

ORNL's role in early reactor safety concerns

(As published in The Oak Ridger's Historically Speaking column on December 24, 2012)

This week Carolyn Krause takes Historically Speaking readers on a journey back to 1972 and a few years before. She tells of the Oak Ridge National Laboratory's involvement in the creation of nuclear reactor emergency core cooling systems requirements during the 1960's.

Remember the energy crisis of the 1970's? Very large nuclear power plants were being constructed by private energy as encouraged in a modification to the Atomic Energy Act. Reactor safety was of paramount concern in the newly emerging field of commercial nuclear reactors.

One of the resources Carolyn uses, David Hobson, had mentioned this subject to me and I had not been able to follow up on his suggestion. So, it is with pleasure that I learned Carolyn was indeed working with David to tell this most intriguing story. Enjoy the reflection back to a time of discovery in the emerging nuclear power reactor story.

Carolyn begins with profound observation:

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The first goal of every organization is to preserve itself. The second is to carry out the functions for which it was created.

This principle of organizational behavior helps explain what happened over 40 years ago when four Oak Ridge researchers testified at the 1972 Rulemaking Hearing on Emergency Core Cooling [Systems] for Nuclear Power Reactors held by the Atomic Energy Commission near Washington, D.C.

Dave Hobson, one of the researchers, talked about the run-up to the hearing and the hearing itself in two Oak Ridge Institute for Continued Learning classes titled " 'Act Responsibly and Tell the Truth': The Untold Story of the ECCS Hearing."

In respect to nuclear power the AEC wore both promotional and regulatory hats, somewhat like a coach also empowered to be the referee.

The Atomic Energy Act of 1946 gave the AEC absolute control over nuclear energy. But the amended 1954 law encouraged private industry to build and operate nuclear power plants.

Westinghouse, General Electric, Babcock & Wilcox and Combustion Engineering began designing and building nuclear power plants, which utilities operated to help meet the nation's growing need for electricity. By 1971, the four reactor vendors were constructing 55 large nuclear plants.

With limited technical capability in building and running nuclear plants, the AEC relied on vendor and utility expertise and mainly issued operating licenses.

Studies at the AEC's national laboratories indicated potential safety problems in the operating nuclear power plants. But the AEC and the nuclear industry avoided disclosing these findings, not wishing to alarm the public whose support they needed.

The nuclear industry recognized from Brookhaven National Lab's WASH-704 study that the consequences of an unlikely but possible catastrophic nuclear accident could drive a vendor or utility into bankruptcy. So, Congress passed the Price-Anderson Act of 1957 to protect the industry from massive damage claims.

In 1962 the AEC report to President Kennedy barely mentioned reactor safety. Yet the AEC's own Advisory Committee on Reactor Safeguards (ACRS), which was required to review the safety of each proposed nuclear power plant, had already identified some unresolved safety problems.

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In 1964 the vendors proposed larger reactors with fuel cores so big that, if water coolant was lost, the fuel could melt and release hazardous levels of radioactivity to the public. Harold Price, AEC's director of regulation, told the ACRS that revealing its findings could "create difficult public-relations problems" for both the AEC and nuclear industry.

The ACRS concluded that the most important safety concern was the emergency core cooling system designed to prevent core damage in the event of a loss-of-coolant accident (LOCA). It called for testing to show that ECCS systems would work.

In August 1966 the ACRS concluded its review of an application for the licensing of the Indian Point 2 reactor in New York. Its public report was intentionally vague. But its private memo to AEC warned that possible pipe ruptures in reactor cooling systems might lead to a meltdown of fuel through the containment structure into the earth. William Ergen of ORNL called this phenomenon "the China syndrome," which became a movie title.

In October 1966 Ergen was named to chair an AEC-appointed group to study the safety problems the ACRS cited. Ergen's group concluded that more research was needed on topics such as the fate of reactor fuel rods that are accidentally overheated because coolant was lost.

ORNL received funding to study the conditions that could lead to fuel failure. Phil Rittenhouse and Hobson's job for the AEC was to determine under LOCA conditions the behavior of the rods' Zircaloy cladding that enveloped uranium oxide fuel pellets.

An alloy of zirconium and tiny amounts of tin and other elements, Zircaloy absorbs only a small percentage of neutrons from the nuclear fuel it clads. Also, it doesn't corrode in water or steam under normal reactor temperatures and pressures.

"The steam reacts with the Zircaloy metal and breaks down into oxygen, which diffuses into the cladding, and hydrogen, which escapes into the surroundings," Hobson said. "The dissolved oxygen can lead to extreme embrittlement."

The ORNL researchers found that overheated, overpressurized cladding tubes swelled and ruptured. The expansion was five times greater than what the vendors claimed. Industry dismissed ORNL results suggesting that the swollen rods could block coolant flow and shatter from embrittlement.

The ORNL results angered the sponsor, Milton Shaw, director of AEC's Division of Reactor Development and Technology. Shaw cut off funding for Rittenhouse's group in early 1971, saying that "we were creating more problems than we were solving," said Hobson. The worst problem was that critics of nuclear power were citing ORNL findings as evidence of serious safety problems.

In the meantime, the Idaho National Engineering Laboratory conducted tests with a simulated pipe rupture and dummy reactor core. "The emergency cooling bypassed the dummy core it was supposed to cool and exited through the same rupture hole that had drained the initial water," Hobson said.

Backed into a corner, the AEC formed a task force headed by Stephen Hanauer, former University of Tennessee professor. The task force met with the reactor vendors, who rejected INEL's findings, and ignored ORNL's concerns. Hanauer's group drafted an ECCS policy in June 1971 that AEC adopted.

In December 1971 ORNL's Bill Cottrell wrote a letter to Manning Muntzing, AEC's director of regulation, that stated: "We are not certain that the ECCS policy adopted by the AEC will provide assurance that such systems will be effective in the unlikely event of a loss-of-coolant accident." ORNL was asked to withdraw the letter.

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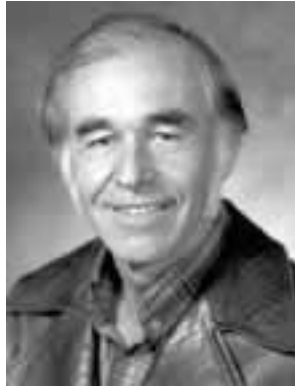
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The controversy had become public, so the AEC was forced to hold a formal rulemaking hearing in 1972 on the adequacy of its new ECCS policy.

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Now there is a study in insight into history that is rarely seen. Thanks to Carolyn for yet another excellent examination of little known or understood aspects of Oak Ridge history.

Next week she will bring out the detailed activities of four ORNL researchers as they participated in the 1972 rulemaking hearing.



Phil Rittenhouse, Group Leader of ORNL's Fuel Failure Group



David Hobson, Researcher in ORNL's Fuel Failure Group