Unfathomable Risk

Stumbling into the Twilight Zone

BY SIDNEY LENS

From 1945, when the first atomic bomb was exploded at Alamogordo, New Mexico, until 1963, when a treaty between the United States and the Soviet Union banned further atmospheric testing, some 282 U.S. nuclear weapons were detonated—two-thirds of them above ground. The devastation wrought by these devices was widely known, and so was the danger of the deadly radiation they released. But few were aware of another effect called electromagnetic pulse (EMP).

It wasn't until 1962—seventeen years after the Alamogordo test—that scientists picked up on the potential consequences of EMP. On a July evening of that year, a rocket bearing a nuclear bomb was propelled into the skies above Johnston Island in the Pacific. "At a point in space 248 miles above the Earth," William J. Broad wrote recently in *Science 83* magazine, "the rocket turned into a ball of fire" and "something so unexpected happened that today, two decades later, military planners still ponder its dark implications for the fighting of nuclear war."

In Hawaii, 800 miles from the test site, some extraordinary phenomena were observed one second after the bomb went off: Fuses blew, power lines went dead, 300 streetlights were extinguished, burglar alarms were set off. Had today's solid-state circuitry been in widespread use at the time, the consequences of the blast would have been much more serious. Neither the Government nor the media understood the full significance of the incident—the press referred to it as a nuclear "shock wave"—but we know today that the disruption was caused by a surge of electromagnetic energy of up to 50,000 volts per meter, traveling at the speed of light.

Scientists saw little reason for concern about EMP. It posed no direct threat to human life, and in the age of the vacuum tube, even the threat to power grids and communications networks was less than catastrophic. But when solid-state integrated circuitry came into common use in the 1970s, it turned out to be a million times more vulnerable to EMP than vacuum tubes had been. Suddenly, EMP posed a critical danger to the civilian economy as well as the military machine.

When the $5.7 billion Safeguard antiballistic missile (ABM) system was developed in 1969, the Pentagon's experts realized that while nuclear-tipped U.S. interceptors might destroy incoming Soviet missiles, they would simultaneously release enough EMP to put the United States out of business, at least temporarily. "We wondered," said Claud L. Beckham, who worked on the ABM, "whether we were going to knock out our own weapons system." Early in 1976, Congress ended the Safeguard program.

By then, it was clear that a single Soviet weapon could disable the entire U.S. economy. A one-megaton bomb carried by a space satellite and exploded 250 miles over Omaha could immobilize telephones, radio, television, computers, radar systems, and power grids all over the United States. The restoration of normal service would take hours, days, perhaps weeks.

"Even if not permanently damaged," Princeton University physicist Daniel L. Stein wrote in a recent issue of *The Bulletin of the Atomic Scientists*, "computer memories would be erased, digital systems might process incorrect signals, trajectories of missiles in flight could be altered, and power outages might occur." With loss of radio contact and radar readings, aircraft would search desperately for emergency landing sites. Late-model automobiles equipped with microprocessors would stall. Communications between the Pentagon and its bases at home and abroad would lapse.

It should come as no surprise that the Government's response to the EMP problem has focused primarily on the military aspects. Steps have been taken to "harden" components of the command and control system, including one command aircraft and some telephone lines (by substituting glass fiber for metallic wires), so that they will be immune to disruption by electromagnetic pulse. Billions of dollars have already been sunk into such efforts, and billions more are sure to follow. Defense Secretary Caspar Weinberger, while insisting that "major improvements have been made" in coping with the EMP problem, concedes that "it would be naive to say that economical and implementable solutions are at hand."

When we contemplate the horror of nuclear holocaust, the danger of EMP disruption seems trivial and irrelevant. What difference will it make, after all, that the President of the United States is unable to communicate with Strategic Air Command headquarters in Omaha while scores of millions of us are dying? What will it matter that our lights and telephones are out while dozens of cities are being reduced to rubble? But there are other considerations: The significance of the EMP phenomenon lies not only in the problems it poses directly, but in its reminder to us that the nuclear age confronts us with uncertainties of a magnitude we have never experienced before.

If the Nineteenth Century inventors of the machine gun had blundered, if the producers of a World War II fighter plane had built a faulty machine, the results might have been tragic, but they would not have been calamitous. No conceivable technological miscalculation could have spelled the end of a nation, or of a species, or of a planet. EMP belongs to an entirely new class of dangers that can never be fully anticipated, tested, or even known. How many other dangers of that sort exist, undetected and undetectable until the ultimate disaster is at hand?

Generating electromagnetic pulse is one of the primary effects of a nuclear explosion, but America's best scientific minds were all but oblivious to the danger for almost a quarter of a century after the first atomic blast. Are they still blissfully unaware of other primary effects, let alone secondary and indirect consequences of nuclear detonation?

In 1975, for example, a National Academy of Sciences report warned that a nuclear

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