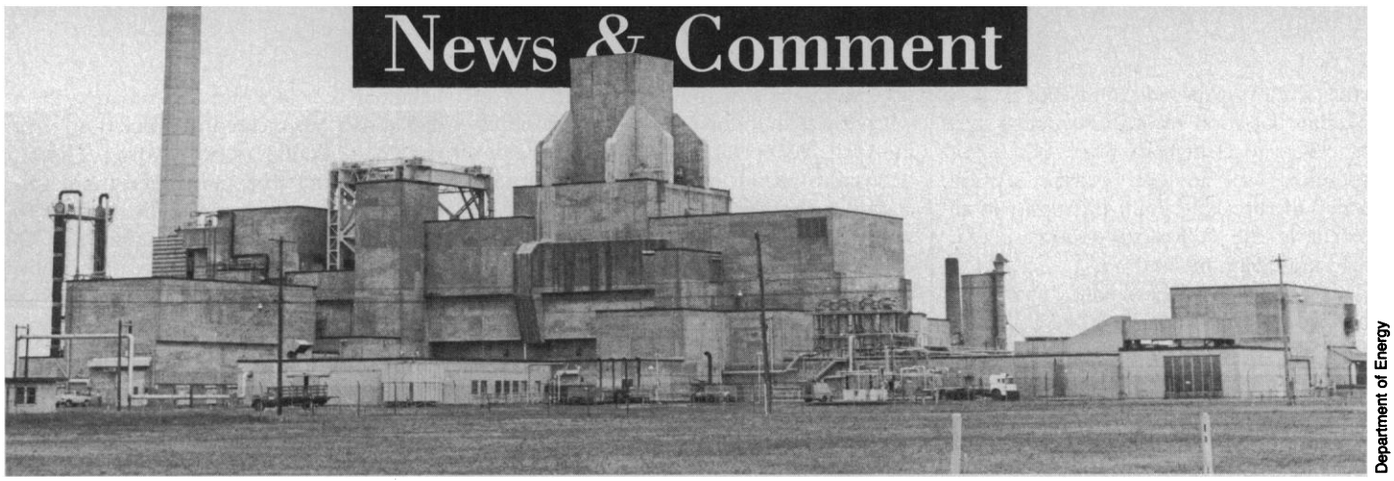

Department of Energy

Down, but not out, *the L Reactor at Savannah River is one of three operable defense reactors down for safety reviews until 1989.*

Savannah River Blues

DOE's new safety team runs into bureaucratic obstacles and an assumption among operators that "reactors are safe unless demonstrated otherwise"

AFTER FOUR DECADES OF POLICING itself on safety and environmental standards, the U.S. nuclear weapons network is being opened to a new breed of inspectors. In fits and starts, the newcomers are making public old problems and long-buried mistakes. Recent examples come from the Savannah River Plant, near Aiken, South Carolina, whose history of spills, leaks, and reactor mishaps was the focus of a congressional hearing on 30 September.

The investigation of past errors may have a long course to run, and there may be more bad news in store for the Department of Energy (DOE), the manager of these aging plants, before it is over. Already it is estimated the repairs and cleanup throughout the DOE system could cost $100 billion.

Officials last week tried to reassure the public that there was no record of injury in the disclosures. But on the day they went before the press, they also had to shut down a plutonium factory in Colorado for safety code violations. Three days later, they had to answer charges about radiation leaks from a plant in Fernald, Ohio.

At present all 14 of the reactors in the DOE network are closed, most of them permanently. DOE Secretary John Herrington told reporters on 11 October that the last three operable reactors—all located at Savannah River—will soon pass seismic and other safety reviews for which they were put on standby this year. He hopes to get the K Reactor running again in December; the L Reactor, during the first quarter of 1989; and the P Reactor, in the third quarter of 1989.

If DOE keeps this schedule, Herrington says, there will be no shortage of weapons material. Earlier in the year, he described the system as being "awash" in plutonium. He expects no supply crisis. Plans for one or two new reactors are in the works and will take 10 years to complete (*Science* 29 July, p. 526). However, another critical material, tritium, has a relatively short radioactive half-life; it disappears at a rate of about 5.5% per year. Tritium demand thus will force the government to get one of its old reactors going within the next few months, Herrington says. Meanwhile, Herrington named a special DOE crew headed by Grover Smithwick to respond to concerns about the Savannah River reactors.

A hearing chaired by Representative Mike Synar (D–OK) and Senator John Glenn (D–OH) revealed that reactors run for DOE by E. I. du Pont de Nemours and Company have had many unadvertised mishaps since the early 1950s. Among them were two episodes in which fuel elements nearly melted. The problems were recorded in log books, monthly reports, and semiannual briefings. But they were not well studied, current DOE safety officials say. Nor were they clearly reported to top officials in Washington. Their implications may not have been taken to heart by the production staff. Many reveal faults in operation, not hardware.

The problems are coming to light now because DOE has hired ambitious new inspectors. They come from the Nuclear Regulatory Commission (NRC), which adheres to a tough policy of safety enforcement at commercial plants. They are probing into the farthest corners of the old weapons complex looking for violations.

DOE Secretary Herrington and Deputy Secretary Joseph Salgado grafted this corps into an agency whose main concern until now has been material output. In 1985, Herrington created an assistant secretary for environment and safety. With Congress applying steady pressure, the office has begun to change the way DOE does business.

At Savannah River, the arrival of the new team "caused a shock to the system," says John Ahearne, chairman of an independent group, the Advisory Committee on Nuclear Facility Safety, also created by Herrington this year. Ahearne, formerly a commissioner at NRC, now works at Resources for the Future, a Washington think tank. "In a sense, the commercial world went on its way" and left the government behind, he says. The system is now going through a painful transition. Du Pont decided in 1987 to give up the contract because of the "increasingly controversial" nature of the job. Westinghouse will take over in April. DOE's chief local manager, Robert Morgan, also retired last year and was replaced by Paul Kaspar.

Many people on the inside, however, see the revelations that have come out of this process as less than earth-shaking. "Don't pay attention to the newspapers," says Gerald Merz, du Pont's chief of reactor technology at Savannah River. "We like to brag that in our 37-year history we've never lost a single workday for a nuclear-related occurrence." He adds: "In all that time, we've had just one person exposed [to radiation] beyond federal regulatory guidelines." In contrast, other DOE facilities and the private

sector have overexposed "thousands."

Despite its good record, the staff is getting orders to change its ways. It has not responded well in every case. Tension reached the breaking point in August in an incident at the P Reactor—the case that Synar and Glenn focused on.

The P Reactor had been shut down for 4 months for a review of its vulnerability to earthquake shocks. The study was ordered by the number two safety official at DOE, Richard Starostecki. Starostecki is one of the new crew from NRC and seems to have little patience for the old way of doing things. In a 7 March memo, he told his boss, the assistant secretary for environment and safety, that seismic analyses at Savannah River "are not consistent with state-of-the-art methods." They could "result in serious design inadequacies." Because these reactors are in an area of high seismic risk, he wanted an inspection by outsiders, with the reactors shut off.

Robert Morgan, then DOE's plant director in Aiken, resisted. He fired a sharp memo back to headquarters on 21 March, saying the concerns were "unfounded," that there had been a "misunderstanding," and that the views of a seismic expert were "not accurately represented" by Starostecki. "We feel that [Savannah River] seismic methods and criteria are appropriate and defensible," Morgan wrote, arguing that they meet or exceed commercial standards. Morgan, who retired in April, declined to elaborate.

Starostecki prevailed. A full review ensued, turning up hundreds of potential structural weaknesses at the P Reactor. The K Reactor is now being reviewed as well. Starostecki reported on 20 May that he had found no "definitive program to assure seismic adequacy at SRP [Savannah River Plant] either in the past or present." The design documentation was "grossly inadequate." During the recent hearing he revealed that plant managers could not put their hands on a set of complete blueprints showing the reactor as it exists now and that some vulnerable components thought to have been removed long ago are still in place.

As the Savannah River staff was recovering from this embarrassment, it created another. The crew assigned to start up the P Reactor after the seismic check on 7 August forgot that the tank still contained old tritium "targets." The tank holds essentially three kinds of assemblies: uranium source tubes that emit neutrons and drive the system; target tubes that absorb neutrons and are converted to plutonium and tritium; and control rods that absorb neutrons and slow the chain reaction when inserted.

The P Reactor was three-quarters of the way through a tritium production cycle when it was shut down for the seismic check in April. As it sat, some of the tritium decayed to helium, which absorbs neutrons and slows the reaction. This was forgotten at start-up. As operators began to pull out control rods on 7 August, they found that they were overshooting the anticipated point of criticality (the extent of rod withdrawal needed to trigger a self-sustaining reaction). But they kept going.

They experienced a power lag, like "hesitation" in an old car when the driver steps on the gas. During start-up, a key indicator

Richard Bloom

John S. Herrington: *"We will not operate unsafe reactors in this complex. . . . "*

of the potential for "prompt" neutrons to create a volatile power burst is expressed in operator jargon as "dollars." One of the mistakes at Chernobyl was that operators let the potential rise to more than 1 dollar. P Reactor operators in August built up a theoretical value, they reported, of 2.8 dollars. A DOE safety inspector from headquarters, Robert Keller, later discovered that the value was 4 dollars, and he thinks the operators may have known it at the time. (They did not record it immediately in the log.) Finally, they gave up and shut down the reactor at 5 a.m. on Tuesday, 9 August.

After checking the numbers, the staff discovered that they had used the wrong table for calculating xenon effects (a by-product gas) and that they had forgotten about helium in the old targets. Fortunately, the 4-dollar gap represented a calculation error, not a huge amount of latent power. The staff rearranged the core and started the reactor safely that night. However, the next morning, while the reactor was running at 720 megawatts, there was a sudden, unexplained power surge. The operators stopped it within minutes by inserting control rods, limiting it to a 2% "blip." The event is still unexplained.

At this point, safety officials in Washington began to get nervous. They had not been well briefed, and they did not hear about the power blip until the day after it had appeared. Keller, who had worked under Starostecki at the NRC, was sent down with a group of experts to sniff around. He was surprised by what he found. According to a memo he wrote later, he asked a reactor technician whether he thought there was any significance to the 4-dollar "lost reactivity" episode. Because the technician could not think of any way that the reactivity might come back suddenly, he said, no, he didn't consider it a safety problem. Not only that, he added, he would probably do the same thing again in the future. Keller was "incredulous." He wrote Starostecki: "I find that attitude unconscionable, complacent, and patently unsafe." Rather than charge blindly forward, Keller says, the operators should have stopped and tried to understand what was going on. He thought they would at least acknowledge the breach of procedure after the event, but they did not.

On Monday, 15 August, Keller and the other inspectors from headquarters recommended that the reactor be shut down until DOE was satisfied that the operators would run it safely. The du Pont crew was unhappy with this. The local DOE manager and higher ups in Washington hesitated. In the end, Keller and his team agreed to ask for a milder rebuke. But before it could be put into effect, the *Washington Post* learned what was happening, and, belatedly, so did John Ahearne, chairman of DOE's new safety group. Ahearne immediately sent a strong letter to Savannah River officials, criticizing them for not keeping him informed. DOE and du Pont decided on reflection that it would be best to shut the reactor down. It will remain out of service pending another safety review.

Since August, investigators have pored over du Pont's records and released controversial memos. DOE's weapons staff interprets the problem mainly as one of public perceptions. The chairman of du Pont, Richard Heckert, said on 11 October, "Things are fine down there if the government will let us go on with our business." He suggested that proponents of building a

new DOE reactor may be behind the fuss.

In the same vein, a report on the incident written for DOE on 23 September by weapons production officials stresses two general points: that the P Reactor was never out of control and that there was no increased risk to public health or safety. The report, which remains in draft form, seems to give equal weight to improving "media policy" for better relations with the press and upgrading "procedure compliance" by plant operators.

On the other hand, Synar's staff has released several historical documents showing that the August events may be part of a pattern of idiosyncratic management. The papers include a 1985 study commissioned by Merz of du Pont, listing 30 major accidents since 1955. Several radioactive spills are mentioned without a full account of the consequences, and two cases of fuel overheating in 1970. Merz says the fuel accidents cannot be compared with a fuel melt in a commercial reactor because the latter are more volatile. In the less serious case at Savannah River, a fuel tube developed pinhole erosion, and in another case, a 5-foot section began to melt. Merz says he asked for this study himself as part of voluntary safety review. It shows that major mishaps all but ended in the mid-1970s.

Synar also released an inch-thick report by the NUS Corporation dated May 1988, reviewing the entire operating history of the Savannah River Plant through 1987. It mentions dozens of environmental spills, reactor incidents, and miscellaneous problems, noting that some important cases were not recorded in the reactor incident logs. It identifies 32 safety topics that still need to be addressed; 10 that are being resolved; and 6 where "resolution appears successful."

There is a hidden obstacle to getting these old issues cleared up, Starostecki wrote in a tough memo to his superiors on 16 September: some senior DOE managers have "an attitude towards production reactor safety which on the face seems to be similar to that which existed in the space program prior to the Challenger accident. . . . Such a mind-set presumes reactors are safe unless demonstrated otherwise." He asked the department to back his effort to change that mind-set, in particular, to demand that managers of the production staff take the new safety goals to heart.

"The harshest critics of this department in the last 3 years have been within the department," says Herrington. While this is not literally true, DOE has begun a sweeping environmental and safety reform. It remains to be seen whether the next administration will have the stomach to finish it.

■ **ELIOT MARSHALL**

Security at Weapons Labs

"Agents Said to Have Entered Bomb Labs," announced a headline in the *New York Times* on 11 October. The following day, newspapers across the country reported that known and suspected Soviet intelligence agents had been admitted to the Los Alamos, Lawrence Livermore, and Sandia National Laboratories, and that citizens of nations believed to be interested in developing nuclear weapons had also been in the labs talking with scientists about potentially sensitive matters.

The source of these "revelations" was a report by the General Accounting Office (GAO), an investigative agency of the U.S. Congress, which provided the basis of a well-publicized hearing by the Senate Committee on Government Affairs. The hearings were chaired by Senator John Glenn (D–OH), who said that these incidents ocurred because the Department of Energy (DOE), which funds the labs, and the labs themselves "systematically failed to enforce existing security standards for clearing foreign visitors." The chief failing was that background checks were not run on many individuals although the regulations clearly called for them.

What got lost in all the handwringing and the publicity was that there is no hard evidence that any classified information has been compromised. The GAO investigation was concerned with procedures for admitting foreign visitors for unclassified meetings in nonsecure areas of the labs, for much the same kinds of talks they might have with colleagues in universities.

Although some previsit procedures were not followed, the visiting scientists were subjected to controls during their visits that are applied to all guests in the labs who lack security clearances, according to lab officials. This means they would have been escorted at all times (even into the bathrooms) and they would not have been permitted into secure areas. "Anybody reading today's papers would believe that we have Soviet agents running freely around the lab, but that is not the case," says Jeff Garberson, a spokesman for Lawrence Livermore. "We do not allow uncleared visitors, whether they are U.S. citizens or foreign visitors, to have access to classified materials, regardless of those background checks."

At the center of all the fuss is the contentious issue of how to control access to scientific information that is unclassified but could potentially be put to military use. The three so-called "weapons labs" conduct a vast amount of unclassified research in addition to their military work, and consequently a constant stream of visitors flows through the labs for scientific meetings and discussions as part of the usual commerce of scientific exchange. These interactions are encouraged. Between January 1986 and September 1987—the period covered by the GAO investigation—6700 foreign nationals visited the three labs.

To help keep unclassified but potentially sensitive information from getting into the wrong hands, DOE requires that visits by scientists from Communist countries and certain other nations be put through an approval process that generally includes background checks on the individuals. Similar procedures are required for visits that may include discussions involving topics deemed particularly troublesome. DOE lists 18 such topics, including uranium enrichment, inertial confinement fusion, and semiconductor manufacturing technology.

The GAO investigation found that background checks were performed on only 6 of 176 visitors from Communist countries before the visits took place, 51 checks were not completed until the visits began or after they were over, and background checks were not performed at all on 119. Some of those visitors were subsequently found to be associated with intelligence agencies. In addition, GAO concluded that DOE failed to identify 37 visits that involved technologies on its sensitive list.

When asked at the hearing whether classified information has been lost because of these lapses, Keith O. Fultz, the GAO official who conducted the study, said he is not confident that it has not been. Garberson says, however, that the controls placed on the visitors while they were in the labs would have been sufficient to protect classified material.

The GAO investigators argued for an expansion of the sensitive technology list. John R. Schultze, one of the authors of the report, pointed to astrophysics because it involves reactions similar to those in nuclear weapons. That prompted Senator Jeff Bingaman (D–NM) to ask "are we getting into a situation where we are trying to limit so much we are unable to limit anything?" ■ **COLIN NORMAN**