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Truth was an early casualty

By ALEXANDER R. SICH

Soviet and Russian authorities have never told the full story of the critical first ten days.

At a May 1986 press conference in Moscow— held just 11 days after the accident at the Chernobyl Nuclear Power Station—the cult of high technology was unabashedly preached to an auditorium full of shocked news correspondents and invited guests. When questioned as to the number of fatalities the accident had caused and the impact of the accident on Soviet society and the Soviet nuclear industry, A.M. Petrosyants (then chairman of the Soviet State Committee on the Utilization of Atomic Energy) responded: "Science requires victims."

The Soviet system numbered its victims in the millions. In a sense, the Chernobyl accident was just one of the many misfortunes misrepresented by the Soviet government over the decades in its continuing effort to shape public perceptions of domestic disasters, natural and manmade. And yet, the international character of the Chernobyl accident, the fact that radioactive fallout knows no national boundaries, made it a watershed event.

The accident exposed glaring weaknesses in the Soviet system: its backward technology, its sloppy safety standards, its inability to admit failure. And it brought to the surface many of the injustices, inefficiencies, and secrets that the Soviet government had tried to keep hidden. With the world's spotlight focused on Chernobyl, General Secretary Mikhail Gorbachev was left with little choice other than to prove to the West his dedication to reform by more fully implementing his recently announced policy of *glasnost* or "openness."

In turn, *glasnost* was a major factor that led to the demise of the Soviet Union, which embodied a system that was fundamentally at odds with freedom of expression and accessible information.

Unfortunately, old habits die hard. Ten years after the accident, many nuclear bureaucrats in the former Soviet Union, particularly in Russia, are still too secretive and too much given to obfuscation.

Heroic but ineffective

By the time of the Chernobyl accident, Soviet citizens had become masters at avoiding accountability for mistakes and failures. Perhaps no other statement quite captures the essence of this lack of responsibility as one allegedly made by a NIKIET specialist, whose organization (the Moscow-based Scientific Research Institute of Power Engineering) designed the RBMK reactor series. When asked to aid in clean-up and mitigation efforts, he was widely quoted as saying: "This is no longer a nuclear reactor. Our expertise is in nuclear reactors . . . so let others clean it up."

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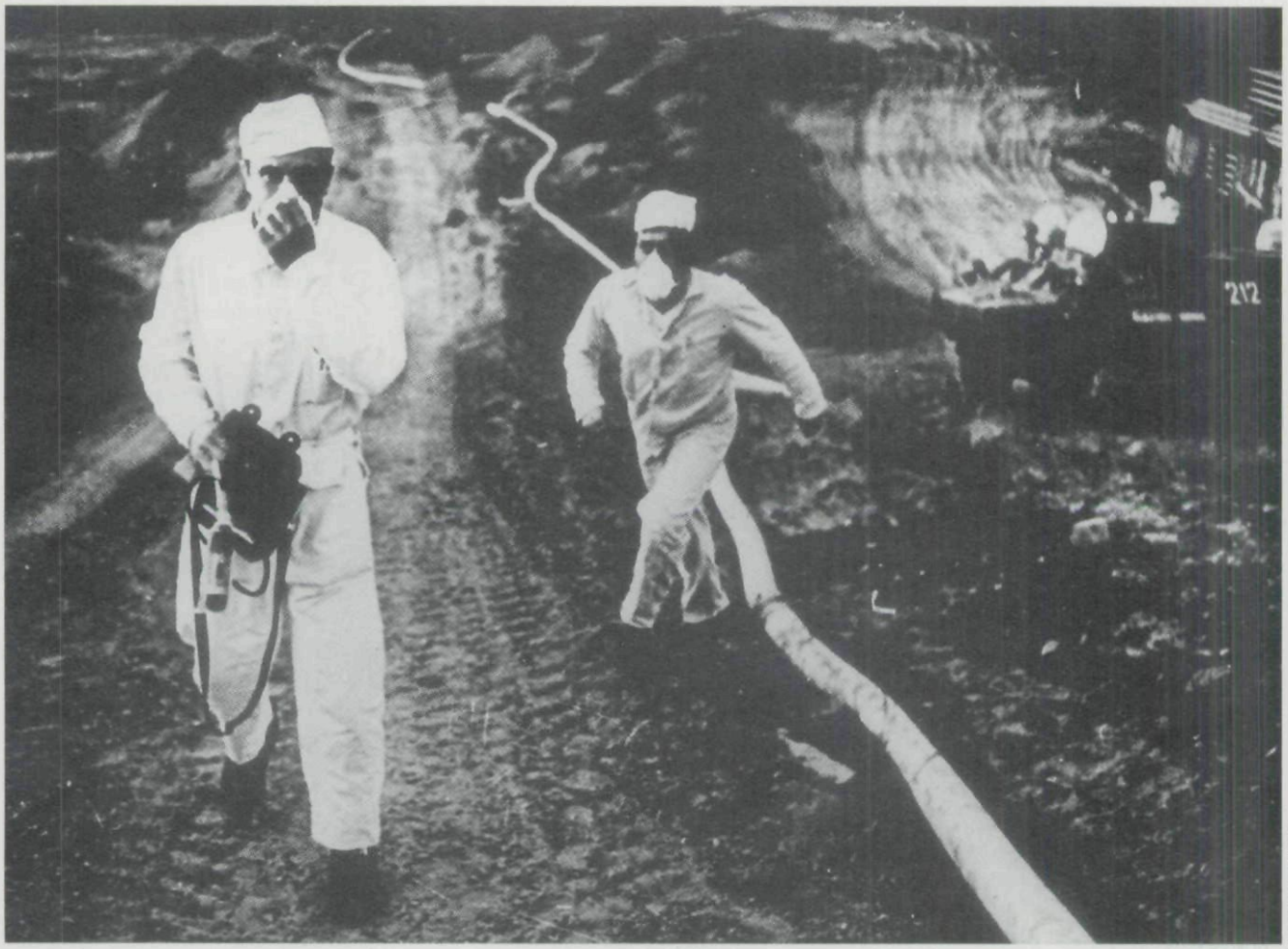


MIKHAIL SERDUKOV

The scale of the Chernobyl accident was greater than Soviet officials had ever believed possible, and they had no contingency plans for dealing with it. Most mitigation efforts were devised on the fly.

And so began an accident containment and mitigation effort portrayed by Moscow as one of the most difficult and heroic engineering tasks ever undertaken. In reality, the period to the end of November 1986, during which the sarcophagus was constructed, was marred by an inept and reckless attempt to conceal the extent of the accident—despite the fact that unwitting "volunteers" (including former Soviet dissidents and political prisoners) risked their lives in several ineffective accident-management actions.

The Governmental Chernobyl Commission (headed by Deputy Chairman of the Soviet Council of Ministers Boris Shcherbina) was formed during the morning of April 26, 1986, and in a manner that resembled a cry to arms, rallied major Soviet organizations and people to mitigate the consequences of the accident. It was clear from the start that no concrete emergency plans had been previously formulated—no one was prepared to respond to an accident of this magnitude.

In 1993, Sergei Shirokov, who headed the Nuclear Energy Division of the Ukrainian Ministry of Energy and Electrification in 1986, told me that it was not until midday on Sunday April 27 that anyone in Moscow had any *official* idea what had happened. People from the station had surveyed the remains of the reactor building in the early morning hours of the 26th, but they were either afraid to report what they thought had happened, or they were simply not believed.

Through most of the first day, Gennady Shasharin, a key Soviet energy official, thought the core was being effectively cooled by water. Based on this and other incomplete information, the central authorities in Moscow did not immediately sense the urgency of the situation and delayed, for example, the evacuation of residents from what later became the 30-kilometer Exclusion Zone. They didn't want to create panic.

After local firefighters had contained or extinguished more than 30 small fires burning in the area of Unit 4, efforts were directed at stopping the release of radionuclides from the burning core. Siege-mentality rhetoric was employed to rally workers to smother the principal fire—the infamous "red glow" thought to be the reactor core—within the reactor building.

In later years, the most startling revelation made by Chernobyl researchers—and to this day not fully accepted by the International

COURTESY OF ALEKSANDR BOROVOI

After the explosion, burning graphite in the reactor core melted the remaining uranium fuel. The fuel (which increasingly became contaminated with other substances) ate through the reactor's Lower Biological Shield, flowed into the lower regions of the reactor building, and solidified. Chernobyl researchers who enter the building to obtain bore samples and to take photos are exposed to high levels of radioactivity. They work quickly.

Atomic Energy Agency (IAEA)—is that the 5,020 metric tons of material dumped from helicopters to smother the smoldering core of the reactor never entered the reactor core shaft. The red glow—ground zero for the helicopter crews—was not the burning core. Rather, it was probably a fragment of the core that had been thrown up and out during the initial explosion. (See "The Denial Syndrome," page 38.) Further, an attempt to quench the fire by displacing oxygen in the core region with nitrogen gas most likely occurred *after* the active phase of the Chernobyl accident had ended.

That these attempts failed suggests that approximately 71 percent of the fuel (about 135 metric tons) burned virtually in the open for nine days until it melted through the lower part of the core region, flowed downward along piping of the pressure suppression system, and quickly cooled and solidified into lava-like substances. (See diagram, page 39.)

All of which means that significantly more radioactivity was released into the atmosphere than Soviet authorities were willing to admit at the first major Chernobyl conference, the IAEA's Experts Meeting in Vienna, in August 1986.

This does not imply that during the active phase of the accident Soviet officials knew that the helicopter campaign had not covered the core. They almost surely believed that the helicopter crews had been successful. But by the time of the August meeting, the officials had had ample time to examine the remains of Unit 4 and to conclude, as is obvious from photos, that the core had not been covered.

The scientific finding that the core had not been smothered after all undermines one of the central tenets of the official Soviet version of the Chernobyl clean-up campaign: the cult of the brave Chernobyl helicopter crews who took actions meant to put out the fire, and whose youthful deaths are honored by a special museum in Kiev. Clearly, these "liquidators" *were* brave and selfless. They were also, unfortunately, used by Soviet authorities to create an impression in the coming months and years that something had been successfully done to contain the accident.

In August 1986, when Academician Valery Legasov, head of the Soviet delegation to Vienna, was faced with the fact that releases of radioactivity began to increase on April 30th and May 1st, and that mitigation efforts apparently had been unsuccessful in stemming these releases, he reportedly exclaimed: "The people would not understand. We have to be seen doing something!" Later that year, Legasov told the Soviet Academy of Sciences: "I did not lie at Vienna, but I did not tell the whole truth." Legasov committed suicide by hanging himself at home on April 26, 1988, two years to the day after the accident.

There seemed to be an overriding desire by the government to convince the people of the Soviet Union and of the world that things were under control, and that the heavily damaged reactor building was isolated and secure. As it was being constructed—and to this day—the most visible and attention-drawing symbol of triumph over the accident, the sarcophagus, was consistently portrayed as a tremendous concrete-and-steel engineering achievement that tightly retained radioactive debris. Further, the government claimed there was a complete accounting of the initial inventory of fuel and fission products.

In May 1991, Richard Wilson, Mallinckrodt professor of physics at Harvard, spoke at the first International Sakharov Conference on Peace, Progress, and Human Rights in Moscow. Based largely on extensive private conversations he had with Russian scientists, he summarized several ways in which the Soviet government had attempted to control or censor information about the consequences of the accident:

■ On Legasov's instructions, about six pages concerning radioactivity released in Belarus were removed from the official report just prior to the August 1986 IAEA meeting and were not discussed.

■ Several pages detailing the large quanti-

ties of radionuclides deposited 100 kilometers and more northeast of Chernobyl in the Bryansk oblast of Russia were removed from the report following directives from the Soviet Central Committee.

- Dosimeters in the possession of physicians and private individuals who had worked in the mitigation efforts following the accident were locked up by the KGB.
- Publication of "unauthorized" measurements of radioactivity were forbidden—even as late as 1990.
- Physicians in Ukraine and Belarus were forbidden to mention radiation in their medical diagnoses.
- Appeals by private individuals in Belarus that children not be allowed to drink milk in the first weeks of May 1986 were stopped for fear such warnings might caused panic.
- Health records of the "liquidators" (soldiers and others who constructed the sarcophagus and did cleanup work in the zone) disappeared after their work was completed. (Since the collapse of the Soviet Union, these data have slowly begun to surface.)

The range of Soviet deception regarding Chernobyl seemed endless. Consider the sarcophagus, which one Soviet document called a "concrete cube." The amount of concrete *claimed* to have been used to construct the sarcophagus ranges from 300,000 to 410,000 cubic meters. However, if one simply takes the cube root of this range of values, the dimensions of a pure block of concrete with these volumes would be in the range of 67 to 74 meters on a side. This is larger (and certainly taller) than the actual sarcophagus, which is mostly empty space.

According to the structural drawings of the sarcophagus, the amount of concrete actually used in constructing the sarcophagus was about 161,000 cubic meters, which is still a lot of concrete. But a great deal of it leaked through holes in the reactor building onto the grounds of the station, or was used to cover the ground to shield workers.

The net effect of the government's propagandistic claims was to draw attention away from the affected people and the extensive contamination of the environment, including great tracts of agricultural land, and focus it on the sarcophagus, which represented "victory" over the accident. The Soviet leaders themselves wanted more than anyone else to believe that most of the contamination was contained within the sarcophagus, and so the stage was set for the creation of a myth that would remain unquestioned for several years.

"They should have given a little thought to the problem before acting so haphazardly," is the restrained assessment outside experts often make of the Governmental Commission's methods. Rather than carefully thinking through mitigation efforts, the Governmental Commission's intentions were dictated by the passion to remain in control. For example, one must question the wisdom of constructing an 8.4-kilometer perimeter wall, which was sunk into the ground to a depth of 30 meters. The project, known as *Casa Grande*, was abandoned when only partially complete. It was supposed to surround the station and stop the spread of radionuclides to nearby bodies of water.

The project was undertaken almost immediately, ignoring the warnings of chemists and hydrogeologists. Apparently little forethought was given to the fact that radionuclides bind chemically in the topsoil. Thus, the contaminants would migrate only very slowly through the clay and sand sublayers into the ground water, which was located approximately 15 meters below the surface at the time of the accident.

The project was abandoned because by the time the workers were ready to extend the wall through the "Red Forest" (so named because the trees turned reddish before dying), the army had not gotten around to decontaminating the area. One bureaucratic tie-up led to another, and the project was eventually "forgotten."

Meanwhile, the partially constructed section of the underground wall between the station and the Pripyat River acts as a dam. The result: the level of the ground water had risen to within 4.5 meters of the surface by 1992, according to Aleksandr Borovoi, head of the Department of Radiation Research at the Kurchatov Research Institute in Moscow. That is, the ground water level, which seems to have reached equilibrium, is much closer to the contaminants now than in 1986.

Another line of defense that was as ineffective as *Casa Grande* was the valiant attempt by miners and engineers to construct a heat exchanger below the core by tunneling beneath the foundation of Unit 4. The reasoning: In the event of a much-feared "China Syndrome," there would be one more barrier between the ground water and the molten core. The project was undertaken well after the active phase of the accident, and when it became clear there was no danger of a melt-through, it was abandoned. Workers in the area now call it the "Moonshine Still," because of its complex array of cooling pipes.

How much fuel?

No one actually knew how much nuclear fuel was left inside Unit 4 after the accident, nor did anyone know its condition well enough to

(continued on page 38)

FOR THE LOWDOWN ON THE SHUTDOWN

turn the page

The denial syndrome

The International Atomic Energy Agency (IAEA) still clings to the myth—first promulgated by the Soviets—that the 5,020 metric tons of sand, clay, dolomite, boron carbide, and lead dumped from helicopters in the first few days after the Chernobyl accident found their mark and succeeded in smothering the "burning" Unit 4 core.

But it is now clear that the helicopter pilots did not cover the core. Rather, with pinpoint bombing accuracy performed under extremely hazardous conditions, these brave pilots managed to smother the infamous "red glow," which was thought to be the burning core. Unfortunately, the red glow is now widely assumed to have been only a minor portion of the core, thrown up and away from the reactor in the devastating steam explosion. The location of the red glow was 12 to 15 meters from the reactor core shaft, on the floor of the Central Hall, which was left roofless by the explosion.

About 71 percent of the fuel in the core (roughly 135 metric tons) remained uncovered in the reactor shaft after the explosion. Eventually the fuel melted through the reactor's lower lid and flowed into the lower regions of the reactor building, where it cooled and hardened into lava-like substances. About 25 percent of the core was scattered in and around the remains of the reactor building, and almost 4 percent dissipated into the environment—producing radiation contamination that was detectable over the entire northern hemisphere.

The bottom line: most of the core remained in the Unit 4 building, as the Soviets later said. But instead of being smothered, the core remained exposed to the environment, releasing radioactivity into the atmosphere for nearly 10 days, at which point the remnants cooled down on their own.

Even today, the IAEA's official position, first expressed in INSAG-1—the International Nuclear Safety Advisory Group's review of the Soviet report presented in Vienna in August 1986—supports the Soviet version of events. It concludes that "accident management actions taken at Chernobyl were, generally, quite successful." Dumping the materials into the reactor shaft, the review added, "stabilized the situation at an early stage."

The IAEA's defense of this position, based primarily on information provided by the Soviet government, seems particularly awkward today, because data and analyses indicating that the core had not been smothered became available in the West as early as 1989. Even more embarrassing, however, is that the IAEA itself sponsored a 1990 report by Aleksandr Borovoi, one of the key scientists investigating the Chernobyl accident. His data clearly indicated that the core was not covered by the materials, and that approximately three times more cesium 137 was released into the atmosphere than the Soviets had admitted. The IAEA apparently ignored Borovoi's work.

My research at Chernobyl, which partially drew on the courageous work of Borovoi and his Russian and Ukrainian colleagues, eventually led to a broad reappraisal of the accident and its consequences. The main intent was to recreate the sequence of events during the nine days following the explosion, when the destroyed reactor was actively releasing radionuclides into the environment.

After my findings became known in early 1994, Morris Rosen, deputy director of the IAEA, noted that he had flown over the reactor in May 1986, and he could vouch for the fact that "the material certainly got into the core region." My work, an IAEA spokesperson told a newspaper reporter in 1994, was "flawed and not worthy of serious attention."

Indeed, it is aerial observations of the destroyed reactor that were more likely to be flawed. For one thing, the 2,000-metric-ton Upper Biological Shield—the reactor's "lid"—was perched, at a cockeyed angle, above the reactor well, blocking the view into the reactor core. (The accompanying diagram makes that clear.) Meanwhile, over the years, the scientists who have actually entered Unit 4, at great personal risk, have taken about 200 bore samples and have made enough visual and robotic observations to conclusively prove that virtually none of the material from the helicopters entered the core shaft. If it had, significant amounts of it would have been found in the lava-like remnants of the core. In fact, only traces were found.

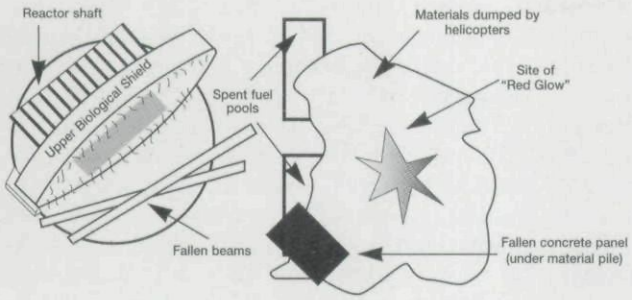
In retrospect, the IAEA's approach to Chernobyl should surprise no one. After all, the IAEA is in the business of promoting nuclear energy, not discourag-

(continued from page 35)

predict its future behavior. Preliminary analyses of hot particles in Sweden and Germany indicated that approximately 3 to 6 percent of the *mass* of the core, or about 6.7 metric tons, had been released beyond the bounds of the station. Based on these early results, the Governmental Commission hastily decided that 96.5 percent of the initial 190.2-ton fuel load was still located within the core region. This official estimate became the ultimate arbiter, the criterion to support the notion that the fuel had been accounted for and was tightly held within the sarcophagus. It was the key bit of data by which to convince the West that everything was under control.

The Soviet leaders themselves, it seems, wanted to believe this, even if based on questionable evidence. For example, one of my colleagues recalls an incident at the Kurchatov Institute in which measurements by the *Igla* System (a wand-like probe suspended from a

BIRD'S-EYE VIEW



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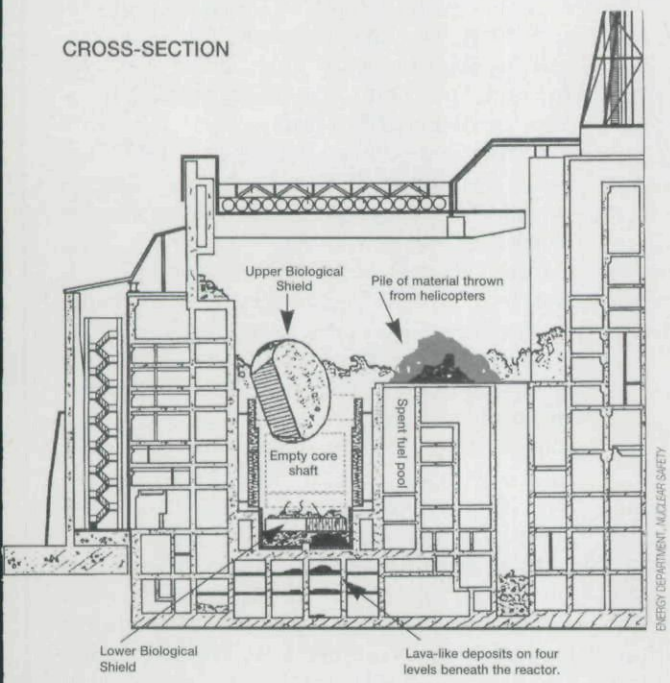

Soviet helicopter crews "bombed" the "red glow," believing it was the reactor core. The author and many other nuclear engineers are convinced that the glow (upper schematic) was a fragment of the core that had been thrown up and away from the reactor shaft. Much of the remaining fuel melted, mixed with other materials, and flowed downward into the reactor building.

ing it. For ten years, the agency has attempted to downplay the consequences of the accident. In 1987, for example, well before information began to filter out of the Soviet Union on the true extent of the accident, an IAEA report reassuringly said, "If anything, there will be a modification downward of early calculations of risks and predictions of health consequences."

And, too, the IAEA has been markedly unaggressive in questioning official Soviet and Russian Chernobyl data and analyses because the Soviet Union (and now, Russia) plays a significant role in the governance of the IAEA.

For several years after the accident, the IAEA seemingly ignored specialists from republics other than Russia, which dominated the Soviet central government. But Russian data were controlled and often suspect: Russia had 11 Chernobyl-type reactors essential to power production, and thus it had a clear political need to minimize the consequences of the accident.

Dealing almost exclusively with the Russians, however, not only restricted IAEA access to information, it alienated the IAEA from the people of Ukraine and Belarus, the republics most affected by the accident. The IAEA didn't help matters by derisively labeling as "radiophobes" those who were genuinely attempting to draw attention to the accident's health effects. (In fairness to the IAEA, though, some environmental organizations, East and West, have worked overtime to exaggerate the extent of the accident by morbidly focusing on unsubstantiated body counts numbering in the tens of thousands.)

Chernobyl has served both sides of the nuclear debate. One need not exaggerate the effects of radiation to know that tremendous damage has been done. Arguing over the definition of a nuclear v. non-nuclear explosion doesn't help decontaminate tens of thousands of square kilometers of farm land. To battle over the body count misses the point: Is not one victim enough to condemn a reactor design long known to be deficient?

And surely we should expect more from the IAEA than Deputy Director Rosen's careless statement at the Vienna conference in August 1986: "Chernobyl shows us that even in a catastrophic accident, we are not talking about *unreasonable* numbers of deaths."

— *A. R. S.*

helicopter) were presented and interpreted. In analyzing the *Igla* data, it was concluded that the largest amount of fuel was contained within the reactor core area. Following this, an internal document was prepared detailing the locations and quantities of fuel within the reactor building.

The document seems to have been used to provide information to the IAEA's Experts Meeting in August 1986. Unfortunately, not only is there almost no fuel in the reactor core area (the core shaft is virtually empty), but a few years later, when researchers entered the area of the Central Hall to examine more closely the remains of the reactor, the *Igla* detector wand was found to be jutting partially out of the southern spent-fuel pool, approximately 12 meters from the reactor shaft, and it remains there to this day.

How much radioactivity was released into the environment? That is still a contentious question. In 1986, the Soviets estimated 50

Ten years later, bureaucratic inertia still hampers scientists.

million curies. That compares to the 1979 accident at Pennsylvania's Three Mile Island nuclear power plant, where virtually all of the radionuclides were kept within the containment structure.

In my study, I concluded that the release of volatile radionuclides at Chernobyl was actually two to three times the Soviet figures. That was in line with earlier Western suspicions regarding the releases, and the estimates are compatible with early satellite imaging investigations by Edward Warman, a vice president at Stone and Webster, an engineering firm that has done a lot of nuclear power work.

In fact, a recent publication by the Organization for European Cooperation and Development presents the findings of Swedish investigator Lennart Devell, which suggest an even greater total release of about 200 million curies, if one adds the contributions of the volatile isotopes, iodine 133, cesium 136, and tellurium 129.

Sadly, these higher release estimates support conclusions drawn by medical experts in a recent study by the World Health Organization, which directly links the marked increase of childhood thyroid cancers and other maladies occurring in Belarus and Ukraine to releases of radioiodine from the accident.

An invincible bureaucracy

Ten years after the accident, Chernobyl is plagued by the legacy of the former regime, whose bureaucratic inertia continues to hamper cleanup efforts and the work of scientists at the site. It is not always clear who is in charge of what in the zone. Every organization associated with Chernobyl or the zone attempts to aggrandize its role. Organizations with curious acronyms such as DerzhKomAtom, MinChernobyl, MinEcoBezpeka, ISTC-Shelter, and NVO-Pripyat all claim at least some jurisdiction.

Much of the paternalism that characterized the Soviet system has been preserved regarding Chernobyl. Many enterprise directors and regional administrators still believe themselves to be socially responsible for the preservation of jobs, and thus they demand control of their fiefdoms. This is especially true for the Chernobyl Nuclear Power Plant, which sees its mission—apart from generating much-needed electricity with its two remaining operable reactors—as supporting the entire infrastructure of the city of Slavutich, where 28,000 people live, including most of the station's workers.

The sarcophagus, which some experts believe cannot reliably withstand the high wind loads or earthquakes that may be encountered in the region, is also under the authority of Chernobyl station, and that leads to tensions between the plant and the Ukrainian Academy of Science's Inter-Branch Scientific and Technical Centre "Shelter" (ISTC-Shelter), the organization that sponsors the small group of scientists who monitor and study the still-dangerous ruins of Unit 4.

The station controls access to the sarcophagus, and it is not eager to permit scientists to conduct research if their findings might help tip the scale toward eventual closure of the station. Scientists from ISTC-Shelter, as well as scientists with the Alliance, a European consortium, and AEA Technology, a British firm, have repeatedly met bureaucratic road blocks, which have slowed their efforts. It is no wonder that people in Ukraine often describe the zone and the work there as *bardak*—a Russian word that literally means "whorehouse," but colloquially implies complete confusion and disorder.

A word must be said about the conditions under which the ISTC-Shelter researchers work at Chernobyl and the problems against which they struggle daily:

I arrived in October 1991, a graduate student from MIT, a Macintosh computer in hand. I soon realized that my computer had more power than the few older-model IBM PCs belonging to the researchers. Imagine my position—a graduate student going to a foreign country to conduct research, and being besieged with inquiries by scientists there on how to get their materials published in the West so that information could get out.

As a consequence of the Three Mile Island accident in the United States, one of the most comprehensive and costly research efforts ever undertaken has produced valuable design improvements that have been implemented in Western reactors, while spurring research into the design of the next generation of "inherently safe" power reactors. At Chernobyl, because of bureaucratic tangles and a lack of funds or general interest, not even all of the melted fuel has been positively located.

A persistent myth in the West is that most scientists studying Chernobyl are poor physicists and unrepentant communists, whose only concern is the exploitation of nuclear energy for the glory of the state. In reality, as in many parts of the world, political agendas, rather than actual or demonstrated energy needs and safety concerns, dictate nuclear energy policy. The scientists I have worked with have either been used by politicians as pawns in a power game, or they and their work have been largely ignored.

Nevertheless, based upon what the former Soviet Union was, it is easy to believe the myth because, until the dissolution of the So-

viet Union, the West was carefully spoon-fed disinformation about most aspects of Soviet life—not the least of which was the Chernobyl accident. So-called scientists and medical experts, such as Yuri Izrael (then chairman of the Soviet Union's Institute of Hydrometeorology and Environmental Control) and Anatoly Romanenko (the Ukrainian minister of health), constantly downplayed the extent of the accident—even when faced with contradictions in their arguments. Yet these people spent little if any time at Chernobyl studying the situation firsthand. Meanwhile, the few competent scientists at the site have been—and still are—largely ignored, partially because their work contradicts official assessments of the extent of the accident.

Although it is a mistake to question the competence of scientists and technicians analyzing the Chernobyl accident, it is another thing to question whether or not the proper specialists are there to tackle the specific problems Chernobyl poses. In fact, there are, as far as I can tell, no nuclear engineers studying the accident at Chernobyl. None of the scientists and technicians on the scene has any extensive training in nuclear reactor systems or in accident analysis. Most of them, however, have adequate training in nuclear physics and are eager to learn more.

For example, Aleksandr Borovoi, the Kurchatov Institute scientist (who also directs ISTC-Shelter's Division of Radiation and Nuclear Safety), was trained as a neutrino physicist. He and his colleagues are excellent physicists, and they have learned a great deal in their exploration of the remains of Unit 4. Nevertheless, they had little previous expertise in reactor safety problems and accident management.

The conditions under which scientists work at Chernobyl can only be described as tragic. There is a core group of about 30 of them struggling with, in the words of one of my colleagues, an "invincible" bureaucracy that serves only to impede their work. Until my arrival in the fall of 1991, no Western nuclear engineer (or any Western scientist, for that matter) had been permitted to conduct research on the accident at Chernobyl, or to work directly with these scientists. However, a number of specialists in ecology, radiobiology, and hydrogeology from South Korea, Norway, Japan, and other states have been involved in short-term research "visits" on environmental contamination and migration of radionuclides in the water and soil.

Some of these research efforts are sanctioned under the auspices of NVO-Pripyat—the Pripyat Scientific and Industrial Association—which was created in 1987 to conduct decontamination work and provide support services within the zone. (Formerly, NVO-Pripyat was called "Kombinat," a division of the former Soviet Ministry of Medium Machine Building, the designers of, among others things, Soviet nuclear weapons.)

ALEXANDER R. SICH

Aleksandr Borovoi, a pivotal Chernobyl scientist (second from right), poses with other researchers and visitors near Unit 4.

NVO-Pripyat's main concern seems to be promoting the idea that something is going on while obtaining hard currency. Often I saw delegations from Japan, the United States, Canada, and various other countries who would visit the zone for the day to discuss various proposals for research. However, as far as I could tell, no formal long-term research projects were being conducted by Westerners in the zone.

Meanwhile, little decontamination work has been done in the zone since the accident, although NVO-Pripyat managed, while I was there, to organize many sightseeing excursions to the sarcophagus for Westerners eager to pay $100 or more a day per person. It also indirectly interfered in the work of ISTC-Shelter scientists trying to conduct research at the sarcophagus. In addition, NVO-Pripyat, through its International Contacts Division, portrays itself to unsuspecting Western researchers as a legitimate scientific research organization that has the authority to sponsor scientific research within the zone—again, for exorbitant fees.

I witnessed one of NVO-Pripyat's clumsy yet effective attempts at "spin control" in November 1991. Academician Ihor Yukhnovsky, then a Ukrainian presidential candidate, arrived in the city of Chernobyl on a preelection fact-finding trip. After a somewhat pointless discussion, Yukhnovsky, along with a television crew that had come with him, were to be driven by car to the sarcophagus to ask some pointed questions.

The NVO-Pripyat people organized three cars: one for Yukhnovsky and his aides, one for specialists from Kiev, and one for the television crew. Yukhnovsky and the second car departed first, because the camera crew's car had not yet arrived. In fact, the third car

Scientists who risk their lives to study the reactor can scarcely afford gasoline for their cars.

never arrived, and the camera crew was later asked to leave the zone. Meanwhile, Yukhnovsky's car conveniently ran out of gas on the way to the power station.

If it had not been for a passing driver who siphoned some gasoline from his own truck, they never would have arrived. Although they got there half an hour late, they were the first to arrive, because the second car had gone by a "different route." And, of course, no television interview was conducted, because the TV crew never got there. NVO-Pripyat was obviously not interested in Yukhnovsky asking the "right" questions on television.

Today, a brief tour of the zone will show anyone that little work has been done to properly dispose of now-radioactive equipment used during construction of the sarcophagus. Located just to the west of Unit 4 is an entire field of contaminated, uncovered, and rusting machinery and supplies.

Moreover, approximately 25 kilometers southwest of the station near the small village of Rasokha are two "machine graveyards"—shopping-center-sized areas full of fire trucks, military vehicles, and helicopters used in 1986 during construction of the sarcophagus and decontamination of the surroundings. All of these are contaminated and standing in the open, surrounded by a double barbed-wire fence—with holes. Astonishingly, workers in the zone, including some of the scientists and technicians, frequently cannibalize this radioactive equipment for spare parts.

The dollar curtain

One of the terrible ironies of Chernobyl is that the world's worst nuclear-power accident has been so thinly investigated. If an accident similar to Chernobyl had occurred in France, for example, the entire nuclear-energy world would have engaged its experts in studying the accident, limiting its consequences, and learning its lessons. In contrast, at Chernobyl, only 30 or so dedicated scientists struggle to find enough gasoline to drive to the reactor where they risk their lives to make their measurements.

Over the past decade, the lack of contact with Western colleagues for these scientists has also taken its toll. While the Iron Curtain is long gone, it has been replaced by a "dollar curtain." Once, the controlling regime discouraged and controlled scientific interchanges between Soviet scientists and Western scientists; today, with the economies of the newly emerged republics struggling to fulfill basic needs, financial realities limit scientific exchanges.

The small research team at Chernobyl cannot afford to buy Western scientific journals and scientific and engineering handbooks, let alone obtain the proper computers and the money to pay for the dangerous work of core-sample drilling within the sarcophagus. This, of course, greatly limits the researchers' ability to compare their assumptions and hypotheses against the experience of others. The result is that several researchers at Chernobyl cling to erroneous models of the accident with an oftentimes irrational mania, and they stake their careers on proving their version of the accident as the only correct one. In turn, this breeds personal conflicts and even the sabotage of contamination monitoring work.

Researchers who take a more rational approach are despondent. Conversations with them have a subtext that is typically Soviet in its degree of cynicism and shame about ordinary life—the latter reflected in the omnipresent see-how-we-live expressions of regret. Many of the researchers I got to know often used the adjective "civilized" when speaking about the West, thus implying that their lives were somehow less civilized.

Ten days

The number of individual victims claimed by the Chernobyl accident is uncertain, and perhaps cannot ever be fully quantified. But one victim, for whom no one should mourn, is certain: the Soviet Union. In his book *Ten Days that Shook the World*, the American journalist and communist activist, John Reed, depicted the Russian revolution as marking the beginning of a workers' paradise and of a just and equal society.

But in one of those strange twists that so often punctuate human history, the traumatic ten days of intense radionuclide release from Chernobyl's Unit 4 arguably marked the beginning of the end of this "paradise"—and of the Russian/Soviet Empire.

Ukrainians, as well as other peoples of the former Soviet Union, used the accident and its concealed consequences as a springboard from which to launch a greater push for *perestroika* and eventually for complete independence. In *The Truth About Chernobyl*, published in 1990, Grigori Medvedev, a Russian nuclear engineer, said the accident "signaled the death throes of an entire historical period." Medvedev writes:

"An abscess, long hidden within our society, had just burst: the abscess of complacency and self-flattery, of corruption and protectionism, of narrow-mindedness and self-serving privilege. Now, as it rotted, the corpse of a bygone age—the age of lies and spiritual decay—filled the air with the stench of radiation."

Medvedev is a man given to purple prose and exalted pronouncements. But, at the core, he got it right. ■

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