Environmental Radioactivity On and Near the Savannah River Site Before the Start of Nuclear Operations

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Abstract

In the spring of 1951, a few months after the start of construction of the Savannah River Plant and now Savannah River Site, a small team of scientists and engineers began a survey of environmental radioactivity at and near the Site. Never before had such a study been conducted prior to the startup of a nuclear facility. The 18-month survey covered 6000 square miles in South Carolina and Georgia. A principal objective was to characterize environmental radiation and radioactivity so that any increase after the beginning of nuclear operations could be readily determined. The survey was to be the prototype for the environmental monitoring program that was to continue after nuclear operations began. Air, surface and subsurface water, vegetation, soil, and other components of the environment were analyzed for radioactivity. Fallout from nuclear weapons tests complicated the study. The survey met its objectives and inaugurated the long tradition of environmental stewardship that has served the Site and its neighbors so well.

In October 1950, the Du Pont Company accepted President Truman's request to build and operate the Savannah River Plant (SRP) for the Atomic Energy Commission (AEC). Du Pont learned from operating a government-owned nuclear plant during World War II that a comprehensive environmental survey before its startup would have been a valuable asset. In the spring of 1951, Du Pont began planning a preoperational survey of natural radioactivity on and near SRP. The study had several purposes. One was to characterize the environmental radiation and radioactivity so that any increase over this baseline could be readily determined and controlled as necessary. Another purpose was to serve as a prototype for the long-term monitoring program that was to follow the preoperational survey.

This was a trail-blazing study. Never before had such a survey been carried out prior to the startup of a nuclear facility. No federal or state regulations mandated it. Years later these surveys became a requirement for nuclear plants in the United States and in many other nations. It is difficult to realize that in the 1950s the thousands of federal and state environmental regulations now on the books didn't exist then. The establishment of the Environmental Protection Agency was still 20 years away. In those earlier days when you said "ecology" you had to explain its meaning.

In the spring of 1951, C.M. Patterson, who had been a leader of Du Pont's radiation protection program at the Hanford Plant during World War II and had recently rejoined the Company, began recruiting a team of scientists and engineers to conduct the SRP environmental survey. The pool of experienced candidates was limited. Only a few AEC contractors were monitoring radioactivity in the environment, and their programs were relatively small. Throughout the nation, probably fewer than 30 scientists and engineers were involved in these activities. Several graduate programs in health physics sponsored by the Atomic Energy Commission had begun a year or so earlier. The team, designated as the Site Survey Group, that assembled at SRP during the summer of 1951 was a mix of people from other AEC sites, universities, and Du Pont plants. I was the team leader.

A year later, C.M. Patterson moved to SRP from Du Pont headquarters in Delaware and was appointed the first head of the Health Physics Section. The Site Survey Group became part of his organization. He directed the successful radiation protection program at the Site until his retirement in 1978.

Ralph Gosline (from Los Alamos) and I (from Brookhaven National Laboratory) were the first team members to arrive at SRP. When we came in June, road construction and the clearing and grading efforts for building sites had just started. Most people still remained on their farms and in their homes in the towns of Ellenton and Dunbarton and several other smaller communities on the Site. Some construction workers lived in tents near these towns because lodgings were scarce and expensive. Stores and other businesses were open. Farmers were growing cotton, corn, and peanuts. Trains still stopped at the Ellenton station. Within a year, the 1500 families who resided in the 300-square-mile area would be gone, with many moving their houses with them. When the environmental survey was completed in 1953, only traces remained of the towns and farms where 6000 people once lived.

About a dozen Du Pont engineers and chemists, who were to work in a pilot plant beside the river, were already here when we came. They were following the plant's construction, scheduled for completion in the fall of 1951. Several laboratories in the construction effort were assigned to the Site Survey Group.

Upon arrival, one of our first tasks was to learn about the Site. It was a difficult area to get to know. Although we had excellent maps from the Army Map Service, they didn't show the impenetrability of marshes and swamps that bordered practically all of the 22-mile stretch of Savannah River that adjoined SRP. The maps didn't indicate the thick briar undergrowth and tall canes that made access difficult to the 75 miles of streams on the Site. The maps didn't show that many of the unpaved roads had clayey surfaces that became slick when wet. Neither did the maps indicate that most roads would soon be clogged with construction vehicles and houses being moved off the Site. Of course, they didn't warn about the alligators and poisonous snakes. We couldn't fully appreciate from the maps the isolation of the river with hardly any traffic and only a few landings on either the Georgia or South Carolina sides for almost a hundred miles downriver.

On July 26, 1951, Ralph Gosline dipped a bottle into the Savannah River at Gray's Landing. A day or so later the water was analyzed for radioactivity in a small windowless construction shed. This was the start of the preoperational study of environmental radioactivity. It was also the birth of the Site environmental monitoring program that has continued for a half century.

As the summer progressed, new members of the monitoring team arrived. At the end of the summer, the team had 12 members. It was the first operations group on the Site, although about 2000 construction employees had already arrived. A few years later the construction force grew to 40,000 workers.

Since the preoperational survey was to be a dry run for the routine monitoring program after SRP startup, its organization and content reflected our concepts of the post-operational monitoring. We anticipated that the reactors and the separations facilities would be the primary potential sources of environmental radioactivity. These facilities were to be built near the center of the Site to provide a buffer zone of about 10 miles between the facilities and the Site boundary. Radioactive releases would first be monitored in facility stacks and pipelines and by monitoring stations immediately outside the buildings. We placed additional monitoring stations in a ring around the area containing the reactors and separations plants and in another ring farther away at the Site boundary. Finally, there were stations 25 miles from the Site. These stations were either small buildings with devices to collect air and rainwater samples or places where soil and

vegetation were routinely obtained. Each site stream was sampled at several locations, and the river was sampled at 16 points. At the stream and river locations where water was collected, sediment samples were also obtained. The density of the monitoring stations was greatest near the nuclear facilities and decreased with distance from them.

Crops from local farms and water supplies in cities and towns as far away as Savannah were also analyzed for radioactivity. We inventoried the many open farm wells and selected those that would be routinely sampled. These were preserved and barricaded. The remaining wells were filled in because they were a safety hazard for construction workers and the Site Survey team.

We anticipated that in the late fall atmospheric tests of American nuclear weapons might deposit considerable radioactivity in the area. Therefore, we pushed hard to collect appropriate samples and to install fallout-monitoring equipment during the summer and fall of 1951. Debris from unexpected Russian nuclear tests blanketed the area in October, several weeks after the air monitoring stations were put into service, two on the Site and one in Aiken. American fallout arrived in November. In addition to the air monitoring stations, large sheets of flypaper were placed at many locations to detect fallout. This low-tech, inexpensive method worked well. Fallout particles adhered to the paper. When the paper was placed on photographic film, dark spots on the film caused by the radiation from the particles were counted to get a relative measure of the fallout.

Before the completion of our laboratories, we processed samples in a construction shed that wasn't air-conditioned. We often worked outside during the summer of 1951 using nearby stumps of large trees as laboratory tables. We quickly learned that some instruments that performed well in the dry climates of Hanford and Los Alamos could not tolerate the high humidity at SRP. Until they were later moved into an air-conditioned laboratory, the instruments functioned only if we loaded them with a drying agent, which had to be replaced every morning. Not having hoods and other common laboratory services and frequent power interruptions beset the analytical program.

During the summer, we met other environmental organizations that were beginning their work at SRP. DuPont engaged the Philadelphia Academy of Natural Sciences to baseline the health of the river. Dr. Ruth Patrick headed the Academy's team. They rented several rooms in a motel in Allendale, South Carolina, and converted one into a laboratory. Another team, under the direction of Dr. Eugene Odum from the University of Georgia, was starting long-term terrestrial studies. His group was housed in a barn-like structure on the edge of the Site. These veterans of southern field studies scheduled their outside work between 4 p.m. and dark when it was cooler. The studies started by Dr. Patrick and Dr. Odum continue today. Dr. Patrick's work represents the longest continuous set of biological studies in an aquatic environment in the United States, and probably in the world. The studies of Dr. Odum's group expanded further, and they became the basis for establishing the Savannah River Ecology Laboratory in 1962.

In 1951, the Savannah River Advisory Board was established by the U.S. Surgeon General to monitor the effects on the river of the Savannah River Site and the Clarks Hill Dam, which was being built. The panel, representing federal and state agencies having jurisdiction over water resources, endorsed the concept of the preoperational survey. The Board routinely reviewed the plans and results of the study. This gave us an opportunity to discuss the Site's programs to protect the environment.

In those years, the media and the public were, of course, very interested in the Site. Du Pont had no public relations organization, and we were often asked by the local office of the Atomic Energy Commission to explain the survey and the Site's plans to safeguard public

health and the environment. These outreach activities demonstrated to a wide audience the strong resolve of SRP to be a safe neighbor.

In January 1953, the 18-month survey was completed. Approximately 6600 environmental samples were analyzed. Radiation and radioactivity were characterized on and around the Site. Monitoring stations, equipment, instruments, procedures, and trained people for the post-operational environmental monitoring were in place. This allowed a seamless transition to the continuing monitoring program. When the final major facility came on line in 1955, the Site's routine monitoring program had been in operation for 30 months.

I will not discuss the results of the analyses of the environmental samples that were collected and analyzed for total radioactivity or for specific radionuclides. These are discussed elsewhere (Reinig et al. 1953). If the study had been made 20 years later, we would have determined the specific radionuclides in many more of the environmental samples using rapid and accurate alpha and gamma spectrometry. But this was not practical using the state-of-the-art methods of the early 1950s. The results of the analyses were generally about what we expected.

But there were surprises. For example, we found that the granite aggregate about to be used to construct laboratories for measuring low levels of radioactivity contained high concentrations of natural radioactivity. It was replaced with an aggregate that had a 100 times less radioactivity. Another surprise was the substantial amount of fallout from Soviet nuclear weapons testing that arrived at the Site in October 1951. While we anticipated the possibility of considerable fallout from American tests, we didn't expect much from the Soviet test half way around the world.

One of the purposes of this prototypical study was to uncover and solve problems so that they would not be encountered later (Patterson 1987). Experience with boats on streams and the river indicated special emphasis on boat safety was needed. This training prepared the crews to respond safely to unexpected events, such as when a snake dropped into a boat from an overhanging branch or when a motor failed far downriver beyond the range of their radio. We discovered that birds damaged the instruments that measured environmental radiation. New "bird-safe" instruments designed and made at SRP eliminated the problem. We learned which instruments required a low humidity environment. The need for additional offsite stations to monitor air and collect rainwater became apparent, and these were put in service in Allendale and Waynesboro, Georgia, soon after the preoperational survey ended. Similar stations were placed about 100 miles from SRP to assist in differentiating SRP releases from fallout.

Many other organizations contributed to the survey. The Corps of Engineers supplied soil samples from test borings, and the Bureau of Mines assisted in thorium analyses. The Philadelphia Academy of Natural Sciences and the Universities of Georgia and South Carolina collected and identified animals and plants. The Coast Guard helped to collect samples in the Savannah harbor. Instruments to measure environmental radiation were calibrated at the Medical College of Georgia. Local health officers assisted in collecting public water samples. The associations with the public health officers, universities, and the Philadelphia Academy of Natural Sciences that started during the preoperational survey were maintained and strengthened during the past 50 years.

Looking back, I'm surprised that none of the team members resigned during the survey. They slogged through swamps; side-stepped alligators; carried a snake-bite kit with an intimidating sharp razor blade; and suffered the hot, humid summers when working inside and outside. Those members with families tolerated inadequate housing. But the technical challenges of this first-of-a-kind activity and the thrill of being part of the atomic age, which was still new and exciting, evidently outweighed these

conditions. They knew that the organized commotion of one of the largest construction projects ever undertaken in this nation would be an unforgettable experience. Another reason may have been that team members believed that in a small way, they were contributing to the security of the nation. These were times of considerable international tension. The U.S. was at war on the Korean peninsula, and the Soviets conducted their first nuclear weapons test in 1949 and in 1952 tested a thermonuclear device.

Why should this study made 50 years ago be considered significant today? My answer is simply this—the preoperational environmental survey inaugurated the long tradition of environmental stewardship that has served the Site and its neighbors so well. By focusing on environmental radioactivity, it helped to imbue in the institutional consciousness of the Site the importance of controlling releases to the environment. Several years after startup, management's philosophy regarding release of radioactivity was explained in the Congressional testimony of J.E. Cole, a director of Du Pont's Atomic Energy Division. In summarizing his statement he said, "It would seem tragic to discover in the year 2000 that improper confinement in prior years had made limited use of some of our water and land necessary, and this by an industry which was hailed with so much hope in 1960!"

References

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Biography

William Reinig served in the Navy during World War II. He received a Bachelor of mechanical engineering from the Polytechnic University. Before joining Du Pont in 1951, he was a health physicist at the Hanford Works and supervised the health physics group at Brookhaven National Laboratory's research reactor.

During Du Pont's operation of the Savannah River Site, he managed the Health Physics and Technical Departments. Under Westinghouse at SRS, he was Deputy General Manager of the Environment, Safety, Health, and Quality Assurance Division, and before his retirement in 1993, he was the principal scientist in that division.

He is past-president and a Fellow of the Health Physics Society. He was chairman of the American Board of Health Physics and a director of the American Academy of Health Physics. He is a consociate member of the National Council on Radiation Protection and vice-chair of Citizens for Nuclear Technology Awareness.

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