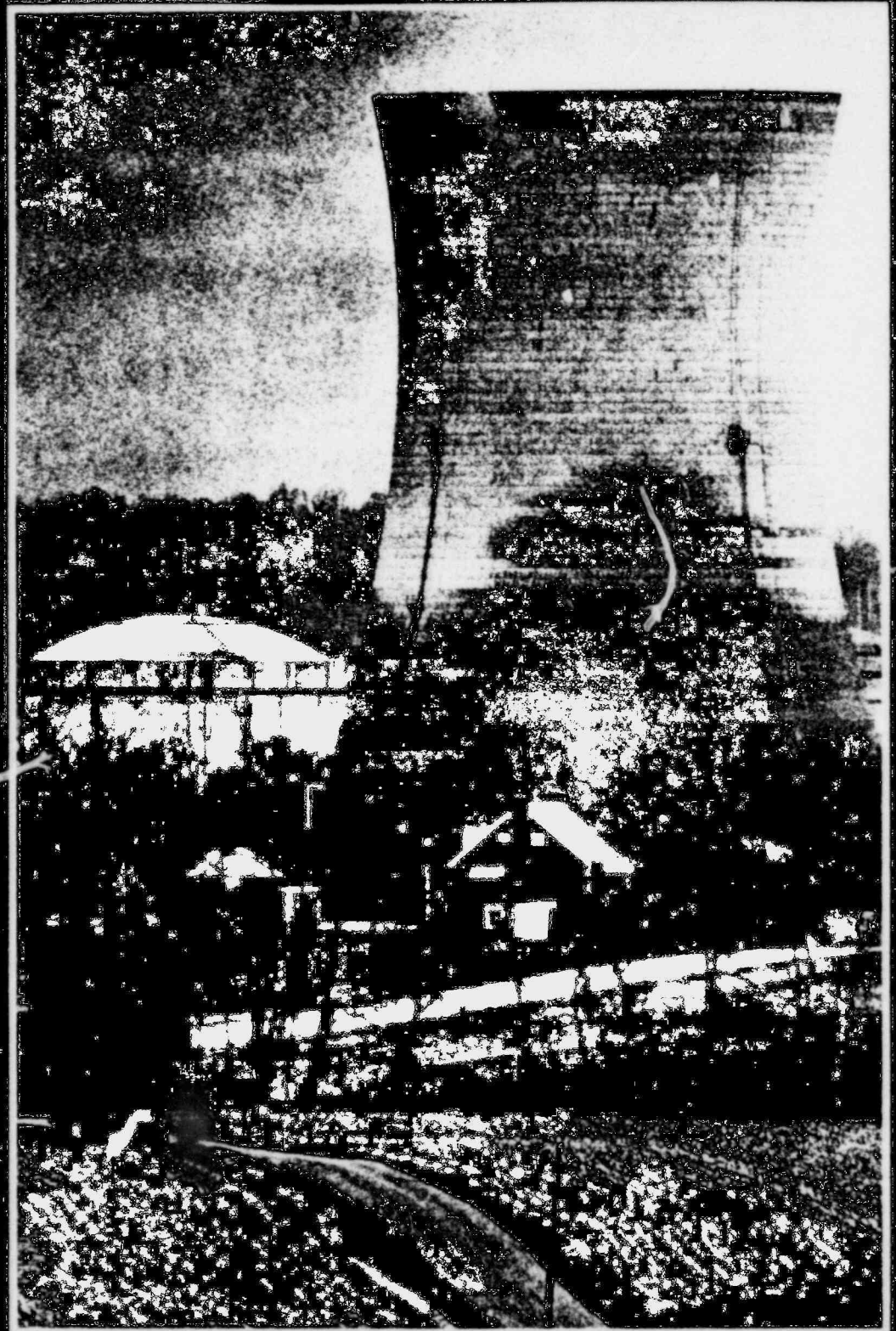


# CRISIS: THREE MILE ISLAND


The Washington Post's special report on America's worst nuclear accident, the near-catastrophe that could alter the future of nuclear power in the nation.



POOR ORIGINAL


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The Washington Post



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# CHAPTER 1

## A Pump Failure And Claxon Alert

The first warning that something was wrong came when a double-tone claxon blast went off in the control room.

Until then, the only sound intruding on the Susquehanna River in the early morning hours was the deep hum of the big bank of turbines hooked up on the south end of Three Mile Island Nuclear Reactor No. 2.

After three months on the line, No. 2 seemed at last to have shaken out its kinks.

Since it began operations just one day before the end of 1978, No. 2 had proved to be a continuing source of frustration. By starting up before the yearend, the plant qualified its owners for as much as \$40 million in federal tax credits and write-offs. In the ensuing days of January, it had been shut down for a two-week interval while engineers from the Metropolitan Edison Co., operators of the reactor downriver from Harrisburg, Pa., traced sources of leaks in the piping and pump system.

But on the morning of March 28, the 880-megawatt plant was going full blast. Large plumes of water vapor drifted from the lips of its two 370-foot cooling towers into the chilly air.

Encased in thick concrete walls and behind bullet-proof windows and reinforced steel doors, the regular four-man crew of control room operators was sitting the watch.

The control room is a vision from science fiction. It sits under the shadow of the 190-foot-high domed

reactor containment building. Inside, a horseshoe-shaped panel stretches 40 feet along three walls lined with dials, gauges and 1,200 warning lights color-coded red and green.

This was the scene inside the control room when, shortly before 4 a.m., something went wrong.

Across the Susquehanna, the nearest house to the reactor belongs to Holly and John Garnish. Their red brick ranch house sits just across Route 441 from the plant on the corner of Meadow Lane. Like most of their neighbors, the Garnishes slept in the shadow of the giant cooling towers across the river.

But that morning, Holly Garnish awoke with a start. Outside, in the direction of the plant, a loud roar came from Three Mile Island.

"Picture the biggest jet at an airport and the noise it makes," she recalled. "That's what I heard. It shook the windows, the whole house."

Her husband did not awaken. She looked at the alarm clock on the night table. It read 3:53 a.m. "I remember because I got up and put the dog outside," she said.

Over on the island, America's worst nuclear accident was taking form in quick, inexorable steps.

A pump that sends hot water to the steam generator failed for reasons still unexplained. Instantaneously, a second pump feeding cooling water to the reactor shut down. It had been fed water from the first pump.

A sensor—"realizing" that the steam generator no longer was receiving water—immediately shut down the plant's giant turbine. With electronic prescience the reactor sensed that the turbine did not want any more steam. A switch was automatically thrown, and a powerful jet of steam shot up from the plant's turbine building at a pressure of 1,000 pounds per square inch.

That was the noise that awakened Holly Garnish.

Only three to six seconds had passed from the start of the incident when yet another event occurred: a relief valve automatically opened to blow off superheated, radioactive water within the containment structure.

No more than six seconds later the reactor "scrammed," the control rods that stop the chain reaction inside the reactor vessel automatically dropped into place among the fuel rods. In effect, the reactor was shut down. Fission inside the uranium fuel rods immediately began to slow down.

The pressure inside the reactor vessel then began to fall. This should have been the signal for the open relief valve to close. Instead, it stayed open, apparently stuck. Pressurized steam went right on pouring out of the reactor.

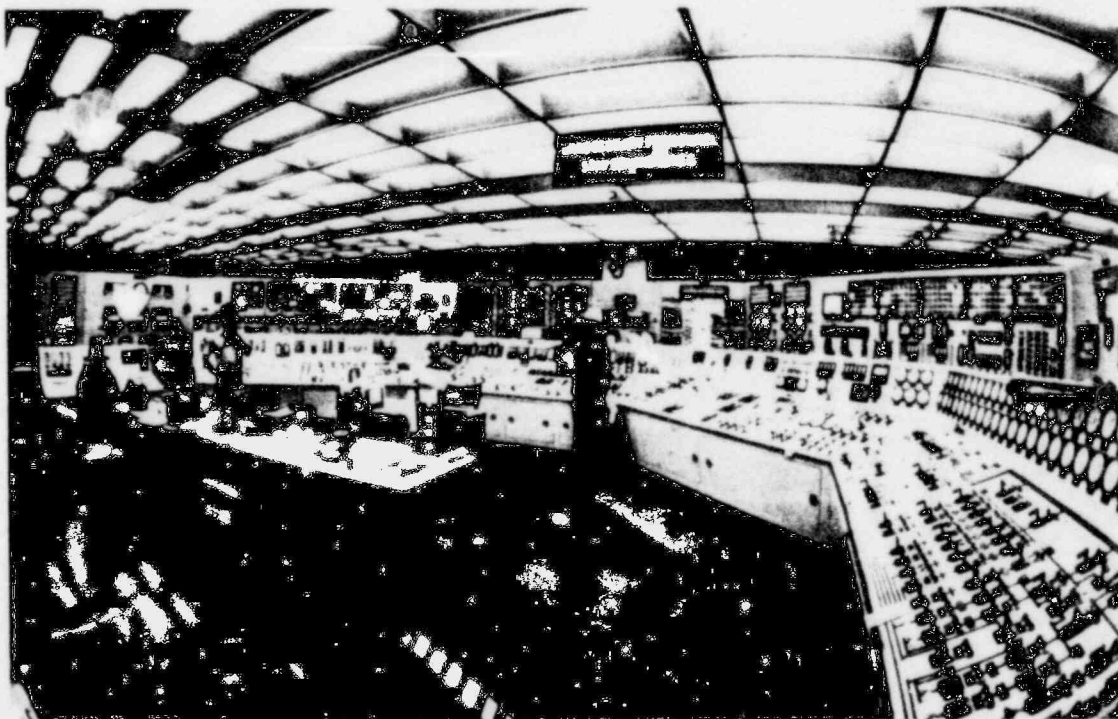
The instant the main pumps failed, three auxiliary coolant pumps kicked on. Unhappily, valves that should have been open in the auxiliary feed-water system were closed, locking out the water the pumps were trying to drive.

As water was lost, the temperatures inside the reactor began to soar. Readings climbed 30 degrees in less than three seconds.

In the control room, "bells were ringing, lights were flashing, and every body was grabbing and scratching," said one Nuclear Regulatory Commission source.

The shift supervisor, sitting in a glass-walled office facing the console, bolted out onto the main floor and took charge.

The pressure, meanwhile, continued to plunge, causing more water in the reactor vessel to flash into steam and escape through the open relief valve.



Control room at Three Mile Island with horseshoe-shaped panel 40 feet long displaying 1,200 warning lights color coded in red and green.

POOR ORIGINAL



At that point—if all systems had been working properly—what had been an unusual but not yet serious occurrence automatically would have been brought under control.

Afterward Nuclear Regulatory Commission officials singled out the valve problem as a key one during daily briefings later with the press gathered in the nearby Middletown Borough Hall. "There would have been an entirely different outcome if they (the pumps) had been operational, as they should have been," said Harold R. Denton, NRC's chief of reactor operations.

Apparently the valves were closed for routine maintenance, in violation of one of the most stringent rules that the Nuclear Regulatory Commission has. The rule states simply that auxiliary feed pumps can never all be down for maintenance while the reactor is running.

"If you take all of these pumps out at once, even for a limited time," said an NRC source, "you're supposed to hit the down button and shut the reactor down in a hell of a hurry."

With no fresh, cold water reaching the steam generator and the reactor, the operators on the control room—whether they realized it or not—were in real trouble.

The steam generator had begun to boil dry, taking even more water out of the cooling system. In the reactor vessel, even though the chain reaction had been essentially halted, heat was still being generated as fission wound down. Temperatures in the reactor continued to climb.

Pressures continued to fall in the reactor because the relief valve was still stuck open. "The flow through that valve could have been terminated by pressing the right button in the control room," said a source at Babcock & Wilcox Co., builder of the reactor. "That was ultimately done but it was done 32 minutes later."

Two minutes into the accident, the pressure fell to 1,600 pounds per square inch, automatically turning on the plant's emergency core cooling system. There was still time to prevent these mishaps from mushrooming into a major accident.

For still unexplained reasons, an operator in the control room turned off the two pumps that drive the emergency cooling system. He shut down one pump 4 minutes 30 seconds into the accident and the second pump six minutes later.

The prevailing theory at the NRC and Babcock & Wilcox is that he was looking at only one of two gauges he should have checked.

He thought he saw fluid rising in the pressurizer, suggesting that the reactor vessel was still filling with the water.

So he thinks, 'Ah, ha. I've got the system full of water; any more I pump in there is just going to spill on the floor'" an NRC source said. "Big mistake!"

What was really happening was that pressure was still plunging, water was still flashing into steam, and water levels inside the reactor vessel were in fact dropping.

Much of that water was still spurting out of the reactor vessel through the open pressure valve into the containment.

Only 7½ minutes after the start of the accident, the radioactive water on the floor of the containment building was two feet deep. The building's sump pumps at this point automatically comes on, rushing the water out of the containment structure into tanks in the auxiliary building.

This development would come back to haunt the operators in the days ahead.

"It would have been a help if they had recognized that they ought to cut off that containment sump pump," an NRC source said. "It should have occurred to them: 'Let's not pump it out to the auxiliary building. Let's just leave it in the containment until we know what's going on.'"

Eight minutes after the start, an operator in the control room must have realized the auxiliary cooling system hadn't worked because he threw the switch he should have thrown eight minutes earlier to unlock the closed valves in the feedwater line, turning on the system.

In three more minutes, an operator restarted the emergency core cooling system that had been mistakenly turned off. For the next 50 minutes, the accident appeared to have diminished in size. Reactor pressure stopped falling. The water level inside the reactor vessel was still sufficient to cover the tops of the 36,000 fuel rods. Though some fuel rods were probably perforated by thermal shock at the start of the accident, they still had not suffered any heavy damage.

"The core had pretty much been covered up to that point," a Babcock & Wilcox source said. "While things weren't real good, things were correctable."

Then, the inexplicable happened again.

Though the cooling pumps had come back on, they were not running smoothly. In fact, they had begun to vibrate as they strained to drive cooling water to a reactor whose pressure had fallen so dramatically.

An operator turned off four cooling pumps, two at 1 hour 15 minutes and two more at 1 hour 40 minutes into the accident. The NRC still has no explanation for these moves, though one explanation could have been concern that the pumps were straining so hard they were about to fail.

"The operators obviously were worried about the pumps damaging themselves," a Babcock & Wilcox source said, "but turning them off was a bad idea."

When the final two pumps were stopped, the water level in the reactor vessel plunged again, uncovering the core and fuel rods for the first time. Heat in the reactor began building up rapidly. Within 14 minutes the temperature at the top of the reactor had climbed right off the scale.

In the control room, the computer monitoring the temperatures in the dome of the reactor printed readings

up to 750 degrees, then began printing question marks for much of the next eleven hours.

Nobody in the plant had any idea that the reactor core had become uncovered—but uncovered it was. The water level had dropped at least four feet below the top of the core, uncovering one-third of the fuel rods. The stainless steel cladding (coating) on the rods had begun to crumble, creating rubble at the top of the core.

Highly radioactive fission products now began to pour from fuel rods that were rupturing in the matter of minutes. The cladding on no fewer than 20,000 of the 36,000 rods is believed to have been oxidized, plunging radioactivity into the reactor coolant. The only thing providing cooling to the fuel rods for the next 11 hours was the steam flashing out of what little water stayed in the bottom of the reactor vessel.

Meanwhile, the number of persons in the control room continued to grow. Executives began arriving in a steady stream in the chilly predawn to join the superintendent of operations, who arrived 20 minutes after the incident started.

"An hour or two after it happened, the place was swarming with white hats," said a control room operator who had been on duty at neighboring Three Mile Island Plant No. 1. "They were looking the thing over, and trying to figure out what to do."

As first light began to break over Three Mile Island, it was becoming increasingly clear to the worried officials that they had a serious threat of radiation leakage.

Shortly before 7 a.m., an emergency siren began to wail—the signal that workers at the Three Mile Island plant should evacuate certain critical areas.

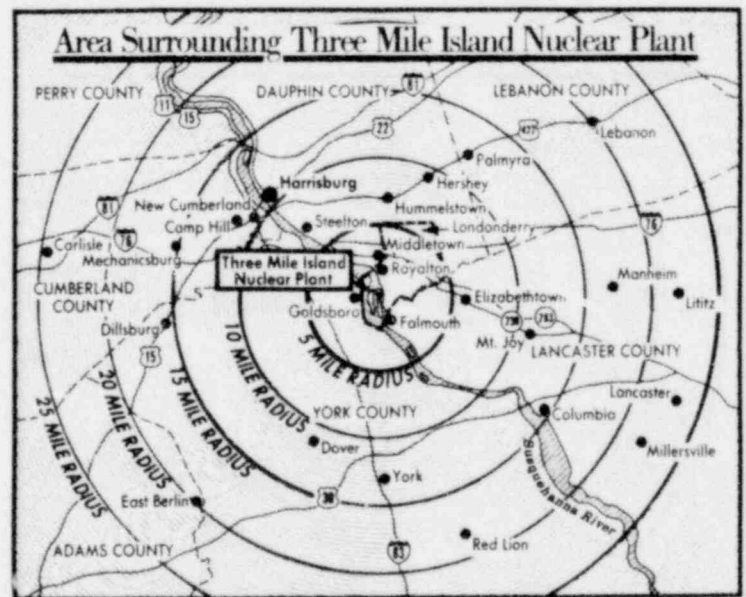
A number of workers dashed for their cars, hoping to get across the bridge to the mainland before they would be confined to the island as a precautionary measure. Two cars made it before the gate slammed.

At 7:02 company officials notified the Dauphin County civil defense office that they had declared a site emergency.

The situation, however, was even worse than they thought.

Back in the control room, less than 20 minutes later, an alarm sounded. An automatic detector in the containment, set to activate when the radiation level reaches 8 rems, had gone off.

Three Mile Island now had become a general emergency. ●



By Dave Cook - The Washington Post



# How the Crisis Was Managed

When word of the trouble at Three Mile Island first filtered out of the plant, the institutions of crisis management lurched slowly into motion.

Kevin J. Molloy, Dauphin County civil defense director, was boiling water for coffee in his home at Hummelstown when the first call came from a dispatcher warning of a "site emergency" at the nuclear power plant. The time was 7:02 a.m.—more than three hours after the first sign of trouble.

That same minute Clarence Deller of the state's Emergency Management Agency logged in a call from a Metropolitan Edison shift supervisor also warning of an emergency at Three Mile Island.

Molloy and Deller began spreading the alarm through a network of local civil defense officials, mayors and state authorities. "My first reaction was: Do we have to evacuate?" Molloy recalled.

It was not until 10 a.m. that Dr. Harold Denton, the chief of reactor operations for the Nuclear Regulatory Commission, was called out of a meeting at the agency's Bethesda headquarters to be informed that a "relatively serious sort of event" had occurred at Three Mile Island.

Yet at 7:20 a.m. Met Ed official Dick Bense told Molloy's dispatcher that a "general" emergency was under way. That meant bigger trouble than the initial alert but not necessarily enough to evacuate residents.

But by 7:30 a.m. a review of evacuation procedures was already being proposed by the state civil defense agency. "We told them not to begin an evacuation until they were instructed to do so by this office," said agency spokesman John Comey.

In a February 4, 1974 letter Met Ed wrote Middletown borough officials that "even the worst possible accident postulated by the AEC [Atomic Energy Commission] would not require evacuation of the borough of Middletown . . . it can be seen that it is unnecessary to have specific evacuation routes identified."

At about 8 a.m. retired Army colonel Oren Henderson, one of the senior military officers in the My Lai operation in South Vietnam more than a decade earlier, was on the phone to Gov. Richard Thornburgh. Henderson, the top official in the state's civil defense apparatus, acknowledged afterward that he didn't know what to do or what to recommend at that point. "We lacked so much knowledge about what was going on," he said.

Shortly after 9 a.m. Wednesday, the calls came in to the Old Executive Office Building in Washington, D.C., almost simultaneously and Jessica Tuchman Matthews fielded them in such rapid-fire order that now she can't remember which one came first.

One was from the situation room in the basement of the West Wing of the White House. The other was from NRC headquarters.

They were calling Matthews, who is the president's National Security Council staff expert on nuclear energy reactors, to report that one had gone bad up at Three Mile Island, Pa., which is a place she had never even thought about.

She remembers mostly that it was all very incomplete. A turbine had tripped, partial loss of coolant, question of possible offsite release of radiation.

Matthews hung up the phones and immediately wrote a short memo—a few paragraphs—to alert her boss, Zbigniew Brzezinski, about what was happening. The memo was taken from her third floor office across the driveway to the White House. Brzezinski immediately took it in to brief President Carter. It was about 10 a.m. Wednesday. "It looked like things were under control," Matthews recalled.

Evacuation was on the minds of state officials early in the day. But no one was prepared to recommend it.

Dauphin County had experienced emergencies before. In 1972 and 1975 the Susquehanna River had flooded. On both occasions Kevin Molloy's office was on alert.

But the severity of what was happening at Three Mile Island was slow to penetrate. For much of the citizens and officialdom of the surrounding communities the plant had been accepted as an economic boon. Word of earlier malfunctions at the plant had been carefully contained and the prevailing local view was that the benefits far outweighed the possible dangers.

Nonetheless, Robert Reid, the mayor of Middletown, just three miles from the plant, became an increasingly angry man from the moment he first got word of the trouble—while he was teaching a high school government class.

Reid tried but was unable to reach officials of Metropolitan Edison in Reading until 11 a.m. When he finally reached them there was no mention of radiation danger. Furthermore, Reid had little idea of how he would deal with the challenge of a largescale evacuation.

Shortly after he became mayor 18 months ago, Reid had decided the city needed a disaster evacuation plan. He assigned the task to Middletown civil defense director Donald (Butch) Ryan. On March 28, the date of the accident, the plan was still in drafting stages.

Had an evacuation order come from the state capital at Harrisburg, Middletown would have had to improvise.

(At a press conference Wednesday night in Harrisburg Lt. Gov. William W. Scranton III assured: "We do not expect there to be any kind of necessity for evacuation . . .")

The adjoining town of Royalton—the closest community to the nuclear plant—was equally unprepared. Two days after the accident, its 74-year-old mayor, Charles B. Erisman, still had not been told by Met Ed that there was a problem on Three Mile Island.

"About 75 percent of our people are retired and half of them have no way out," Erisman said of the town's 1,040 residents.

Reid, nonetheless, expressed the prevailing attitude of charitable coexistence with the nuclear genie of Three Mile Island. "You know," he said, pointing out of his office toward the railroad tracks, "I've always been more worried about that than Three Mile Island." A train rumbled by, loaded with toxic chemicals.

At the King of Prussia, Pa., regional office of the Nuclear Regulatory Commission,

a group of technicians gathered by 8 a.m. and established a crisis response center. Their crew was detached, as was appropriate for professionals.

"We had an open line to the control room (at Three Mile Island) in about 30 minutes," said Thomas Elsasser, the NRC state liaison officer. "There was no tension or apprehension at that point."

"We knew that since they had got the radiation alarm there was something wrong there. But we knew the plant was shut down, and there had been no release of radioactivity."

At 8:45 a.m. six NRC inspectors piled into the office's emergency vehicle, a red station wagon with flashing red lights, and began a highspeed run down the Pennsylvania Turnpike to Harrisburg, 86 miles away.

In Bethesda, chief of reactor operations Denton was confused by the fragmentary information trickling in from the field, particularly the reports of radioactivity. He was deeply worried by the possibility of reactor fuel damage. "We never had any incident of fuel overheating in a lightweight reactor plant before," he said afterward. Fuel damage raised the specter of a reactor "meltdown."

Two additional carloads of NRC officials soon left Bethesda and raced northward across the rolling Maryland and Pennsylvania countryside to link up with the team from the King of Prussia office.

When the NRC inspectors converged on the scene the capricious forces of technology had another surprise. Three Mile Island phones were jammed.

Two different telephone companies, Pennsylvania Bell and United Telephone, served the opposite shores of the Susquehanna River. Three Mile Island is served by both companies.

"There was just a terrible communications problem," Denton said. "All the phone lines were jammed up there. You got only bits and pieces."

As the day progressed, the surprises were increasingly ominous. Officials watched with growing concern the reports trickling into the NRC response center of high radiation levels in the plant's auxiliary building.

Denton, ironically, had packed his bags the previous day for a trip to Phoenix and then to sign off on the safety systems for a controversial new nuclear plant in California. It was a trip he never made.

Wednesday night Denton and his task force of NRC officials felt things were under control. The levels of radiation that were being monitored, they thought, corresponded to damage affecting about 1 percent of the fuel in the reactor—a relatively low level.

"We had a rough sequence of things that had gone wrong, we thought. We didn't know what the cause was. I thought it had been a small loss-of-coolant accident," Denton said.

Despite the feeling that things were substantially in hand, Denton decided to stay on that night at the crisis center.

At about 2 a.m., Thursday, he decided to grab one of the cots and a blanket that had been stored there. He lugged them down to an empty office where he caught a few hours' sleep.

The first word to the outside world came in the form of an "urgent" message—a signal of more than routine but hardly catastrophic import—over the Associated Press wire at 9:06 a.m. on Wednesday. It said: "Officials at the Three Mile Island Nuclear plant have declared a 'general emergency,' a state police spokesman said today."

There were no details, no explanation of what a "general emergency" was. AP quoted "spokesman" James Cox as saying that "whatever it is, is contained in the second nuclear unit."

That was enough, however, to fuse the explosion of news media attention that was by 1:30 to surround the plant with some 120 reporters, photographers and television technicians. The

three networks as well as local television stations and newspapers from Philadelphia, Harrisburg and Baltimore were prowling the grounds, clustering about anyone who seemed to be in a position to speak authoritatively about what had happened.

Residents from nearby Middletown, Royalton, Londonderry and elsewhere, poured out to the scene—bewildered by events at the plant and dazzled by the occupation army of news figures and government technicians. Mike Connor, skipped school for the day, he decided he would set up a hot dog stand but his mother, Rita, said no. John Garnish boasted that he had been interviewed by five different local television stations, by ABC, by

Newsweek and by the New York Daily News.

"Sixty Minutes will be here any minute," he predicted with the confidence of a newborn media star.

That night Walter Cronkite opened his nightly CBS television news program with these words:

"It was the first step in a nuclear nightmare as far as we know at this hour, no worse than that. But a government official said that a breakdown in an atomic power plant in Pennsylvania today is probably the worst nuclear accident to date."

Three Mile Island at that point became indelibly engraved as a historic place name in the nuclear era. ●

## CHAPTER 3

# A Swift Rethinking Of the 'Unthinkable'

If it did nothing else, the accident at Three Mile Island injected new urgency into the national debate on nuclear power.

Demonstrations, sit-ins, plant shut-downs, occasional radiation leaks—none evoked the "unthinkable" aspects of living with nuclear power as starkly as the accident that Wednesday morning. What often had been dismissed as impossible now seemed to be unfolding on the banks of the Susquehanna.

Ironically, the accident at Three Mile Island raised the issue of nuclear safety all over just as it had become the least urgent of the three basic parts of the debate on nuclear power. The last three years had seen the threats of the spread of nuclear weapons and the disposal of radioactive waste become more central to the debate than the issue of safety.

In more than 20 years of operations in the United States, there had never been a nuclear accident as threatening to property and human life as Three Mile Island.

Thousands of reactor operating plant-years in the civilian power program have gone by without the loss of a single life. Not a single accident involving the nuclear propulsion system has ever befallen the world's nuclear navies. Only once before, in 1961, when Army technicians mistakenly started a chain reaction while working on a test reactor, had there been a fatality from a nuclear accident.

Nuclear advocates had hammered home this safety record. One famous assessment on which they relied was the so-called Rasmussen report of 1975, a probability study which said the likelihood of nuclear catastrophe is very low.

But the Rasmussen report also identifies certain sequences of events which it says are not as unlikely as others. One is called "TMLQ" in the code of the study. It means loss of feed-water plus failure of a safety valve. It is exactly what happened at Three Mile Island.

If ever a meltdown were to occur, according to the controversial study, this is one of the likely ways it might happen.

In the latter half of the last decade, the nuclear debate has inflamed sections of more than 40 states, dividing communities and even households. Sit-ins, walk-ins, pray-ins and shout-ins have been held for and against nuclear power. There are dozens of different bumper stickers damning and praising nuclear power.

The most debated issue in the nuclear controversy had not been the safety of plants. Three Mile Island. It has been whether it is safe to bury the wastes that can remain radioactive for thousands of years.

Second to that is the issue of nuclear weapons proliferation. When India exploded an atomic bomb almost five years ago with the plutonium it extracted from the spent fuel in a nuclear reactor, that issue grew dramatically in importance. On April 6, the United States suspended economic aid to Pakistan over evidence Pakistan was headed in the same direction.

With antinuclear ranks certain to grow because of Three Mile Island, the debate may once again shift back to safety. At the very least, the nuclear electricity industry faces new and stiffer regulations that could raise costs, shut down some plants and delay others.

It could be worse. The hearings the nuclear industry faces in the House and Senate for the next year over Three Mile Island may bring the types of stiff controls and demands that grind the industry to a halt. It has already slowed to a walk. Last year, only two new nuclear plants were ordered by U.S. electric companies, down from a peak of 41 ordered in the wake of the 1973 Arab oil embargo. In the last three years, 31 nuclear projects were canceled or deferred.

Real opposition to nuclear power surfaced in 1968 and has been growing since. That was the year Sports Il-

lustrated published an article titled "The Nukes Are in Hot Water." It raised questions about the impact of nuclear hot water discharge on sportsmen's fishing reels.

As alternatives to nuclear power, its critics advocate hydro, coal, wind and geothermal energy as the answers to the nation's energy needs. They regard as the most promising energy source the sun, which could provide limitless heat and electricity without polluting or endangering the air and water.

Solar technology has already made definable inroads in hot-water heating for individual homes, an appealing alternative to diminishing and increasingly costly oil and gas. But the time and expense involved in harnessing of the sun's power as a major energy source is enormous.

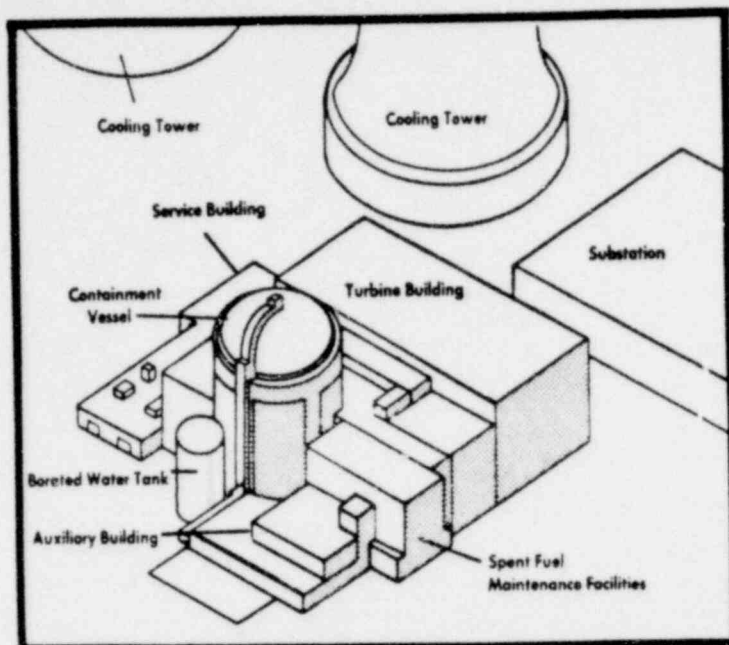
At this point there seems little prospect from either political or technological stand-points that the nation will reverse its commitment to nuclear energy.

The consequence of the Three Mile Island accident is that it will undoubtedly shake the unquestioning acquiescence with which many Americans have accepted nuclear power as the chief ingredient in the nation's long-term energy base.

That may also be its only blessing. ●



The Washington Post



## CHAPTER 4

# The Tough Fight to Confine the Damage

At Three Mile Island the abstractions of the national debate over nuclear power were reduced to frightening particulars: escaping radiation, a "minor" hydrogen explosion, radioactive contamination of the Susquehanna River, the specter of a fallout cloud over the East Coast.

These were the ponderables weighing on the team of government and corporate technocrats struggling to confine the damage. The crisis managers from state and federal agencies as well as the company contractors gathered in an overnight trailer settlement, a technological campground, across the river from the reactor complex. The mood was shifting from the smugness of scientific certainty to humility, skepticism and increasingly, fear that something had been unleashed over which science appeared to have lost control.

Though on Wednesday, March 28, the plant's managers assured the Nuclear Regulatory Commission that the reactor itself was under control, the federal counterparts were skeptical.

Inside the reactor vessel the pressure in the cooling system was fluctuating wildly. Each time the pressure went up blasts of radioactive steam would shoot out of the relief valve, escaping into the containment structure.

A series of alarms warned the control room team of the increasing radiation level inside the containment shell. Yet no one pushed the button that would have sealed off the structure. It was not isolated until the rapidly rising pressure in the building resulting from intermittent steam bursts triggered the automatic cutoff mechanism in the plant.

By mid-morning, Wednesday, with the heat readings in the core going off the scale and printing question marks on the computer, plant officials were getting desperate over their inability to bring the temperatures down.

At 11:30 a.m. officials decided to "blow down" the system—to try to reduce the pressure in the cooling system to 400 pounds per square inch. This was the level which would permit them to turn on the huge pumps normally used to bring the reactor to a "cold shutdown."

At first, all seemed to be going well. But within the system the coolant was bubbling like champagne. Officials worried that as the pressure on the coolant system dropped, bubbles would be released, forming a pocket of explosive gas at the top of the reactor vessel.

At about 2 p.m., with pressure almost down to the point where the huge cooling pumps could be brought into play, a small hydrogen explosion jolted the reactor.

The explosion set off the emergency sprays up near the dome of the containment structure, which began pouring 5,000 gallons of white sodium hydroxide solution all over the reactor.

Officials in the control room—who now had their first definitive sign that gas bubbles had formed in the reactor—reluctantly abandoned their effort to depressurize the system.

At 5:30 p.m., they decided to try to bring the pressure back up in an effort to collapse the bubbles. They also decided to try to restart the main reactor coolant pump, which had shut down at the start of the accident.

When it started, water began to circulate again through the reactor, finally immersing the top of the core, which had been left exposed and disintegrating for more than 11 hours.

During the course of Wednesday night, the situation in the reactor began to stabilize. The temperature started to come down, and pressure was held around 1,000 pounds per square inch.

On Thursday morning, confident

Metropolitan Edison utility officials began a public relations campaign to persuade the public that the situation soon would be in hand.

Appearing on ABC's "Good Morning America," Met Ed President Walter M. Creitz told viewers that the plant soon would be safely closed down without injury to anyone.

At a late morning press conference in Hershey, Pa., Creitz introduced Met Ed's top technical official, John G. Herbein, who was quickly ambushed by a pack of reporters.

Way, someone asked, had the company waited three hours to warn area residents of the accident.

"There was no delay," Herbein insisted. "We were carrying out normal plant procedures up to 7 a.m."

He admitted that it was "unusual" that the reactor's pressurizer relief valve had stuck in the open position, releasing radioactive water into the containment. And he acknowledged for the first time that there may have been human error in the control room. But like Creitz, he continued to walk a delicate line. What the company believed—or at least wanted the public to believe—was that the danger had passed.

Still the reporters pressed him. "I live a mile from the plant," yelled one. "What are you going to be doing to protect my family?" "Mr. Herbein," another shot out, "is your plant a lemon?"

Suddenly someone else grabbed the microphone. It was Middletown's mayor, Robert Reid. Why, he demanded, hadn't his community been told of the danger for three hours? Herbein apologized, promising to do better.

Finally, with television cameras zeroing in on his perspiring face Herbein's composure broke. "We didn't injure anybody with this accident, we didn't seriously contaminate anybody, and we certainly didn't kill anybody."

Meanwhile, radioactive gas and steam were building up to potentially explosive levels in the auxiliary building. Company officials were forced to vent radioactive gases into the atmosphere.

As a result, the spread of radiation was now at the forefront of concern, although little had been done to assure systematic monitoring of radiation levels in the area.

Early Thursday afternoon, Congress, in the form of two visiting delegations, made its appearance on the stage in Pennsylvania. Company officials gave them the same assurances they had given to the press earlier. The politicians were skeptical.

The company, seeking not to offend the visiting dignitaries, allowed one congressman, John J. Wyder (R-N.Y.), to go onto the island. Later it allowed Pennsylvania Lt. Gov. William W. Scranton III into the auxiliary building for a personal inspection. "I was suited up in an extraordinary suit," he told reporters after the visit. Asked how he felt, he replied cheerily, "I feel fine."

By late afternoon on Thursday, it appeared that the company's soothing reassurances no longer squared with the reality inside the reactor core. Met Ed's credibility was coming in for a licking.

Part of the problem was simply the volume of requests for information coming into the company's small public relations staff. One PR man said the company received 4,000 inquiries during the first two days of the crisis.

Other voices added to the confusion. Two prominent academicians, both critics of nuclear power, made their appearance in the Three Mile Island



drama to join the issue with the company.

Dr. Ernest Sternglass, a radiology professor from the University of Pittsburgh, said he had done samples at the Harrisburg airport, three miles north of the Three Mile Island site. They showed radiation levels 15 times the normal amount expected at the airport, Sternglass said. Dr. George Wald, a retired Harvard biologist, warned of the effects from radiation on pregnant women and children.

By midafternoon calls were pouring into the offices of the governor and

other state officials from worried expectant mothers.

What might be termed the coup de grace to the day's confusions came late Thursday afternoon when all phone communications went out between the Three Mile Island control room and the command post across the river.

"For several hours, these these guys were trying to keep atop of the situation using walkie-talkies," an NRC source said. "The whole situation—simply incredible."

But there was one more startling breakdown to come. Just after mid-

night, a press aide for the state Department of Environmental Resources turned up in the deserted press room on the second floor of the state capitol. The department, in an untimely release, said that because Met Ed's holding tanks at Three Mile Island were dangerously overloaded with radioactive waste, the utility had for hours flushed the water into the Susquehanna during the afternoon. When it learned of the flushing, the state had ordered it halted.

But no one had bothered to tell the communities downstream. ●

## Glossary of Nuclear Power Terms

Following are some of the technical terms and their definitions used in nuclear energy:

**CHAIN REACTION:** When uranium atoms split, they emit neutrons that split other uranium atoms in a continuing process. When the number of neutrons emitted is sufficient to keep the chain reaction going, the reactor is said to have reached criticality or has reached critical mass.

**CLADDING:** The material that coats or surrounds the nuclear fuel.

**CONDENSER:** The heat exchanger in which steam is transformed into (liquid) water by removing heat.

**CONTROL RODS:** Carbon that, when inserted into the nuclear core, neutralizes the fission, causing the reaction to slow down or stop.

**COOLANT:** The fluid that removes the nuclear-generated heat from the core. In most plants, water.

**PRIMARY COOLANT SYSTEM:** The entire circuit through which the fluid passes including piping, vessels and components; may include the reactor vessel, coolant pump and steam generator.

**COOLING TOWER:** An hourglass

shaped tower in which heat from the reactor is released to the air by evaporating water. This process does not release radioactivity.

**CONTAINMENT BUILDING:** The thick-walled building that surrounds the reactor vessel. It is the second line of defense against radioactivity being released to the atmosphere.

**CORE:** The center of a nuclear reactor that contains the fissionable fuel that, when activated, splits atoms of uranium and thus produces heat. The heat in turn converts water in nearby generators into steam that operates the turbines that produce electricity.

**DECAY HEAT:** The heat produced by radioactive decay of materials that are primarily the remnants of the chain reaction.

**DOVE:** The top of the structure that houses the core. The core of the Three Mile Island dome structure has 8.4-inch high-strength carbon-steel walls. It is housed in the "containment building" with walls 4-foot-thick made of prestressed concrete and steel reinforcing rods.

**FISSION:** The splitting of the nucleus of an atom enabling the creation of nuclear energy.

**FUEL PELLETS:** The form in which the uranium is contained.

**FUEL RODS:** Hollow pipes containing uranium fuel pellets that fuel the reactor to produce heat.

**MELTDOWN:** The overheating of a plant's nuclear fuel to such a degree that it melts the protective shell around the nuclear reactor core, resulting in release of radioactive contamination.

**MILLIREM:** The term used to measure absorption of radiation by humans. The average American is exposed to 100 to 200 millirems of radiation per year, including radiation from x-rays to cosmic rays. A normal chest x-ray exposes a person to between 20 and 30 millirems.

**NUCLEAR RADIATION:** The release of nuclear energy which, when absorbed by the human body can damage or kill human cells. The dangers of radiation include death, latent cancers, genetic damage and contamination of the environment.

**REACTOR VESSEL:** The pressure tank that surrounds the core, control rods and related equipment. It is the first line of defense against the release of radioactivity to the outside.

**URANIUM:** The element—a metal, with radioactive properties—used as fuel because of its ability to undergo continuous fission. ●

## CHAPTER 5

# A Disturbing Signal Of Vented Radiation

Early Friday morning, one of the small planes circling continuously above the Three Mile Island plant picked up a disturbing signal—a high and unexpected plume of fresh radiation coming from the stack alongside the auxiliary building.

Within minutes the reading had flashed down to NRC headquarters in Washington and back to Gov. Richard Thornburgh's office, setting off a string of reactions that would suddenly escalate Wednesday's incident into a full-blown crisis.

The first word reaching Washington that morning indicated that the radiation level above the plant had hit 1.2# millirems. NRC officials, alarmed by the strength of the radiation and even more by its very existence, bypassed normal channels and quickly alerted the Pennsylvania Department of Environmental Resources in Harrisburg, which in turn notified Thornburgh's

office of the new problem. Shortly after 9 a.m., radios in the Harrisburg area informed the public that there was an "uncontrolled release of radiation" coming from Three Mile Island.

In fact, what that small plane had picked up was a deliberate venting of radioactive gas by Metropolitan Edison, part of an effort by company technicians to relieve pressure that was ominously building up in a holding tank. But the company had failed to give the necessary warnings to state or federal officials and so authorities, unaware that the venting was deliberate and not part of a spreading accident, set in motion extraordinary plans to protect the residents of the area.

In Washington, in the basement of West Wing of the White House the Situation Room is equipped with the most complete electronic instrumentation possible to assure the president of

the best intelligence communication. Two of the machines are the Associated Press and United Press International wire service tickers—and it was these machines that first let the president's staff know early Friday that things had taken a turn for the worse in Pennsylvania.

With the new report of radiation, the Situation Room called the National Security Council's Jessica Matthews, who quickly wrote a memo to national security affairs adviser Zbigniew Brzezinski, who briefed the president. Carter then called Joseph Hendrie, chairman of the Nuclear Regulatory Commission.

Suddenly the situation was unpredictable and the outlook was not good.

Carter asked Hendrie: What can we do to help you? What do you need? Hendrie answered immediately. They needed to get another team to the site and better communications. Carter's aides already knew that. They had tried to reach Thornburgh's office in Harrisburg and had been unable to get a call through for half an hour.

Brzezinski got his military aide, Col. William Odum, on the case and within an hour helicopters were landing at the Bethesda Naval Hospital pad to pick up the team from NRC headquarters in Bethesda to ferry them to Three Mile Island. Meanwhile the White House signal corps was installing "drop lines," which plugged the Pennsylvania state offices at Harrisburg and the control room at the nuclear plant into the White House switchboard. It was done in four hours.

This spreading sense of trouble, however, had somehow missed state and federal officials nearest to the plant. At about 8:30 a.m., E. C. McCabe of the NRC told reporters huddled at the door of his trailer across the Susquehanna from the plant that his monitors had measured "a maximum of 20 millirems for a few minutes and then it dropped off very fast."

At about the same time, William Dornis of the State Department of Environmental Resources was telling his superiors that radiation levels that morning appeared lower than the day before.

And just before 9 a.m., as he headed through the plant's north gate, NRC supervisor Carl Berlinger said he knew nothing about a radiation leak. "I'm sure they wouldn't let us in there if there was a serious health problem."

But in Harrisburg the tension continued to ratchet upward. Thornburgh, totally dependent on the conflicting advice of experts, felt compelled to act—but not in order.

At 10 a.m. he urged everyone within a 10-mile radius of the plant to stay indoors until further notice.

The word spread immediately down Highway 441 to Middletown, where Mayor Robert Reid and civil defense chief Butch Ryan sent sound trucks into the street to warn residents to take cover. "Stay tuned to television and radio for more information," the loudspeakers boomed. "Do not call friends and neighbors. Keep the telephone lines open." Similar warnings were issued in other communities near the plant.

Inside the borough hall, Ryan was hustling his volunteers toward the streets with radiation counters. He handed one of the yellow Geiger counters to a worker and gave blunt instructions: "If you read 100 or more on this thing, you get your ass back here. DON'T go on the radio. I don't care if you use a siren or what. Just get back here."

Reid and his aides called the schools. Cancel recesses, they said. Every child must eat lunch at school. No one goes into the streets.

But the mayor wasn't heeding the governor's advice to stay inside. In minutes, he had driven from the town hall to the American Legion post, where officials of Metropolitan Edison had scheduled a press conference.

Even as Reid was arriving and the semicircle of tripods and hot lights was forming near the stage at the front of the legion hall, another act in the growing sequence of confusion began.

At 11:15—whether deliberately or accidentally—the air raid sirens began to wail across the city of Harrisburg. Some now believe it was the work of an employe in the Employment Management Agency, trying to reinforce Thornburgh's warning to stay indoors. Instead it had the opposite effect. Back at the legion post in Middletown, a television technician in contact by walkie-talkie with Harrisburg turned to a colleague: "People in Harrisburg are running around like crazy," he said.

At the same instant, Middletown's overloaded phone system went dead.

It was with that prelude that John Herbein of Met Ed began his delayed press conference. "Conditions," he said, "are stable."

Under questioning, Herbein admitted that the company had deliberately vented radioactive gas into the atmosphere for 45 minutes that morning, from 7:30 until 8:15. He also admitted that the venting had caused radiation levels above the plant that were higher than expected. But he disputed the NRC readings of 1,200 millirems. The level, he said, was closer to 350 millirems.

Nor did Herbein see any need for panic. "It's certainly the civil defense's prerogative to take those steps," he said, "but we don't think it was necessary. If the civil defense chooses to tell inhabitants of Middletown to keep their windows and doors shut, that's their prerogative." And then, almost defiantly, he added: "We have our windows and doors open."

Almost lost in this free-for-all between the company and the media was Herbein's passing mention of a bubble of hydrogen gas apparently building up in the reactor core.

"It's serious, but not to the extent that we have to evacuate the citizenry," he said.

But in Harrisburg, Gov. Thornburgh was being told just the opposite. Since urging all residents to stay indoors, the governor had raced through a series of phone calls and meetings, seeking to understand more fully the events of the morning and the potential danger they held for his state. The plain fact was that no one then knew the extent of the danger of low-level radiation to the residents closest to the plant, but by then no one was willing to take chances.

Thornburgh met with officials from the Pennsylvania Emergency Management Agency, who urged him to order a partial evacuation, even though they believed the radiation levels were still below the danger level.

A similar recommendation came from NRC Chairman Hendrie in Washington. His experts had advised him that the gas bubble then building was potentially more serious than Herbein had hinted to the press. Hendrie told Thornburgh he should urge—not order—people to begin to move out.

Thornburgh also conferred with Carter about the problem. They

agreed there was no reason for panic. But at the White House, Brzezinski had called the president's assistant for intergovernmental relations, Jack Watson, to tell him that the situation on Three Mile Island was "at best uncertain." Watson would become the chief link between the governor and the White House. Within minutes, Matthews and Odum were in Watson's office briefing him and his chief aide, Gene Eidenberg.

Eidenberg recalls that he asked how serious it could become and that Matthews replied: "This could be very serious."

Still uncertain of conditions at the plant, Thornburgh decided he must act again. At noon, he called reporters to the media center on the sixth floor of the state Capitol.

"I am advising those who may be particularly susceptible to the effects of radiation, that is, pregnant women and pre-school-age children, to leave the area within a 5-mile radius of the Three Mile Island facility until further notice."

Despite the governor's repeated efforts to play down the severity of the situation, the effect of the evacuation order was chilling. In Middletown, a convoy of 26 yellow school buses began lining up on the edge of town to take people to the Hershey sports arena 11 miles away.

Near the town hall, five small children clung tightly to their mother and each other. "Mommy, I'm scared. Mommy, I'm scared."

At the Middletown Elementary School mothers arrived running to retrieve their children.

"The kids were calm, but we had a hard time keeping the parents from panicking," said Joe Prokopchop, the principal.

Bonnie Morgan, 19, and Clarence Bankes, the father of the child she was expecting any day, came into the borough hall after hearing the warning. Their eyes were red. They were distraught, scared.

"Nervous? That's not the word for it," Clarence said.

By then traffic was thickening on Union Street, the town's main drag. Cars loaded with clothing and suitcases began crawling up the hill heading out of town.

As the painful exodus mounted, Mayor Reid stood in front of the borough hall watching. He had just issued orders to his 13-man police force to shoot all looters. ●



Two-year-old Dionne Baylor sleeping in the evacuation center in Hershey.

POOR ORIGINAL

## Danger of Day 3: Nuclear Shower If the Core Melts

Of all the words in the lexicon of nuclear power, none is more hideous than "meltdown," an event so sinister that many physicists find it distasteful to talk about.

It is as simple as it is sinister: the nuclear fuel overheats to such a degree that it melts through the floor of the reactor vessel and the rock beneath it, resulting in the release of deadly radioactive contamination into the air or water.

By the night of Friday, March 30, the third day of the Three Mile Island incident, the possibility of a meltdown had become frighteningly real.

But that wasn't all. There was also a chance that the reactor might explode with enough force to shatter the containment and shower nuclear rain over a Pennsylvania countryside beginning to show signs of spring.

All of this because of a bubble.

This bubble had appeared late Thursday or early Friday. At first the

Metropolitan Edison people believed it was a steam bubble. Then the experts from Babcock & Wilcox, which built the plant, and the Nuclear Regulatory Commission agreed that, with pressures of up to 1,000 pounds per square inch in the reactor, it couldn't be a steam bubble. A steam bubble would have collapsed.

That left only one possibility: a gas bubble containing hydrogen, temperamental, volatile hydrogen.

The bubble, 1,000 cubic feet and growing, would make Saturday the worst day of the crisis.

Shortly after 1 p.m. on Friday, a giant Sikorsky helicopter with Air Force markings began circling Three Mile Island, then put down in a cornfield behind the Met Ed command post on the west bank of the Susquehanna River. A tall husky man with thinning, sandy hair and long sideburns jumped

out, followed by nearly a dozen aides.

Earlier, when the chairman of the NRC, Joseph Hendrie, briefed President Carter on the situation, the president had asked for one good man at the scene, someone who could speak authoritatively for the government about what was going on. He's on his way, Mr. President, Hendrie replied. His name is Harold Denton.

Terrible events have a way of distorting and enlarging personalities, of turning unknowns into heroes. At Three Mile Island there would be no heroes, but in the tension and confusion of the weekend, Harold Ray Denton, a Washington bureaucrat, would come to symbolize a kind of technocratic reasonableness that helped to ease the public mind.

As he arrived at the command post, Denton also knew he was there to end as much as possible the public bickering between the company and the government. "We plan to work very



State trooper at plant gate admits Navy flatbed loaded with lead bricks for use as radiation shields.

Associated Press

POOR ORIGINAL



closely with the governor," Denton said as he walked past the guards at the door of the command post.

He did not mention Metropolitan Edison.

The specialists he had brought included some of the nation's top experts in reactor safety, in meteorology (to track wind patterns in hopes of keeping an explosive shower from drifting too far) and—more ominously—in treating victims of nuclear exposure. More specialists were on the way from Washington.

Denton's team was ushered into a windowless room in the command post for a briefing from Met Ed's John Herbein. He assured Denton things were under control. At about that time, monitors in the NRC's mobile trailer measured a 90-millirem "spike" of radiation. Two workers in the plant had uncoupled a hose full of radioactive water. They were quickly hustled off the site to be checked for radiation.

Herbein's briefing continued, but just as he raised the question of coexistence between the NRC and Met Ed, Denton was summoned to a greenhouse next door.

It was the president calling.

Denton found himself momentarily at a loss for words. "I relayed to him whatever I knew at the time," he recalled. "He wanted me to get on top of the situation, to keep him informed, and provide the full resources of the government to do whatever was necessary to protect the public health and safety."

Back in Washington, the bureaucracy under presidential assistant Jack Watson had begun to do the same. Because of the danger of possible radiation contamination, Watson's office authorized the Food and Drug Administration to contract for the manufacture, packaging and shipping to Harrisburg of 240,000 one-ounce vials of potassium iodide. It could be administered orally to collect in the thyroid, hopefully saturating the gland with this non-radioactive and non-cancer-causing agent before any radioactive iodine could reach it.

For evacuation planning, Watson had dispatched Robert Adamcek, a regional director of the Federal Disaster Assistance Administration, from Philadelphia to Harrisburg to coordinate with Gov. Richard Thornburgh. He had sent John McConnell, assistant director of the Defense Civil Preparedness Agency, to consult with county civil defense officials in the region surrounding the plant.

Watson's office also coordinated the shipment of 70 tons of lead bricks from depots around the country to the Three Mile Island plant. Dosimeters, blankets and cots were gathered and sent to centers that could be used in the event of evacuation.

These preparations, according to quick estimates, cost the government \$1.7 million.

Denton hung up after conferring with the president, then walked out to the lawn in front of the house to brief the press. Before he could begin, a television reporter asked him to move—once, twice, a third time—so that the huge cooling towers of the nuclear plant formed the backdrop for the cameras.

Denton's remarks to the press were short. The White House, he said, was concerned that the reports being given the public weren't "hard, firm facts." To dispel this concern, Denton said he would send his team of experts onto the island for a first-hand inspection. They would report to the governor early in the evening, and a press conference would follow around 8:30 p.m.

But there was much to learn on the island and they stayed longer than expected. It was nearly 8 p.m. before the Denton team arrived at Thornburgh's office to give the governor his first full report.

He would hear two pieces of alarming news.

The first was that the reactor core was more badly damaged than first believed—at least one-third of it. This had occurred on Wednesday when the falling coolant levels in the core exposed the top of the fuel rods. Unprotected by cooling water, the cladding on the outside of the fuel rods heated up rapidly. The zirconium in the cladding oxidized, releasing more heat, which in turn ballooned and split the cladding, allowing radioactive gases like xenon-133, krypton-85 and iodine-131 to seep out through the cracks.

NRC investigators had first learned of the extent of the damage to the core when they got back an analysis of the primary coolant sample. The damage, according to Denton, suggested that the radioactivity in the system of water in the containment was "hotter than hell."

The second alarming development was the gas bubble containing hydrogen, 1,000 cubic feet in size, at the top of the reactor. The reactor had become so hot that the coolant water had decomposed into its primary elements: oxygen and hydrogen.

The biggest danger was the possibility that the bubble would continue to grow, forcing all the coolant water out of the reactor, allowing the temperature of the fuel rods to build up until they reached 5,000 degrees.

At that heat, the uranium would begin to melt.

Short of the meltdown, there was the possibility of an explosion, either in the containment building or in the reactor core. On the first day of the accident, there had been a small hydrogen explosion in the containment—an event Met Ed officials didn't tell state or federal authorities about. When NRC experts found out, they launched an immediate effort to analyze the physical chemistry of the bubble.

Thornburgh was told that the NRC's analysis showed that the hydrogen could become flammable or explosive in a matter of days.

A Princeton University scientist calculated that the energy in the bubble was enough to set off an explosion equal to three tons of TNT. Such a force could rip the top of the reactor dome right off, flooding the containment with radioactive debris. There were also fears that the hydrogen would escape to the containment and explode there. One engineer calculated the a hydrogen explosion three times the force of Wednesday's blast might breach the four-foot-thick walls of the containment, releasing radioactive material into the air.

Thornburgh wanted to know about the worst case, a meltdown.

Once the core reaches 5,000 degrees, he was told, the rods begin to melt, and once the melting is under way, the heavy metals like uranium and strontium begin to run right through the floor of the reactor.

Even after a loss of coolant, there would still be a four-foot pool of water below the fuel rods at the bottom of the reactor vessel that had not boiled off. The melting core would fall into that pool of water, possibly producing a steam explosion that would blow the reactor dome off like a missile and break through the containment walls.

Meanwhile, the molten core would continue to bore down through the concrete floor of the containment and into the ground. A report on reactor safety prepared by Dr. Norman Rasmussen of MIT talks about the core

## A Slight Error In Geography

Movie title notwithstanding, if there had been a meltdown at Three Mile Island, it would properly have been called a case of "Diamantina Syndrome."

If the Pennsylvania nuclear plant had melted straight through the earth, it would not have emerged anywhere near China but rather in the Diamantina Trough, a section of the Indian Ocean about 1,000 miles off the southwest tip of Australia.

Despite the popular notion about "digging straight through to China," the antipodal point on the globe for any spot in North America is somewhere in the Indian Ocean.

boring at least 40 feet into the earth, stopping only when enough rock and soil have mixed with it to dissipate its heat.

In the worst possible case, a meltdown at Three Mile Island that forced a break in the containment and poured radioactive debris into the atmosphere could trigger a catastrophe.

One of the first and most abundant fission products released in a meltdown would be a swarm of radioactive iodine, a mix of gas and liquid that could be carried far downwind in the plume escaping the plant. People living downwind would almost surely inhale some of the iodine. Rain would bring more of the iodine out as a kind of fallout, settling on the ground and dosing anybody nearby with as much as 150 rems of radiation in a single day.

The lethal dose is described as 400 rems, but the sick, the elderly, young and unborn children could easily die from a dose of 150 rems. A dose that strong could be to kill bone marrow so fast that death might follow in a matter of months.

To many scientists, the worst consequence of an overdose of radioiodine is not the lethal dose a few might get. It is the non-lethal dose which would concentrate in the thyroid gland in the throat, where radiation might produce tumors in thousands of people over a period of 30 years.

MIT's Rasmussen postulated that in the worst possible case as many as 60,000 thyroid operations would be required over 30 years to cure the after-effects of a massive radioiodine fallout.

The long-term effects of a meltdown are felt if radioactive cesium and strontium get into the air and water. They contaminate the land for years to come.

The half-life of cesium-137 is almost 30 years, during which time it emits gamma rays so penetrating that no living thing could survive for long on ground badly contaminated by cesium fallout.

Denton's briefing of Thornburgh ran 90 minutes. Despite the seriousness of the situation at the plant, there was no imminent danger that would force an evacuation. Thornburgh was relieved.

At 10 p.m. he and Denton arrived in the cramped press room on the sixth floor of the Capitol. Public television carried the briefing live to hundreds of thousands of homes.

Thornburgh spoke briefly, to say he would order no evacuation at that time but would reconsider as events warranted. Then he turned it over to Denton.

"This is easily the most serious situation in the life of the reactor program," Denton said. And in the next few days, he said, the federal government, not Metropolitan Edison, would be making the crucial decisions. ●

# The Phenomenon Called Radiation

A woman who lives across the river from the Three Mile Island nuclear plant said last week: "As long as that plant is out there, I'm going to live with some kind of fear."

The fear that she and millions of others felt last week was a new one for most Americans—a dread of the unseen, unfelt phenomenon called radiation.

The German professor, Wilhelm Konrad Roentgen, felt no such fear, only high excitement, when he discovered X-rays in 1895. But within four months, a Dr. J. Daniels of Vanderbilt University in Nashville, experimenting with the mysterious rays, found that they made a colleague's hair fall out.

Today scientists know that the radiation from an X-ray tube strips electrons from—or "ionizes"—the atoms of cells. If the ionization is extensive enough, it rearranges the cell's molecule, and can kill it.

Today, too, scientists know that some 60 substances in nature, like radium and uranium-235, and some 200 man-made substances, are radioactive, meaning they are gradually disintegrating and shooting off unseen, unfelt particles and rays that are physical cousins of Wilhelm Roentgen's unseen rays.

Various radioactive substances, like those produced in nuclear reactors,

variously give off gamma rays, very much like X-rays, and three possible kinds of ray-like particles, alpha particles (nuclei of helium atom), beta particles (high energy electrons), and neutrons. For example, radioactive iodine—which emerged in small amount, at least, from Three Mile Island—emits beta and gamma rays.

When ionizing radiation enters a body cell, it can break down its membranes and internal structures and kill it. Or, at lower levels, it can alter the cell's metabolism or the way it uses the body's nutrients. And the radiation can disorder chromosomes, the thread-like units of heredity, and alter their tiny molecules of DNA (deoxyribonucleic acid), whose composition dictates the shape of our descendants.

The effect on an individual? Probably none, if the radiation is at low levels, like the 20 or so millirems—thousandths of radiation units—of an average chest X-ray. But one must say "probably" none, for most scientists think that a few individuals exposed to even the smallest amounts of ionizing radiation pass on a disordered bit of DNA to some descendant, or after 10 or 20 years develop a cancer.

What are the odds? For the 2 million people living within a 50-mile radius of Three Mile Island, there should be no cancers at all, the radioactive emissions were so small. Health, Education

and Welfare Secretary Joseph A. Califano Jr. estimated. Dr. Karl N. Morgan, an elder statesman among health physicists, thinks there may be one excess cancer. He also acknowledged that a few scientists, with whom most authorities disagree, think there may be as many as 50.

Some known facts about radiation are that:

• We all live with an unavoidable radiation "background" from elements in rocks, soil and the air, and from man's works, like enclosing us in buildings made of ordinary granite and brick, which emit some radioactivity.

• The natural background at Harrisburg, Pa., is 88 millirems an year, just about the same as the added man-made dose. Califano says a Harrisburg area resident may have had in the first five days following the nuclear accident.

• A resident of a high-altitude city like Denver unavoidably gets nearly twice the natural Harrisburg dose, or 147 millirems a year, because of more exposure to cosmic rays.

• The average American gets half his annual radiation dose from natural background, and 90 per cent of the rest from medical and dental radiation. Doctors say: avoid unneeded medical radiation; accept it when necessary, since the probable benefit outweighs the possible risk. ●

## CHAPTER 7

# A Watchful Eye On the Black Ink

In the corporate boardroom in Reading, where the bottom line is black ink, the long view about Metropolitan Edison Co. was upbeat, for good reason. The darling of the system, the new nuclear unit No. 2 at Three Mile Island, had begun... delivering power last Dec. 30.

As books are balanced and tax laws written, that date—one day before the federal tax year ended—would play an important role in the flow of black ink in Reading. By getting TMI 2 into service 25 hours before the new year, Met Ed saved itself upwards of \$40 million in taxes.

For such decisions, corporate managers win praise. Met Ed's annual report took note of the tax advantages gained by putting TMI 2 into service. Walter M. Creitz, the graying company president who wears designer eyeglasses, wrote that that would make 1978 "a memorable year."

TMI 2 meant more to Met Ed and its parent holding company, General Public Utilities Corp. (GPU) of Parsippany, N.J., than just another marvel of mod-

ern engineering. It was the \$180 million vehicle that would get Met Ed stockholders' return on their investment back up near the 13.6 per cent level allowed by the state Public Utility Commission. In ledger books where black ink is measured in decimals, 1978 had not been all that good—megawatt-hour sales were up about 7 percent, but revenues climbed only 2 percent. The rate of return on common stocks was 12.9 percent, down slightly from the 13.1 percent of 1977.

Met Ed is one of three electric companies that operate under the umbrella of GPU, and it owns half of the Three Mile Island complex. The other partners are Jersey Central Power & Light Co., and the Pennsylvania Electric Co. Among them, they provide most of the electricity used in Pennsylvania and New Jersey.

By getting TMI 2 into service before the end of the year, Met Ed, as principal operator of the plant, stood to gain in three ways.

Its pending rate-increase request with the state (a 19 percent boost took



Among the Met Ed safety precautions were radiation suits for the workers.

effect the day after the accident) hinged on getting the plant into operation. The sooner it went on the line, the sooner the new rate could be collected.

And there were two other considerations. The company was able to claim about \$20 million for six months' federal tax depreciation by putting TMI 2 into service before the end of the year. And according to data Met Ed filed

with the Federal Energy Regulatory Commission, it expected to gain between \$17 million and \$28 million in investment tax credits—direct writeoffs.

Creitz conceded to reporters after the accident that Met Ed had gained tax advantages by getting TMI 2 into service in 1978. But he and John G. Herbein, his vice president for power generation, insisted that there had been no "rush" to beat the calendar at the expense of safety.

Yet, the record suggested questions. Between March 28, 1978, when the chain reaction began in the nuclear unit, and its December entry into commercial service, the plant had been shut down for repairs 195 of the 274 days—71 percent of the time. That was not typical of the industry as a whole, which reports about a 40 percent malfunction rate during early reactor operations. And during those 274 days, Met Ed found problems that were similar to those that occurred on the day of the Big Accident. Operating prob-

lems continued after the plant was put into service, but, Creitz said, they had nothing to do with a rush for money.

"We certainly never would have put it in service unless we were convinced it could be safely operated," Creitz said.

The NRC, in its preliminary reports, said that human errors as well as trouble with valves within the plant's cooling system were major contributors to the accident. Warning signals had shown up earlier. In January, TMI 2 was shut down for two weeks because of problems with the cooling system.

But the men at Met Ed apparently felt confident. The NRC had licensed the plant in February 1978 after a decade of hassling and citizen protests in Dauphin County. And in September, Deputy Energy Secretary John F. O'Leary had flown to Three Mile Island to dedicate the plant as another "success" in the nation's effort to wean itself from dependency on oil.

Success, of course, is relative, and the accident has dealt a severe blow to the electrical system's financial stability, even though Met Ed has \$33 million of liability insurance on the plant. GPU has stopped all but the most critical construction work to conserve cash; it may need for rehabilitation GPU stock that was selling at 17 3/8ths before the disaster closed at 14 on April 6.

The bottom line still is written in black ink. Six days after the accident, GPU Chairman William G. Kuhns hastened to reassure stockholders. Public health and safety were being dealt with at the plant, he wrote in a mimeographed letter which included a lengthy report on the financial picture.

Kuhns' letter did not mention this among the steps taken to preserve Met Ed's fiscal integrity: The firm ruled that pregnant employees who were evacuated from the radiation danger area would not be paid for time away from work. ●

## CHAPTER 8

# An Open Conflict Over Authority

By Saturday morning the two central institutions in the Three Mile Island crisis, the corporation and the federal agency charged with regulating it, were drawing into open conflict with each other. The corporation was Metropolitan Edison; the federal watchman was the Nuclear Regulatory Commission.

It was a familiar adversary drama and the press, clamoring insistence, poked around at the widening public confrontations between the two sets of briefing officials.

At 11 a.m. Met Ed president Walter M. Creitz held what he announced to be the last press conference the utility would hold. His tone was terse and subdued. Only a few in the room knew that the White House had decreed that the NRC would assume the role of public explainer for the balance of the crisis period. In effect the company had been told to shut up by the administration, which held full licensing powers over the plant.

The transfer of responsibility for telling the Three Mile Island story to the public was made at back-to-back press conferences, first by Metropolitan Edison and then a separately scheduled session by Harold R. Denton, the NRC's chief for reactor safety.

Met Ed's Creitz turned the floor over to John Herbein, a vice president of the utility, who told the conference that the deadly gas bubble in the reactor had dropped in size Friday night from 1,000 to 800 cubic feet. The NRC publicly disagreed, saying there had been no significant shrinkage.

Reporters, openly skeptical of Met Ed reassurances that everything was under control, now battered Herbein with questions. They extracted from him the information that the company's engineers had to abandon their efforts to shrink the bubble for 2½ hours for fear of a hydrogen gas explosion.

Herbein nonetheless insisted that "I personally think the crisis is over."

At his own press conference an hour later, Denton contradicted Herbein

openly. The crisis would not be over, he said, until the reactor was in a state of cold shutdown. One problem Herbein failed to mention was that inside the reactor the oxygen level in the bubble was climbing, thereby heightening danger of a gas explosion.

Herbein retreated from his earlier prediction that cold shutdown would be achieved within a day. Now, he acknowledged, it would be a matter of days.

"We attempted to tell the president and the country to the best of our ability what we thought was happening," said the utility executive. "This is the first time, I guess, that anything of this magnitude has happened."

Denton, in a later interview, described in sympathetic terms the plight of Met Ed when he arrived to take over, at Washington's direction.

"I was dealing with absolute chaos," he said. "They (Met Ed) were fighting fires. They were trying to cope with all the demands being placed on them and they didn't have enough staff to turn to."

"I was concerned that they were so thin technically at that time, that I couldn't find anyone who would give me the kind of information I would have expected," Denton said. "And I was getting more hard facts from my staff in terms of analysis and potential seriousness than I could get out of them."

As the NRC officials who were arriving at the scene in greater numbers began taking a more direct role, however, Metropolitan Edison rebelled.

During one angry encounter with Denton, Metropolitan Edison officials threatened to pull all of their operators and technical personnel out of the Three Mile Island plant and dump the whole mess into the NRC's lap. The company retreated from its threat.

But by the end of the week, while NRC officials continued to pay lip service to the notion that Metropolitan Edison was making the decisions subject to their approval it was clear who was really calling the shots.



The NRC's Denton assumed responsibility and control over the operations.

"Since I'm the director of the office of nuclear reactors, I can issue, modify or suspend licenses," Denton said repeatedly through the days. "So I never had any doubt that if I didn't like the way they were running it, I could issue an order on the spot."

Meanwhile, in Washington, NRC Chairman Joseph Hendrie was issuing grim news. Residents of the central Pennsylvania area around Three Mile Island ought to be prepared to evacuate from a downwind swatch of up to 20 miles. Since no one would know which way the wind would blow, it was the farthest-out evacuation warning yet and stretched the perimeter for evacuation to cover 630,000 persons.

Just before 8:30 p.m. came the final straw. Associated Press sent out an urgent story warning that the bubble situation had become extremely dangerous. In fact, the story warned, the unnamed experts were warning that the bubble might explode at any minute.

Denton, on his way to brief Gov. Richard Thornburgh at the Capitol, was hastily taken before the skeptical and by-now panicky press in the Capitol to assure them that the situation was not that critical. ●



## CHAPTER 9

# The Media Corps' Ali Out Invasion

The press, no matter its nationality, thrives on red meat. Red meat is disaster, tragedy, conflict—wars, assassination, a Jonestown massacre, exploding coal mines.

The Three Mile Island nuclear accident was red meat, of a sort never before experienced by the press: all the fine fiber of a Dalmonico. It was a story of technology run amok, man forced from his home by the peaceful atom, the prospect of a stretch of the eastern seaboard being turned into an irradiated wasteland.

It was a heiluva story and the media turned out in force. They came from around the world to witness this "event," as the nuclear technicians were calling it, and they came in droves.

By conservative estimates, there were 300 journalists and media technicians on the scene. No one knew who all of them were, where they all came from, or how many there were, but it was plain that few red meat events had ever drawn this kind of attention. It was a media event of such dimension that the Columbia Journalism Review sent two reporters to write a piece about the reporters. Rolling Stone magazine contracted with Mike Gray, an engineer who did the screenplay for "The China Syndrome," to tell the story of Three Mile Island—chillingly similar to his film fantasy.

The United States, Canada, England, West Germany, Japan, France, Australia, Switzerland, Denmark, Sweden—all were represented. Radio and television independents and networks. Large papers, small papers, magazines. Men from Action News and Eyewitness News and See It Now cruised the streets of Middletown and lined the road across from Three Mile Island. Camera crews roamed through little Middletown.

Mayor Robert Reid, an easygoing and gracious schoolteacher, said he gave at least 100 interviews. He took calls from all over the country and from abroad. His fellow townsmen adjusted to the invasion as well as he did. They willingly gave interviews and many kept count of which papers and which stations had sought their views. A civil defense worker who was pictured in Newsweek's post-accident coverage was teasingly called "star" by his pals. A drugstore clerk, having read her remarks in a newspaper, thanked a reporter the next day for the "miracle" of quoting her correctly. She said it with a smile.

The volume of material sent from the area was prodigious. Major newspapers printed two, four, eight stories each day on the event. The Philadelphia Inquirer sent more than a dozen reporters to turn out a special section each day. During the daytime cycle on Friday, March 30—the tense day of the hydrogen bubble crisis—the Associated Press rewrote its lead story a record 27 times because of the fast-changing situation.

Just as unrelenting was the quest for local color, the seasoning of red meat stories. Reporters quickly identified

the Railroad House, a Middletown bar adjacent to the Penn Central tracks, as the place to go to rub shoulders with workers from the plant. Workers were not all that communicative—many felt the press was blowing the incident out of proportion.

No wonder. An NBC camera crew showed up at the bar to film the scene of distraught workers crying in their beer. The network men played the same jukebox song over and over to provide appropriate sound backup. Not long after that, an ABC crew showed up with the same idea. They fed coins into the jukebox, playing the same country song again to get just the right effect.

Middletown dealt with these intrusions in good spirit. A downtown merchant reacted to the ubiquitous camera crews with his own spoof. He stationed a youngster with a minicamera inside the front window, filming passersby and projecting the image onto a large TV screen facing the street. At Karl Kupp's diner, a gathering spot that features homebaked pies and classic smalltown banter, out-of-town reporters were joshed by Kupp and patrons alike. For all the grimness of events unfolding down the road at Three Mile Island, Middletown could smile at itself and these newsgathering strangers.

The logistics became an enormous problem. When President Carter decided to visit Middletown, the gym in the borough hall was converted into a press center by the Nuclear Regulatory Commission. The daily press briefings were held there, almost as raucous as the briefings by Three Mile Island operator Metropolitan Edison Co., and NRC press aide Joe Fouchard pleaded with the reporters to "discipline yourselves."

Because of the complexity of the story, NRC brought press assistants from field offices around the country. They were available to answer technical questions, and often did so with careful detail. But even the flacks had problems. "I finally did something right," said NRC's Karl Abraham after arranging with a printer to have a briefing transcript delivered in 90 minutes. The printer missed his deadline by several hours and reporters were seething. Abraham could only shrug his shoulders.

NRC's words and those of anyone else who was quoted were sent to the outside world by telephone, facsimile machine, radio, air. NBC ferried its crews between a motel and the plant site by helicopter. The New York Times sent an editor from the home office to direct its news team. One organization dedicated an editor fulltime to harassing Pennsylvania Bell until it installed a telephone in the Middletown press center for private use of the newspaper. Newsweek had a team of nine on the scene, CBS more than 40.

Reporters in some cases ended up interviewing each other. In Middletown, a TV crew photographed two reporters standing on a corner eating slices of pizza. On the Friday when Pennsyl-

vania Gov. Richard Thornburgh warned area residents to take cover, the community of Falmouth, a mile or so south of the plant, became a ghost town. Helen Rank, reporting for the weekly in nearby Elizabethtown, stopped in the village to conduct interviews. She found only a reporter from Washington, D.C. They exchanged views and took notes.

Looking back on it, Jim Hill, a reporter for the York Daily Record, a paper published about a dozen miles from the island, wrote: "After three days feeding on the carcass of Three Mile Island, I was beginning to feel as ugly as what I ate. There was nothing delicious about this story."

Hill was right. There was nothing delicious about the story. It was a painful, distasteful one for some, who feared its potential. Reporters themselves could be victims of the ultimate disaster. Unlike a war or a riot, where refuge can be found from bullets and bricks, there was no refuge from invisible, tasteless, odorless radiation. If the unthinkable happened at Three Mile Island, if there was a core meltdown in the reactor, radiation would not discriminate.

Most editors understood that. Some sent in radiation exposure badges for their staffs. Others rotated reporters in and out of the area as a precaution against possible overexposure. AP shipped breathing devices and protective clothing for its staffers.

The fear was real. Jack Knarr, a columnist for the Philadelphia Journal, stayed at home. He wrote a piece saying "these people are nuts." An editor wanted him to go to Harrisburg and Knarr said no way.

Paul Critchlow, the governor's press secretary, saw it from another angle. He remembered the Saturday night, just after 9 o'clock, when the Associated Press reported that the hydrogen bubble in the reactor was about to explode.

"About 20 or 30 reporters burst through the door of this office," he said. "They said, 'We want to know if our lives are in danger. What the hell's going on here? We want to know if we have to get out.' . . . They were pale. They were frightened. At that point, they had lost an interest in the story they were supposed to be covering."

There was cloak-and-dagger stuff, too, which would be humorous in movies but was even richer in reality. One night, alerted by a rumor that Carter was arriving any moment, a gaggle of photographers burst out of Lombardo's restaurant in Harrisburg, each toting unclean, expensive, Italian dinners in doggy bags. Another evening two Philadelphia Inquirer reporters monitored a radio conversation between two Met Ed employees on a secret channel. They were talking about a leak of hydrogen. "Shut the damn thing down and quit screwing around," one man said. The next day, the NRC's Harold Denton was startled when the Inquirer reporters read him a transcript of the confidential conversation. He explained, after hearing the details, what was going on. No great revelation.

If it was a fear-inspiring story, it also was a confusing and complicated one for most reporters, unshooled in the language and the complexities of nuclear science. The Chicago Tribune hired a professor as a technical adviser. A network did likewise. It was, ultimately, a story in which answers could be provided only by a small group of experts.

Before the NRC on Sunday, April 1, took over the sole role of issuing formal statements, confusion and contradiction had been rampant. Met Ed's

press conferences degenerated into shouting matches, frustrated and belligerent reporters challenging John Herbein, the company's vice president for power generation.

Herbein brought it on himself, in a way. His style was clear on the afternoon of the first day, when he sat

down with Lt. Gov. William Scranton III to explain the situation. He provided an "encouraging picture," Critchlow said, with "the situation very much under control." No radiation emissions, he reported. Then the state people confronted him. Their own environmental resources teams

had detected radiation. What about it? Oh, yes, Herbein acknowledged, between 11 a.m. and 1:30 p.m. the company has been putting gas into the air above the island. Had Herbein told the press? "They didn't ask," he told Critchlow.

An oversight, for certain ●

## CHAPTER 10



President and Mrs. Carter, with the NRC's Denton, and Gov. Thornburgh, get briefing from control room employee during visit to plant.

# A Presidential Tour to Calm Fears

In the gymnasium of Newman High School in Wausau, Wis., the White House telephone rang.

Stuart Eizenstat was calling from Washington with an idea.

The president was, for the moment, unavailable; he was up at the microphone churning his way through a Democratic fund-raiser speech of standard fare—heavy on the politics, and not a mention of the crisis at the Three Mile Island nuclear power plant.

Eizenstat, the president's domestic policy chief, dictated his thoughts to Susan Clough, who is the president's personal secretary and was traveling with him that Saturday, March 31.

Eizenstat's idea: Carter should go to Three Mile Island to personally tour the crippled reactor site.

Carter read Eizenstat's suggestion on Air Force One, while flying to the next site of his day of politicking, nearby Milwaukee.

The memo was short and to the point. Carter should go to Three Mile Island because his visit would demonstrate his concern for the crisis at hand and it would reassure people in the area about their own safety.

Up until then, Carter had not said much nor done much in the way of personal, visible actions of concern about the crisis. He had voiced his concern through spokesmen and had designated his aides to do all they could. But his public comment had been limited to one statement to a group of editors at the White House on the Friday

of the radioactive ventings—that the crisis "will probably lead toward even more stringent safety and design mechanisms and standards." (To some, even on his own staff, it had evoked memories of Carter's old statement in the tobacco lands of North Carolina about how he hoped cigarettes could be made "even safer.")

And yet Carter was personally very concerned about the problem at the nuclear plant and he was surely better equipped than any previous president or any political figure to take a leadership role for the crisis. He had campaigned for the presidency by telling people he was a nuclear physicist and nuclear engineer. And he had written in his autobiography, "Why Not The Best?," about his role with an early Navy crisis team that had helped disassemble a damaged reactor core at a plant in Canada.

Behind the scenes he had been taking an active part in the management of the crisis. No sooner had the Nuclear Regulatory Commission's Harold R. Denton arrived at the plant site than he was pulled from his initial briefing there to take a call from the president. Carter had questioned him at length and often, asking specific and technical questions, and finally they had made it a matter of routine that Denton would call Carter at 7:45 a.m. and 3:45 p.m. each day to brief him on the technical state of the reactor.

During one of the earliest briefings,

when several of Carter's technical questions could not be answered, the president asked one official drily, "Do you think there is anyone there [at the site] who knows what's going on?"

Aboard Air Force One, Carter discussed Eizenstat's suggestion with Jody Powell.

Among the factors that fed into the decision making was Carter's belief that the media had exaggerated the dangers and had unduly alarmed the public. In his autobiography, Carter had written of his "confidence in the safety of the reactors which we studied and operated." He did not like to see that confidence shaken by others less informed than he.

On Friday, Carter had ordered his staff to assemble all of the television coverage of the nuclear power plant events from the previous evening's news and that morning's; he watched videotapes of the entire coverage of all three networks at noon.

"There are too many people talking," Carter had told Powell back in Washington. "And my impression is that half of them don't know what they are talking about. . . . Get those people to speak with one voice."

Yet, as Carter viewed it, the exaggerated coverage had continued, raising public fears the level of public understanding.

"I'm inclined to go," Carter told his press secretary. "Why don't you call Denton and find out if that would cause any problems."

POOR ORIGINAL

In Milwaukee, Carter went about the ritual of politicking, beginning with a reception for Rep. Clement Zablocki and moving on to a second for the organizers of the evening's Jefferson-Jackson Day dinner.

Meanwhile, Powell telephoned Denton. Should the president come? "Yes," Denton replied. "I think it would be a great help."

Powell wanted to make sure that Denton was not merely trying to be bureaucratically correct. "I don't want to pressure you," Powell said. "I could tell the president your initial inclination is yes, but you want time to consult with people."

But Denton replied quickly. "No. I don't need more time. I can guarantee you it would be very positive."

Powell told Carter of Denton's enthusiastic response. Meanwhile, there was another bit of information that had reached the traveling White House. It was the latest wire service advisory.

**HARRISBURG, Pa. (AP)**—Federal officials said Saturday night that the gas bubble inside the crippled nuclear reactor at Three Mile Island is showing signs of becoming potentially explosive, complicating decisions on whether to mount risky operation to remove the gas.

Officials said earlier that tens of thousands of people might have to be evacuated if engineers decided to try to remove the bubble, operations that could risk a meltdown of the reactor and the release of highly radioactive material into the atmosphere.

But the Nuclear Regulatory Commission said Saturday night that it might be equally risky not to try the operations, because the bubble showed signs of gradually turning into a potentially explosive mixture that could wreck the already damaged reactor.

Some presidential aides still steam when they remember that story. "That AP piece was the crowning blow," one aide said. "The president felt that the information had been in general handled irresponsibly—mishandled—and it was frightening a lot of people. He wanted to show the public that it was not dangerous."

Inside the sterile, cavernous Milwaukee Exposition and Convention Center, Carter began yet another political potboiler of a speech. In the press area, the members of the White House press corps half-listened, bored at the thought of sitting through still one more stemwinder and still complaining (some of them) about how difficult it had been to turn that earlier speech in Wausau into something that would resemble a news story for the first editions (there is this feeling, somehow, that if you make a presidential trip you must produce a presidential news story even if the president does not produce news).

Twenty minutes into his speech, Carter gave his press corps their news:

"As you know, we have presently a very serious problem with one of the atomic power plants on Three Mile Island in Pennsylvania. I have just had word from that site that the situation is still stable and slowly improving. But many people in that region have been severely frightened, and the crisis is not yet over. . . . In the near future, I will be going to Three Mile Island to learn personally about the situation there."

Carter would be going the next day. On the flight back to Washington, Carter's aides began making the arrangements. They called Denton from Air Force One. Gov. Richard Thornburgh's office was notified. Appointments secretary Phil Wise worked on the logistics of it all. Powell arranged for press coverage.

Sunday morning, Wise handed Carter a schedule for the visit and Carter approved it. Meanwhile, Jessica Tuchman Matthews, the National Security Council's staff expert on the affair, had written a memo for the president on the situation at the plant site.

Carter attended church, returned to the White House, and boarded Marine One for an hour-long helicopter flight to Harrisburg. En route, his aides wrote remarks that Carter would give in Middletown, Pa. The remarks were shown in advance to Thornburgh, who suggested some changes that were made.

The president, accompanied by his wife, landed at the Air National Guard facility in Middletown, three miles upwind from the cooling towers, and was met by Thornburgh and Denton. The NRC expert briefed Carter on the situation at the site. Meanwhile, the chief of the Air National Guard fire department, Charles Kline, was telling a reporter that Carter's visit "has helped morale tremendously up here—they think if it's safe for the president of the United States to come up, it's not too bad."

The presidential motorcade drove to the Three Mile Island plant gates where the president, the First Lady, and the rest of the party were issued yellow plastic shoe covers which would prevent them from tracking around radioactivity that might be on the ground. The booties were sealed by tape to their pantlegs, and then they were given radiation dosimeters to measure the cumulative dose of gamma rays absorbed at the plant. One reporter's dosimeter read 6 milliroentgens when he put it on, and 7 milliroentgens when he left the plant.

Carter spent a total of 36 minutes in the plant, 15 of that in the control room being briefed by officials. Its walls are lined with control panels and decorated by a picture of a baby that is captioned: "Sometimes I don't know whether to cry my eyes out, scream, or

wet my pants."

Carter then traveled to his news conference in the black presidential limousine, moving past about 1,000 persons lining the sides of West Emaus Street. They cheered his arrival and he grinned as he climbed out. He headed into the borough hall. He stopped and drew more cheers by shaking a couple of hands.

Inside his speech was short and reassuring. He stood before a lectern set out just beyond the foul line on the gymnasium floor. The gym, attached to the borough town hall is a worn structure and for the occasion of the president's visit the gray bleachers had been pushed back.

While the president spoke there were cheers coming through the gym windows as Rosalynn worked the crowd outside, comforting residents.

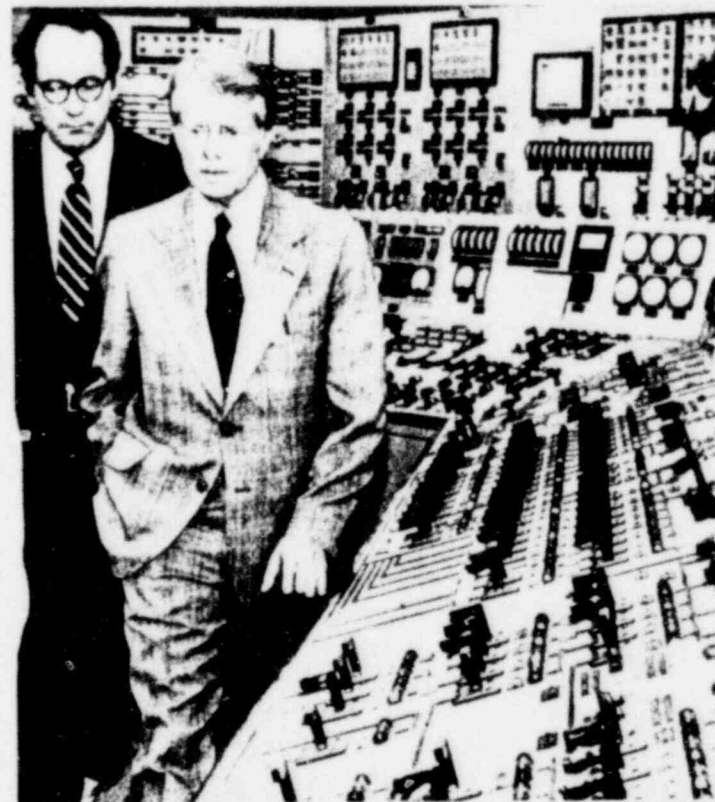
Carter was flanked by Thornburgh and Lt. Governor William Scranton III during the two-minute speech and left after the governor stepped up to the lectern to thank him for coming.

Carter moved right into the waiting limo after he left the gym and drove away while the crowd was still clapping and cheering.

Some people were not impressed. "What has he got to do with all this," said Carl Lonkart, a 45-year-old ironworker who helped work on the plant. "It's just good politics."

But 16-year-old Fred Lynch, who helped direct traffic for the president's limo, said, "The president of the United States doesn't just walk into a danger area. It kind of makes you feel comfortable."

On April 6, Carter discussed his trip with a group of editors at the White House. "I felt perfectly safe last Sunday when I was in the control room just a hundred feet away from the reactor core itself. The level of radiation was carefully monitored even before they found out the president was coming. (laughter) ●



Carter and Governor Thornburgh inspect the control room during half-hour visit to the plant. Later, the president would speak to reassure residents.

POOR ORIGINAL



# CHAPTER 11

## Weighing Options On the Gas Bubble

The growth of the hydrogen bubble and its inherent threat of a meltdown alarmed the engineers at the Nuclear Regulatory Commission as much as any single incident after the onset of the accident.

"The principal problem we have right now is to work out a means of dealing with that gas bubble," NRC Chairman Joseph M. Hendrie had said in a weary voice at a crowded news conference Saturday afternoon at NRC headquarters in Bethesda. "We have to get that gas bubble out of the reactor."

The day before, early Friday afternoon, Sol Levine, head of the NRC's reactor safety division, called the Energy Department's Idaho National Engineering Laboratory 60 miles west of Idaho Falls and told it to crank up some schemes for getting rid of the bubble. Levine called EG & G in Idaho Falls, a major government contractor employing 4,000 nuclear technicians, to help come up with solutions to the troublesome bubble.

Engineers had told Levine there were four ways of dealing with the bubble, all involving some risk. The two simplest plans were favored. One called for raising the pressure inside the reactor in an attempt to collapse the bubble and dissolve it in the water flooding the reactor room. If the bubble dissolved, it could be pumped out with the coolant into waste water tanks outside the reactor.

Another plan was to lower the pressure, a safer procedure in itself but a riskier one in the long run because lowering the pressure would expand the bubble, exposing more of the reactor core. The attraction of this plan was that an attempt then could be made to siphon out the bubble with the coolant water.

Two other plans were discussed, both even riskier than the first two. One was to "sink" the bubble by dropping the water level, exposing most of the core, then flooding the reactor with fresh water. The fourth option was to restart the reactor and create so much heat the the water would flash and break it.

This last plan was dropped almost as soon as it was proposed. Engineers pointed out that so many of the fuel rods had been bent and crumbled that there was no guarantee they could restart the reactor. The control rods that move in and out of the reactor to start or stop the chain reaction probably were also damaged.

"There's a chance the rods are damaged and won't fit back in and might not come back out when you wanted them to," one NRC official had said Friday night. "There's also the chance the rods might scrape on something and start a spark that could ignite the hydrogen bubble."

Back in Idaho Falls, technicians at EG & G flooded the NRC engineers in Middletown with questions. How big was the bubble? Where was it likely to be? How much hydrogen was in the

bubble? Was there any helium in it? How much oxygen? Was the pressure fluctuating inside the reactor? By 9 o'clock Friday night, EG & G was reviving up its experimental replica of a nuclear plant to simulate the bubble and test a few solutions.

Five technicians went to work making the Idaho Falls replica look as much like Three Mile Island as they could. The Idaho Falls facility has a core heated with electricity instead of uranium, which makes it safe for technicians to simulate engineering problems on a small scale.

Modifications took five hours to complete. Sometime early Saturday morning, nitrogen gas was injected into the Idaho Falls reactor and quickly formed a bubble that approximated in size the best estimate of the bubble back at Three Mile Island.

At the same time, engineers at EG & G were working through the night in conference rooms, chalking on blackboards options for collapsing the bubble and venting the hydrogen. At 7 a.m. Saturday, crews began to run the first tests. A computer named Puff, the Magic Dragon, sent out 240 separate printouts of information on what was happening inside the replica of Three Mile Island.

Meanwhile, at Three Mile Island, encouraging news was developing concerning the reactor for the first time. The bubble had stopped growing and began to shrink. Early Sunday morning, the day President Carter decided to visit Three Mile Island, the bubble appeared to have shrunk from 1,000 cubic feet, down to 350 cubic feet and then to 650 cubic feet.

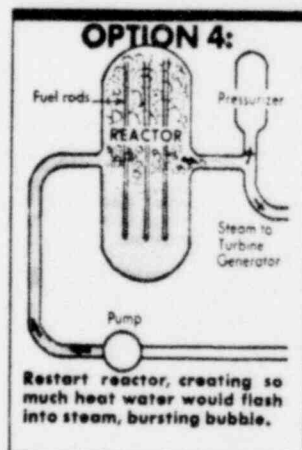
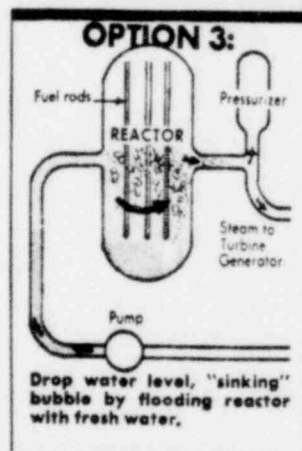
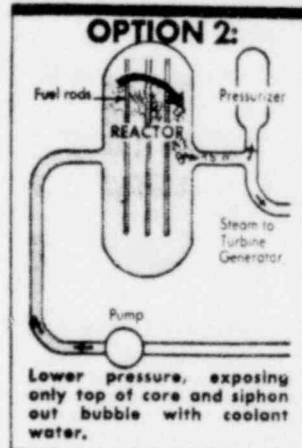
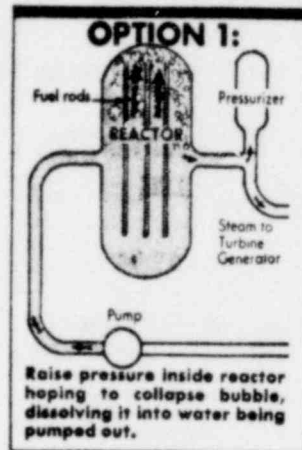
"When the president arrived," the NRC's Denton said, "we had seen a noticeable change."

Denton decided to treat what seemed like good news with caution. The only method technicians could use to measure the bubble's size was imprecise, involving as it did a possibility for error that ranged up to 200 cubic feet.

"I was afraid of being too optimistic," Denton said. "And when the data came down, I knew everyone wanted it to come down so much that I wanted to be sure they weren't forcing their views to come true."

By Sunday night, another piece of good news came from Three Mile Island. Engineers concluded that their early calculations on how much oxygen might be in the reactor were too high. And while a hydrogen bubble is bad, it is worse if a certain amount of oxygen joins the bubble and creates the spark for an explosion.

Despite the encouraging new signs, however, the NRC went ahead with preparations for what surely would have been a risky maneuver to get rid of the bubble later in the week. Plans still were being drawn up to evacuate the entire region around Three Mile Island. Privately, Denton was telling colleagues to pick a day, a time of day and a state of readiness: Operation Bubble was still a strong possibility. ●



By Robert Barkin—The Washington Post



Shirley Flowers reads of possible Harrisburg exodus, ponders going to Virginia.

United Press International

## CHAPTER 12

# Swiftly Gearing Up For Evacuation

As the weekend passed the concentric circles on the evacuation maps at the Pennsylvania Emergency Management Agency rippled farther and farther out from the bullseye of Three Mile Island.

Three miles, 5 miles, 10 miles, 15 miles, 20 miles. On Sunday the last ring was added, sweeping in everything within 25 miles of the wounded atomic plant.

It all looked very tidy. But no one in authority wanted to see the precision of maps and charts put to the ultimate test. No one, least of all Gov. Richard Thornburgh, wanted an evacuation.

In the division of labor for managing the accident, Thornburgh had but one real responsibility, but it was in many ways the most awesome. He alone could trigger the exodus of hundreds of thousands of Pennsylvanians from their homes. Almost as much as the reactor itself, Thornburgh could produce—through a mistake in judgment or a miscalculation in timing—a disaster.

There is, in truth, something commonplace about evacuations. In almost any month, some Americans somewhere are forced from their homes by disaster—by flood or mud or a train wreck that releases a cloud of noxious chemicals. But most of them are nothing compared to the task facing Thornburgh in the early days of the crisis. And he knew it.

Late Friday, after telling area residents that there would be no evacuation for the time being, he was talking privately to a reporter. How do you actually move hundreds of thousands of people out of the area, the reporter wondered. I don't know, the governor replied, but there is a plan.

The responsibility for such a plan rested with the state Emergency Management Agency. Its top officials are former military officers. Col. Oren K. Henderson, who carried with him the notoriety of association with the My Lai massacre in Vietnam; Col. Charles (Charlie) Crowe, a blunt, no-nonsense West Point graduate; Clarence Deller, a former Navy captain.

The agency had been gearing up since Deller first received word at 7:02 a.m. Wednesday that there was an emergency at Three Mile Island. Everyone soon learned that, in an emergency, they could move swiftly. "Before this, if someone had asked me how long it would take this office to prepare a 10- or 20-mile evacuation, I would have responded that, with a concentrated effort, we could do it in several months," Henderson said later. "But with everyone pitching in together, it took us only a few days."

Each colored circle on the maps on the agency's walls meant more: more people to move out, more evacuation centers to designate, more food, beds, clothing and other supplies to requisition. More confusion.

An evacuation of everyone within five miles of the plant would affect 24,522 people. Ten miles meant 133,672. Twenty meant 636,073. That's where it stood Friday evening.

"Suddenly, out of the clear-blue sky, you were faced with planning on a much wider magnitude," Henderson said. Still, there was a set sequence on paper for launching the exodus. Under the most normal condition, the state Department of Environmental Resources would notify Henderson if radiation levels were dangerously high. Henderson would tell the lieutenant governor, who would tell the governor, who would make the decision.

State officials would then contact county civil defense authorities, who would spread the word to their emergency teams. The state, through radio and television stations, would warn the public.

But federal officials, who were monitoring developments at the plant, had their own contingency for issuing a warning—agreed upon by President Carter, Joseph Hendrie, chairman of the Nuclear Regulatory Commission, and Harold R. Denton, the NRC's top man on the scene. If there was time, Denton would call Hendrie who would call Gov. Thornburgh. If there wasn't, Denton was to call the governor direct.

As the planning continued, a sequence of events set into motion an incremental evacuation.

On Friday, Thornburgh recommended that pregnant women and preschool children within five miles of the plant leave the area. The vanguard of women and children gathered at Hershey Sports Arena, which had been stockpiled with cots, blankets and food.

On Saturday, Hendrie warned that evacuation of an area 10 to 20 miles from the plant might be necessary because of the bubble of hydrogen gas.

By the weekend, thousands of people—estimates ranged from 80,000 to 200,000—voluntarily had left their homes for safer ground. Their departure would lessen the chaos of any official's order to evacuate.

Still, everyone knew that an evacuation could bring the ultimate traffic jam that would turn an orderly dispersal into a knot of violent confusion. It left open the danger of looting, it meant lost money—through lost wages, lost sales and insurance payments to those ordered to leave. "Evacuation is not something you undertake lightly," Thornburgh would say later in a startling understatement.

But by the time President Carter arrived in Pennsylvania on Sunday, evacuation had been brought to the brink of inevitability. It would be a "precautionary" evacuation affecting residents up to 20 miles downwind of the plant. It would come just before the scientists attacked the bubble of hydrogen gas.

Everyone knew: It would come Tuesday. ●



Teletype is clicking at emergency plans center in sub-basement of capitol.

Associated Press

POOR ORIGINAL

## CHAPTER 13

# Hoping the Bubble Will Slip Away

Middletown did not sleep easily Sunday night. But it could have.

The visit by President Carter momentarily lifted the town's sagging spirits, but the residents went to bed that night with more on their minds than presidential good wishes.

They were still thinking about the bubble.

Until that bubble could be chased safely from the core of the reactor, the residents of Middletown — and thousands of their nearby neighbors — faced the terrible prospect of an evacuation. It could come slowly and orderly or, if things suddenly changed in the reactor, it could come in an instant.

the bubble, as if by an act of presidential exorcism, might slip silently away.

On Friday afternoon, E. C. McCabe, an official of the Nuclear Regulatory Commission, was talking to two reporters about the bubble, which then was turning the accident at Three Mile Island into a crisis. McCabe described to the reporters a simple way to reduce the bubble's size, but the reporters did not understand. McCabe then drew them a diagram. They still did not understand and promptly forgot about it.

Dick Ryan awoke early on Monday. Like many others, he had gone to bed nervous about the bubble and its portent. But he was there on assignment for the Detroit News and he had to be up early to chase the story for that afternoon's editions.

Around 7 a.m., he routinely checked in with Metropolitan Edison. He heard, almost in disbelief, that the bubble was nearly gone. Another call to the NRC office confirmed what the utility company was saying — yes, it seemed to be diminishing. NRC's presiding official at the site Harold R. Denton, would have more to say later in the morning, Ryan was told.

Ryan and other afternoon-paper reporters with looming deadlines were tapping into the first big break in the story. But there were caveats. Since Saturday, Met Ed had been muzzled, in effect, and its officials were keeping a low profile, saying as little as possible. On top of that was the company's credibility record. Since Wednesday it had been a case of Met Ed saying one thing, NRC another. It was vintage confusion and contradiction, as puzzling to the public as the press.

At Middletown's borough hall, civil defense director Donald (Butch) Ryan and Irv Strobecker, who had lined up buses for the evacuation, described the doubts that continued to hang over their townspeople.

"The people here want to know if they have to leave and, if so, when," said Strobecker, whose wife and children had already gone to a hideaway 70 miles north (she came back that morning to get more clothes).

"They are more inquisitive about what's going on," said Butch Ryan, who was working 18-20 hour days since

Wednesday and talking to dozens and dozens of people with problems. "We put our faith and confidence in these officials. They say it's stable, but that's not enough."

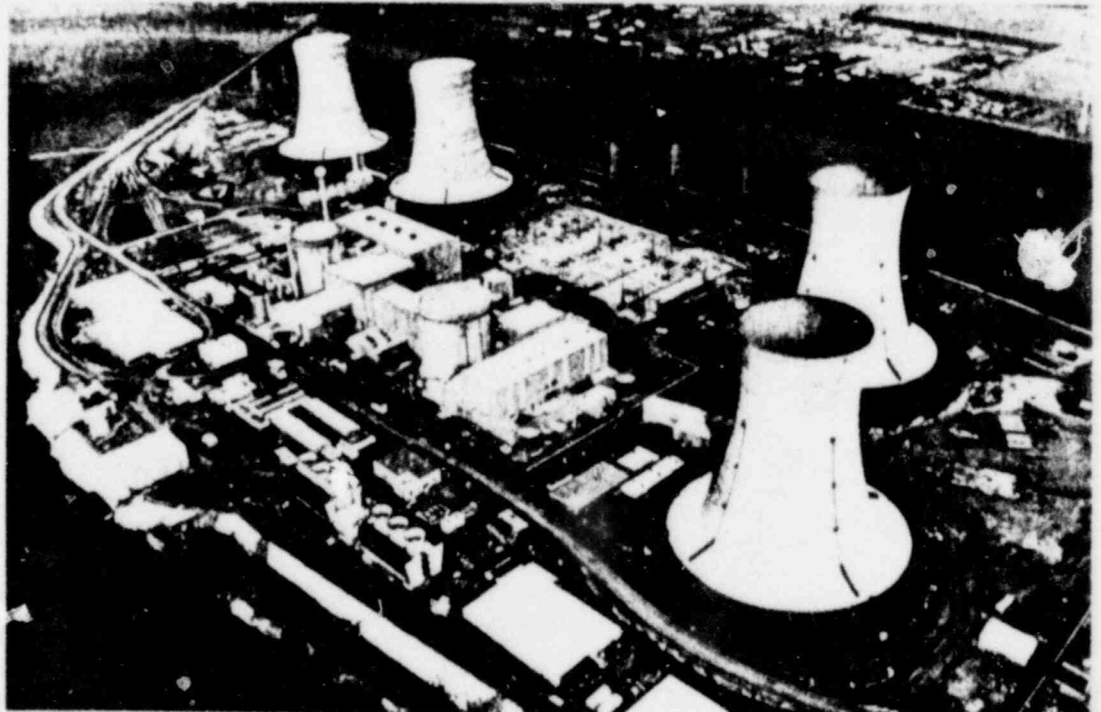
Ryan was prudent enough to have given his daughter some advice. Take the two children and go to the sports arena at Hershey to wait it out, he had told her when Gov. Richard Thornburgh made the suggestion Friday because of the radioactivity. She did.

But by then, Associated Press reporters were getting the same information as the eerily-calling reporters. By 10 o'clock they were readying bulletin material that would take the word across the country. Minutes later, the dispatch was torn from the wire machine at a Harrisburg radio station. An announcer read the news at 10:30: the hydrogen bubble was nearly gone and cooling of the reactor was continuing. Then came the music and it somehow seemed just right. They played "You Light Up My Life."

Through these five days of uncertain crisis there had been little sign of panic. There had been that rush around the capitol Friday morning when the air raid siren went off. There was the building tension throughout Friday and all day Saturday, the fear that the mysterious powerful bubble would be the final detonation of disaster. But panic, there just wasn't any. Those who were leaving left without rush, by ones, twos and threes, in family groups.

Butch Ryan knew why it was that way. Dauphin County, for example, had battled the flooding Susquehanna in 1972 and again in 1975. The losses were severe, and while no one ever whips a river, not even the Army Corps of Engineers, people didn't panic.

"People around here are great believers," he said. "They wait for their orders. We find through our emergencies that people cooperate. They are very good. Now, this is a situation that is out of the ordinary. A couple TV flashes caused some alarm, but most people are calm. A hundred percent best people in the world."



Reactor No. 1 is shut for routine maintenance; at ruined No.2 workers are waiting for water temperature to go below boiling

POOR ORIGINAL



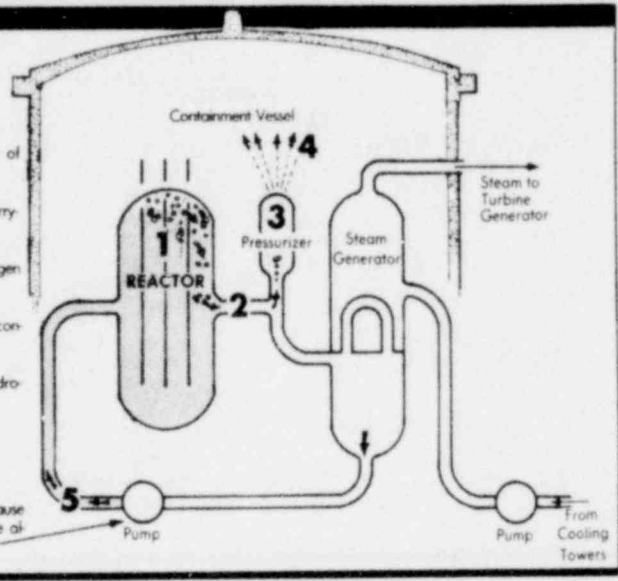
POOR ORIGINAL

### VENTING THE HYDROGEN GAS

- 1 Pressure in reactor vessel forces hydrogen out of bubble and into coolant
- 2 Coolant moves from reactor into pressurizer, carrying away the hydrogen
- 3 Coolant is sprayed into top of pressurizer; hydrogen is released
- 4 Hydrogen vented from pressurizer into dome of containment vessel
- 5 Coolant returns to reactor to pick up more hydrogen

### DANGER:

Hydrogen removal process was delicate because the wrong level of coolant pressure would have allowed the gas to jam the primary pump



In a way, though, Ryan was only half right. Not everyone was a believer. As he was talking, Middletown's two banks and others in the five-county area were experiencing an "extraordinary" run — clients were withdrawing money for evacuation and others were simply cleaning out their accounts, safety deposit boxes, everything.

Ben McEnteer, the state banking secretary, said the run on the exchequer had occurred between 8 and 10 a.m. Logical enough. The news had improved that much overnight, the evacuation threat still was real, officials were talking about progress down at the island but nobody was saying it's over.

Back at the NRC press center in Middletown, reporters were growing restless. Denton was driving. The AP story had made the rounds, but still there was that grain of doubt. No one would believe until Denton came out and confirmed it. Joe Fouchard, the information man, came out before the microphones ahead of Denton. He asked for calm and discipline — he was exasperated with yammering reporters one-upping each other — and then said, "We have some important information to convey to you this morning." Townspeople, some wearing work clothes and baseball caps, huddled on the bleachers in the austere little gym, hanging eagerly on the words.

Denton was wearing his long days on his face. There was a shadow of beard, a sleepy look. Long sideburns and the receding hairline highlighted the white gauntness. He teased a bit. He wanted to say first that NRC resident inspectors had been assigned to all other Babcock & Wilcox plants around the country. That was important, of course, but it had nothing to do with a bubble down on the island.

Then the big news. The temperature inside the reactor was going down — not much, but going down. And there had been a "dramatic" decrease in the size of the bubble, Denton reported. "There is reason for optimism."

Metropolitan Edison engineers would say later that they had never lost control of the bubble. "Based on the game plan, this is exactly what we expected to happen," said John Hilbill, a nuclear engineer for the company.

In fact, the procedure that chased the bubble was precisely the one E. C. McCabe had outlined for two reporters on Friday afternoon.

Still later, other NRC engineers claimed that the bubble, which of

course no one ever saw, was not a bubble at all but a froth. It would have taken 88 days to get rid of an actual bubble, one NRC official said.

None of this may be important in the aftermath. What is significant is that the danger passed as quietly as it had arrived.

What did happen was a gradual bleeding off of the hydrogen that had formed on the top of the reactor. It was a delicate balancing act in which engineers and specialists experimented with varying pressures in a band somewhere between 900 pounds per square inch and 1,100 PSI inside the reactor's primary coolant system.

The coolant then carried the hydrogen in the form of small bubbles to the pressurizer, a cylindrical dome that rose slightly higher than the reactor. Nozzles inside the pressurizer sprayed the hydrogen-laden coolant into the top of the pressurizer where it gave off the hydrogen like fizz from a soda pop. A vent in the top of the pressurizer allowed the hydrogen, which was radioactive, to escape into the containment building.

In the containment building, hydrogen and oxygen were converted back into water by devices called recombiners.

The problem with the recombiners — which were not ready to go when they were needed — was that their controls were in the auxiliary building where the radioactive waste water had been dumped. So Met Ed quickly had rounded up tons of lead bricks from places like the National Cancer Institute. They arrived in hurried ship-

ments to the plant on the backs of flat-bed trucks and in the bellies of C131 cargo planes flown into Harrisburg throughout the long days and nights. They were cemented in place igloo-fashion over the recombiner control panels.

When everything was in place the recombiners were turned on and the system worked.

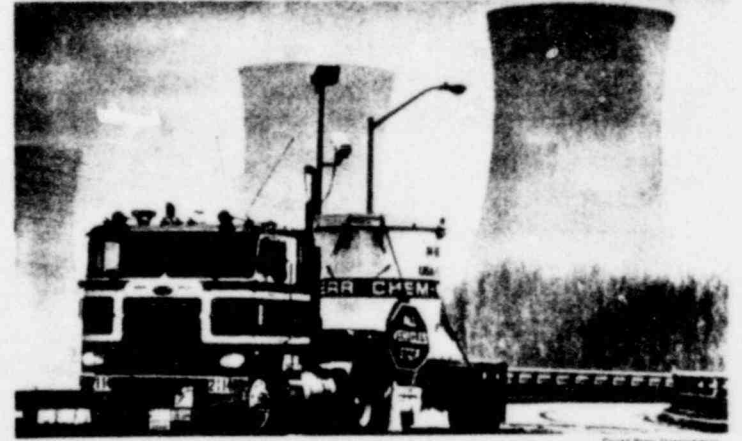
So the crisis of the bubble was over, for all practical purposes. A slow trickle of evacuees began returning to homes in the area, still uncertain of the denouement of the ongoing emergency at Three Mile Island, but a bit more relieved.

It was now, as before, an event which seemed so grim for all its awesome potential that the only remedy was to smile. At the Middletown Elks Club, they renamed the standard cheeseburger "The Meltdown." A bowl of chili with beans became the "bubble buster."

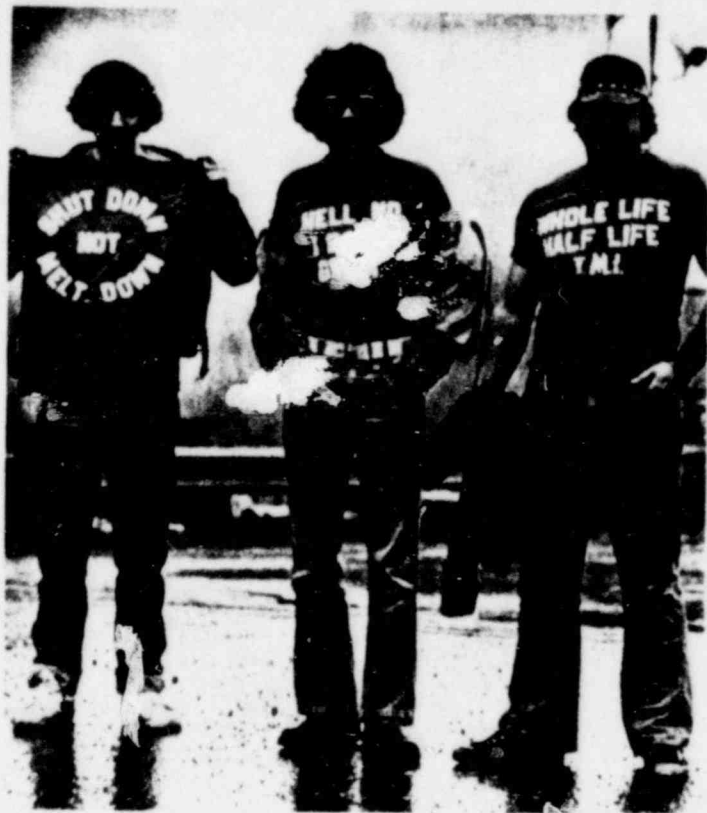
Bob Davis, a caseworker at the Dauphin County mental health crisis intervention center, thought a letdown surely would come, maybe not this week or next, but there would be a let-down.

"When this dies down, I think it will hit us," Davis said that afternoon. "A lot of people will want to talk about what they went through, that they felt inadequate in the crisis and embarrassment at being scared."

Very likely, but at his meeting with the president the day before, Thornburgh said something that had caught a flash of what was going on. "Pennsylvanians are tough people," said the governor. They had to be. ●



Container of radioactive waste leaves Three Mile Island for disposal in South Carolina



These T-shirts emerged in Harrisburg area in wake of Three Mile Island mishap.

## CHAPTER 14

# Inhabitants Wonder What to Believe

On the hockey rink ice was a makeshift plywood floor. On the floor was a long row of rickety Red Cross cots. On each cot was a stiff gray Army blanket. On the blanket on her assigned cot sat Carole Roy, her belly big with child, her face etched with discomfort and fatigue.

It was Saturday, April 7—ten days after the first alarm at Three Mile Island, eight days after the warning to Carole and other members of the "vulnerable population" to flee whatever poisons might have been carried in the stream that poured out into the wind over the nuclear plant, five days after the demise of the bubble had left the plant in more or less stable condition—and Carole Roy, with the child she had been carrying for seven months, was still a refugee.

Carole's husband had driven her from their home in York Haven, three miles straight south of Three Mile Island, to the refugee center in the hockey rink at Hershey Sports Arena ("Home Den of the Hershey Bears") within two hours after they had heard the "evacuation advisory" on the radio. She had been determined to stay there as long as the danger lasted.

But eight nights on that stiff, narrow cot had taken a toll. Eight days of utter inactivity in what seemed more and more like a nuclear prison had been enough. "Well, I'm worried about the radiation, if there still is any, because I

don't know," she said. "But I think I'm going to go home."

Carole seemed to feel guilt about her decision and the effect it might have on the child in her womb; it might be too soon, she kept saying. In fact, however, she was one of the last holdouts. Although the evacuation advisory was still in effect, by the end of the week the evacuation itself was effectively over.

By Friday, April 6, the state Office of Civil Defense estimated that 90 percent of those who fled the nuclear accident had returned home. Whether or not you could trust that statistic—since the Civil Defense types could not say, within 100,000 people, how many had left, they could not really say how many had come back—it was evident that life in Harrisburg and its suburbs was returning to routine.

The threat of disaster had made normality a news event, and so this was the news from the area around Three Mile Island by the end of last week: There were traffic jams at rush hour. There were shoppers in the grocery stores (although few stocked up for more than a day or two at a time). There were students in class at most schools. There were people—but still a minority—who on radio call-in shows complained about something other than Met Ed.

For the time being, however—and perhaps for a long time to come—the

very concept of "normal life" would be a relative term for the people unlucky enough to live near the nation's first serious nuclear mishap.

Nor was the plant itself the only problem for the people of the Susquehanna Valley.

After effects of the accident seemed to be a tableau of compounded unfairness. For one thing, the victims found when they came home that they would have to help pay the bill for the accident that victimized them. Since the nuclear plant had provided about 40 percent of Met Ed's power, the utility had to replace it by buying higher-priced power elsewhere—and the cost, about \$7.50 a month for the average customer, would be passed on automatically. Under the rate-setting statutes, moreover, Met Ed's customers could be charged for some of the cost of cleaning up the utility's nuclear mess.

There was other economic fallout as well. Real estate prices seemed sure to plummet. "Who's going to buy a house in the shadow of this plant?" one realtor asked rhetorically. Despite daily assurances from federal agencies that the region's environment and agricultural products had not been contaminated, the public seemed wary. Gov. Richard Thornburgh complained about stores posting signs declaring "We Don't Sell Pennsylvania Milk." The Pennsylvania Dutch Visitors Center said half the hotel reservations in the Lancaster area had been canceled the week after the accident, foreboding bad times for the region's important tourism industry.

Eleven miles northwest of Three Mile Island, at its headquarters on Chocolate Ave. in Hershey, the Hershey Food Corp. was frankly worried about the impact of the accident on its \$678.7 million in annual sales.

Daily the firm announced that its flagship product, milk chocolate, was being made with stores of milk laid in before the plant vented radioactive gases into the air.

And it mobilized a team to monitor its products, gather radiation data and be prepared to counter whatever suspicions chocolate lovers might be harboring.

The most serious difficulties facing the returning refugees, though, were the intangibles—the seeds of anxiety, distrust and anger sown with the first alarms from Three Mile Island and fertilized by the confusion and contradictions that marked the official response to the crisis.

For some people, the gnawing sense of being trapped in a situation that no one could control was so troublesome that they sought professional help. "My phone was ringing constantly," Dr. Robert Fisher, a Harrisburg psychiatrist, told a newspaper. "People were very frightened."

There was, for most people, the wrenching realization that something they had come to trust was no longer trustworthy. The people around Three Mile Island had generally been boosters of nuclear power, scoffing at the warnings of the antinuclear lobby. But the accident in their back yards brought a change in attitude.

"If our faith in Met Ed is shaken," wrote the Middletown Press and Journal in a front-page editorial, "our belief in the entire nuclear power industry also rides on thin ice too."

There were, to be sure, some who said their belief in the nuclear plant was not undermined. "The way I see it," said a bartender in Goldsboro looking out his door at the cooling towers a mile and a half away, "the damn thing worked. They had a problem, and they took care of it. Who got hurt?"

To the extent one can judge from a few days' visit, however, that seemed

POOR ORIGINAL

to be a minority view. More common, at least among those who were making their opinions known, was the mental conversion experienced by Jim Larry, a lawn service worker in Yocumtown.

"Eefore," Larry said glumly. "I bought the sales pitch, the whole 10 yards—that the chances of anything bad at the plant are minuscule. And now here we are. I've changed my views on the thing, personally."

In between were the many who said they were still not sure what they thought about the experience that controlled their lives. They wanted to believe that nothing serious had happened—but could they really believe that?

"Just because we didn't all drop dead, people here think we're okay," said Carmella Swartz just yesterday. Last night was the first night that Michael, her son, and scores of other children here had slept in their own beds since the evacuation of pregnant women and small children 11 days ago.

As she straightened the hood on her son's parka, she said, "I don't think these children should be brought back yet."

Nevertheless, the children of Middletown were back yesterday. In the Swartzes' case it was pure economics. They couldn't afford to pay for a motel room after emergency assistance was cut off yesterday.

Karen Cooke, 20, one of the hundreds of pregnant women evacuated from the immediate area of the plant, was back at work for the first time in the 11 days. "What's the sense of dwelling on something like this," she said. "What's going to happen is going to happen."

But the strong undercurrent of anxiety persisted. Skip Campbell was worried about his home and his 5-year-old son Mat, whom he took to have examined for radiation.

Several score people were examined in a mobil radiation scanner that looks like an aluminum coffin attached to a series of computers. All tests came up negative.

"We didn't expect to find anything and we haven't yet," said Dr. R. L. Gotchy, a Nuclear Regulatory Commission radiation expert. "The main thing is to provide assurances to people. A lot of people here are scared to death."

"I don't know," Carole had said over the weekend, looking up from her Red Cross cot. "I don't suppose I'll forget this, living in this place for a week. But



what happens next? I don't know what to say."

As she began gathering her things to go home, Roy paused for a minute over one item of apparel somebody had given her in the hockey rink—one of those sick-humor T-shirts that cropped up as soon as people recognized that there was money to be made in the aftermath of the accident. Roy de-

ecided she didn't want to take it home at all, so she plopped it on an empty cot and went on packing.

The shirt lay there, unwanted, bearing the slogan that captured the unhappy consensus among the neighbors of the nuclear accident that couldn't happen:

"I Survived Three Mile Island . . . I Think." ●



Associated Press

United Press International

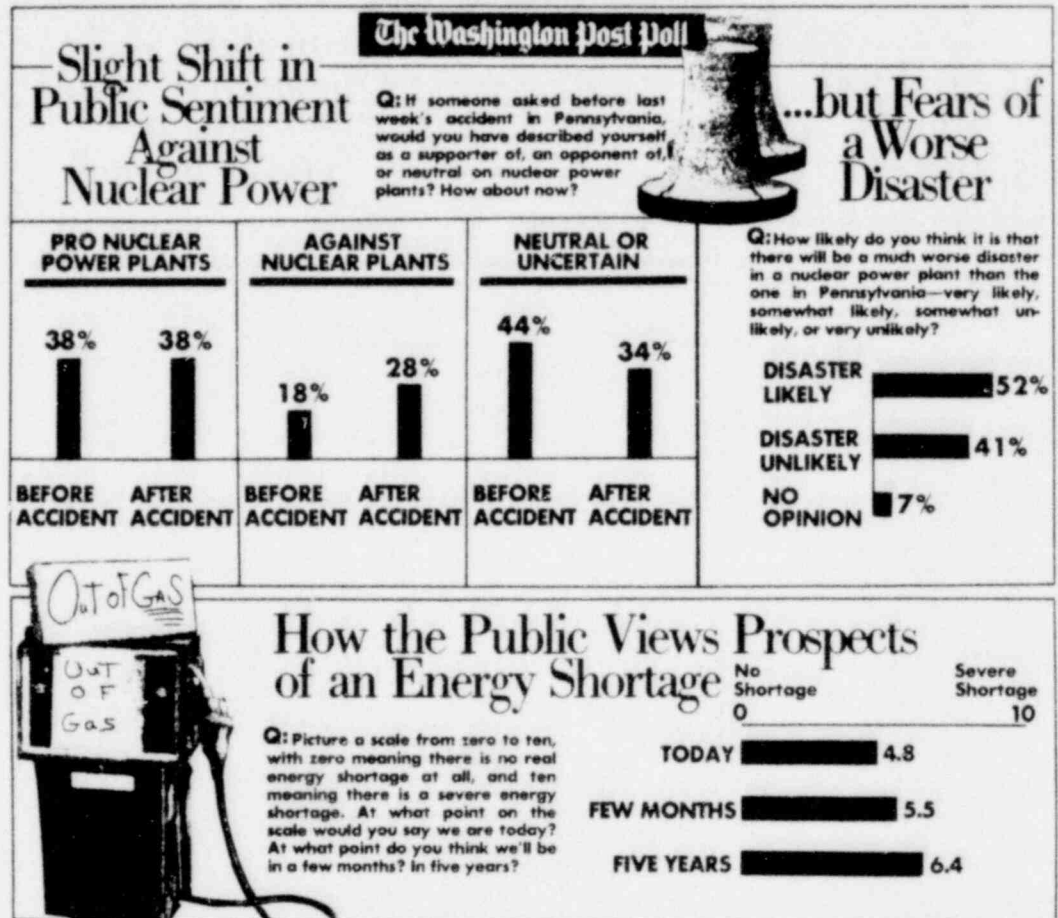
Harrisburg residents file insurance claims for their moving costs, some of which, right, were paid quickly.

POOR ORIGINAL



# APPENDIX I

## Despite Fears, D.C. Area Residents Resigned to A-Power



Results from poll of 934 Washington area residents, taken Tuesday through Friday.

The Washington Post

The jarring Three Mile Island accident 100 miles from here has left most Washington area residents persuaded that there will be a much worse nuclear disaster in the days or years ahead. But it has failed to make them reject nuclear power as an answer to the nation's energy needs.

These are among the chief findings of a Washington Post telephone poll on nuclear power and energy problems conducted Tuesday through Friday.

Large majorities of the 934 people interviewed feel that Metropolitan Edison Co., the utility that ran the power plant at Three Mile Island in Pennsylvania, could have prevented the accident, that it did not know what to do once the accident occurred, that it understated the problem and that it was not candid with the public.

The federal government, while considered much more candid and able than Metropolitan Edison, still was seen as falling short in its handling of the incident. Only 43 percent of those interviewed said they felt the government knew what to do once the accident occurred, while 45 percent felt

the government did not know what to do.

"I just feel terrible for the families there who have to be exposed to that and have to leave their homes," a young District of Columbia woman said. "This is something that can happen to all of us at any time."

That woman, who said she was an opponent of the use of nuclear power both before and after the Pennsylvania accident, was one of 52 percent of those interviewed who feel that a worse nuclear power plant accident is likely in the future. Forty-one percent of those interviewed said they felt such a disaster would be unlikely; 7 percent had no opinion.

In response to question after question, the bulk of Washington area residents show themselves to dread nuclear power but to feel stuck with it. That was how they say they felt before the near meltdown and how they feel now. Hardly any of those interviewed say their opinions on nuclear energy have changed as a result of the accident.

That they take the events of the past 10 days seriously is beyond question.

One-third of those interviewed said they thought the Pennsylvania accident presented a real danger to people living in the Washington area; only half said they were as likely now as before the accident to visit the beautiful Pennsylvania Dutch country or other places near Three Mile Island.

Sixty-six percent called the incident very serious and 25 percent termed it somewhat serious. Only one person in a hundred said it was not serious at all.

Asked whether they supported, opposed or were neutral toward nuclear power before the accident, 38 percent said they had been supporters, 18 percent described themselves as opponents in the past, and 44 percent said they had previously been neutral or had no opinion.

Asked whether they supported, opposed or were neutral toward nuclear power after the accident, the same number—38 percent—said they were supporters. Twenty-eight percent said they were opponents and 34 percent said they were neutral or had no opinion.

The accident, then, appears to have shifted the opinions of some 10

percent of the population pushing them from undecided or neutral into a position of opposition of development of nuclear power plants.

It has hardened opinions as well. "I was opposed before, but I'm more opposed now," a Bethesda woman said. "Not enough people are talking about long range goals with regard to energy."

An explanation for the lack of a massive shift against nuclear power may be quite simple: Washington area residents appear more willing to face the unknown danger of a catastrophe elsewhere than go without power in their own homes or pay huge electric bills.

The Post poll set four energy policy positions before the public, asking those interviewed to state which one they tended to approve most.

The first policy would have the government shut all nuclear plants and go all-out to develop other sources of energy, at the risk of power outages and much higher electric bills. Seven percent said they supported such a policy.

The second advocated tougher inspection of existing nuclear plants and government refusal to allow the building of new nuclear plants. Twenty-eight percent chose that position.

The third called for the government to "continue to develop nuclear power plants, but with more stringent safety and inspection rules." Fifty-eight percent, by far the largest group, chose that option.

The fourth policy would have the government continue to promote nuclear power under existing safety and inspection rules. Only 5 percent chose it.

Go nuclear, but with as much care as possible, was the clear majority theme, often articulated in volunteered comments from those interviewed.

"I was really surprised how close to a meltdown the thing came," said a 27-year-old Montgomery County man. "I knew they would prevent a meltdown, but it came really close. Apparently we need more regulations, although there are a lot now."

The sense of having to live on the edge was voiced by a 22-year-old Herndon woman who feels there is no energy shortage and that there will not be any but that the United States is caught in a bind nevertheless. "This is something I expected to happen," she said of the accident, "but I believe nuclear power plants are imperative to the future."

One other factor may help account for the failure of opponents of nuclear power to develop greater support here following the Three Mile Island accident—the absence of nuclear facilities in the immediate area, and the probable conviction on the part of many that none will be built.

In recent years, antinuclear groups have been successful in blocking the construction of many nuclear facilities. The people interviewed by The Post were asked how they would feel about having a nuclear plant within a five-mile radius of where they live.

Only 33 percent said they would not be against one. Sixty-one percent said they would be against one, and 6 percent said they were uncertain.

With sentiment like that, the likeli-

hood of a nuclear facility that could cause a local catastrophe may not be very threatening to most Washingtonians.

Ordinarily, public opinion is sharply swayed by especially jolting events. Sentiment leans heavily toward capital punishment after horrid highly publicized murders. But if reaction from Washington area residents is typical, then the events in Pennsylvania may have resulted in only a slight national shift in attitudes toward the need for nuclear power.

In 1976, the Gallup Poll asked Americans how important they thought it was to have more nuclear power plants to meet the future power needs of the nation. Thirty-four percent nationwide said it was very important and 37 percent said it was somewhat important.

In the Post poll last week, the same question was asked. Twenty-nine percent said nuclear power plants were very important, and 36 percent said they were somewhat important—a decline from 71 percent to 65 percent.

In his televised energy message Thursday night, President Carter asked people to pay attention to what he had to say. They probably did, for they certainly have been paying attention to the events in Pennsylvania. Of those polled by The Post, 97 percent said they had heard of the accident there, and 85 percent said they had been following it very closely or somewhat closely. ●

## Methods Used In Post Survey

A total of 934 residents of the District of Columbia, Arlington, Alexandria, Fairfax County, Montgomery County and Prince George's County were interviewed by telephone April 3 through April 6 in the Washington Post's poll of attitudes towards energy matters.

Telephone numbers were generated at random by a com-

puter in a procedure that selects respondents from each area in relation to its proportion of the overall population.

The theoretical margin of error for a sample of 934 people is approximately 3.5 percent, although normal problems encountered in polling tend to make the probable margin of error somewhat higher.

## APPENDIX II

# "Too little information too late..."—the NRC Meets

After the accident at the Three Mile Island power generating plant on March 28, the Nuclear Regulatory Commission went into "continuous" meetings on March 30.

The meetings continued whenever a quorum of three commissioners was present, with tape recorders keeping an account of the conversations. The last of the meetings was

April 2, when the crisis diminished measurably.

Following are excerpts of transcripts of tapes, made available Thursday by the NRC after Rep. Toby Moffett (D-Conn.) threatened to subpoena them for use by a congressional committee.

## Nuclear Drama Participants

Among names appearing in transcripts of Nuclear Regulatory Commission meetings on the Three Mile Island emergency:

Joseph M. Hendrie	NRC Chairman
Victor Gilinsky	Commissioner
Peter A. Bradford	Commissioner
Richard T. Kennedy	Commissioner
John F. Ahearne	Commissioner
Harold R. Denton	Nuclear reactor regulation director
Roger J. Mattson	Systems safety director
Albert Kennecke	Technical review director
Lee K. Gossick	Operations director
Joe Fuchard	Public affairs director
Richard Thornburgh	Governor of Pennsylvania
Jody Powell	White House press secretary

Friday, March 30

The discussion was about evacuation of an area near the plant due to fear that radiation escaping from the reactor might cause public health damage. It was one of the tensest periods in the entire sequence of events.

DENTON: Yes, I think the important thing for evacuation to get ahead of the plume is to get a start rather than sitting here waiting to die. Even if we can't minimize the individual dose, there might still be a chance to limit the population dose.

COMMISSIONER GILINSKY: Well, what did they tell them, was it for the northeast quadrant?

CHAIRMAN HENDRIE: Yes. COMMISSIONER BRADFORD: It ought to be made clear that you are not talking about lethal doses.

DENTON: But the people at the site are obviously much better to direct and run emergency plans than we are, and I would hope the plant people and our own people are really monitoring what is going on in there and acting on it from moment to moment.... It just seems like we are always second, third hand, second guessing them. We almost ought to consider the chairman talking to the owner of the shop up there and get somebody from the company who is going to inform us about these things in advance if he can, and then what he is doing about it if he can't. We seem not to have that contact.

GILINSKY: Well, it seems to me we better think about getting better data.

FOUCHARD: Well, the governor is waiting on it, and Mr. Chairman, I think you should call Gov. Thornburgh and tell him what we know.... The Civil Defense people up there say that our state programs people have advised evacuation out to five miles in the direction of the plume. I believe that the commission has to communicate with that governor and do it very promptly.

FOUCHARD: Don't you think as a precautionary measure there should be some evacuation?

HENDRIE: Probably, but I must say, it is operating totally in the blind and I don't have any confidence at all that if we order an evacuation of people from a place where they have already gotten a piece of the dose they are going to get into an area where they will have had 0 of what they were going to get and now they move some place else and get 1.0.

(The discussion continued in that vein—what to do about the radiation dangers and how to extract answers out of the confusion at the plant.)

DENTON: Well, people who go up there fall into a morass. It seems like they are never heard from. It seems like you might want to consider having something like rotating shifts through senior people there in the control room or in a room off the control room that we could communicate with about these kinds of things directly. I would be happy to volunteer and see how things go along for a while.

HENDRIE: Now, Joe, it seems to me I have got to call the governor—

FOUCHARD: I do. I think you have got to talk to him immediately.

HENDRIE—to do it immediately. We are operating almost totally in the blind, his information is ambiguous, mine is non-existent and—I don't know, it's like a couple of blind men staggering around making decisions....

(Hendrie reached Thornburgh in Harrisburg. The governor expressed some displeasure with limited and conflicting information he had been getting. He wanted some authoritative

word about the need for evacuation. Hendrie said it would be desirable to "suggest" that people within five miles of the plant stay indoors that morning, which Thornburgh did later. But the governor still was puzzled.)

THORNBURGH: Was your person, Mr. Collins, in your operations center, justified in ordering an evacuation at 9:15 a.m. or recommending that we evacuate at 9:15 a.m., or was that based on misinformation? We really need to know that.

HENDRIE: I can't tell what the—I can go back and take a check, governor, but I can't tell you at the moment. I don't know—

THORNBURGH: Okay. That would be extremely helpful, because if we get any further recommendations, we really have to know what the basis of those are.

HENDRIE: Yes. THORNBURGH: Do we know the precise time of the release of radioactivity?

HENDRIE: I doubt it with any precision....

THORNBURGH: Do we have any assurances that there is not going to be any more of these releases?

HENDRIE: No, and that's a particularly important aspect.... As best I can judge from the kind of information coming through from the plant, it is not clear that they won't get into this kind of situation again....

(The information gap continued to nag everyone. Metropolitan Edison Co. is as controlling the flow of information and events, and NRC people were increasingly frustrated. Among those complaining was Roger Mattson, who called in from Pennsylvania.)

MATTSON: There is a problem incidentally in tracing the damned things to the back panel and they can't find them. So there are people busy doing other things and they are not getting it done.... We just learned—I don't know—three hours ago, that on the afternoon of the first day, some 10 hours into the transient, there was a 28-pound containment pressure spike. We are guessing that may have been a hydrogen explosion. They, for some reason, never reported it here until this morning. That would have given us a clue hours ago....

(Mattson later talked about the escape of radiation from the plant that morning. He was concerned about the effects on nearby residents.)

MATTSON: The latest burst didn't hurt many people. I'm not sure why you are not moving people. Got to say it, I have been saying it down here. I don't know what we are protecting at this point. I think we ought to be moving people....

KENNEDY: How far out?

HENDRIE: How far out?

MATTSON: I would get them downwind, and unfortunately the wind is still meandering, but at these dose levels that is probably not bad because it is (inaudible).

KENNEDY: But downwind how far?

MATTSON: I might add, you aren't going to kill any people out of 10 miles. There aren't that many people and these people have been—they have had two days to get ready and prepare.... It's too little information too late unfortunately, and it is the same way every partial core meltdown has gone. People haven't believed the instrumentation as they went along. It took us until midnight last night to convince anybody that those goddamn temperature measurements meant something....

(As the day wore on, concern grew about the need for evacuating pregnant women and young children. By

afternoon Denton was in Pennsylvania. He reported by phone that the situation was tense but stable.)

DENTON: Hello, Mr. Chairman. HENDRIE: Hi there. DENTON: Quite an experience. HENDRIE: Well, I didn't tell you about this when we made you director of the office, Harold. Actually, I thought I was going to let you know later this summer, actually. How's it going?

DENTON: I think it's going all right—the communications are just frightfully inadequate because of the crunch, but they spent an hour working on this line.... So I would say the situation is stable, I don't see any immediate threat there. We've got our own people fanned out to really get up in each one of these areas.... My concern... might help warrant a forced evacuation, but the precautions they have taken are pretty reasonable....

(Throughout the Friday session there was concern about what was being reported in the press, who would speak for the NRC and what, when a spokesman was chosen, he would say. Jody Powell was involved in telephone talks with Hendrie about coordinating press releases. This exchange followed one conversation with Powell.)

HENDRIE: He says watch out. He's right. There will be a tape from Harold in the back yard at Three Mile Island and a tape of the dumb chairman answering the same question insufficient (sic) and they will pick out the divergencies even though they may not be matters of substance....

(Gerald Rafshoon of the White House staff wanted an NRC official to appear on the McNeil-Lehrer public television news show that night. Gilinsky was chosen, but he canceled not long before an time. The TV producers were upset and the commissioners talked about that.)

HENDRIE: Yeah, but still it's awful cold thing.

KENNEDY: Tough. Well, the life of newsmen. That's why they drink so much. They're always losing their stories just before they file them....

(The McNeil-Lehrer show didn't get its way, but the commercial networks were leading the evening news with the story of Three Mile Island. The commissioners were keeping a wary eye on the tube.)

KENNEDY: It is the lead story at all networks succeeded only by the ship that is burning in St. Thomas, where people are really going to get hurt.

HENDRIE: There's a ship burning in St. Thomas?

KENNEDY: A cruise ship.

HENDRIE: Holy mackerel. I was thinking about taking a cruise this winter, when I decided I wasn't going to ski. Good thing that never got off, isn't it?

KENNEDY: By ship nothing is riskless.

(Alarm bells were set off at the meeting when commissioners learned that United Press International carried a story speculating that there could be a reactor core meltdown—and very severe public safety consequences—if things worsened at the island. It bothered the White House, too, which called Fouchard in Pennsylvania.)

FOUCHARD: Jody Powell just called and said something about some story on meltdown.

HENDRIE: Yeah—we had a UPI condensation of a briefing given in the press room at Bethesda.

FOUCHARD: Goddammit....

HENDRIE: Now when I talked to Jody Powell a little bit ago we were concerned about having press conferences there at the site and then up



here and people comparing tapes....

FOUCHARD: Harold just talked very briefly with reporters here because there was no way we could hide him.

HENDRIE: Yeah... Well alrighty, listen I think Fouchard ought to call Jody Powell and report in on these public information developments....

*(There was more talk—lengthy talk—about the details and precision of an NRC press release. The commissioners took turns editing each other, and Hendrie read a final version to Powell. But the UPI story on a meltdown possibility continued to nag.)*

HENDRIE: ... We are, however, having to deal with this media report that's going running from the UPI report and so on about meltdown being imminent and we are putting together, by the way, a press release that says no, there's not an imminent danger of a meltdown.

GOSSICK: Yeah. I had a call from the White House situation room on that. I told them what had happened, that our guy had been taken out of context and misquoted.

HENDRIE: Yeah....

### Saturday, March 31

*Early in this session, which began at 10:27 a.m., the commissioners were still discussing the possible need to evacuate the area around Three Mile Island. Though later in the day they would receive more reassuring news from Harrisburg, at this point they were still quite uncertain what they should do, as this excerpt shows.*

GILINSKY: Look, what about—where do we stand on this question of whether people ought to be advised to move out or not?

I guess even though the situation looks better to me today than it did yesterday, I wonder if well, oughtn't we think about at least urging people who are real close in, they don't have to be around here now to, if they've got relatives 20 miles away, to go visit them?

KENNEDY: Given what we know today as contrasted with what we knew yesterday, let's say, in comparison of law, what would be the rationale for it?

GILINSKY: Well, you see the way it looks to me is that, in a number of ways the situation looks better. I mean, the temperatures in the reactor in these hot spots seem to be going down and that's better, and we've got a lot of talent on the spot that can think things through and they're organized and that's much better.

KENNEDY: And they're making—taking steps to minimize the effect of any subsequent release which might have to be evacuated.

KENNEDY: And they're making—taking steps to minimize the effect of any subsequent release which might have to be evacuated.

GILINSKY: Yeah. Right. So that's another—

KENNEDY: Is that better?  
GILINSKY:—that's another point on the plus side.

On the minus side is, they still don't have a way of dealing with this major hydrogen problem in the pressure vessel and, even though things are better, you know, there's still a possibility of the system degrading and, if it does, the time scales over which things might happen seem rather shorter to me—if I understand them correctly—than I understood them to be yesterday.

KENNEDY: That's something we need to—

GILINSKY: Check, sure.  
KENNEDY:—we need to check out.

GILINSKY: Absolutely.  
CHAIRMAN HENDRIE: Yeah.

GILINSKY: So I guess in my mind, I guess I view it as whether it's worth

buying a certain amount of protection for limited dislocations, limited economic costs and terms, and costs of other kinds involved when you start moving people.

And I—you know, I'm sort of thinking—if I had a friend in Harrisburg, I guess I'd—I don't think I'd tell him to move, I'd tell him to keep close to his radio, something, if you had somebody really close in, you might tell him, if he didn't have to stick around, why maybe he oughtn't to be there.

These are the people who would have the least time. You know, if you really got into a situation that was bad, people further out would have more time. You also would have a more specific evacuation. In other words, you wouldn't be doing it in a circle. And I guess I just don't think the situation calls for going beyond that.

On the other hand, it seems to me, it might be prudent to move them. And, I don't know. I'm also thinking in my mind, if the guy's got cows he's got to feed, I guess I'd probably tell him to stay there and feed his cows. But I think I'd go beyond women and—pregnant women and children.

KENNEDY: The farmer doesn't need to think about where he's going to get the feed to give the cows.

GILINSKY: Yeah. So it's not a simple answer to this, and I'm raising it for your consideration, you know....

KENNEDY: Yeah, but don't you—if you're going to take that kind of a step—don't you have to be more direct about it? I mean, you can't sort of—the agency to whom they would look for advice—you can't sort of toss it out and say well, you know, go'... maybe—

GILINSKY: Well, I—  
KENNEDY: You gotta say—say something fairly clear, a fairly clear indication of what you're saying to them. You can't leave it ambiguous.

### Tuesday, April 3

*By this point the damaged power plant was in a relatively stable condition. The question was whether to drift along that way, or take new potentially risky steps to bring the reactor to what the experts call "cold shutdown."*

*Among other things, these passages give a hint of the complex relationship between the NRC and industry representatives on the scene.*

DENTON: And what I think is the missing role and the one Dick and Roger were earlier trying to simulate, now is—Let's get out of this flabby mode (inaudible), and let's seriously consider ways and pros and cons for getting this thing down. Because I don't think DeCamp (a company official) has any perception of the federal, state and social costs that are going on. He would probably be just as happy to stay in this mode for the next six

months—you know, "don't touch a thing."

You know, "We know what we're doing now, why move?" And it's not a bad posture to be in if the whole social system could stand it.

CHAIRMAN HENDRIE: Well, I got the notion that GPU is still in a bit of shock—a state of shock, in a sense.

DENTON: Well, I will be meeting with them. I hope then to get my own operation here focused the same way. I think Roger and I can start thinking about where we want to be tomorrow, rather than blasting off at every latest item of something wrong.

COMMISSIONER BRADFORD: What are you looking at now in terms of the worst things that could go wrong, and the warning times you'd have on them?

DENTON: Well, my concerns are considerably alleviated since we've come to a view regarding the hydrogen....

BRADFORD: Do you have an estimate as to the least amount of warning time you think you'd get?

DENTON: I think it's very long now....

I guess what I need a feel from you on is. How critical is the need to show progress now? The whole—many of the—technical staff, I am sure, would take the view that, "why rock the boat?" We can sit right here and next week the core power level will be 5 megawatts. You know, that's a—and why make any changes in the stable system so that you might have a prime release, or some problem would develop or something would happen?

*[Simultaneous conversations.]*  
BRADFORD: That sounds good to me.

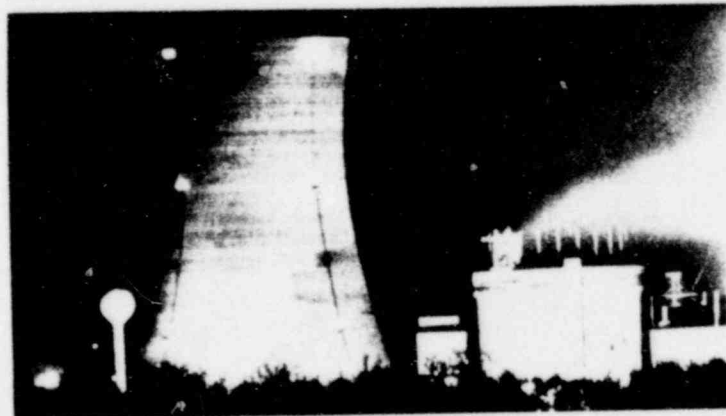
COMMISSIONER AHEARNE: You've got to (inaudible) explanation to the public in that area. Three quarters of a million people sitting on the edge of their chairs, intense.

DENTON: But obviously, if you were here and locked out, the place has changed dramatically since we got here, you know, with the visitors centers, and there were five trailers, and now there are ten, and there are tents, and communications J—they're even putting out a newspaper. The state is on readiness alert, and their resources are thin. So there is high social and political cost in maintaining this kind of—this steady condition. I don't know—I guess I don't have a feel for how destructive this is for the whole governmental process.

HENDRIE: I think what I'd like to—

DENTON: I think I will have to overcome the resistance of the staff, you know, to make any change. Obviously, there are a lot of views that just maintaining it right now, don't change a single temperature pressure or anything in the system, let's just hold it.

AHEARNE: That's an issue we're going to have to discuss.... ●



By John McDonnell—The Washington Post

# APPENDIX III



The Washington Post



American Press



United Press International

## The Newest Human Guinea Pigs

The people who live around the Three Mile Island nuclear power plant have become the newest human guinea pigs in a health experiment that has been going on—without a final result—for more than 30 years.

The question to be settled is what are the long-term health risks to individuals exposed to low levels of radiation?

It is a question that today is being sharply and bitterly debated by scientists and doctors both inside and outside government.

The debate has the same overtones that accompanied the cigarettes and cancer controversy—but with a difference.

The Pennsylvanians did not volunteer to be dosed with low level radiation.

Nor did other human subjects in this experiment—the Japanese survivors of Hiroshima and Nagasaki; the Marshall Islanders exposed to radioactive fallout in 1954; the GI's and Utah residents exposed by the 1950s Nevada nuclear tests.

Little more than a month ago, Health, Education and Welfare Secretary Joseph A. Califano Jr. declared that no one knows for sure how to estimate the risks of cancer from low level radiation. But he termed finding some answer high on the public health agenda.

Until the past few years, however, the government and the public seemed willing to accept standards in existence for almost 20 years. These said low doses of radiation—below 5,000 millirems a year—would not cause significant health problems even over the 10-20-30-year periods during which some cancers develop.

In recent years, however, a series of highly publicized findings, based on studies of limited groups exposed at different times to low radiation levels, have sharply challenged the existing theories. They have tended to show cancers developing 10 to 20 years later among individuals exposed to dose

levels recorded far below the 5,000 millirems per year figure.

Eight GIs with exposure records indicating 1,500 millirems or less during a 1957 nuclear weapons test called Smoky later developed leukemia. A Center for Disease Control study determined eight was more than twice the leukemia cases that should normally have been found.

A Utah State scientist studied Utah children exposed to fallout that drifted 100 miles from the same 1950s Nevada weapons tests. He found they had twice the number of leukemia cases than children who had lived in the same areas before and after the tests.

A statistical survey of workers at the government's nuclear facility at Hanford, Wash., turned up a slight increase of some types of cancers, although the workers had absorbed less than 5,000 millirems.

Opponents of nuclear power seized upon these studies and added them to their anti-nuke arsenal. On the other side, supporters of nuclear power produced doctors and scientists to attack the findings, or the manner in which the studies had been done and even the qualifications of the researchers.

Radiation, absorbed into the body, can kill human cells. Radiation can also alter cells. But not all absorbed radiation causes damage and some of the damage to cells is repaired by normal mechanisms.

The degree of harm from radiation thus relates to a series of complex factors—the type of radiation, the extent of the dose and length of time of exposure, the portion of the body exposed and the tissue or organs involved.

Scientists agree that women and children are more prone to radiation damage than men. And pregnant women are perhaps the most vulnerable since absorbed radiation could do severe harm to a fetus in the womb.

These considerations led Pennsylvania Gov. Richard Thornburgh to suggest evacuation of pregnant women

and children from the areas within five miles of the Three Mile Island plant.

Since man became aware of radiation and its hazard to human health, the amount of radiation exposure considered "safe" has been going steadily down.

At the turn of the 20th century, X-rays were an enormously popular new medical discovery. Despite evidence at the time that heavy X-ray doses were harmful, it was not until 1921 that any limits were set.

By 1925, the international standard was put at 1,000 millirems a week. In the U.S., that level prevailed until 1934, when an American-based organization, the National Committee on Radiation Protection, recommended 500 millirems a week.

In the post-World War II days, with the experience of the Japanese atom bomb victims analyzed, the U.S. recommended dose level dropped again. In 1949 it was put at 300 millirems per week. Eight years later, in 1957, it was dropped sharply to 5,000 millirems in a year (the earlier weekly limit worked out to 15,600 millirems over a year).

In addition, a general population exposure level of 500 millirems in a year was set—putting it at one-tenth the exposure permitted workers in nuclear facilities.

The lowering levels were accompanied by additional incidences of cancer which turned up primarily in Japanese groups whose post-exposure health was being followed.

HEW Secretary Califano said last week that the evacuated women and children from around Three Mile Island, plus workers at the stricken facility, would be prime subjects for a proposed long-term health study.

Such a program not only will permit the people to keep track of their health, but could give the government additional information it needs to help solve the vexing low-level radiation problem. ●

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