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ADMIN RECORD

ROCKY FLATS PROBLEMS OVERSTATED BUT
CHANGES COULD REDUCE RISK STILL FURTHER, STUDY SAYS

Finding a Comfort Level -- Truth and Myth at Rocky Flats, Independence Issue Paper No. 9-90, by Michael Fumento, was published this week by the Independence Institute.

Fumento, a noted science writer, points out with considerable documentation that plutonium related cancers among the weapons plant workers actually occur less frequently than among the population at large, and that there is no evidence that the surrounding population has been harmed by the plant.

There are, he goes on to say, examples of industrial diseases among plant workers, specifically chronic berillium disease, and there is some risk of chemically polluted water seeping across plant boundaries, but that it would take "at least 40 years" for this to occur.

Because of these, and other less serious risks, Fumento concludes with five suggestions to improve safety at Rocky Flats.

1. That more clean-up monies be spent at Rocky Flats.
2. That competitive bidding be used to engage contractors and subcontractors.
3. That Department of Energy Safety Standards be replaced with OSHA and EPA standards.
4. That contractors not be protected from lawsuits by federal immunity.
5. That weapons production and waste handling, with their inherent conflicts of interest, be contracted out to separate companies, rather than both being handled by one company, as at present.

The Independence Institute is a Golden based think tank specializing in Colorado issues. The paper can be ordered by phone or mail at \$5.00 per copy.

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June 25, 1990

FINDING A COMFORT LEVEL -- TRUTH AND MYTH AT ROCKY FLATS

by Michael Fumento

Introduction

Man's fascination with the possible effects of radiation on animal life, along with his fear and misunderstanding, was illustrated vividly in a spate of 1950s horror films such as The Beast from 20,000 Fathoms, Godzilla, Them!, The Giant Behemoth, and Attack of the Crab Monsters in which exposure to man-made radiation through atomic explosions caused otherwise benign organisms to grow to tremendous proportions and begin feeding on human prey.

Ironically, even as the movies were being churned out, shoe stores were using x-rays to measure customer's feet, watch dial painters were using their tongues to narrow the points of their radium-coated brushes, and U.S. soldiers were being exposed to massive amounts of radiation from nuclear fallout. Such is the ambivalence that has surrounded Americans' views of radiation. But by 1964, it was time for the first nuclear waste horror movie, The Horror of Party Beach in which a human skull lying on the ocean floor comes into contact with leaking barrels of waste and becomes a man-sized lizard walking on two legs (the film was on a tight budget) which terrorized bikini beach bunnies. Unfortunately, even

(Continued on page 2)

In Brief

The evidence provided in this paper indicates that the threat posed by the nuclear weapons fabrication plant north-west of Denver has been exaggerated by the media. Although like any large factory, there is some risk to workers on-site, the author systematically refutes reports of both off-site radiation and off-site chemical pollution, citing instead some potential risk in both areas.

To further reduce risks, he then makes five recommendations, including competitive bidding, applying OSHA and EPA standards (the plant is now largely exempt from them) stripping away the contractor's federally imposed immunity from lawsuits, and separate contracting for weapons production and waste handling.

He discusses numerous possible risks, and cites the evidence which indicates that the chances of any of these occurring is small.

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Horror of Party Beach.

The Origins of Controversy

The controversy over Rocky Flats stems in great part
location. It is only sixteen miles northwest of Boulder
perhaps more importantly, it is only 11 miles from Boulder
is one of the nation's centers of left-wing and environmental
activism. The designers of Rocky Flats might have anticipated
Denver would eventually become a major metropolitan center
activism coming out of Boulder is something they could not
expected.

Rocky Flats has been in operation since 1953 and has been
administered by a succession of private companies, all until
transferred to the federal government. In 1975 Dow Chemical transferred
administration to Rockwell International which administered it
until January of this year when it turned over the reins to
& G. (the initials come from the founders' names), a \$100 million
engineering firm that administers other nuclear facilities in
Idaho, Nevada, and Miamisburg, Ohio (see appendix). E. G. & G.
chosen last summer, quickly and without a bidding process to
administer Rocky Flats after Rockwell filed suit against DOE
seeking to ensure that it would be indemnified for suits filed
itself. A study commissioned by Rockwell and prepared and
published at the University of Colorado at Denver's Graduate School of
Public Affairs found that Rocky Flats bought \$102.4 million in
services from Colorado vendors in 1987. Rocky Flats would
be the state's ninth largest employer, paying out \$27 million
in wages and benefits to its then-5,300 employees. In
April 1990, Rocky Flats employed about 5,500 workers of which
100 worked under DOE on a complex that covers 6550 acres. In
April they announced plans to hire several hundred more.

Ultimately, the responsibility of running Rocky Flats lies with
the Department of Energy (DOE). Most of the work is done
done by the contractor, E.G. & G., which occasionally hires
subcontractors. The federal Environmental Protection Agency has
oversight on environmental issues but under the Superfund
Conservation Recovery Act, the State of Colorado is subject to
its hazardous waste laws to the plant in those areas where
are stricter than EPA's. Recently, DOE, EPA, and the State of
negotiated an inter-agency agreement which specifies the
responsibilities and authorities between each agency, and sets
to accomplish clean-up efforts. The agreement is currently
undergoing required review procedures before it can be made
law. Permits for waste treatment must be obtained from the
State. Rocky Flats must also comply with some local
regulations and plant public affairs spokesman Paul

five times outside the plant.) In both 1983 and 1989, Flats foes attempted to encircle the plant linked hand-to-hand but failed. There are literally dozens of anti-Rocky Flats organizations that picket the premises, although presumably they have a strong overlap. The demonstrations are often held on the anniversary of the atomic bombings of Hiroshima and Nagasaki. The picketers receive free legal defense from the National Lawyers Guild. Emotions run very high at the protests. At one, a leader compared Rocky Flats with the death camps of Nazi Germany, "hidden away where no one can see them." Said Sam Day Jr., the coordinator for Nukewatch and a former editor of the Bulletin of the Atomic Scientists and The Progressive: "The German people chose not to find out what was going on. But we've got to bring the American people to their senses."

Local media coverage of Rocky Flats is extremely heavy. The Rocky Mountain News newspaper library contains 32 envelopes of clips on the plant, dating back only to 1978. By contrast it has only 21 on abortion, perhaps the most volatile political issue in the nation and one of tremendous local interest as well. It is also fair to say that Rocky Flats coverage has been essentially negative, and that indeed this slant goes beyond mere safety issues. For example, many stories concern lay-offs at the plants, but hirings or rehiring virtually always go unreported. Looking at all the stories on lay-offs one would think no one was left at the plant. One local alternative paper, Westword, a free weekly, has crusaded against the plant continually for years. Thus, in its March 21-27, 1990 issue it stated flatly that Rocky Flats has caused cancer among its workers and Denver residents, a position from which both of the local dailies, the News and the Denver Post, have shied away.

Do We Need Rocky Flats?

In evaluating the risks and benefits of Rocky Flats, this paper will assume that the plant--or at least one like it operating elsewhere--is important to the defense of this nation. DOE Secretary James Watkins has testified recently before Congress that "there will be severe ramifications" for the nation's nuclear weapons arsenal if operations are not resumed "pretty soon." Timetables for 1990 have already been rendered unkeepable. Recently Sen. Tim Wirth (D-CO) has stated his belief that the thaw in U.S.-Soviet relations should negate the need for more or better weapons, but it bears noting that the Soviets have not retired a single strategic nuclear weapon and that already the Soviet nuclear arsenal is considerably larger than that of the U.S. Allegations that "we already have enough nuclear weapons to blow up the whole world several times over" are false, the origin of the statement being that someone once figured that if all the destructive force released by our nuclear arsenal were neatly divided up person by person, there would be enough to kill several times the world's population. But there are also enough kitchen knives to kill the

world's population several times over, or for that matter, one man can produce enough sperm to populate the planet in a week. Delivery is everything, which is why the U.S. arsenal continues to be updated even as the Soviet defense systems are improved. Whatever the feelings of the Rocky Flats picketers, it is the belief of most Americans that a strong nuclear deterrent is vital to our defense. For example, according to one 1988 poll, 77 percent of all Americans favor the use of nuclear weapons against the Soviet Union in the event of a full-scale attack against the U.S.

Since nuclear warheads have to be reprocessed every ten years or so because of radioactive material decay, the existence of an installation like Rocky Flats is necessary to maintain the nuclear strike force. Indeed, even the dismantling of nuclear weapons would require such an installation in order to ensure safe disposal. Thus this paper will instead concentrate on the following issues: What threat does Rocky Flats pose to residents of the Denver metro area, what threat does it pose to its own workers, what would be the advantages of moving Rocky Flats operations elsewhere, and how extensive should a Rocky Flats cleanup be?

Plutonium: Fallout and Fear

The greatest fear aroused by Rocky Flats concerns its use of radioactive plutonium. Radiation terrifies people because of many of its intrinsic properties. It is odorless, tasteless, invisible, impossible to feel or hear, and except in massive doses causes neither sickness nor death until often decades after exposure. The media have done little to explain plutonium radioactivity and done much to fan hysteria. For example, Time in 1987 declared, "Plutonium, even in tiny quantities, is searingly radioactive and ranks with botulin toxin as one of the world's most poisonous substances." In fact, plutonium is primarily an alpha emitter, meaning that its radiation is absorbed within one or two inches of air and is therefore essentially harmless unless the plutonium itself gets into the body. The prime danger of this is in inhaling plutonium dust and contracting lung cancer some 15 to 45 years later as the plutonium continues to bombard the lung tissue forcing cell-level mutations. Most other radioactive materials emit gamma rays, which require several feet of earth and concrete as protection or simply lots of distance. Plutonium may also be dangerous if ingested or absorbed through the skin, but even here if a soluble salt of plutonium 239 were injected intravenously, then by molecule per unit body weight, botulism toxin is more than 1300 times more lethal while anthrax spores are ten times more toxic yet.¹

The carcinogenicity of plutonium even when taken into the body is still not well known. Of the 26 Manhattan Project workers who suffered as much as twice the current maximum-allowed plutonium exposure rate in 1944-45, only six have died--a number considerably

lower than would be expected considering their average age is now 69. Of these, according to the study supervisor George Voelz of the Los Alamos Laboratory, three did die of lung cancer but all three were "moderate to heavy" smokers until shortly before their deaths. The other three deaths were not related to cancer, this even though autopsies revealed that about half of the plutonium found in the bodies of those who did not die of lung cancer was in either the lungs or the lymph nodes. Nor have there been any non-fatal internal organ cancers in the group, even though about two-thirds of the group are or were smokers. One is suffering bone cancer of the limbs, called osteogenic sarcoma or osteosarcoma, a comparatively rare tumor but one which most often strikes those between the ages of 10 and 20 and after the age of 60. This victim is in his 60s.

Waste Disposal

There are basically three types of radioactive waste: high level, trans-uranic, and low level. Waste which can be harmful to humans or animal life either directly or because it is considered a potential cause of cancer but is non-radioactive is called hazardous. High level waste essentially means spent nuclear reactor fuel, and Rocky Flats produces none of this. It does produce the other types of waste, including mixed trans-uranic and mixed low-level, meaning that there are both radioactive and hazardous wastes in some combination. Trans-uranic is essentially waste contaminated with plutonium, such as metal pipes, gloves, or glass. It is put into either steel drums or boxes with multiple layers of containment. Because of its lengthy existence (a half-life of almost 24,000 years), plutonium must eventually be stored below ground in a safe area, since the steel drums will not last as long as the plutonium. In other words, the drums must eventually be put somewhere where it doesn't matter if they leak. Formerly, this material was sent to the Idaho National Engineering Laboratory for storage, although it is now stored on-site pending shipment to the Waste Isolation Pilot Plant in Carlsbad, New Mexico when that facility opens in the next few years.

Low level radiation means it is at essentially the level of natural background radiation. Low-level waste is shipped to Nevada, which will also soon be taking low-level mixed waste. Hazardous waste is sent to an off-site recycling company if there are commercially recoverable materials present. Otherwise, it is sent off-site to be destroyed.

Last year, Governor Roy Romer caused much commotion when he declared that the waste storage of the plant would reach capacity around March of 1990 and that he would shut the plant down rather than see the waste limit exceeded. But Romer's aides later admitted that the limit on waste storage was considerably more politically than scientifically based and that the limit, which had been chosen more or less arbitrarily, could be exceeded without

threat to safety.' Nevertheless, DOE has committed itself to keeping waste limits within the original guidelines. One way of doing this will employ a new supercompactor which compresses to an overall 50 percent reduction in volume both trans-uranic and trans-mixed waste. The plant is also pursuing a waste minimization program and is attempting to replace hazardous with non-hazardous wastes, for example using water instead of solvents. According to Etchart, about two years ago the plant was generating an average of 200 cubic yards a month of trans-uranic waste, but before curtailing its operations last November it had lowered this level to about 60 to 70 cubic yards per month.

Critics and Criticality

Plutonium does not occur naturally, rather it is created by irradiating naturally-occurring uranium 238. Plutonium burns chemically just as wood or coal does. In fact, Rocky Flats experienced an explosion and plutonium fire in 1957, and a plutonium fire in 1969, with an additional fire that exposed workers to radiation in 1965. The worst accident in terms of contamination took place on the 903 Pad and was discovered over a period of time in 1967-1968, in which a chemical reaction caused barrels stored above ground to leak, allowing a mixture of radioactive and non-radioactive waste to leak. According to plant officials, this one incident was probably responsible for about 98 percent of total air emissions from the plant (caused by the material becoming resuspended in the air after the drums were removed), although opponents of the plant insist otherwise. No one was seriously hurt in any of these accidents but eight workers were exposed to radiation in the 1965 accident and an undetermined amount of plutonium was released into the atmosphere following the 1957 one.

Much of the fear of plutonium concerns the possibility of an accidental explosion, or "uncontrolled criticality" that would either cause wholesale destruction on the order of a nuclear weapon or that would, while on a much lesser scale, disseminate considerable amounts of plutonium into the atmosphere. Criticality is reached when enough neutrons from the plutonium slam into enough other plutonium atoms to cause them to split and form a chain reaction. A nuclear weapon is designed to get to an extreme state of supercriticality as fast as possible before the energy generated by the buildup of the chain reaction has a chance to shut the reaction down by blowing the material away. Yields from criticality accidents are about 10 to the 17th power fissions (split atoms), which would produce an explosion equivalent to that of 1.5 sticks of dynamite. Noted a DOE-sponsored study (discussed in greater detail below), a small nuclear weapon would require:

. . . over a million times as many [fissions] as occur in a typical criticality accident. An accident at Rocky Flats [also] could not come close to the fission product yield from a typical (1,000 megawatt, electric) nuclear

power plant. It takes less than one thousands of a second of operation for such a nuclear power plant to produce the same amount of fission products as a typical criticality accident.

Yet in light of the revelation that an estimated 62 pounds of plutonium was found to be in the Rocky Flats ventilation system this past March, the press talked about the substance in terms of the number of bombs it could have fueled (six), as if bombs were sitting in the ducts waiting to go off. Editorial cartoons in both the Rocky Mountain News and the Denver Post depicted a thermonuclear explosion with a mushroom cloud spreading over the sky above the plant. Political cartoons, obviously, are often meant to be exaggerations but in this case mere exaggeration simply doesn't fit the bill. The 62 pounds of plutonium is spread over a ventilation system 4,000 feet long and is mixed with inert matter such as dirt, dust and lint. Yes, there may be enough plutonium for six bombs, but spread out evenly there would only be about .02 pounds per foot of duct, as opposed to the approximately 10 pounds of plutonium that would need to be clumped together in a space of far less than one square foot to achieve criticality. Making plutonium engage in a nuclear reaction is not easy. It requires a large amount of plutonium compacted together in sufficient mass and density. The chance of it clumping together in ventilation duct in just the right shape and volume to go critical approaches zero. This risk would be increased if water got into the duct since water serves to "moderate" or slow down neutrons and hence increase their chances of colliding with other atoms and causing fission, but a risk slightly above that near zero is still a risk near zero. And again, even if it did go critical the explosion would blow out most of the fissionable material and, as noted, would confine the explosion to about the equivalent of 1.5 sticks of dynamite.

Foes of Rocky Flats contend that one or both of the fires may have resulted from criticality. These fears reached a new height in the wake of a massive FBI raid on the plant in June of last year seeking evidence of criminal wrongdoing. The raid prompted the DOE to engage a group of scientists, none of whom worked for DOE but one of whom was appointed by Governor Romer. This group searched three months for evidence of such a reaction and found that none had taken place.

Criticalities have occurred in U.S. processing facilities--a total of seven with the last in 1978. The DOE-appointed group found that the probability of a criticality accident at Rocky Flats "ranges from one event in one thousand years to one event in one hundred thousand years for each year of future Rocky Flats Plant operation The probability of an [sic] criticality accident is small." The seven criticality accidents at other installations resulted in two worker deaths and 19 significant incidents of overexposure of workers to radiation but, noted the report:

The seven events . . . resulted in virtually no exposure to the public. This is not unexpected because the public is far removed (relative to the range of the radiation) from processing facility sites so that the burst of radiation from a criticality (even gamma rays and neutrons) would be of no consequence. In addition, the amount of fission products from a criticality accident would be very small [and] it is very unlikely that a criticality accident would produce enough energy to disperse fission products to the general public.

Incidentally, the FBI raid itself proved something of a bust, insofar as the most spectacular allegation in the warrant appears to be false. This allegation was that the plant had engaged in "midnight burnings" of radioactive material. In late November, Gov. Romer and U.S. Rep. David Skaggs (D-Boulder) said they believed that, after consulting with Flats officials and federal investigators from both the FBI and EPA, no such burning took place. It is doubtful that much harm would have been done by such a burning, at any rate. After opposition from environmental groups and the Colorado Department of Health, DOE abandoned plans for a test burn of 3,100 pounds of low-level mixed waste. For all the hue and cry, however, including one September 1987 article in the Rocky Mountain News that stated that such incineration "could [accidentally] release enough plutonium to kill 63 million people" (followed the next day by a correction which said some people would die but gave no number), one might never know that the federal Centers for Disease Control (CDC) estimated the risk of cancers caused by the burning at one in 48 quadrillion. At any rate, the plant has been burning material all along as part of the plutonium recovery process.

The Risk of Plutonium Releases

Yet, plutonium did escape the plant during the fires and so the question is to what extent has the neighboring populace been endangered? In 1981, then-Jefferson County Health Director Carl Johnson projected 12,000 deaths among Denver residents by the year 1990 due to plutonium released by the plant. Johnson, who was later forced to resign, died in 1988 without ever producing any evidence to back up his claim. In 1985, readings taken by the Colorado Department of Health found that the level of plutonium in treated water in Broomfield, Arvada, Boulder and Golden were nearly three times as high as the level found in the New York City water supply. The irrepressible Dr. Johnson leaped at the chance to blame the level on "routine emissions from the plant" which the plant operators denied occurred. The problem with comparing the two cities' levels, however, is two-fold.

First, as the official in charge of monitoring radioactivity for the CDC explained at the time, "When you're that close to zero, you expect fluctuations. We call it noise. Some of it is statis-

tical noise and some of it is electrical noise." Statistical noise is like the statistical insignificance pollsters talk about when a presidential poll has one candidate ahead by only a couple of points. The margin of error in extrapolating from the polled persons to the general population is greater than the margin in the poll. Electrical noise means that even sophisticated instruments will rarely measure flat zero even if zero of whatever they're measuring is present. At the very bottom of the range, anything within certain bounds is masked by this measuring problem. Only when one is above this range can one have any certainty that a measurement is accurate.

Second, above ground testing of nuclear weapons was conducted in the Southwest U.S., close to Colorado but far from New York. Al Hazle, the official in charge of monitoring radioactivity for the Colorado Department of Health, said that most of the high readings probably have nothing to do with Rocky Flats but rather reflect residue from the above-ground testing.

At any rate, the readings, which were as high as 150 to 270 femtocuries of alpha radiation per liter depending on the city, were far below the EPA action level of 15,000 femtocuries per liter. (A femtocurie is a billionth of a millionth of a curie. A curie is a measure of radioactivity.)

A 1989 study by the Colorado School of Mines found levels of plutonium in the Great Western Reservoir north of Broomfield to be "28 to 77 times [higher than] the levels found in other Colorado reservoirs, but the chief author of the study noted that "Plutonium is so binding to the sediment, I can hardly envision anything unlodging [sic] it to the point it would become harmful."

In the wave of fear that followed the FBI raid, several communities began digging costly interception ditches to catch Rocky Flats run-off. Residents increased their buying of water filters costing up to \$4000 apiece from salesmen whose flyers were labeled a "Neighborhood Alert" and warned: "Results from drinking this area's water: 1) Leukemia/Brain Tumors/Cancer, 2) Miscarriages/Birth Defects, 3) Hundreds of other severe health risks . . ." the Denver Post rehabilitated Jefferson County Health Director Carl Johnson ("In light of new allegations . . . Johnson's warnings have gained new believers and new respect, even from past critics"), and the demonstrators demonstrated with renewed vigor. All this despite assurances from Colorado Department of Health that the water supply was safe. Indeed, the State has done increased testing since last July, as a result of heightened concerns, to check for wide range of pollutants. Within the last three months, the Water Quality Control Commission has applied stricter standards to streams coming from Rocky Flats. Yet all pollutant levels have been consistently found to be within state standards.

As to air contamination, a three-year study released in 1984 by the National Weather Service in Denver found that if radioactive materials were released accidentally from the Rocky Flats plant, normal winds would probably carry contaminants northeast or west rather than southeast toward Denver. Nevertheless, wind patterns are not constant and airborne emissions must be kept to a minimum at all times.

In 1979 DOE began a study to investigate plant risks and the impact of relocation. To oversee the study, then-Governor Richard Lamm and then-Representative Tim Wirth appointed a Blue Ribbon Citizen's Committee. Released in 1983, the report found that if current safety systems were maintained, an accident sufficiently serious to kill one or more residents of metro Denver living within 50 miles of the plant would be expected to occur less than once every thousand years. Even the worst possible accident envisioned in the study--a jumbo jet crash into the main plutonium processing building--would result in only about 70 fatalities once every seven million years. For those living near the plant, there is less than one chance in a million that any cancer will have been caused by an accident at the plant. The study also found that plant relocation would take between 13 and 19 years and cost at least \$1.8 billion and that this would work out to about \$23 billion per life saved, a rather steep price considering the entire state was only spending about \$2 billion annually for health care at that time.

In October of 1989, a DOE task force stated that Rocky Flats might be releasing more pollution, including plutonium, into the environment than its monitors had indicated, but that such releases posed no imminent threat to the public health. Melinda Kassen, an attorney with the Environmental Defense Force responded to the conclusion declaring, "How can they say that? It's totally hypocritical." Apparently she could not understand how emissions could be higher than previously admitted but still well below danger levels. Indeed, earlier that year scientists at an international conference concluded that even if it were true that Rocky Flats was illegally releasing plutonium, the risk of cancer to nearby residents is probably negligible." The radiation experts categorically rejected Johnson's findings as, in the words of a newspaper reporter, "the work of a good scientist who got lost in trying to prove a point." Doctor Marvin Goldman, a University of California expert on plutonium, stated that to cause lung cancer "the radiation dose would have to be hundreds of times larger" than the exposure that could be expected from the plutonium particles that may have been released from Rocky Flats incinerators during the alleged burning.

A DOE study released in May, 1987 found that urban problems in the Denver area, such as air pollution and water pollution, contribute to an increased cancer rate in the area. The study said Rocky Flats was not a major factor. Johnson sought to refute the study, saying that since the late 1960s and 1970s, the Denver area

has seen a 15 percent increase in cancer incidence, while the national average is about a nine percent increase, but he missed the entire point which was that the industrialization of Denver-- which at that time was proceeding at a far faster pace than growth in the nation as a whole--was said to be responsible for increased cancer rates, not the weapons plant.

Many people do not understand that radiation is everywhere, emitted from many different sources. Natural sources, such as radon, cosmic radiation, rocks and soil, and radiation inside the body itself comprise over 80 percent of the radiation we receive. Of man-made radiation, most is from medical x-rays with the remainder from nuclear medicine and consumer products. Radiation from power plants, nuclear fallout, and weapons plants such as Rocky Flats comprises less than one percent of our total radioactive exposure.' Indeed, a study done by the Inhalation Toxicology Research Institute of Albuquerque, New Mexico compared the emissions of Rocky Flats with those of the Valmont coal-fired power plant in Boulder and found:

On the basis of yearly average releases, the Rocky Flats plant and the Valmont plant could be judged to provide equal potentials for the inhalation of alpha-emitting radionucleides by the humans."

Further, the report stated,

The Rocky Flats releases were accidental and releases of this magnitude are unlikely to occur in the future. The Valmont Plant releases are routine and will most likely continue to occur at the [present rate]. Most of the plutonium released from the Rocky Flats Plant was in plutonium contaminated oil [Pad 903, referenced on page 7]. The material has to be resuspended and carried down wind before it can be inhaled by individuals living near the Rocky Flats Plant. The releases from the coal-fired power plant are vented directly to the air in the city of Boulder."

Incidentally, the Valmont release is comparable to that at two other western coal-fired plants studied. But coal-fired plants are something we've lived with all our lives and no one has ever bothered to picket one, even though the "greenhouse" or global warming theory has now villainized all carbon fuel facilities.

Dr. Petr Beckman, Professor Emeritus at the University of Colorado at Boulder, has estimated that in fact each year 37,000 Americans die prematurely from exposure to coal-fired power plant pollutants, using data from the Brookhaven National Lab. An accumulation of small particulates in the lungs of the elderly and sick is probably responsible for most of this. Unfortunately, since people are somewhat irrational and emotional, they often base

risk avoidance schemes not on the likelihood of death but instead inversely on the infrequency of it. But coal plants are something we've lived with for a century, long before which coal was burned in individual homes. But nuclear weapons plants beget fear of the unknown, namely, exactly how radiation causes cancer and how often it does so. Thus the widespread fear over Rocky Flats and complacency over much more frequent causes of death.

Witness the case of a film aired in 1989 by the Public Broadcasting System called "Dark Circle." It is notable that PBS, known for its animosity to defense industries and for its very strong environmentalist slant, nevertheless concluded the film was not objective and would not air the film for three years until it had established a "Point of View" series which encompassed strongly biased films. Even then, Barry Chase, the head of programming at PBS, expressed grave reservations. According to a story in the Denver Post, "Chase said he considers the movie a personal expression by the filmmakers and not a conventional piece of reporting in which an audience can make its own conclusions." The film focused on interviews with what it claimed were victims of plutonium pollution in the Denver area, and with survivors of the explosions in Hiroshima and Nagasaki. It combined official documentary footage of nuclear blasts and tests to present its vision of the danger posed by nuclear pollution. According to PBS, it failed to present opposing views and relied on anecdotes instead of proof.

One of those anecdotes concerned a 12-year-old girl who died of bone cancer of the leg. As noted, this type of cancer has its peak occurrence in persons between ages 10 and 20, with about 520 new pediatric cases per year in this country. But the girl's parents have convinced themselves that this bone cancer was Rocky Flats related. Dr. Johnson weighed in with his opinion, saying "It's a rare tumor. Plutonium causes bone cancer in animals. She was outdoors a good part of the time. That area is contaminated. To me, it's an open and shut case." But the year the girl was diagnosed, about 519 other children got bone cancer of the limbs who lived nowhere near Rocky Flats; further, there is no evidence of plutonium causing bone cancer in humans. Finally, contamination of the area has been found to be very low. That Johnson could find this to be an "open and shut case" is telling indeed. But it was good enough for the girl's parents, good enough for Dark Circle, and apparently good enough for the Denver Post which in December of 1988 devoted a massive 36 paragraphs with photo to the girl's story.

Despite Dr. Johnson's opinion of the case as "open and shut," the parents never brought suit. Well that they didn't, at least if they planned to have Dr. Johnson as an expert witness. For a 1984 U.S. District Court thought very little of the doctor, declaring his refusal to measure radon gas at a site after he promised to do so--an action which would supposedly help a plaintiff establish a case of radiation poisoning--to be "incompetence

at best and deception at worst."¹² The court also found Dr. Johnson's willingness to give an opinion that the source of radiation in question was the cause of the poisoning "absurd, since the international and national experts in this field have un-animously agreed that safety standards for workers can be set at [over ten times the Johnson figure]."¹³ The court went on to challenge Dr. Johnson's credentials, stated on two occasions that "either Dr. Johnson is correct or the rest of the world is correct," and declared, "This court has no faith in Dr. Johnson's opinions."

Make no mistake; fear is a great motivator, and when someone feels his cause to be both just and difficult to attain, fear will be resorted to. One group, the Committee Against Radiotoxic Pollution, has taken to printing horrifying notices with the symbols of such official government offices as Housing and Urban Development at the top--neither kosher, nor legal.

Worker Exposure to Plutonium

What evidence, then, is there of sickness caused to employees through exposure to radiation? Clearly, some widows of men who have worked at the plant are convinced their husband's cancers were work-related or at the very least they are convinced that they have a chance to win a lawsuit alleging as much. Most have failed in their attempts to collect, but some have not. What makes a widow think that her husband's cancer resulted from exposure at Rocky Flats rather than some other source? A good example comes from a Post write-up of Ann Schamper, whose husband smoked a carton of cigarettes a week until four years before his death of lung cancer in 1984. "Ann Schamper is convinced it was radiation that caused the cancer that killed her husband," said the Post.

I remember when he used to come home after he was scrubbed because he was exposed to radiation that day," she said. "His skin was red and his back was bloody from the scrubbing with bleach."

He never talked about it. But he never allowed any of us to step [sic] foot in Rocky Flats, even on family day. All he said was, "You don't want to go there."¹⁴

Whatever sympathy we may have for this woman, she has hardly established a case for her husband dying from radiation exposure when in fact 85 percent of all lung cancers are smoking related and her husband had smoked heavily. (This is not to imply that the other 15 percent come from radiation; they come from a variety of sources.)

What we do know is that worker safety conditions have been less than ideal at the plant. In October, 1988 a DOE safety inspector filed a report saying that the work environment in the

building was "unsafe and unhealthy," as a result of sloppy maintenance," although the workers themselves in the wake of the FBI raid rallied around their employer and defended the plant's safety record. Further, the report dealt with potential problems, not actual ones. In fact, only two deaths can be positively attributed to Rocky Flats and in those cases radiation had nothing to do with them. In one, an electrician died from electrical burns. In the other, a jogger was hit by a truck. That a judge has occasionally ruled in favor of a Rocky Flats widow is by no means conclusive evidence. As Peter Huber points out in his book Liability: The Legal Revolution and its Consequences, such lawsuits are rather like spinning a roulette wheel. The plaintiff argues that there was a causal effect and proffers experts (such as Carl Johnson, perhaps) to testify as much, while the defendant argues no causality and proffers witnesses to testify accordingly. Sometimes the plaintiff wins the spin, sometimes he loses. The mixed outcomes probably tell us more about our system of jurisprudence than about cancer.

The most thorough analysis of the possibility of worker death due to radiation exposure was in a Los Alamos study released in the February 1987 American Journal of Epidemiology, which found that Rocky Flats workers had a higher-than-average risk of dying from brain tumors and from cancers of the prostate, stomach, digestive tract and blood and that the probability of becoming afflicted seemed to increase with time of exposure. Such a report might be alarming until a few factors are taken into account. First, the law of probability says that not every test group can be average in everything. Any randomly selected group will have an above average cancer rate for some cancers and below average for others. As it happens, among those cancers found to occur less frequently at Rocky Flats were those normally related to plutonium radiation exposure, lung cancers. Cancers of the liver or the bone were also found to be below that which would be expected. The greatest threat by far from plutonium exposure is lung cancer. Further, when dealing with such small numbers it is easy for a single case to appear vastly overrepresentative. Only brain cancer was found to be statistically significantly higher than would be expected, meaning the difference could not be accounted for merely by the lower number of persons being analyzed. For the other categories, the numbers were too small to judge. As the assistant director of the state's Office of Health Care said, "The rate of prostate cancer might be 4.9 times the national average, but that was still only two deaths." Moreover, the overall cancer rate at Rocky Flats was significantly lower than would be expected in a randomly selected population. As to brain cancer specifically, it was found that the Denver area in general had a higher incidence than the national average and that the Rocky Flats worker rate was no higher than the Denver rate. Finally, the Rocky Flats workers are thought to have been exposed to ten or eleven thousand times the amount of plutonium that persons living near the plant would receive. Follow-up articles in the local dailies pointed some of

these facts out; unfortunately the first items to appear in both papers did not. In fact, the first line of the News article ran: "Rocky Flats workers exposed to radioactive plutonium run a higher-than-normal risk of dying of several kinds of cancer, federal officials said yesterday . . ." It went on to quote Carl Johnson declaring, "It says that I was correct after all."

All the study really said was that it cannot be used to rule out the possibility of worker harm from exposure to plutonium. As one DOE scientist put it, the connection between elevated risk and continued exposure "throws up a flag that says we want to continue to monitor the situation."

The aforementioned 1989 international conference which concluded that risks to the population were probably negligible also concluded that the risk to workers fell into the same category, citing, among other evidence, the history of the Manhattan Project workers. In June of 1989, DOE officials said they planned to make medical files on some 600,000 nuclear workers available to independent researchers. The data is considered the best in the world on the effects of long-term exposure to low levels of radiation, but has been guarded closely for decades. Analysis of that data is anxiously awaited, although it is probably significant that DOE was willing to release it in the first place. In the meantime, while ample safety precautions to protect workers at nuclear plants are certainly in order, it would be premature to conclude that Rocky Flats workers or others who handle plutonium regularly are at increased risk for cancer.

The most recent scare concerns a study in the February 17, 1990 issue of the British Medical Journal (BMJ), which reported on higher-than-average leukemia rates in offspring near the Sellafield nuclear processing plant on the northwest coast of England. Government studies found a tenfold increase in childhood leukemia a mile from the plant, with the risk being highest if the father was employed at the plant. A prominent member of Physicians for Social Responsibility, an anti-military group which had earlier bestowed honors on Carl Johnson, quickly drew a parallel between the British plant and Rocky Flats. Ignored by the media was a study reported a little earlier in the Journal of the Royal Society of Medicine in which doctors conducted a survey of a larger number of pregnancies in the area around Sellafield during the years 1975 to 1985, when the reprocessing plant was dirtier than it is now. The doctors found that in each of the five categories they monitored, the Sellafield babies had fewer defects than those born elsewhere. Without exception the Sellafield babies were healthier. Another article, in the March, 1990 issue of the British periodical Nuclear Issues, also found the BMJ study greatly wanting. It noted, for example, that as opposed to the results from this one British plant, data from offspring of people exposed to the atomic explosions in Japan, along with data from nuclear plants in India, Brazil, and even Cornwall and Devon in Britain have shown no such

effects. Further, the author of the Nuclear Issues article noted that childhood leukemia clusters have been identified elsewhere for reasons having nothing to do with nuclear or other man-made pollutants. Indeed, an editorial in the same issue of the BMJ in which the alarming Sellafield study appeared also noted the Japanese exposure, which was four times that of the Sellafield workers. It also stated that there is "no known substance which increases the risk of leukemia in offspring of those exposed." Nevertheless, while the first article was greatly played up in the Colorado press "Leukemia-Flats Link Suggested" ran a title of a story in the Post, they failed to mention the editorial or the Nuclear Issues article, probably because no national organization had brought it to their attention.

Nearby Resident Exposure to Hazardous Substances

The vast majority of potentially harmful waste produced at Rocky Flats is not of the radioactive type but rather is hazardous. According to a Colorado Department of Health report released in 1986, there are about 2,300 sources of potentially hazardous or radioactive wastes or a mixture of both at Rocky Flats. This was about eight times what had been expected. A waste source is anything that produces radiation or produces or uses chemicals. Thus towels used to clean solvents from machinery or to mop up spills would be considered a waste source. Further, what plant spokesman Etchart calls "past thoughtless practices" have resulted in numerous hazardous waste contamination sites. Before these wastes were considered hazardous, workers sometimes simply dumped them on the ground. Underground tanks and pipelines have leaked. A DOE report released in December of 1988 found Rocky Flats' groundwater contamination to be potentially the worst environmental problem in the nation's nuclear weapons complex, although DOE officials also said that it would take at least 40 years for the contamination to leave the plant and endanger drinking water supplies. Ironically, for all the fear of radiation poisoning, the greatest possible danger to metro Denver residents is not plutonium nor any other radioactive substance but rather a host of chemicals that could be used by a plant that had no radioactive materials.

The most highly ranked toxic waste site at Rocky Flats (not because of the concentration of waste but because of its proximity to Woman's Creek and hence the Standley Reservoir) has been found on Hillside 881 at the southeast corner of the facility. It has been measured as containing up to 20,000 parts per billion of the chemical trichloroethylene or TCE, used as a mechanical degreaser and to make industrial solvents. TCE is a suspected human carcinogen. Nevertheless, it has not reached Woman's Creek and hence has not affected the source of drinking water for several suburbs northwest of Denver. Further, the levels of TCE drop to about 500 parts per billion within 100 feet of the highest reading and the area is already undergoing clean-up, meaning there is no reason

for the TCE ever to reach the drinking water supply even in small amounts.¹⁶

Concentrations of trichloroethylene (TCE), tetrachloroethylene (PCE) and carbon tetrachloride in some groundwater on the plant site are 20,000 times above the drinking water standard. In 1989, in a response to Rep. Skaggs, DOE said cleaning up the plant would take 30 years, "due to the long period of time required to pump and treat the contaminated groundwater."

Thus, hazardous waste run-off is a very real potential problem at Rocky Flats and the 40-year grace period must not be used to sit around contemplating action. Such a clean-up, however, won't be cheap. How extensive it should be will be discussed below.

Worker Exposure to Toxic Substances

Unfortunately, there has recently arisen evidence that Rocky Flats has been far more than a potential non-radiation hazard for some workers. A report released in January, 1990 found 12 cases of chronic beryllium disease, a nuclear plant version of black lung, among Rocky Flats workers. No deaths have yet been reported, but the disease is incurable and proves fatal to about 30 percent of victims. It's caused by the inhalation of beryllium, a strong, lightweight metal used in the manufacture of components for nuclear weapons. In the previous four years, DOE had spent \$2 million on a program to improve safety conditions and reduce airborne beryllium concentrations in manufacturing areas. According to an article in the Denver Post, DOE has kept such a tight lid on health records that countless workers unknowingly may have been exposed to risk without their knowing.

Should Rocky Flats be Moved?

To quote a 1987 statement by the United Steelworkers of America local 8031, "It does not make any sense to merely relocate a problem if one exists; the problem is . . . how well the facility is managed and regulated."

Put another way: For all the problems at Rocky Flats past and present, there is no guarantee that simply moving the plant will make any of them go away, since similar problems can arise at the new location. The anti-militarists have a simple solution to that: Shut the plant down and don't build a new one anywhere. But that option has already been rejected as unrealistic. Really, the only advantage to moving Rocky Flats is that it would no longer be so close to a major urban area. However, a former area newspaper editor, Ed Quillen, has made some interesting points concerning the plant's proximity to Denver. He notes that the plant has almost 6,000 employees and that each primary job has been estimated to lead to at least 2.8 secondary ones at gas stations, grocery stores and the like; that there are at least two people for every job

(children or spouses); and that therefore Rocky Flats would have at least 34,000 persons living nearby no matter where it was. The problem with isolating such a community is that it would become a company town with a timid company town newspaper and radio station. Concluded the former editor,

Move Rocky Flats, and you'd have toxic stuff leaking all the time without anybody noticing in a company town where no one dared protest. Since radiation spreads, the overall threat to the public health might well be greater with a remote Rocky Flats. If we must have a bomb plant, this one's in the safest possible place."

It's an intriguing argument. Another one is that moving the plant would simply pollute an additional area while doing nothing in and of itself to clean up the original. Colorado could lose one of its largest employers while perhaps gaining little. At any rate, Rocky Flats isn't moving anytime soon. Energy Secretary Admiral James Watkins told a congressional panel in March that it would be at least 20 years before the plant could be moved. "You just don't transfer a Rocky Flats function. You're talking about billions and billions of dollars of reinvestment in somebody else's back yard," said Watkins. "I just don't see somebody coming forward and saying, 'We'd like to have Rocky Flats in our back yard.'" In the meantime, then, the question is how to continue to ensure the safety of the Denver area during the plant's operation.

To What Extent Should Rocky Flats be Cleaned Up?

Should Rocky Flats be returned to pristine condition as if man had never so rudely tromped upon its soil? To the utopian environmentalist the answer is: Of course! The problem is that as with anything else, the law of diminishing returns comes into play. Simply put, making Rocky Flats clean enough so that it poses no potential threat to its neighbors will cost X, while making it prime picnic territory will cost many times X. In 1989 the U.S. Comptroller General, the head of GAO, said that Rocky Flats and three other nuclear weapons plants are "irreversibly contaminated" and will need to be isolated from the public indefinitely. The other plants were the Feed Materials Production Center, the Hanford facility, and portions of the Savannah River plant. If the U.S. were willing to hock the Pacific fleet (not a bad idea if you're an anti-militarist), it is possible that the site could be cleaned up enough to turn into a giant playground. But surely even the anti-militarists could find better ways of spending billions of dollars. Indeed, why should Rocky Flats be made so clean as to allow residential housing to be built on it, as would be the case with a complete clean-up? There is no shortage of room for residential housing (or for picnics for that matter) in Colorado and the astronomical costs for such an operation must be looked at in terms of lost opportunities. That is, if the cost of a complete clean-up were just \$2 billion above that of a minimal safety clean-

up, that's over \$1000 for each resident of the metro Denver area or over \$4000 for a family of four. How many families of four would elect to give up that money to ensure that if they feel like it they can walk onto some land northwest of Denver in the future which they can't get access to now?

Pollution Solutions

The actual problems with Rocky Flats, when the hype and hysteria are stripped away, are as follows, with possible solutions appearing thereafter:

1. PROBLEM: Other plants sometimes lumped with Rocky Flats are the K Reactor at Savannah River, the Fernald, Ohio enrichment plant, and the N Reactor in Hanford, Washington. The real problem is that these plants are getting old and need modernization or replacement. (Fernald has in fact now been closed except for clean-up.) In the final days of the Reagan administration, DOE estimated that it would take \$244 billion over the next 20 years.

According to a 1987 report by the Environmental Policy Institute, Rocky Flats is the third most polluted weapons plant in the country, but receives only 1.3 percent of DOE's environmental protection budget. A DOE spokesman denied it, saying that some money comes from "operating dollars . . . but it may not show up in a line item which you may be able to see." He was unable, however, to come up with a dollar amount.

SOLUTION: The residents of Denver, as a quid pro quo of their support of the U.S. defense effort, deserve to have as much money as is reasonably available set aside used to clean up Rocky Flats. Spending should be commensurate with need.

2. PROBLEM: E.G. & G. was chosen with no competitive bidding. Although they have as yet been subject to little criticism, picking a sub-contractor secretly is an excellent recipe for ensuring overpriced service with understated quality.

SOLUTION: Use competitive bidding to engage all contractors and subcontractors.

3. PROBLEM: The Energy Department is self-regulating and not subject to most of the safety and environmental laws that govern private industry.

SOLUTION: DOE safety standards should be replaced with those which apply to private industry, namely OSHA and EPA standards, and the inspectors should be from these agencies.

4. PROBLEM: Subcontractors are presently protected by DOE from most types of liability, insulating them from market pressures. In 1988, the Senate defeated an amendment offered by Howard

Metzenbaum (D-OH) that would have forced contractors to carry their weight by making them accountable for accidents caused by gross negligence or intentional misconduct.

SOLUTION: Contractors must no longer be protected by DOE from suits. Negligence, strict liability, and intentional torts should all be the responsibility of the subcontractor. Further, the contractor should be made to warranty its work to DOE.

5. PROBLEM: The current system gives an impossible assignment: Primary responsibility for weapons production and primary responsibility for waste handling and clean-up. It is not humanly possible to serve fully two "primary" responsibilities.

SOLUTION: DOE should contract separately for the waste handling. It could then be the arbiter of disputes between the Management and Operations contractor and the commercial waste contractor (many of which now exist and do both radioactive and toxic clean-up.) This way, at the very least DOE would hear about problems, something that does not happen until they are outrageous, under the present system. Such a dual system would also increase the likelihood of getting the best company for the job as opposed to settling for a jack of all trades.

Conclusion

Rocky Flats is not without safety problems, actual for plant workers and potential for persons living nearby. The real potential threat for the residents of metro Denver, however, is not so much the plutonium bugbear but the possibility of non-radioactive hazardous chemicals eventually seeping into the water table. As noted, further steps can and should be taken to reduce this risk to an even lower level at a reasonable expense. But Rocky Flats must be looked at for what it is: not the unmitigated blessing as it was originally portrayed, nor as the "monster" that the plant opponents characterize it as, with the frequent help of the media. It provides many jobs to the Denver area, it provides security to the United States and its allies, on the one hand, and it requires consistent caution and monitoring on the other.

Former Rocky Flats operators Dow Chemical and Rockwell International are currently the subject of a \$250 million class action lawsuit, filed in early 1990, claiming pollution from the nuclear weapons plant has lowered property values. After the 1990 suit was filed, the local office of Housing and Urban Development and some area realtors were quick to respond that they had never seen an instance of a house being devalued or less quick to sell because of proximity to the plant. But the suit raises an interesting question. Since a devaluation would be based on perception of a pollution problem rather than the actual existence of pollution, could Dow and Rockwell name as co-defendants both the media

and the environmental groups that have so doggedly and so effectively spread fears of the plant?

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APPENDIX: U.S NUCLEAR WEAPONS PLANTS

Laboratory, location, date established, job performed.

1. Los Alamos national lab: Los Alamos (New Mexico) 1943, research and development
2. Feed Material Production Center Fernald: (Ohio) 1951, uranium processing (now active only for clean-up)
3. & 4. Hanford: Richland (Washington), two sites, 1970 and 1943, one research and development, the other materials production
5. Idaho National Engineering Laboratory: Idaho Falls (Idaho), 1949, materials production
6. Kansas City Plant: Kansas City (Missouri), 1949, components production
7. Lawrence Livermore National Laboratory: Livermore (California), 1952, research and development
8. Nevada Test Site and Tonopah Test Range: Nye County (Nevada), 1952, testing

9. Y-12 Plant: Oak Ridge (Tennessee), 1943, production of weapons components
10. Oak Ridge Gaseous Diffusion Plant: Oak Ridge (Tennessee), 1945, uranium enrichment and production
11. Pantex Plant: Amarillo (Texas), 1951, weapons assembly
12. Pinellas Plant: Largo (Florida), 1956, electrical and mechanical components production
13. Rocky Flats: Golden (Colorado), 1953, components production and plutonium recovery
14. Sandia National Laboratories: Albuquerque (New Mexico), 1949, research and development
15. Savannah River Plant: Aiken (South Carolina), 1950, materials production
16. Mound Plant: Miamisburg (Ohio), 1947, weapons component production

FOOTNOTES

1. Calculated from Bernard L. Cohen, "Hazards from Plutonium Toxicity," Health Physics, vol. 32, May 1987, p. 366.
2. Personal communication with Dr. George Voelz, Los Alamos National Laboratory, 26 April 1990.
3. Personal communication with Cindy Parmenter, Public Affairs Officer, Office of the Governor, 9 November 1989.
4. Lou Chapman, "Disease Chance from Test called Minuscule," Denver Post, 30 July 1987, p. 3C.
5. Thomas Graf, "Broomfield gets U.S. Go-ahead to Dig Ditch Diverting Flats Water," Denver Post, 13 July 1989, p. 7A.
6. Bruce Finley, "Flats Neighbors Filter Water, Scare-tactics Warning Issued," Denver Post, 9 July 1989, p. 4B.
7. Fred Gillies, "Study says Wind would take Flats Fallout away from Denver," Denver Post, 27 September 1984, p. 6A.
8. "Plutonium Cancer Risk Negligible," Denver Post, 28 June 1989, p. 17A.
9. Raymond L. Murray, Understanding Radioactive Waste (Battelle Press: Columbus, Ohio, 1989), 3rd ed., p. 21.

10. Inhalation Toxicology Research Institute, Lovelace Biomedical and Environmental Research Institute, "Perspectives on the Microdosimetry and Health Risks from Inhaled Radioactive Particles: Communication to the Hearing Panel on the Rocky Flats Plant Draft Environmental Impact Statement (Albuquerque, New Mexico: June, 1978), p. 22.

11. Ibid.

12. G. Johnston v. United States, 597 F. Sup. 374 (1984), 416.

13. Ibid.

14. Thomas Graff, "Flats Widows Fighting an Uphill Battle," Denver Post, 20 November 1989, p. 9A.

15. Alan Gottlieb, "Flats Operation called 'Unsafe,'" Denver Post, 27 October 1988, p. 1A.

16. Lou Chapman, "Flats Groundwater Pollution High; No Health Risk," Denver Post, 26 August 1987, p. 2D.

17. Ed Quillen, "Safest Place for Rocky Flats," Denver Post, 9 August 1989, p. 7B.

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26/26