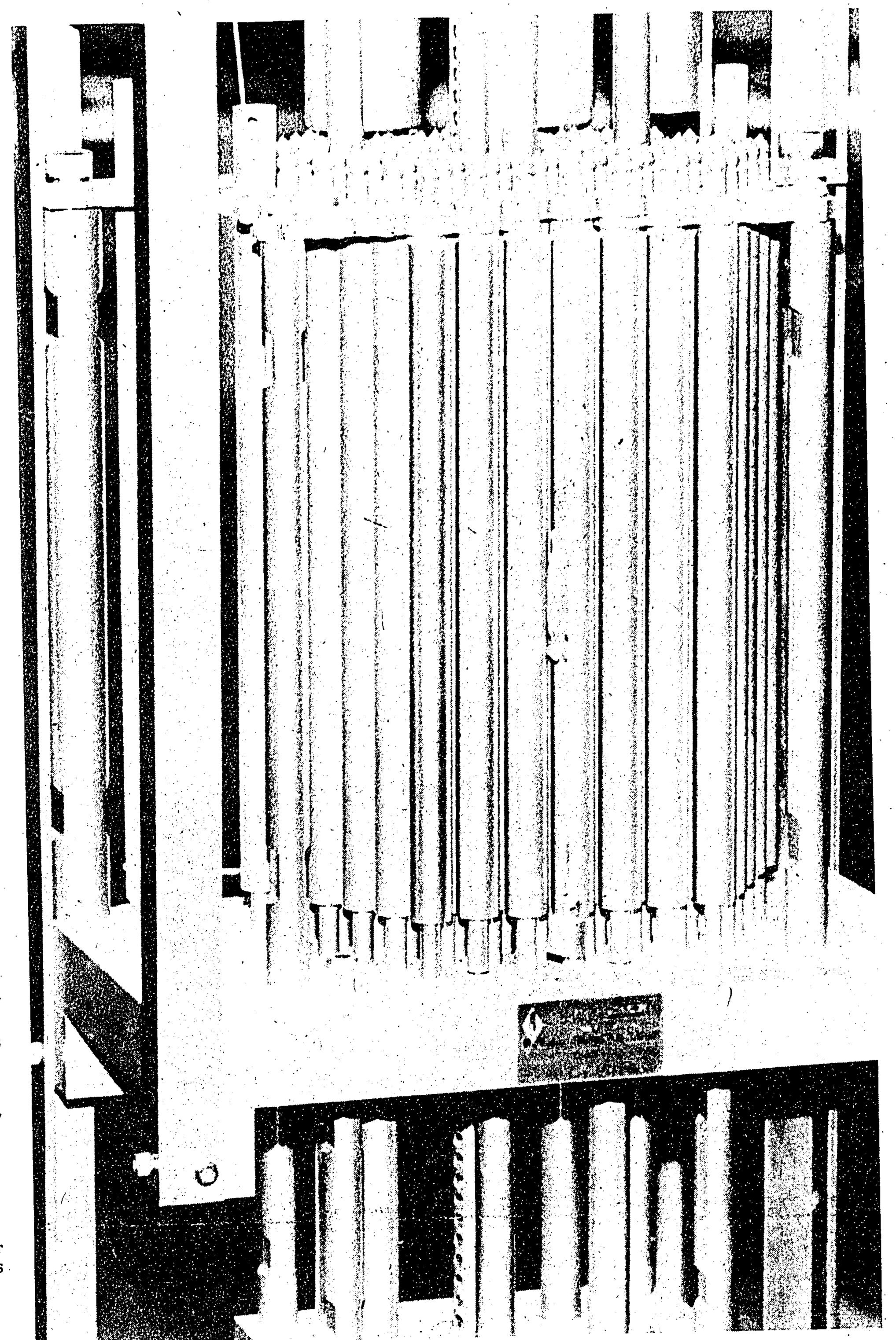
Water itself does not become radioactive, impurities within the water do. Because the water in the pool is distilled and impurity free, radiation is kept at a very low level, he said.

The water is kept in a closed system, eliminating the possibility of a radioactive water leak. The only loss of water is due to evaporation, Bonner said.

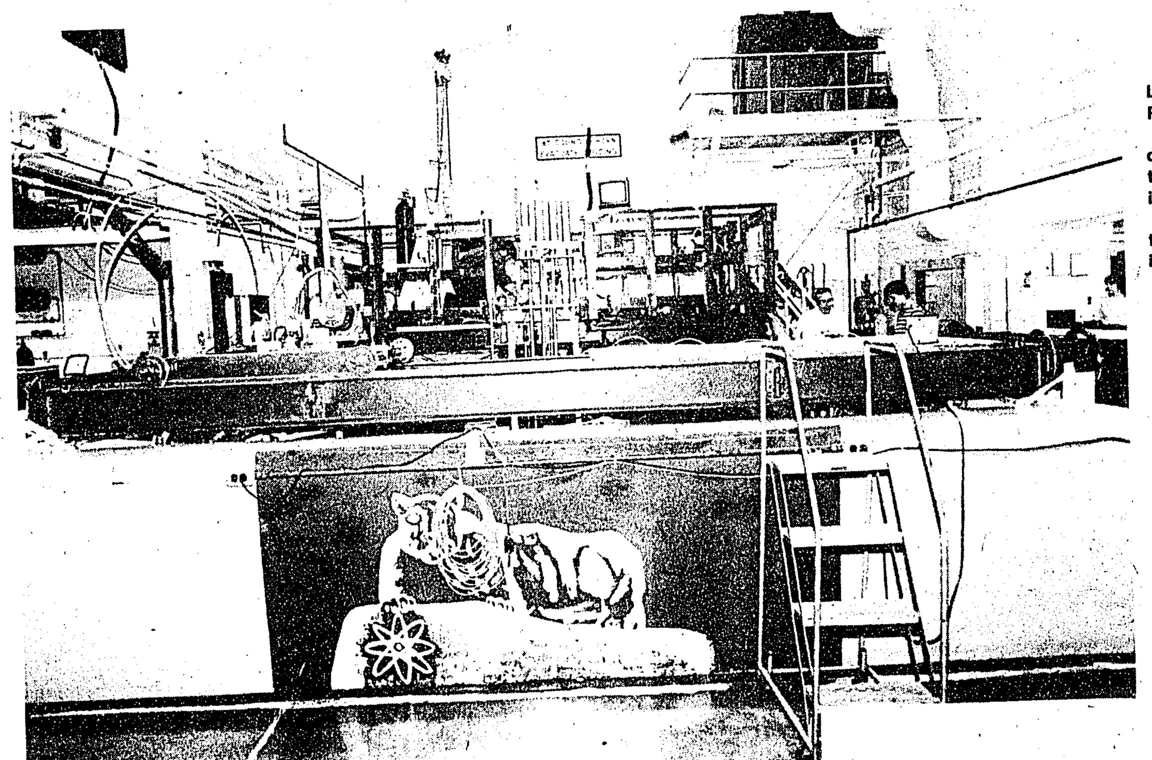
There is no need for cooling towers at Breazeale because the power level at which the reactor runs is not sufficient to substantially raise the temperature of water around the core. Breazeale is a one-megawatt reactor as opposed to the3,000-megawatt commercial reactors, Bonner said.

Bonner described the experimental uses of radioactivity as essential to many forms of scientific research.

"If we had to stop using it, we would be in deep trouble."

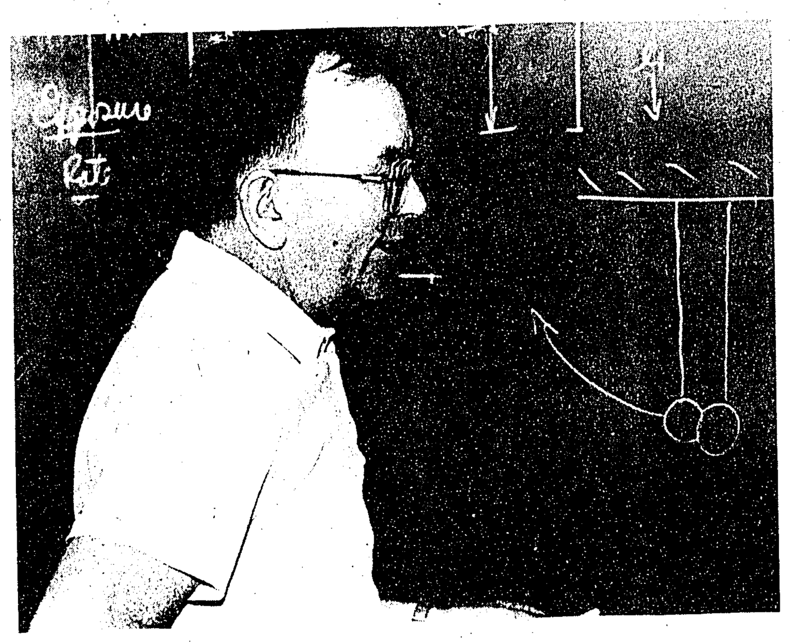


A model of the reactor core displays the uranium 235 fuel rods, four control rods and a sample that is placed between the rods, where it would be irradiated.

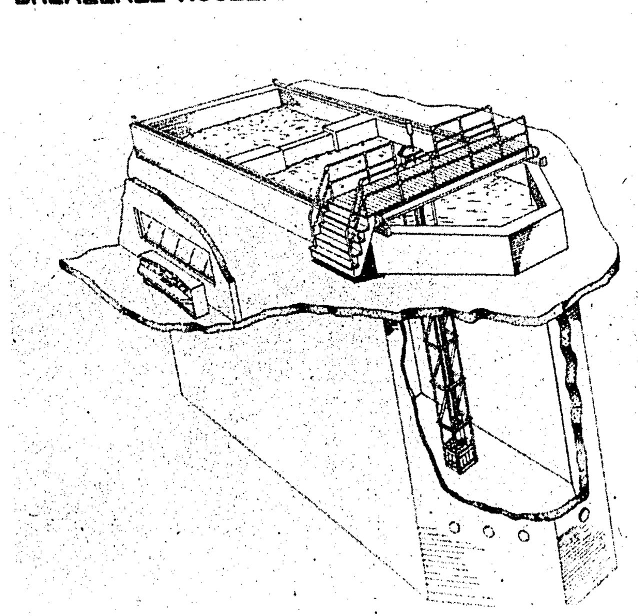


Left: A view of the Breazeale Nuclear Reactor Facility from the pool's edge.
Below, left: With the help of a pendulum diagram, Joe Bonner explains the Breazeale Nuclear Reactor's built-in safety feature.
Below, right: A diagram of the reactor core and the pool in which it is immersed.

Photos by
Scott Wilkerson



BREAZEALE NUCLEAR REACTOR FACILITY



Zero Year Reunion to be held for seniors

By DOUGLAS WOLFSON
Collegian Staff Writer

Graduating seniors will have the opportunity to take one last look at their fellow classmates Friday on the HUB lawn when the Lion Ambassadors and the Undergraduate Student Government sponsor the first-ever "Zero Year Reunion."

The idea for the reunion, which originated at Carnegie Mellon University in 1978, is an attempt to foster better relations between seniors and the Alumni Association, Lion Ambassador Executive Vice President Scott Lockledge said.

The reunion will begin at 3 p.m. and end about 5:30, Lion Ambassador Jean Guskey said, and will feature free pizza and soda for all seniors. Entertainment will be provided by the Penn State Pep Band, the Phyrst Family and Bad Humour. Seniors can pick up buttons entitling them to the pizza and soda on the HUB ground floor through Thursday or on the HUB lawn Friday.

Donna Miyamasu, chairwoman of the event, said one of its main goals is to promote the idea of future reunions — to get graduates to return to University Park for their fifth, 10th and even 50th anniversary reunions.

Kenny Jackson, former Nittany Lion star wide receiver, will be the the Philadelphia Eagles last year, is graduating this spring and will talk about what graduation means to him.

Jackson said he was very lucky to be drafted and have a job immediately out of college.

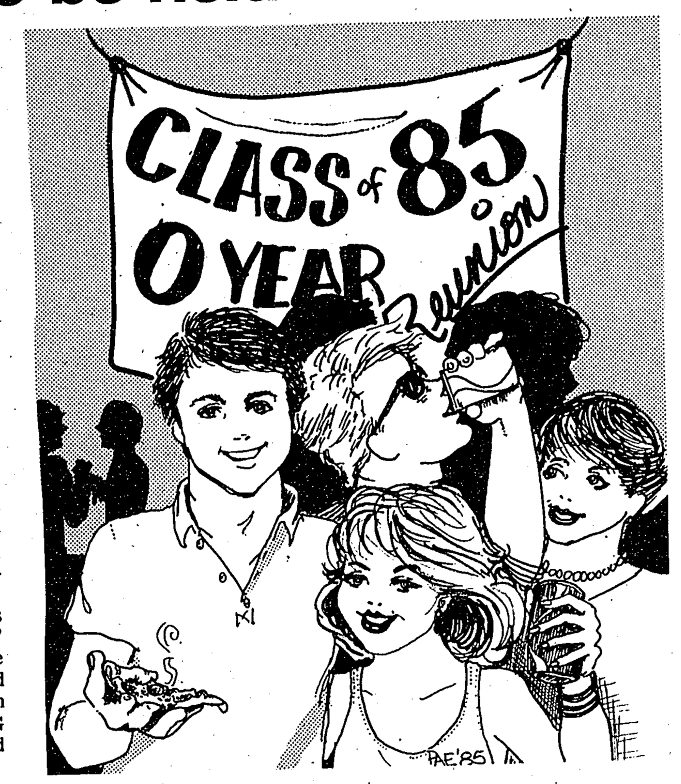
"The education I've had here is very valuable," Jackson said. "Football is only going to last for a short period of my life. Beyond that, my future is up in the air, just like everyone else's."

These are the best years of life, Jackson said. Students may not realize it now, but they will once they graduate.

The Zero Year Reunion will cost more than $3,000 to stage, with the Undergraduate Student Government contributing funds for pizza and soda.

Dave Rishel, USG Senate president, said a major factor in the USG involvement was the University's decision to split up graduation into 11 separate commencement ceremonies.

"It's the last chance for all seniors to get together before next weekend," Rishel said. "Of course this is the feature speaker. Jackson, who signed a 4-year, $2.6 million contract with first year — if it's a big success, USG will probably get a lot more involved next year."



Social work students develop drug program

"Reach Out Before It's Too Late!" say the social work 411 students who have developed a program to educate high school students on the dangers of drugs and alcohol.

Every semester, University junior social work majors in this class decide on a community project, and this year's class chose drug and alcohol abuse for their theme, Trish Diobilda (junior-social work) said.

Maura Cowan (frehsman-social work), explained, "We feel that it's really an important problem right now and it's not being dealt with."

State College residents apparently feel the same. In a recent survey appearing in the Centre Daily Times, 70 percent of the residents surveyed believe that drug and alcohol abuse is the biggest problem in the schools while 90 percent of those surveyed believe drug and alcohol abuse education should be required, according to a press release.

The program, titled "Reach Out Before It's Too Late!" will be held for 10th grade students at the State College Intermediate High School Thursday in an attempt to alleviate the problem.

Various speakers will talk to the 10th grade class as a whole before breaking into smaller workshop and discussion groups.

The program, held in cooperation with Students Against Drunk Driving, will begin with a luncheon for the speakers and then move to the auditorium, where SADD will start the presentations. Expected speakers include: Fran Stoffa, director of On Drugs; state policewoman Sally Brown; nurse Linda Martina of the Altoona Drug and Alcohol Clinic; Beth Machon of Bi-county Rehabilitation; Linda McCracken of On Drugs; representatives from Total Alcohol Awareness Program and a rehabilitated student, Cowan said.

—by Erika Brazzle

UNIVERSITY CALENDAR
Tuesday, April 30

RHAB meeting, 6:30 p.m., Room 324 HUB.
National Society of Black Engineers meeting, 6:30 p.m., Room 103 Osmond Laboratory.
Student Union Board meeting, 7 p.m., Room 307 HUB.
Gamma Sigma Sigma meeting, 7 p.m., Room 217 Willard.
USG Senate meeting, 7 p.m., Room 225 HUB.
Circle K meeting, 7 p.m., Room 311 Boucke.
Penn State Science Fiction Society meeting, 7 p.m., Room 316 Boucke.
Penn State Sailing Club meeting, 7:30 p.m., Room 109 Boucke.