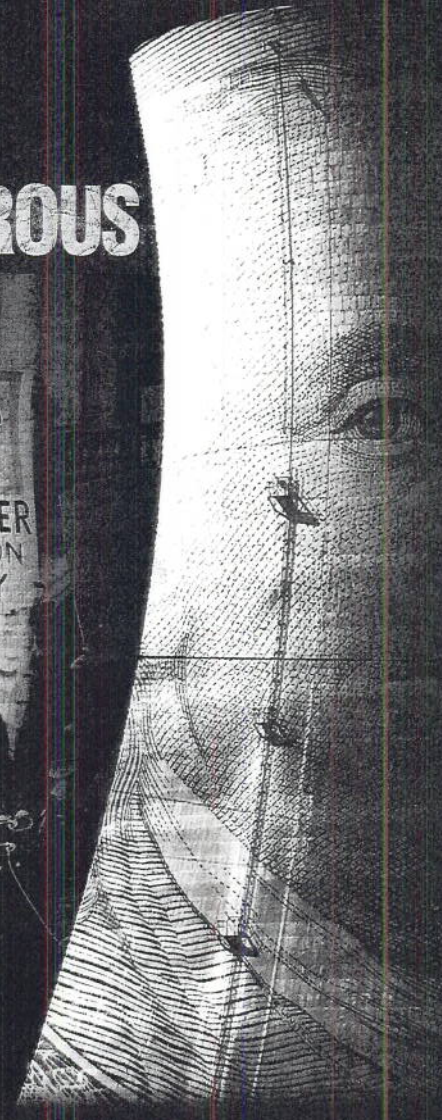
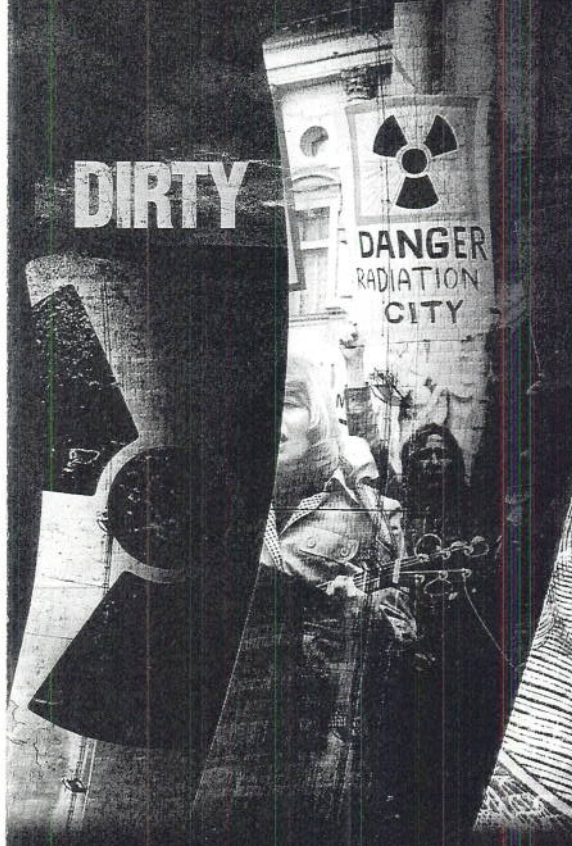


EXPENSIVE

DANGEROUS

DIRTY



THE VERDICT IS IN ON NUCLEAR POWER.

Nuclear power is dirty

THE FUEL:

Nuclear reactors use uranium. Therefore they release radioactive waste into the environment at every stage of the fuel cycle—starting first at mines, then at mills where enormous piles of tailings are left behind, and finally during chemical conversion, enrichment, and fuel fabrication. Radioactive radon gas that escapes in the West can float across the U.S., over the Atlantic, and beyond.



Valid concerns exist about global warming caused by carbon dioxide from coal-fired power plants. Yet production of uranium fuel also results in greenhouse gas emissions. Indeed, uranium mining and milling are among the most carbon dioxide-intensive industrial operations.

Nuclear reactors use uranium to power turbines by releasing intense heat and radiation through a process called fission. Old fuel rods must be replaced periodically with fresh ones. The irradiated rods are stored in a water-filled pool within the reactor building or in an adjacent building. After a few years, rods may be placed in steel-lined concrete casks outside, to await shipment to a still-nonexistent permanent repository.

Because no such repository has been built anywhere in the world, the nuclear industry would like to reprocess the irradiated rods. The rods would be cut up, soaked in acid, and reprocessed so residues of plutonium and uranium could be extracted and turned into usable reactor fuel. However, the other leftover radioactive fission products, now liberated from the fuel rods, remain as a containment problem for many thousands of years. Reprocessing is extremely hazardous to workers and to the public downstream and downwind. It produces its own massive wastes and releases radioactive CO_2 as well as other radioactive materials into the environment.

ROUTINE RELEASES:

Nuclear power plants don't have to blow up or melt down to release their radioactive poisons. During routine operation, they release pollutants into the atmosphere and into the rivers, lakes, and oceans that provide reactor cooling water.

It is impossible to run a reactor without these routine releases. No economically feasible technology exists to filter out all the radioisotopes, including tritium (radioactive hydrogen) and radioactive krypton and xenon gases, some of which convert into radioactive strontium and cesium.

NO ONE KNOWS HOW MUCH RADIOACTIVITY IS RELEASED:

Some radioactive wastes are released into the environment from a nuclear power plant

On the cover, center cooling tower: A public protest in Harrisburg, PA in 1979, after the major meltdown of the reactor core at the nearby Three Mile Island nuclear plant.

On the right tower: The face of Ben Franklin is on the \$100 bill. It would take at least a hundred-twenty million \$100 bills to construct a single nuclear reactor if one were ordered today. That's twelve billion dollars, not counting cost overruns, which historically averaged about 200 percent.

whenever the concentration level of radioactivity in the waste water is below the level that the monitoring equipment is set to detect. The U.S. government has approved this level to be "permissible." But "**permissible**" **does not mean safe**. It means "as low as reasonably achievable"—that is, as low as the nuclear industry claims it can afford to achieve.

The Nuclear Regulatory Commission relies on the reactor owner's self-reporting and computer modeling to estimate a plant's radioactive releases. A significant portion of the monitoring data is extrapolated—so it's virtual, not real. Therefore, **no one really knows how much** radioactive poison is released. Radioactive gases, liquids, and solids spread near and far.

PERMANENTLY HOMELESS WASTE:

No permanent repository exists for the irradiated fuel rods (termed high-level waste), and may never exist. In fact, no facility exists for most so-called "low-level" waste, either—that is, for the radioactive sludges and saturated air- and water-filters, as well as the pipes, pumps, and other components that must be replaced as they wear out or malfunction. Much of this "low-level" waste is so highly radioactive that it must be handled by remote-control equipment. The longer a nuclear plant operates, the greater is its accumulation of radioactive waste.

THE LETHAL LEGACY:

Radioactive waste is dangerous not only now, but some remains dangerous *virtually forever*. Each type of radioactive isotope continues to give off rays and radioactive particles at a constant rate regardless of the temperature, pressure, or chemical environment, until it decays into a different radioactive or stable isotope. Nothing can alter or stop this rate.

A radioactive isotope emits appreciable radiation for over 10 times its half-life. (After one half-life, half the radioactivity is gone. After two half-lives, three-quarters is gone. But even after 10 half-lives, some radioactivity remains.) This means some radioisotopes, like plutonium-239 with its 24,000-year half-life, will be dangerous much longer than modern humans have walked on the Earth.

Nuclear power is dangerous

ACCIDENTS HAPPEN:

An article in an MIT publication describes an unfortunate fact: "Human factors and the effectiveness of people determine success or failure at every stage, from the design of a plant and its equipment, through manufacture, construction, installation and calibration,



to testing, maintenance, repair, and management." ("Human Error in Nuclear Power Plants," *Technology Review*, Feb.1980, p.28)

Every nuclear plant is extremely complex, with thousands of pumps, valves, motors and miles of electrical circuits. Therefore, human error, design flaws, and equipment malfunctions are common.

"All nuclear-power-plant systems, structures, components, procedures, and personnel are potential sources of failures and malfunctions. Problems can arise from defects in design, manufacturing, installation, and construction; from testing, operational, and maintenance errors; from explosions and fires; from excessive corrosion, vibration, stress, heating, cooling, radiation damage, and other physical phenomena; from deterioration due to component aging, and from externally initiated events such as floods, earthquakes, tornadoes, and sabotage." (Daniel F. Ford: Three Mile Island, 1982, p.29)

Because many experienced workers have retired or are nearing retirement age, the industry is faced with a serious shortage of qualified personnel, including some who have important memories of past plant problems.

An average reactor contains the equivalent long-lived radioactivity of at least 1,000 Hiroshima bombs. An accident can be catastrophic, causing the release of tremendous amounts of radioactivity.



Few if any communities have adequate emergency plans, including reliable warning systems and emergency responders who are trained and equipped to deal with radiological devastation on this scale. They lack isolated hospital space for the treatment of irradiated victims. It is unrealistic to assume that a large, panicked population could be evacuated safely. No emergency plan addresses the permanent relocation of people from their homes and communities because of long-term radioactive contamination.

HEALTH HAZARDS:

Exposure to ionizing radiation increases the risk of damage to cells, tissues, and DNA, potentially causing mutations, cancer, birth defects, and reproductive, immune, cardiovascular and endocrine disorders.

Radioactive hydrogen and carbon, produced in great quantities, can be incorporated into protein, carbohydrate and fat molecules throughout the body. Fetuses and children are especially susceptible to radiation injury because of the rapid and abundant cell division in their bodies during growth.

According to the National Research Council's BEIR VII report ("Health Risks from Exposure to Low Levels of Ionizing Radiation," 2005), no level of radiation exposure is harmless.

WORKPLACE RISKS:

The nuclear industry depends on workers who are allowed to be exposed to much more radiation than members of the public. Many of the aging metal components, and even just the rust, in nuclear plants give off penetrating gamma rays. When clogged or leaking pipes must be replaced or repaired, a worker can receive a maximum permissible annual dose in mere minutes while making even a minor repair.

TERRORISTS:

A typical commercial reactor produces enough plutonium every year to make at least 40 nuclear bombs. If irradiated fuel rods are reprocessed, the extracted plutonium can be diverted to make nuclear bombs. The remaining radioactive materials can be used with conventional explosives to make a "dirty bomb," capable of dispersing radioactivity.

Every nuclear power plant is a potential candidate for a terrorist attack—by land, water or air, and by persons employed within the facility or outsiders who gain access. Terrorists could attack a reactor, the fuel storage pool, or other critical components, causing the release of vast amounts of radioactivity. No existing U.S. nuclear power plant building was designed to withstand a deliberate attack by a jumbo jet.



RADIOACTIVE ROADS AND RAILS AND NEIGHBORHOODS:

If a permanent disposal facility for irradiated fuel rods were ever built, transport of the waste on trains, trucks and barges would put countless communities at risk. If a site were chosen in a western state, long-distance transport would be required because 77 of the 104 operating reactors are east of the Mississippi River.

The potential for an accident, terrorist attack, or theft of nuclear materials during transit is real.

Nuclear power is expensive

A CONTINUING FINANCIAL BURDEN:

Nuclear power cannot survive in a market economy without massive subsidies.

Federal subsidies include loan guarantees for construction and funds for research and development, including the search for a solution to the problem of radioactive waste.

In the event of a major disaster, the Price-Anderson Act requires the nuclear industry to pay for only the first \$10 billion—for deaths, injuries, and property damages—a mere fraction of the liability costs federal taxpayers would have to cover. According to the 1982 Nuclear Regulatory Commission CRAC2 report, damages could run as high as \$314 billion, depending on a reactor's surrounding population density, and other factors. That would be approximately a trillion dollars today.

If a new reactor were to be built, state regulators would have to be willing to boost electric rates.

Without assurance of such state and federal handouts, private investors would refuse to finance the construction of new nuclear reactors.

CONSTRUCTION COSTS:

Because nuclear power plants are so complicated and dangerous, construction costs are extremely high; lengthy delays are common. Because of a shortage of certified "nuclear-

**TIME HAS
RUN OUT
ON THE 1950s
NUCLEAR
MINDSET:**

Instead of "electrical energy too cheap to meter," tomorrow's nuclear reactors can generate only power too expensive to compete in open markets.



grade" parts manufacturers, substandard or counterfeit components from domestic or foreign vendors may be installed, increasing reactor hazards.

OPERATING COSTS:

From the start, nuclear plants become radioactively contaminated. Large and small components and whole buildings get "hot." Therefore, operation is expensive; and as reactors age and become more radioactive, operation becomes even more expensive. Repair or replacement of defective, obsolete, or worn-out equipment requires shielding for workers, as well as protective clothing, monitors and respirators. Far more workers, time, and money are required to fix a nuclear plant than a coal- or gas-fired power plant, or a wind or solar farm.

As high-quality uranium ore becomes more scarce, its use as reactor fuel will become even more expensive, and its manufacture into fuel will increase the emission of greenhouse gases.

PERPETUAL COSTS:

Dismantling a decommissioned nuclear plant would also be expensive. Because no disposal site exists for most radioactive wastes from most states, contaminated buildings and equipment may remain on site for many years. Because of the dangers, environmental monitoring and armed guards will be needed indefinitely.

**NUCLEAR POWER CAN AND SHOULD BE PHASED
OUT AND REPLACED WITH CLEAN, SAFE, AND
ECONOMICALLY SUSTAINABLE ENERGY ALTERNATIVES.**

**HELP SPREAD THE WORD: NUCLEAR POWER IS
BASED ON FALSE PROMISES AND REAL DANGERS.**

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November 2009. Design by AvengingAngels.org*