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Many of these incidents occurred years ago. Possible effects of such exposures, including cancers that can take years to develop, are just now being alleged by significant numbers of chip workers. Some researchers also worry that workers in both older and newer plants may face health risks from chronic exposure to very low levels of chemicals. Safety equipment designed to protect against chemicals, many workers say, often has been inadequate, inoperable or ignored.

No health authorities have concluded that there is a definitive link between chip making and cancer or birth defects. The industry has opposed epidemiological studies of cancer rates in workers or birth defects in their children; it says studies aren't warranted, and also is apparently concerned about liability.

Still, some health experts have seen enough to be convinced that something troubling is happening. "We've been

warning for years you can't use these chemicals in a cavalier manner," says Bruce Fowler, director of the University of Maryland's toxicology program and an expert on chip materials. "The blotches are starting to show."

National Semiconductor says its plants are safe. At Greenock, "we have never exposed our employees" to chemicals above legal limits, says Edward Sweeney, the company's vice president of human resources. "We have seen no pattern of abnormalities at that plant."

Ms. Morrison, 56 years old, found out she had uterine cancer two years ago, shortly after leaving National Semiconductor in a downsizing. The news was especially chilling, she says; Irene Gorman, a member of her six-person work crew, was already dead of uterine cancer. A third woman told colleagues a Pap test showed she had a precancerous condition. A fourth had a hysterectomy after uncontrollable uterine bleeding. On the day Ms. Morrison learned she had cancer, her sister, who worked in the plant for 15 years, was diagnosed with leukemia.

About 75 women here in Greenock have formed a support group that blames National Semiconductor for cancer or reproductive problems. A similar group formed recently at Motorola Inc.'s plant in nearby East Kilbride. James McCourt, manager of the employment-rights center, has fielded similar complaints from workers at other plants across Scotland's "Silicon Glen," belonging to International Business Machines Corp. and Seagate Technology Inc.

In the U.S., 128 former chip workers have sued IBM in the past two years, blaming health problems on chemical exposures in IBM plants in East Fishkill.

*Please Turn to Page A13, Column 1*

## Industry Challenge Computer-Chip Plants Aren't as Safe and Clean As Billed, Some Say

### Women at Scottish Factory Tell of Spills and Fumes, Face Host of Medical Ills Firms Won't Help Do a Study

By BILL RICHARDS

Staff Reporter of THE WALL STREET JOURNAL

**GREENOCK, Scotland** — At the Inverclyde Advice and Employment Rights Centre here, two dozen women crowd around a table. In angry Scottish burrs, they recite a litany of medical problems: cancers, birth defects, multiple miscarriages.

"There's a whole lot more who would be here with us," says 61-year-old Doreen Robinson, who has breast cancer. "But they're already dead."

The Greenock women blame the toll on one thing: They say that for years, while they made computer chips at National Semiconductor Corp.'s plant at the edge of this industrial city of 70,000, they were barraged with toxic chemicals that spilled, leaked and sometimes exploded from chip-making equipment.

"We all got a cocktail of gases, acids and chemicals," says Grace Morrison, a National Semiconductor employee for 16 years who has uterine cancer.

Semiconductor manufacturers always have portrayed their industry as clean, free of smokestacks, with no visible pollution and no health risks. Workers wearing head-to-toe "bunny suits" toil in sterile "clean rooms" where the air is filtered to remove particles down to 1/100th the width of a human hair. "This is an environment that is cleaner than an operating room at a hospital," says Lee Neal, head of safety, health and environmental affairs for the Semiconductor Industry Association.

#### A Different View

That image, however, is being challenged by some occupational-health experts, government scientists and chip workers. A growing body of circumstantial evidence, ranging from worker anecdotes to federal job-safety data, suggests chip making can be dangerous and damaging work, especially in older plants like Greenock's, which was built in the early 1970s. In interviews, dozens of past and current workers describe scenes of bunny-suited employees stumbling off chip-production lines, bleeding from the nose, vomiting in clean-room emergency showers, and passing out after chemical leaks.

# Some See Perils at Computer-Chip Plants

Continued From First Page

N.Y.; Burlington, Vt.; and San Jose, Calif. Among those suing are Henry Drew, a manager at East Fishkill from 1977 to 1992, and his wife, who also worked there and who has a brain tumor.

"There were chemical leaks all over the place," says Mr. Drew, who helped set up clean rooms at the plant. He testified in depositions in New York state court in Westchester County that monitors that were supposed to warn workers of leaks often didn't work because of corrosion from acids and water. In an interview, he says that supervisors sometimes shut monitors off to maintain production rates. After four women in his section miscarried, Mr. Drew says, he began telling senior officials the plant had a problem. "They told me, 'Henry, don't make waves,'" he says.

A spokeswoman for IBM says it doesn't believe any illnesses were caused by anything at its plants. She declines to comment on Mr. Drew's specific allegations. Motorola and Seagate say their workplaces are safe. Most of the lawsuits against IBM were filed by the Alexander Law Firm, San Jose, Calif.; Levy, Phillips and Konigsberg, New York; and attorney William DeProspero of Goshen, N.Y.

Making semiconductors requires hundreds of chemicals, some of which are either known or suspected carcinogens. The known carcinogens include arsenic, benzene and chromium. Industry officials say that any chip workers' cancers and other medical problems are more likely due to factors unrelated to the job, such as genetics, smoking or diet. Manufacturers also say that over the years, as awareness of chemical hazards has grown, they have phased out some toxic chemicals and lowered exposures to others.

## Checking the Records

In interviews at the Greenock plant and at National Semiconductor headquarters in Santa Clara, Calif., company officials initially said that records for the Scottish plant going back to 1976, four years after it opened, showed no serious chemical releases or health problems among the plant's roughly 1,300 employees or among any former workers.

"We are confident our people are not, and were not, exposed to hazardous chemicals," said Iain MacLeod, facilities manager for the Greenock plant. He said former workers' accounts of leaks and other mishaps were "exaggerated" and theorized that claims concerning miscarriages might reflect workers' "guilt feelings" at losing their babies.

Records compiled by the Health and Safety Executive, Britain's chief occupational-safety agency, show that between 1981 and 1996, the Greenock plant reported at least 63 injuries involving three

or more days of hospitalization or lost work. The plant reported 10 "dangerous occurrences"—defined as explosions, chemical spills or other major incidents—between 1981 and 1996, agency records show.

The agency says details of the incidents—such as whether chemicals were involved—generally aren't available. But in 1984, an agency spokesman says, the plant had "an uncontrolled release of a harmful substance" that caused "major" injuries to seven workers from "poisoning and gassing by gas vapors and fumes."

Told of the agency's data, company officials said a further review confirmed the 1984 incident. They said it involved hydrogen chloride gas, which is toxic but not a known carcinogen. They said the review found that 17 workers lost at least three workdays because of chemical-related injuries between 1981 and 1996. They said about 60% of the incidents reflected in the safety agency's records didn't involve chemical exposures.

## Incidents Recounted

Some former National Semiconductor workers say that not all leaks were reported to the safety agency. In one incident in the early 1980s, a furnace called a vapox reactor released phosphine gas that put five women in the Royal Inverclyde Hospital for three days, say several former workers, including two who say they were among those hospitalized.

John Watson, who was the women's supervisor, says alarms that were supposed to warn of any phosphine leak didn't sound. He says he submitted a written report to his superiors about the accident. The safety agency says it has no record of the incident, and company officials say they aren't aware of it. Phosphine is toxic but isn't a known carcinogen.

"We got gassed all the time," says Helen Clark, who started working at Greenock in 1979. In 1982, she says, she was operating a machine that bakes compounds onto silicon wafers. It uses arsine gas, which contains arsenic.

The machine blew up, she and other former workers say. Supervisors evacuated the plant. When workers returned, Ms. Clark says, she was assigned to wash the chemical residue from the clean room's walls. "I asked the supervisor for someone to help me," Ms. Clark says, adding that "he said, 'No, you go and do it, Helen. You've already had your family.'"

Three years later, Ms. Clark was diagnosed with stomach cancer. "I was 39," she says. "The doctors told me I had the stomach of an old woman."

National Semiconductor says it is unaware of the explosion Ms. Clark cites.

## Glycol Ethers

Other former workers say women of childbearing age sometimes worked at jobs that exposed them to solvents called glycol ethers. These were found in the early 1980s to pose a reproductive hazard. Bryan Hardin, deputy director of the U.S. National Institute for Occupational Safety and Health, says its studies of them in the

early 1980s were so conclusive "that no one doubted glycol ethers were a reproductive hazard for women and did semen damage to men as well."

The Semiconductor Industry Association, in a 1982 memo to semiconductor executives, warned that NIOSH and chemical-industry studies had identified the solvents as potential reproductive hazards. It cited warnings from Dow Chemical Co., a maker of the solvents, that exposure limits should be drastically lowered.

National Semiconductor, like most other chip makers, didn't begin phasing out glycol ethers for a decade, until about 1993. Before that, a company spokeswoman says, the solvents were handled in a "highly automated and carefully controlled environment."

Some workers dispute that. Debra Tannock, an employee at Greenock from 1980 until she was laid off last February, says she worked with glycol ethers from 1988 to 1993. They were used to spread other chemicals evenly across silicon wafers. "Every few hundred wafers, we have to stop the machine and clean it out," she says. "If you be all over you: when you rubbed your nose."

Ms. Tannock, 37, says she passed out several times on the job because of fumes. She says workers sometimes complained that the venting systems that were supposed to draw off the fumes didn't work. She says supervisors told them to ignore it and go back to work.

Sandra Miller, another former National Semiconductor worker, miscarried in 1988 and again in 1990. The second miscarriage occurred while she was working on the production line. She told her supervisor, but a senior plant official asked that she finish her shift, Ms. Miller says. The supervisor, Dorothy Murdock, confirms this account. Ms. Murdock says she took Ms. Miller to the plant nurse, who, she says, insisted on verifying Ms. Miller's pregnancy with a local clinic before she was allowed to leave.

"Everybody was under pressure to maintain production," Ms. Murdock says.

National Semiconductor says the accusations alleged by Ms. Tannock, Ms. Miller and Ms. Murdock would be against policy, but it emphasizes that it is unable to confirm that such incidents took place.

## Safety Warnings

The company says it didn't have solid evidence that glycol ethers were a reproductive hazard until late 1988. But James Stewart, its director of safety and health in the early 1980s, says he circulated several memos in 1981 and 1982 to officials at all company plants, warning that the solvents posed potential reproductive risk.

Dr. Stewart, now an industry consultant and lecturer at Harvard's School of Public Health, also says senior company officials knew in the early 1980s that plant workers were being exposed to low levels of dangerous chemicals from leaky equipment. Memos outlining efforts to cut those exposures were circulated to top executives, Dr. Stewart says. He says the efforts were ineffective.