A Radiation Health Information Project Report

PLUTONIUM AND THE WORKPLACE:

An Assessment of Health and Safety Procedures for Workers at the Kerr-McGee FFTF Plutonium Fuel Fabrication Facility Crescent, Oklahoma

Kitty Tucker
Eleanor Walters

March, 1979

Environmental Policy Institute

Dear Bella + Roger,
Looking forward together to working for a non-nuclear future!
Kitty

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The ENVIRONMENTAL POLICY INSTITUTE is a public interest research and citizen information organization specializing in energy and natural resource public policy issues. Since its inception in 1975, the Institute has been the principal group in this country focusing on the importance of tighter standards to protect the public and nuclear workers from cancer-causing low-level ionizing radiation emitted from man-made sources.

The RADIATION HEALTH INFORMATION PROJECT was organized in early 1978, within the Environmental Policy Institute, to stimulate more medical research and broader public understanding of low-level ionizing radiation, its man-made sources and impacts on human health, and to provide policy alternatives for federal and state radiation programs.

This Project is the first program in the United States to deal comprehensively with the research, occupational and public health standards, federal radiation jurisdictional conflicts, the growing scientific and public debate over man-made low-level radiation hazards and the impacts those hazards have on national energy policy and nuclear weaponry programs.

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INTRODUCTION

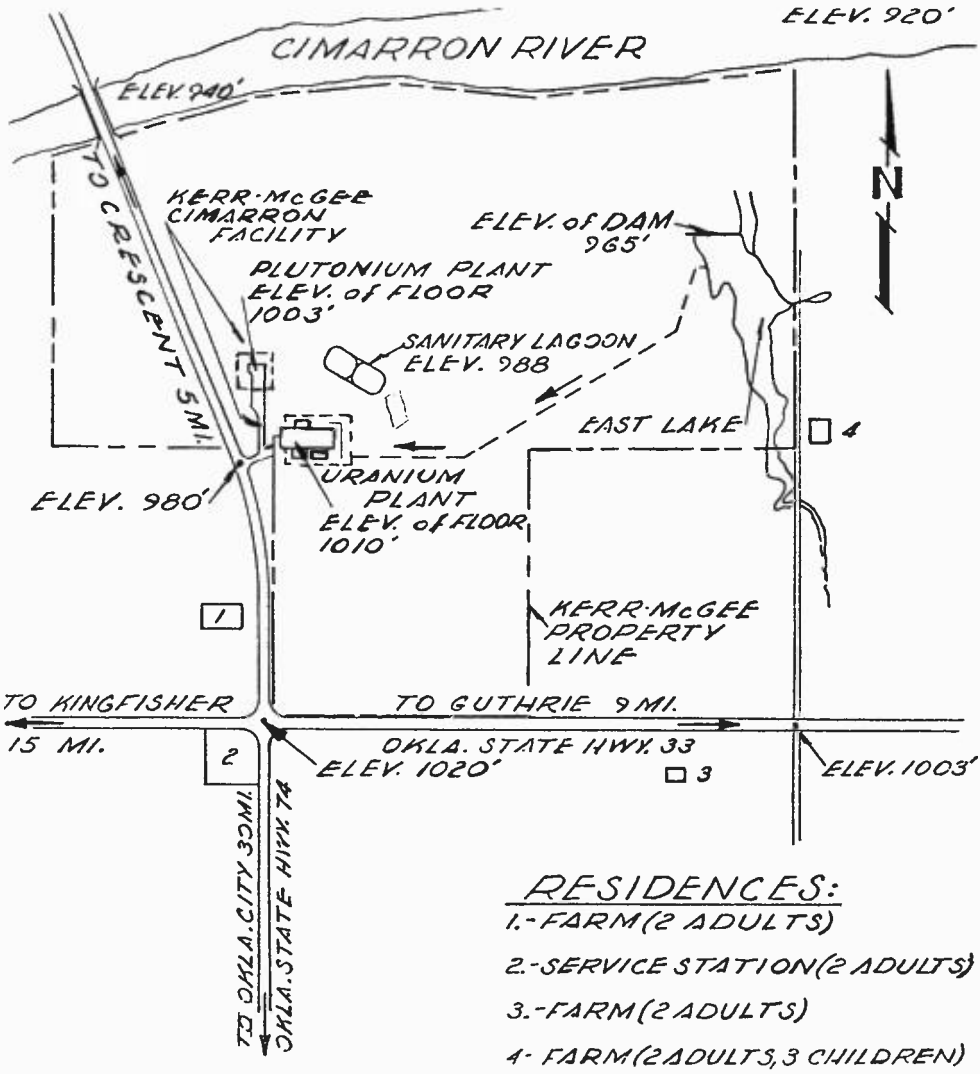
The health follow-up for Kerr-McGee (K-M) fuel fabrication workers was initiated through a $12,000 grant from the Albert A. List Foundation in June 1977. The grant enabled the Environmental Policy Institute to identify and locate former Kerr-McGee workers to seek their cooperation in a long-term health follow-up.

Nuclear fuel fabrication workers are exposed to low levels of ionizing radiation and face an increased risk of contracting bone, lung, or pancreatic cancers.[1] Kerr-McGee opened uranium and plutonium fuel fabrication plants in 1968 and 1971, respectively. These plants were located on the Cimarron River outside Crescent, Oklahoma (see map 1). The plants closed in December 1975, due to the expiration of fuel supply contracts.

Evidence gathered from Congressional hearings and the Atomic Energy Commission (AEC) and its successor agency, the Nuclear Regulatory Commission (NRC), indicates exposures to radiation were frequent and high at the K-M facility. Because the Cimarron facility is closed, exposure periods of each worker can be determined, making the former K-M workers an ideal population for a long-term follow-up study.

Long-term data collection on people exposed to protracted doses of radiation is a necessity. The K-M worker health follow-up will:

1. Help assess human costs of plutonium production.
2. Check implementation and adequacy of industrial and government health and safety regulations.
3. Determine adequacy of present exposure record-keeping by nuclear facilities.
4. Provide data about health effects on workers handling radioactive substances.



Map 1. Cimarron Facility--Vicinity Map. Kerr-McGee Corporation, Nuclear Division, Oklahoma City, Oklahoma.

The high toxicity of plutonium makes the plutonium plant workers an especially important group for long-term health follow-up. Plutonium is a man-made element, first generated during the atomic weapons program research undertaken in the early 1940s. Plutonium decays through the emission of alpha particles, giving off 140,00,000 alpha disintegrations per minute per milligram. Although primarily an alpha emitter, it does emit x-rays and weak gamma rays as well.[2]

Plutonium, a silvery white metal, melts at 539.5° C. It is a reactive metal and oxidizes readily in air upon warming. In finely divided form, plutonium metal may be explosive. It is extremely unpredictable and readily catches fire. There are 16 isotopes of plutonium, all of which are radioactive. Plutonium-239 has a half-life of approximately 24,000 years.[3] Plutonium-239 was handled at the K-M plant.

Plutonium may enter the body through inhalation, ingestion, or through a wound. It can be inhaled in liquid form as an aerosol or in particle form. When inhaled, some remains in the upper air passage. Some passes into the large bronchial tubes where it may be removed by ciliary action and passed back into the throat and swallowed. Some passes into the smaller air tubes and finally into lung tissue.[4] In time, some plutonium-239 will dissolve in body fluids and reach the blood stream and lymphatic system, eventually passing to the liver, bone marrow and skeleton.[5] Plutonium is usually handled inside sealed gloveboxes to prevent airborne exposure to plutonium, but gloves can leak, containers outside the gloveboxes can spill, and pipes can break or leak.

When plutonium is ingested, some is absorbed in the intestinal canal. The very young or extremely anemic person may absorb more through this process.[6] Consequently, this hazard is less than inhalation for workers who are normally healthy.

When plutonium gains access to the blood stream through a wound, it will translocate at varying rates depending on wound size, nature of the contamination, and form of the plutonium. Wound hazards are high for workers, despite the protection of handling plutonium inside glove boxes.

In order to evaluate the radiation hazards and exposures at the K-M facility, all public AEC and NRC documents on the K-M facility were reviewed. Interviews were also conducted with a number of former workers. Other work conducted for the study is reviewed in Appendix I.

In testimony before the Subcommittee on Energy and Environment of the Committee on Small Business, Dr. Karl Morgan gave an evaluation of the Kerr-McGee operation after his review of government records:

> I'm often referred to as the 'father of health physics,' the science and profession of radiation protection, and for over 20 years I was chairman of both the national and international organizations that set the present standards and level of permissible exposure to plutonium, and all the other regular isotopes that are produced in such large quantities in nuclear reactors.
>
> * * * * * * * *
>
> I have never known of an operation in this industry that was so poorly operated from the standpoint of radiation protection as the Cimarron facility, unless it was the early underground uranium mines or the Nuclear Fuel Services Organization in West Valley, N.Y., the West Valley reprocessing plant in New York State.
>
> It is difficult for me to comprehend and appreciate why the U.S. Atomic Energy Commission and more recently the Nuclear Regulatory Commission, permitted this facility to continue in operation for such a long time.
>
> * * * * * * * * *
>
> In reading over the past years of operation of the Cimarron facility, there were four things in the operation that were most disturbing to me as a health physicist:
>
> One: The frequent incidents of airborne plutonium dust and numerous accidents resulting in body contamination, both external and internal. By this I mean exposure of the employees from external radiation, from radiation outside their bodies, and exposure from plutonium and other radioactive material that

they inhaled or ingested, which entered their bodies.

Two: The second thing that caused . . . concern was the poor criticality control.

Three: The serious lack of security control.

Four: A lack of adequate health physics program, and no certified and qualified health physicist in the entire organization.

I consider this plant a good example of how not to run the nuclear energy industry.[7]

The following report will detail some of the reasons for the conclusions reached by Dr. Morgan. After a brief overview of Kerr-McGee Corporation, the plants at the Cimarron facility will be described and the hazards of ionizing radiation will be reviewed. Problems at the K-M Cimarron facility, including the inadequate training, safety and health problems, government inspection shortcomings, quality control deficiencies, repeated problems of material unaccounted for (MUF), and inadequate security will be discussed in detail. Finally, the treatment of K-M workers at other operations will be discussed.

NOTES

[1]Environmental Policy Institute. Proceedings of a Briefing on Low-level Ionizing Radiation. September 21, 1978. New York, New York. p. 2.

[2]M.H. Parker. "Plutonium Industrial Hygiene, Health Physics and Related Aspects," in: H.C. Hodge, et al. (eds.), Uranium, Plutonium, Transplutonic Elements, Handbook Experimental Pharmacology 36. Berlin: Springer Verlag. 1973.

[3]Ibid.

[4]W.J. Bair, et al. "Plutonium in Soft Tissues with Emphasis on the Respiratory Tract," pp. 503-568 in: H.C. Hodge, et al. (eds.), Uranium, Plutonium, Transplutonic Elements, Handbook Experimental Pharmacology 36. Berlin: Springer Verlag. 1973.

[5]ICRP Publication 19. The Metabolism of Compounds of Plutonium and Other Actinides. Pergamon Press. 1972.

[6]J.M. Vaughan. The Effects of Irradiation on the Skeleton. Oxford:Clarendon Press. 1973.

[7]K.Z. Morgan. Problems in the Accounting for and Safeguarding of Special Nuclear Materials. Presented at hearings before the Subcommittee on Energy and Environment of the House Committee on Small Business. 94th Congress. 2nd Session. 1976. pp. 3-4.

BACKGROUND ON KERR-McGEE CORPORATION

Kerr-McGee Corporation, listed in FORTUNE's top 200 companies,[1] is a diversified energy conglomerate with assets of more than $1 billion in oil, uranium, potash, helium, asphalt, and coal interests.[2] The K-M trademark flies at hundreds of service stations throughout the Southwest. The late Robert Kerr, co-founder of K-M served as governor of Oklahoma in the 1940s before his election to the U.S. Senate in 1948. Growing K-M nuclear investments matched a growing federal budget for nuclear supplies, and Kerr was regarded as "the uncrowned king of the Senate."[3]

Uranium Mining and Conversion

The Atomic Energy Commission founded in 1948 to promote the development of atomic energy, authorized purchases of uranium for its nuclear weapons program the same year. K-M signed 20-year leases with the Bureau of Indian Affairs in 1949 for the Cove and Red Rock uranium mines on the Navajo Reservation near Shiprock, Arizona.[4] By the 1970s, K-M, mining and milling tons of yellow-cake uranium, had become the nation's largest producer of uranium.[5]

After mining and milling at the mine mouth, uranium is shipped to one of two commercial uranium fluoride (UF_6) production facilities: the Allied Chemical plant in Metropolis, Illinois, or the Kerr-McGee facility in Gore, Oklahoma. The $25 million Sequoyah facility in eastern Oklahoma began operation in 1970. In 1974, at an incremental cost of $7 million, the facility increased its capacity from 5,000 to 10,000 tons of uranium per year. Thus, K-M had the capacity to convert all the uranium oxide output from its mines and mills to UF_6.[6] The UF_6 is enriched at government facilities and fabricated into fuel by private industry.

Uranium Plant Process

The K-M uranium fuel fabrication plant, opened in 1968, produced fuel rods for light water reactors. Use of uranium in the lightwater reactor fuel cycle is described more fully in Figure 1.

Uranium came to the plant as yellowcake. It was placed in cylinders and vaporized with steam. Next, it was mixed with ammonium hydroxide and turned into a paste. The paste was pumped onto a drying belt where it was dried back to a solid. At the end of the belt, the substance went into a hopper where it was vacuumed up into the calciner (similar to a kiln or oven). The uranium mixture was baked, and came out of the calciner in powder form. Then it was pressed into pellets.

Workers in the uranium plant had to endure high temperatures -- the processes gave off a great deal of heat and the plant was not air conditioned. While uranium workers were not exposed to plutonium, there often was airborne uranium dust at the plant.

Plutonium Plant Process

A plutonium fuel fabrication plant opened in Crescent, on April 2, 1970. The plutonium plant was divided into several areas: wet ceramic area, fabrication area, assembley area, final inspection area, scrap recovery area, laboratory, and vault. The plant layout is shown on Map 2. Original management plans for the facility were to keep a staff of 42 at the plant. This staff would include 16 operators, four shift supervisors, and two health physics technicians.[7] As of 19 September 1973, 55 employees worked at the plutonium plant out of Cimarron's total 219, and 119 were hourly wage workers.[8]

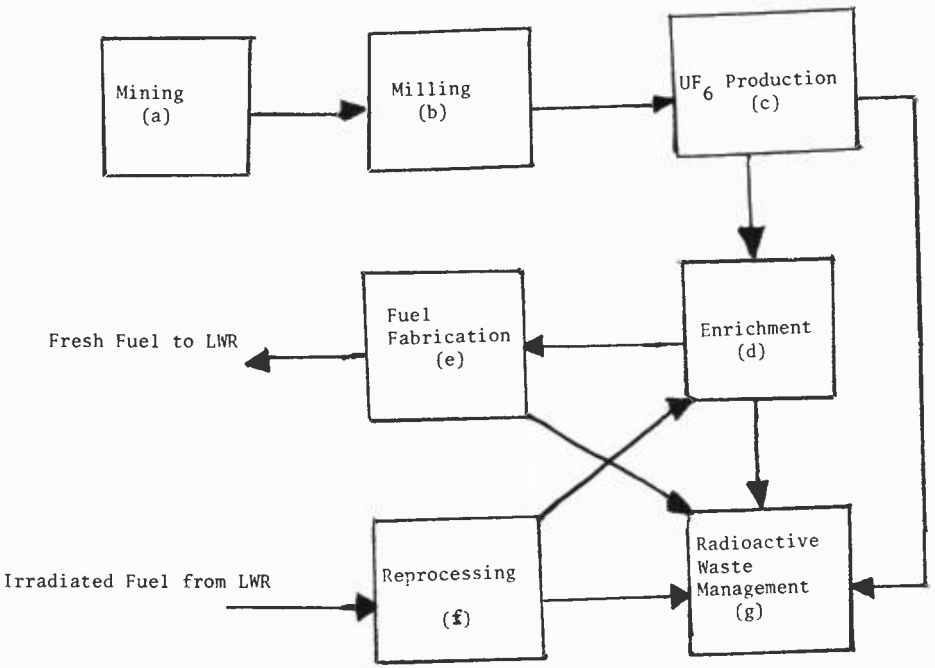
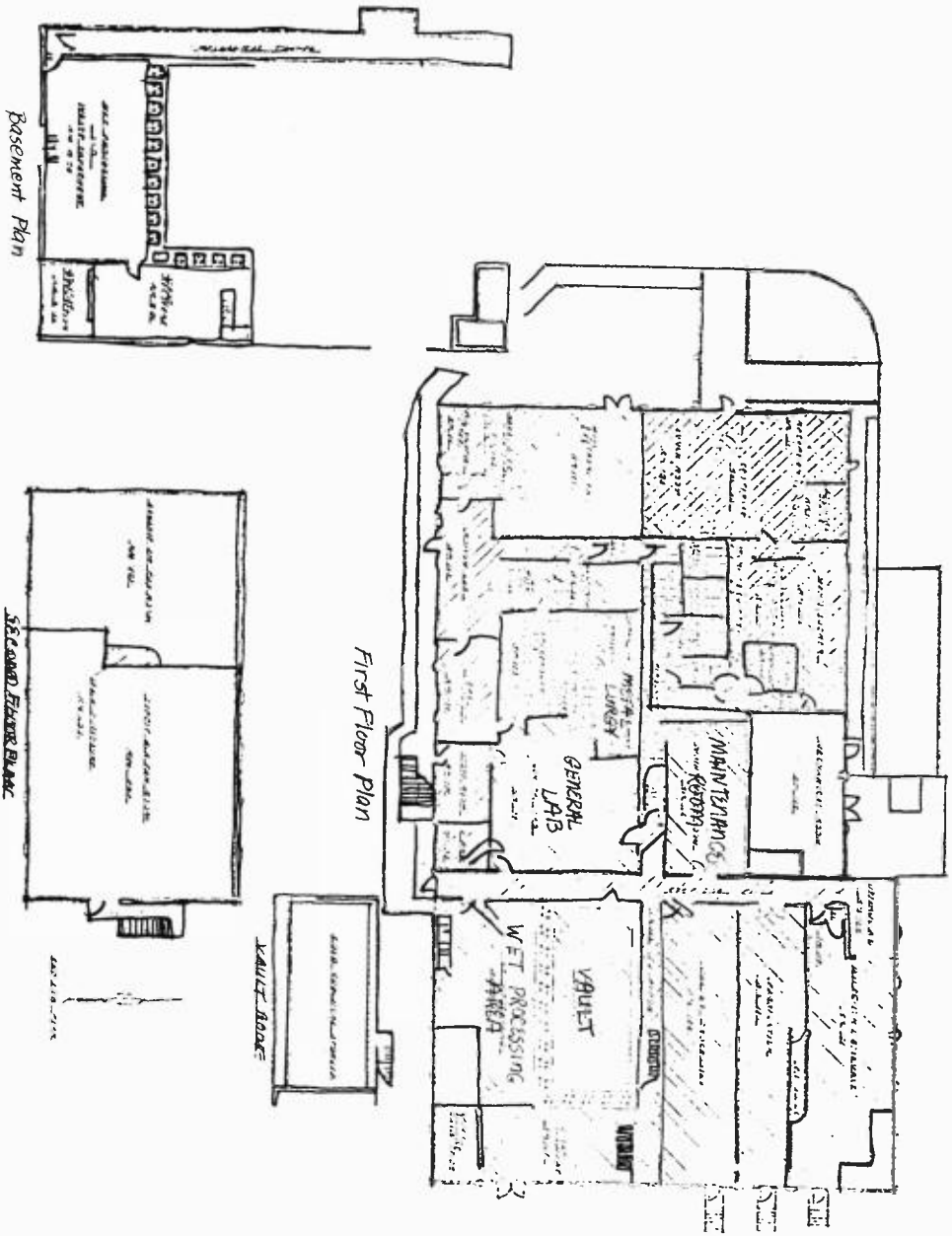


Figure 1. Light water reactor fuel cycle--no uranium recycle.

Light water reactors require many supporting operations, most of which relate to the supply of fuel and spent fuel treatment. Where no uranium is recycled, all light water reactor fuel comes from virgin natural uranium enriched to about 3% in uranium-235. Fuel operations include the following:

--Mining of uranium ores, both underground and in open pit.
--Milling, to produce a semi-enriched uranium oxide (yellowcake).
--Refining and converting yellowcake to volatile uranium hexafluoride.
--Enrichment of uranium hexafluoride.
--Conversion of enriched uranium hexafluoride to oxide.
--Fabrication of the oxide into pellets, encapsulation into fuel rods, and assembly into elements.
--Spent fuel storage (temporary).
--Long-term storage of spent fuel.

Source: U.S. AEC. Environmental Survey of the Nuclear Fuel Cycle. November 1972. p. S-3.



Map 2. Kerr McGee Plutonium Plant Floor Plan. **Cimarron Facility,** Crescent, Oklahoma.

Entrance to the Kerr-McGee Cimarron Facility, Crescent, Oklahoma.
Photo courtesy of K. Tucker.

Kerr-McGee Cimarron Facility, Crescent, Oklahoma. The plutonium plant is deserted, surrounded by a wire fence to keep unauthorized personnel out. Photo courtesy of K. Tucker

K-M received plutonium nitrate solution from AEC/ERDA. The 10-liter containers were shipped by the Atlantic Richfield Hanford Company.[9] After analysis, the plutonium nitrate was transferred by vacuum into a receiver tank in the glove box system and then pumped into a weigh-tank.[10] Uranyl nitrate was shipped from the K-M Sequoyah Plant in plastic drums inside 55 gallon steel drums and transferred to a stainless steel tank after certification.[11]

Selected batches of nitrate and recycle solutions were blended in four tanks of critically safe geometry. (Caution must be used as too large a quantity of plutonium in close proximity can cause a criticality accident releasing massive radiation.) After proper blending and adjustments, the final blend was fed to the coprecipitation unit where NH_4OH was added at a controlled rate. The slurry produced flowed to a precipitation tank and then to a pan filter. The resulting moist cake was washed and transferred for calcining at high temperatures.[12]

The calcined product was milled and blended into a powder. The powder was slugged and granulated before being processed into pellets. The pellets arranged in molybdenum boats, were sent through a special furnace for eight hours. The pellets were ground, sorted, and samples taken for final certification. Pellets were outgassed in a vacuum furnace, inspected visually for defects and then assembled into fuel pins or rods.[13]

The first fuel pin assembly step involved welding an end cap to a cladding tube to form the subassembly. These subassemblies were loaded into a "gatling gun" fixture in lots of 60 along with six-inch test samples. The subassemblies were placed inside the glove box area, where fuel pellets were waiting for insertion. The pellets were again visually inspected during this feeding operation. The pins were loaded into the cladding tubes, the ends of the

tubes were decontaminated, and a temporary cap was placed in the open end. After welding the open end of the fuel pins, the pins were decontaminated, sample welds were tested, and pins were inspected and inserted into steel cylinders. These cylinders were placed in a "birdcage" for shipping in sealed vans.[14]

Plutonium Fuel Fabrication Contract

Kerr-McGee Corporation participated in a program to develop the industrial capability to produce mixed oxide fuel for the breeder reactor program. The government-sponsored multi-phase program began in 1968. K-M participated in a pre-qualification phase with two other industrial suppliers. In February 1972, K-M and NUMEC, a division of Babcock and Wilcox located in Apollo, Pennsylvania, were awarded fixed-price contracts for production of fuel pins for the Fast Flux Test Facility (FFTF) at the Hanford site in Richland, Washington.[15]

The FFTF is a test prototype for the proposed breeder reactor at Clinch River, Tennessee. It uses plutonium as a fuel instead of the uranium now used in light water reactors. The FFTF has suffered many setbacks, but is now scheduled to begin operating in late Summer 1979.

The first phase of K-M's $7.2 million contract called for production of 500 fuel pins.[16] After Hanford Engineering Development Laboratory accepted the initial contract order, K-M began producing a minimum of 1,000 fuel pins per month to meet the contract's 18,000 fuel pin order. The contract was later modified, increasing the cost to $7,572,210, approximately twenty percent less than the NUMEC price.[17]

Unless noted otherwise, all incidents and conditions mentioned in this report refer to the operation of the plutonium plant in fulfilling the obligations of this contract.

A technician inspects a prototype nuclear reactor fuel rod. This type of rod was manufactured at the Kerr-McGee Facility. Photo courtesy of U.S. Department of Energy.

NOTES

[1]Howard Kohn. "Nuclear power on trial." Rolling Stone. May 4, 1978. p. 48.

[2]_____. "Malignant giant." Rolling Stone reprint. March 27, 1975. p. 1.

[3]_____, "Nuclear power on trial." op. cit. p. 49.

[4]Tom Barry. "The Navajo lung cancer widows." The Navajo Times. August 24, 1978. p. B-13.

[5]Kohn. "Malignant giant." op. cit. p. 1.

[6]David G. Snow. Kerr-McGee Corporation: growth stock indexed to inflation. Mitchell, Hutchins Inc. December 1974.

[7]Atomic Energy Commission. First prelicense inspection. September 17, 1969. p. 4.

[8]_____. Inspection Report Nos. 070-925/73-05 and 070-1193/73-06. September 17-21 and 26, 1973. p. 10.

[9]U.S. Energy Research and Development Administration. RRD review team report on quality review of FFTF fuel pin manufacture and quality assurance practices at the Kerr-McGee Cimarron plant. April 11, 1975. p. 9.

[10]Ibid., p. 10.

[11]Ibid.

[12]Ibid., pp. 10-11.

[13]Ibid., pp. 11-14.

[14]Ibid., pp. 16-21.

[15]Ibid., pp. 1-2.

[16]U.S. General Accounting Office. Report to the Subcommittee on Reports Accounting, and Management Committee on Government Operations, U.S. Senate: federal investigations into certain health, safety, quality control, and criminal allegations at Kerr-McGee Nuclear Corporation. May 30, 1975. p. 13.

[17] Ibid.

RADIATION HAZARDS

Dr. Karl Morgan, a founder of the health physics profession in the United States, stated, ". . . there is no safe level of exposure and there is no dose of radiation so low that the risk of a malignancy is zero," in the September, 1978, issue of the Bulletin of the Atomic Scientists.[1] Dr. Morgan's pro-nuclear position remains unshaken, but admits that earlier theories of radiation effects underestimated the damage now being suffered in human populations.

Early radiation standards were set on the assumption that ionizing radiation did no harm below certain levels of exposure. The level of exposure regarded as safe has continually dropped. Scientists assumed that this safe level was equivalent to about 52 rems per year until 1950, when a new exposure level of 15 rems per year was recommended by the International Commission on Radiological Protection. (A rem is a unit used as a measure of biological damage from radiation.) In 1956, reduction was recommended to the current level of 5 rems per year for a worker.[2] The Natural Resources Defense Council, Inc. and Dr. Rosalie Bertell petitioned the NRC to reduce this exposure level ten-fold in 1975 and 1978, respectively.[3]

Since radiation cannot be seen, heard, smelled, or touched, people are not even aware of its presence. Furthermore, cancer has a latency period between the time of exposure and its appearance, so the association between exposure and injury is difficult to prove.

Dr. Thomas F. Mancuso of the University of Pittsburgh studied the death certificates of former workers at the Hanford nuclear facility in Washington State. (Hanford is the principal producer of plutonium for the nuclear weapons program.) The study, involving a data base of over 35,000 workers, showed increases in bone marrow, lung and pancreatic cancers. These increases occurred at exposure levels 10-20 times below federal standards.[4]

Cancer is not the only problem resulting from radiation exposure. Dr. Rosalie Bertell, a cancer research scientist, discovered radiation exposure seems to speed the aging process.[5] Consequently, susceptibility to diseases associated with aging is heightened.

Rapidly dividing cells are highly susceptible to radiation damage. Thus, an infant is more susceptible than an adult, and an embryo or fetus is more susceptible than an infant. The data of Dr. L.H. LeVann show each radioactive atom is 10-100 million times more toxic to developing embryos than a molecule of the most potent teratogenic substances such as thalidomide.[6] Radiation standards are targeted to infant organs, rather than to an embryo or fetus.

The Nuclear Regulatory Commission sets occupational exposure standards for the nuclear facilities it licenses.[7] The general standard of external exposure allows a whole body dose to a worker of 5 rems per year, but the licensee may expose an individual to greater amounts of radiation if the total dose does not exceed the number produced in an age formula.[8] This formula would allow-up to 12 rems per year exposure.[9]

The NRC sets standards of exposure for internal radiation equivalent to 5 rems per year.[10] The NRC adds the internal exposure to the external exposure, so a worker could legally be exposed to 17 rems per year.[11] Thus, a worker can legally be exposed to 680 times the EPA's new standard of .025 rem for the public.[12]

These worker exposures greatly increase the risk of genetic damage to the worker's offspring. Drs. John Gofman and Arthur Tamplin assembled a vast body of data indicating there would be at least 32,000 and perhaps as many as 64,000 additional radiation-related deaths each year if the radiation doses for workers were also applied to the general U.S. population.[13] These figures did not include fetal and infant mortality, genetic defects, or any more subtle long-range effects on health.

Risks to the unborn fetus are 200 times greater than the risks to a 50-year old man, according to the National Academy of Science.[14] Nevertheless, the NRC has refused to take any action to protect the unborn beyond issuing a special Regulatory Guide warning female workers to take certain precautions if they become pregnant: 1) the woman should ask to be reassigned; 2) leave her job; 3) delay having children; or 4) take the increased risk.[15] The greatest risk to the unborn is during the first three months of pregnancy, when the woman may not be aware she is pregnant.

The National Academy of Science reports that one rem of radiation before birth can raise the incidence of leukemia and other types of cancer from 3.7-5.6 per 10,000 children, an increased risk of sixty-six percent for a dosage that is now average for workers.[16]

Workers in plutonium fuel fabrication plants face even greater danger than uranium workers, as plutonium is far more toxic than uranium. Swallowing a barely visible quantity of it can sear the digestive tract, killing quickly and painfully. Microscopic amounts can lead to cancers years later. Plutonium remains deadly for at least 24,000 years. Once it escapes into the environment, it cannot be recaptured or destroyed.[17] Plutonium dioxide particles handled at fuel fabrication facilites are the form and size most likely to cause lung cancers to develop.[18]

NOTES

[1]Karl Z. Morgan. "Cancer and low-level ionizing radiation." Bulletin of Atomic Scientists. September 1978. p. 30.

[2]Ibid., pp. 30-32.

[3]NRC Docket #PRM-20-6. Petition to amend 10 CFR 20.101, exposure of individuals to radiation in restricted areas by the Natural Resources Defense Council, Inc. Filed October 29, 1975. p. 1.
NRC Docket #PRM-20-6. Petition to amend 10 CFR 20.101 exposure of individuals to radiation in restricted areas. Filed July 18, 1978 by Sr. Rosalie Bertell. p. 1.

[4]G.W. Kneale, et al. "Re-analysis of Data Relating to the Hanford Study of the Cancer Risks of Radiation Workers." Reprint from Late Biological Effects of Ionizing Radiation. Vol. 1. IAEA-SM-224/510. International Atomic Energy Agency, Vienna, Austria. 1978. pp. 387-409.

[5]R. Bertell. "X-ray Exposure in Premature Aging." Journal of Surgical Oncology. 1977. 9:379-391.

[6]L.F. LeVann. "Congenital Abnormalities in Children Born in Alberta During 1961." Canadian Medical Association Journal. 1963. 89:100.

[7]10 Code of Federal Regulations, Part 20. 1978.

[8]10 Code of Federal Regulations, Part 20.101. 1978.

[9]10 Code of Federal Regulations, Part 20.101(b)(2). 1978. "The dose to the whole body, when added to the occupational dose accumulated by the worker shall not exceed 5(N - 18) rems where "N" equals the individual's age in years at his last birthday."

[10]10 Code of Federal Regulations, Part 20.103. 1978.

[11]Letter from Kay Drey, University City, Missourie, dated October 14, 1978, and telephone interview with Tom Murphy, Radiological Impact Section, Office of Nuclear Reactor Regulation, NRC, on January 12, 1979.

[12]Ibid.

[13]J. Honicker, Petition for Emergency and Remedial Action, Before the NRC of the U.S.A. 1978. pp. 5-38.

[14]Ibid.

[15]G. Dixon. Personal Radiation Exposure in the Nuclear Power Industry: A Preliminary Study of Standards and Risks. Presented to the State of Wisconsin Assembly Committee on Commerce and Consumer Affairs. March 8, 1976. pp. 8-9.

[16]J. Honicker. op. cit., pp. 5-38.

[17]Kohn. "Malignant Giant." op. cit., p. 1.

[18]J.W. Gofman. "The Plutonium Controversy." Journal of the American Medical Association. vol. 236. July 19, 1976. p. 286.

TRAINING

Nuclear facilities have a responsibility to inform their employees of the potential health hazards resulting from radiation exposure. Adequate job training must be provided to ensure workers realize the importance of completing their activities safely and correctly and of the proper procedures to follow in case of an on-the-job accident.

According to the first AEC prelicense inspection report on September 9-11, 1969, training plans called for 160 hours of training for all shift people. This training was to include 120 programmed hours described in the license application and an additional 40 hours of on-the-job training.[1] On September 18, 1969, an AEC inspector commented that plutonium facility management was disconcerted by the AEC request for training records at the final prelicense inspection scheduled for late October 1969.[2]

A worker at K-M when the plutonium plant opened said he had had an intensive training session of one to two weeks when he started but, as years went by, the training time was reduced until there was only one half-day session. There was high turnover at the plant, so K-M would let new personnel work until they had enough people to make a training session feasible.[3] By June 1973, training for new employees and rehirees shrunk to about 24 hours of general and specific operational safety training, according to the AEC.[4] The K-M license renewal application, reviewed by AEC Inspector Ridgway in October 1974, reduced radiation safety training from 40 to 20 hours. Ridgway commented, "We feel 40 hours is borderline and 20 hours is inadequate to cover the subjects listed in the noted pages."[5]

Charges of inadequate training at K-M were investigated by the AEC during 21-22 November and 5-6 December 1974 inspections. This inspection report was critiqued before a Congressional Committee by Sara Nelson, National Labor Task Force coordinator of the National Organization for Women and Kitty Tucker,

president of Supporters of Silkwood:

> . . . The "Report of Investigation" (Report) does not provide enough information to satisfy the doubts raised about the adequacy of training at Kerr-McGee, although the investigator concluded that conditions were good. In an industry handling such an extremely dangerous substance, the 35% work force turnover is very high. (The figure would be higher if management and supervisory people with a lower-turnover rate were excluded.) The Company's records showed that 62% of the hourly workers had less than two years experience.
>
> Only 20 hours of classroom training are required for new workers. A former employee suggested that training was not taken very seriously, and reported that some new workers slept through the training sessions.
>
> Workers hired for the plutonium plant spend four hours in classroom sessions and four on the job during the week of training offered sometime each month. Workers hired before the scheduled training week are always supposed to be escorted in the plant, and they receive a two-hour indoctrination by health physics before entering the plant to work. The Report describes this indoctrination:
>
> > "The indoctrination includes discussion of radiation and contamination, radiation and contamination control procedures and levels, air sample program, issuance of a film badge and its use, explanation of bioassay schedule and programs, issuance fo a urine sample kit, explanation of protective clothing, alpha survey meter and demonstration of the proper personal survey technique."
>
> The two-hour indoctrination places heavy emphasis on company procedures, according to the list above. Yet, the suggestion that "training is aimed at job performance of specific tasks rather than hazards of the work" is dismissed by the AEC investigator in the following paragraphs of the Report. The two-hour training is obviously inadequate to put anyone on the job in a plutonium plant, given the dangers of radiation or fires. Many workers did not understand the hazards of their jobs after the full training session, so it is doubtful that they realized the danger after a two-hour session that focused on job performance.
>
> An incident substantiated in the Report demonstrates the problem of on-the-job training. A new employee hired July 15, 1974, became contaminated on July 23, 1974. He had begun classroom training on July 16, but had only completed four days of the training eight days later when

the contamination occurred. The shift supervisor responsible for instructing the new worker spread the contamination to other areas of the plant when he led the new worker through the plant instead of properly confining the dangerous substance to the initial area of contamination. The shift supervisor either did not know or failed to follow proper procedures. The contaminated employee quit shortly thereafter, and Kerr-McGee did not bother to complete an evaluation of the severity of his exposure.

Another contamination incident involved a vacuum cleaner. A lab analyst who had undergone training was contaminated in an effort to decontaminate a vacuum. The personnel record of the contaminated worker failed to show an entry of the exposure. The "hot" vacuum was left sitting for 14 days before it was decontaminated after a worker complained.

In the nearby Kerr-McGee uranium plant, an "employee brought a pellet gun to work so that he could shoot uranium dioxide fuel pellets at his colleagues whenever he got bored." This pellet gun was found by AEC investigators at a later time. Clearly, an employee who understood the danger of radioactivity would not shoot radioactive substances at a co-worker as a pastime.

Given the 74 plutonium exposures that had occurred at the plant by the time Union officials met with AEC officials on September 27, 1974, there was ample reason to question the training after looking at the resulting exposures. But the inspectors looked at the training curriculum, reviewed the training records of eight workers and discussed training with only three workers. They concluded that training was adequate. Given the charges that training was not taken seriously by the workers, the fact that "the training includes instruction in the biological effects of exposure as described in pages 26 through 34 of the Kerr-McGee training manual" does not guarantee understanding on the part of workers. Signatures of attendance at training sessions cannot demonstrate understanding either.

The Union attempted to educate the workers about the biological effects of exposure to plutonium by bringing in two plutonium experts, professors at the University of Minnesota, Dr. Donald Geesaman and Dr. Dean Abrahamson. They arrived in Oklahoma October 10, 1974, to conduct a crash course for workers. For many workers, it was the first time that the link between inhaling plutonium and later developing cancer was ever made clear, despite the training manual.

> When workers went on strike for safer working conditions, better training, and higher wages in 1972, the company rushed in untrained strikebreakers giving them as little as four hours training. An inexperienced substitute became the plant's safety officer.
>
> "The Report of Investigation" substantiated charges that waste jugs were filled in excess of company procedure; the safe operating limit of 220 grams of plutonium per room had been exceeded; respirators were not routinely checked for defects, and the need to wear respirators was not always posted. When misvalving errors that could have posed a criticality problem occurred, the licensee failed to notify the Region office of the AEC. (A criticality alarm goes off when there is too much plutonium in one area, creating the danger of an explosion.) Leaking gaskets, plastic piping and faulty glove boxes caused further problems of contamination.
>
> . . .
>
> Ar Kerr-McGee in Oklahoma, procedures that require showers and radiation monitoring before workers leave the plant were apparently not adopted. The plant had only two shower heads for 75 workers per shift, and no paid time was provided for showering at the end of a work shift. The company did not provide a complete change of clothing, so employees might leave the plant with contaminated undergarments. Employees could check themselves for contamination on their own time before leaving the plant, but at best the company only conducted spot-checking once a week. For a period of time before Silkwood's death, no checks were routinely made at all.[6]

Interviews with former K-M employees confirmed and expanded comments made at the hearings. Several workers did not recall being told about plutonium causing cancer. One person recalled 16 hours of training about plutonium, but does not recall a connection being made between ingested plutonium and cancer. He remembers being told that if he were contaminated at the uranium plant, the radiation would pass through his body.[7]

Most people neither understood nor cared about possible plutonium overexposures, according to one interviewee. This worker stated that many employees were young transients, who may have been more careless than other workers.[8] Temporary workers were used frequently by K-M. These workers would be fired before they accumulated enough working time to receive union

job security protection.[9]

Contamination at the plant that resulted at least in part from inadequate training included a new worker in the wet ceramic area putting his hand through a glove. He did not know that he should immediately pull his hand out. His arm was completely covered with toxic plutonium cake.[10] A young man who used rags to clean off plutonium and wastes from the inside of a glovebox proceeded to use the same rags to wipe down the outside of the box. This error may have contaminated the entire room.[11]

Training at the uranium plant was practically nonexistent, according to several former employees. The same day a worker passed his physical for the uranium facility he was placed on the ceramic line with no previous training in uranium production. He got what he called "on-the-job" training, learning as he went along and learning by his mistakes. Later, he was shown a couple of films. He said there was a very high turnover at the plant, and when new people came in all the time, things got sloppier and more accidents occurred.[12] An office worker revealed that, during the 10-week union strike in 1972, she pressed uranium pellets on the production line without any training.[13]

Former employees explained training did not always occur before beginning work on the production line. One employee worked two weeks before any training session. He advised that many workers worked even longer before training. He felt that management downplayed the dangers so that, unless a person was very interested. there was very little knowledge available.[14] On the first day at work in 1974, a new worker was placed on the glove boxes. in the plutonium plant, without any prior training. Another glove box worker helped provide the necessary training to run the gloveboxes. The trainee said there was often whiskey of the co-worker's breath and that he was not very helpful in training. Consequently, this worker did not have a very good understanding of plutonium or the job to be done at the plant.[15]

A worker transferred from the uranium plant to the plutonium plant in December 1974, received neither work training nor classroom instruction at the plutonium plant. Someone showed him the job as he went along, but he felt he really did not understand his job. When he asked questions about glove box safety and what would happen if this broke or that blew up, he was given different answers by different people. He said no one there really knew "what the stuff was all about."[16]

Another transferred worker not given any specific training said it seemed as though there were never enough workers at the plutonium plant, so everyone had to hurry to get all their work done.[17]

NOTES

[1]Kohn. "Nuclear power on trial." op. cit. p. 48.

[2]Ibid., p. 49.

[3]Interview with worker #69.

[4]Atomic Energy Commission. RO Inspection Report Nos. 070-925/73-04 and 070-1193/73-05. June 18-22, 1973. p. 10.

[5]K.R. Ridgway memo to H.D. Thornburg, thru G. Fiorelli. "Comment on K-M Plutonium Plant license renewal submission." October 8, 1974. Attachment 1, p. 1.

[6]Statement of Sara Nelson, National Labor Task Force coordinator, National Organization for Women, and Kitty Tucker, president, Supporters of Silkwood. April 26, 1976, at Problems in the accounting for and safeguarding of special nuclear materials hearings before the Subcommittee on Energy and Environment of the Committee on Small Business. U.S. House of Representatives. pp. 230-231.

[7]Interview with worker #69.

[8]Interview with worker #73.

[9]Interview with worker #70.

[10]Interview with worker #54.

[11]Interview with worker #50.

[12]Interview with worker #59.

[13]Interview with worker #52.

[14]Interview with worker #54.

[15]Ibid.

[16]Interview with worker #60.

[17]Interview with worker #62.

SAFETY

The health and safety of workers is of primary importance in all industries. Unsafe working conditions (including those created by ill-trained employees) can cause serious accidents, management-employee unrest and decreased efficiency.

Fire

Fire is a grave danger at a facility handling plutonium. Plutonium can spontaneously ignite. The second most expensive industrial accident in U.S. history occurred at the Rocky Flats Plant in Colorado, which fabricates the plutonium components for both nuclear and thermonuclear weapons. Plutonium stored in a cabinet spontaneously ignited, causing $50 million worth of damage and consuming $20 million worth of plutonium.[1] An undetermined amount of plutonium escaped into the atmosphere from the Rocky Flats Plant in a 1957 fire also caused by spontaneous combustion.[2]

As of the May 1974 AEC inspection, no in-house fire fighting training had started, and the local fire department had not been invited to visit the facility.[3] Although emergency plan agreements with all outside organizations were required to be in writing, no such documents could be produced during a March 1974 inspection. The Guthrie assistant fire chief was contacted. He advised that the Guthrie Fire Department had orally agreed to aid the licensee if requested and that ". . . although no specific training had been received by personnel in his organization, he had been told that the licensee would direct all firefighting activities at the Cimarron Facility."[4]

A fire occurred in the incinerator baghouse on October 18, 1972. "All dust collector bags failed and all incinerator HEPA filters were damaged. Incinerator stack air concentrations were two times MPC on October 19."[5] Since all HEPA filters were damaged, the conclusion that emissions were below

levels reportable under 10 CFR seemed to lack foundation.

Combustible plutonium wastes were required to be removed daily, but AEC inspectors found such combustible wastes stored near the compactor in the basement recovery area during their February 1973 inspection. Dates on the bags indicated they had been stored there several days.[6]

Plutonium Fire--March 1973

At about 7:12 a.m. on March 5, 1973, two glove box operators were completing a bag-out operation in room 128 to remove waste cleaning wipes from the glove box system. The material to be removed is placed into the end of a long plastic bag which is attached to a circular glove box port with O-rings and/or clamps. A seal or a series of seals is made across the end of the bag with a heat seal machine. The bag is cut through the seal, separating the enclosed material with a miniumum of contamination release. After completing the heat seal, an employee noticed a plume of smoke arising from a small hole in the bag. He alerted three other employees in the room below and four of the five employees in room 128 evacuated. The fifth stuffed wet wipes into the bag hole and left the room.

Plutonium aerosol concentrations were very high during this incident.[7] Respirators were not being worn during the bag-out procedure, although it was considered a good practice in the industry. Respirators were not available at the work location as required by the license, so workers had to go out into the hall to get them.[8] The AEC expressed concern that the Continuous Air Monitoring chart had run out three days earlier for the room in question, and it had not been replaced as required. Concern was also expressed about the poor employee response in submitting bioassay samples.[9] AEC also found "Technical support in the area of radiation protection appeared to be inadequate."[10]

The facility was so heavily contaminated that it required about two weeks of continuous decontamination to reduce the initial levels of 100,000

disintegrations per minute per 100 square centimeters to normal working levels.[11]

Despite a management directive to discontinue the use of dielectric sealers after the fire until the committee investigating the fire had determined the cause, an AEC inspector observed a sealer being used in the plutonium plant on March 9, 1973. After critical remarks in an AEC inspection report, W.J. Shelley, director of regulation and control for the nuclear division of K-M, wrote that "We believe that the attitude that a commercial operation must be equipped to completely research the cause and effect of any such incident as we have experienced is beyond the requirements of the regulations and sound business judgement."[12]

Worker Fatality

A maintenance worker with no expertise in working on the compressor was asked to fix a valve. He began working on it, but apparently put the check valve in reverse. He did not know what the problem was, but the compressor would not work at all. Meanwhile, all the pressure was backing up into this valve. Another worker, Troy Goodman, went up to inspect the compressor. By this time the built-up pressure blew the check valve off, taking one-half of Goodman's face with it and splattered the remains on the ceiling. Goodman died instantly, but workers had to keep production going while others cleaned up the area.[13] Later investigation showed a pressure relief valve recommended by the manufacturer had not been installed by K-M.[14]

According to one worker, "Kerr-McGee (was) concerned only with production--not safety of workers."[15]

Plutonium Spill on Truck

Ilene Younghein, Conservation Chairperson of the Sierra Club and a member of Friends of the Earth, was telephoned on the evening of August 28, 1973,

by two men who described themselves as employees of the K-M Cimarron plant. Both were concerned about health and safety of employees at the plant, but preferred to remain anonymous for fear they would be fired. They advised the Youngheins that a recent plutonium spill had occurred when some drums of waste stored in a truck van leaked through the van bed, contaminating the floor, frame, undercarriage, and soil beneath the van. The callers felt the spill should have been reported to the AEC. They claimed soil was removed and placed in burial drums and the van was repainted.[16]

A call by AEC personnel after learning of the complaint revealed that the incident occurred on August 25. Contamination ranged up to 100,000 disintegrations per minute (a later report established soil contamination ranging up to 500,000 disintegrations per minute.)[17] K-M did not consider the problem reportable.[18]

The employees called the Youngheins again on September 9, 1973 to tell them that tires, axles, and springs of the truck had been removed and presumably buried. They stated that "word had filtered down from management that the AEC would probably conduct an inspection in the near future."[19] One of the callers claimed "he was shown a note from the 'Chief of Health Physics' that licensee reports dealing with the recent van spill should be 'back-dated' to reflect the date of occurrence as August 18, 1973"[20] rather than August 25.

An AEC inspection report for September 17-21 and 26 indicated leaking waste drums were a recurrent problem even before the August incident. Wastes shipped for burial were not in dry solid form as required by their license on two occasions. A "super Tiger" packaged shipped for burial was received on June 15, 1973. It included 3 drums containing liquids, and the inner packages containing liquids did not meet the Department of Transportation (DOT) drop test requirements.[21]

A second DOT violation of permit requirements occurred in a shipment received July 11, 1973. The shipment had been made in a "Poly Panther" drum and one drum contained liquid on arrival.[22]

Leaks attributed to leaking "solidified" waste drums were recorded on April 24 and May 7, 1973. During the second leak contamination levels up to 10,000 disintegrations per minute per 60 square centimeters were detected on the ground under the trailer. Licensee representatives confessed that, in early 1973, almost every drum of solidified waste had residual liquid in it, liquid content varying from dampness to complete separation.[23] Despite these recurring problems, K-M took no action until anonymous workers brought the incidents to the attention of the AEC and the public via the Youngheins.

The plutonium leak was recorded as occurring August 18, in the AEC September inspection report. The leaks occurred outside the plutonium building, where there apparently was no ongoing capability to measure alpha radiation via filters or continuous air monitors. Original contamination levels were greater than 1,000,000 disintegrations per minute per 60 square centimeters on the trailer floor and on the ground underneath the trailer; trailer tires showed greater than 100,000 disintegrations per minute. No records were made of readings on the outside of the trailer. The contaminated areas of the trailer not buried were covered with three layers of paint.[24]

Other Incidents

Kerr-McGee dumped thorium and uranium in a burial ground at the plant site and posted "Danger--Radioactive" signs, according to a former worker. K-M never had a license to dump there, it just did it. There were also pools about 300 feet long, 50 feet wide and 20 feet deep to store plutonium and uranium waste. The staff was only allowed to fill the pools two feet be-

low ground level because rain filled the pools so fast. There is no longer any sign of the pools. While K-M claims they were "evaporated" by the sun, a former worker suspects they were emptied into the Cimarron River.[25]

One room at the plutonium plant was so hot that the clean-up crew did not know what to do with it. Even after scrubbing the place down, it was still "screaming." So, the crew bought some cheap paint at a special discount store and painted the room with 19 coats. It worked for a few days, but then the paint would start to chip and the room would be "screaming" again. The paint was so thick it would stick to a worker's shoes, and then the worker would have to take off the shoes and bury them too.[26]

At one time, the government was getting rid of nuclear machinery at Rocky Flats that it felt was outdated and of no use. K-M immediately bought the equipment and installed it at their Cimarron facility. "That is how tight they were," according to a former supervisor.[27]

On October 24, 1975, a worker was operating inside a glove box, working with liquid plutonium, and while swishing his hand around the inside the box, a piece of wire cut through the two pairs of gloves he was wearing and cut his left middle finger. He had to be sent to the doctor at K-M, where he was decontaminated and had a portion of his finger removed to rid his body of the plutonium contamination.[28]

An infraction noted in the June 2-5, 1975 inspection involved K-M's failure to notify the carrier and the NRC of a shipment arriving from Hanford (Richland, Washington) with contamination of more than 100,000 disintegrations per minute per 100 square centimeters on a drum holding plutonium nitrate. Health physics personnel were not even aware of the requirement to report removable contamination greater than 22,000 disintegrations per minute per 100 square centimeters, and did not have the current section of Part 20 of the Code of Federal Regulations containing the requirement.[29]

The uranium plant also had safety problems. For example, in December 1971, there was a defective valve at the uranium plant. A worker who said that he knew what to do went in to fix the valve, but did not seal it properly. The worker left the room and when a second worker walked by the valve, it exploded and the uranium mixed with ammonium hydroxide splashed onto his face. The injured worker still has scars on his face suffered in the accident.[30]

Repeated Violations

In August 1970, K-M improperly stored plutonium wastes in a semitrailer parked by a facility loading dock, where wastes accumulated over a 4-6 week period. The license required all waste materials to be stored inside the plant.[31] The same violation was cited in the December 1970 inspection.[32] The AEC found that K-M stored plutonium nitrate solutions not continuously vented in both the August and December inspections.[33]

K-M notified the AEC October 30, 1972 by letter that it no longer had a Nuclear Safety Officer nor a License and Regulation Officer on staff as required by its license.[34] AEC inspections on February 12-16, 1973,[35] June 18-22, 1973,[36] and September 17-21 and 26, 1973[37] indicated that neither officer had been properly replaced. A part-time Nuclear Criticality Safety Engineer was finally hired January 21, 1974.[38]

In February 1973, many operating procedures at the plutonium plant had not been reviewed for a full year, although such a review was required by the AEC license.[39] Furthermore, no procedures had been developed for future loading, closing, and shipping of the FFTF shipping container.[40]

Although a Change Review Request (CRR) form had been developed for any facility change at the plant, no formal procedure existed for handling the forms and no individual was responsible for a centralized record repository.[41] This problem still existed during a June 1973 inspection.[42] A March 1974 inspection revealed that only one of eight older CRR files pulled in a spot check

had been initialed as being checked by the Licensing and Regulation Officer as required by the AEC license. In addition the developed CRR procedure did not explain who could initiate maintenance work.[43]

During a February 1974 inspection, the inspector stated that several glove boxes in the plutonium recovery and waste processing areas needed cleaning. Solids were building up on the floors and visibility through some panels was poor.[44] Glove box visibility was still a problem during the February, April, and June 1975 NRC inspections.[45]

Leaks in the Harper Furnace occurred in early February 1975. The leaks were repaired and K-M claimed no overexposures occurred. At the end of the month, leaks again developed. Some leaks were located and repaired, but the problem still existed during the March and April 1975 NRC inspections.[46]

NRC inspectors noted in March 1975 that many Safe Operating Limit (SOL) cards had been signed by personnel no longer associated with the company; some were not very legible while others were located in spots that were hard to read.[47] SOL signs at the control areas were found to be approved by people no longer employed at K-M. There also were discrepancies in the SOLs for glove boxes and the vault.[48] An April inspection still revealed discrepancies between SOLs and conditions used in safety analyses and limits stated in Standard Operating Procedures.[49] Two SOL signs were obstructed by cards during a May inspection.[50] Several violations were also noted during the November 1975 inspection.[51]

Unsafe Practices

Sometimes workers were given a double message about safe practices, according to a former worker. A supervisor might explain all of the steps to be taken with mop water from cleaning the floor: it was supposed to be measured for radiation, the measures were to be recorded and the mop water stored in a special place. However, if the worker accidentally spilled the water out

the door, nothing could be done about it. He said that this was just an example of practices that frequently occurred at the plant.[52]

There are about 750 glove ports in the plant. In the early days of the plutonium plant, the glove boxes were inspected regularly in preventive maintenance. A former worker stated they might be checked once a day, but later on, one was lucky if they were checked once a week. This was the main reason there were so many problems in that area.[53] There were 420 occasions when one or more of the air samples in a room exceeded maximum permissible concentrations from July 21, 1974 through February 20, 1975, according to the NRC. Glove failure or contaminated gloves caused 128 of these incidents. Three incidents involving overexposure to airborne radioactivity were attributed to glove failure.[54]

The June 1975 inspection also showed sixteen glove ports not having inner rings to seal the gloves firmly against the interior diameter of the glove ring. Absence of the inner rings increased the risk of airborne plutonium escaping from the glove boxes.[55]

Plutonium nitrate leaked from a bag during bag-out operations on April 22, 1975. Although a 10-foot square area was contaminated up to one million disintegrations per minute per probe, K-M claimed that air samples showed no airborne contamination during decontamination procedures.[56]

The plutonium nitrate unloading box was found with about 12 inches of acid and plutonium on the floor from a partially opened acid supply valve. About 468 liters containing 164 grams of plutonium were recovered by vacuum transfer to another glove box after a proper safety assessment had been made.[57]

During an NRC inspection in February, inspectors discovered K-M did not have a plan or procedure for handling unusual conditions--exceeding safe operating limits, equipment failures or operational errors--where corrective actions should be carefully evaluated by knowledgeable persons before being undertaken.[58]

A March 1975 NRC inspection revealed several infractions regarding storage of radioactive material in the vault. The four problems mentioned had the potential for causing an occurrence with safety significance.[59]

A radioactive waste burial facility at Beatty, Nevada received a waste shipment from K-M containing a box that was hot to the touch on June 25, 1975. The box contained a HEPA filter from the scrap recovery operations at K-M. Investigation revealed an exothermic reaction had occurred due to the interaction of the waste and the packaging materials. This infraction had potential for causing a health or safety problem.[60]

During a May 1975 AEC inspection, a package of special nuclear material was found stored on the vault floor in violation of procedures. There were other irregularities regarding vault storage, including the fact that the hand printing on some of the item cards was nearly illegible, making it difficult to determine the amount of special nuclear materials stored in the packages.[61]

An NRC inspection in April, 1975, revealed several infractions at the K-M plant. Respirators stored in the operating portion of the plant were not properly bagged to prevent them from becoming contaminated. Ventilation airflow and pressure in hoods, slot boxes, and glove boxes were not checked and recorded each shift.[62]

No written procedures were available for in-place testing of HEPA filters, and K-M shipped a HEPA filter containing too much radioactivity for the package it was shipped in. Air is supposed to flow from nonradioactive areas of the plant into radioactive areas to prevent the spread of contamination, but AEC inspectors observed air flowing from the laboratory areas into the hall and locker room areas.[63]

Similar ventilation problems occurred at the uranium plant. A worker explained he couldn't even see the floors through the dust at the uranium plant. He also said doors were flung wide open and there

were fans in the uranium plant "blowing the stuff right out the door into the atmosphere!"[64]

Record Keeping

The June 18-22, 1973, AEC inspection revealed K-M failed to keep proper records on the fissile content in a glove box, and stored more than the safe operation limit of containers of plutonium in a glove box.[65]

A February 1973 inspection indicated that no internal audits had been made since the Criticality Safety Officer performed one in September 1972, despite the license requirement for a monthly audit for nuclear criticality safety. Only two audits had been performed by consultant Battelle Northwest Laboratories.[66]

The AEC license required that all plant and equipment changes be physically inspected by the Nuclear Safety Officer and the Health Physics Officer before being put into use. These inspections were needed to prevent danger of a criticality or contamination accident, but there was no evidence of these inspections for recent changes at K-M.[67]

Physical inventories of fissile material in control areas limited by safety masses were not maintained according to a June 1975 inspection. A written operating procedure was not provided for the rinsing of cans in a six-liter, large diameter vessel in a glove box. A criticality accident could have resulted from such a failure. A similar failure was found in operating instructions for calcination of combustible waste in the calcining furnace and two glove boxes.[68]

The March 1974 inspection revealed that neither the high efficiency filter nor an exhaust system had been tested within the past year. The test was three month overdue and failure to test was a violation of the license.

Off-Site Pollution

The Cimarron Facility leaked large quantities of ammonia into the Cimarron River on August 4-6, 1970. Analytical results from the state of Oklahoma showed 11 parts per million ammonia downstream of the plant versus 0.5 parts per million upstream of the uranium plant process waste discharge point.[69] A worker said that the ammonia killed every fish in the Cimarron River, ". . . was white with fish all dead and floating around." The same worker stated that many K-M employees were sent to the site of the fish kill to help in the clean-up operation.[70]

Plutonium was released by the K-M plant several times. On December 4, 1973, the final filter bank serving the acid glove boxes broke through. Removable contamination up to 70,000 disintegrations per minute was found downstream from the filters. Five times the allowable environmental plutonium concentration was emitted during the period from December 21, 1973 to January 20, 1974. K-M admitted releasing 6.4 microcuries of plutonium in 1973.[71] During the period from December 21, 1973 to January 20, 1973, 18 microcuries of plutonium were released. Federal regulations permit releases to be averaged over periods up to one year, so the AEC concluded the release was not reportable to the AEC.[72]

A total of 179 microcuries of airborne radioactivity was released through the plutonium plant stack by December 20, 1974.[73] During 1974, 896 microcuries of radioactivity were released into the plutonium plant sanitary lagoon. This lagoon overflows into the Cimarron River.

NOTES

[1]Rocky Flats Action Group. Local Hazard: Global Threat. 1977. pp. 3-4.

[2]Ibid.

[3]Atomic Energy Commission. RO Inspection Report Nos. 070-925/74-03, 070-1193/74-05, 040-7308/74-02. May 20-24, 1974. p. 9.

[4] Ibid.

[5] _____. Inspection Report Nos. 070-925/05 and 070-1193/73-06.

[6] Energy Research and Development Administration. Quality Assurance Practices, op. cit., p. 10.

[7] Neil Wald. Summary Report: Evaluation of Biomedical Aspects of the Kerr-McGee Incident of March 5, 1973, to the AEC. February 20, 1974. p. 1.

[8] Energy Research and Development Administration. Quality Assurance Practices, op. cit. pp. 1-2.

[9] U.S. General Accounting Office. Federal Investigations. op. cit., p. 13.

[10] Energy Research and Development Administration. Quality Assurance Practices, op. cit., p. 3.

[11] U.S. General Accounting Office. Federal Investigations. op. cit., p. 13.

[12] W.J. Shelley. K-M communication to Mr. Boyce H. Grier. June 8, 1973. p. 1.

[13] Interview with worker #67.

[14] Atomic Energy Commission. CO Inquiry Report No. 1193/71-03. December 22, 1971. p. 2.

[15] Interview with worker #67.

[16] Atomic Energy Commission. Region III Files Memorandum: allegations--Kerr-McGee Corporation. September 4, 1973. p. 2.

[17] Atomic Energy Commission. Regulatory Investigation Report, Kerr-McGee Corporation, Cimarron Facility, License No. SNM-1174 (Docket No. 1193). Allegations regarding unsafe practices. November 2, 1973. p. 15.

[18] Atomic Energy Commission. Region III Files Memorandum, op. cit. September 4, 1973. p. 3.

[19] Atomic Energy Commission. Region III Files Memorandum: allegations--Kerr-McGee Corporation. September 13, 1973. p. 1.

[20] Ibid., p. 2.

[21] Atomic Energy Commission. RO Inspection Report Nos. 070-925/73-05 and 070-1193/73-06. Sepember 17-21 and 26, 1973. p. 3.

[22] Ibid.

[23] Ibid., pp. 6, 17-19.

[24] Ibid., pp. 24-25.

[25] Interview with worker #67.

[26] Interview with worker #57.

[27] Interview with worker #67.

[28] Interview with worker #68.

[29] Atomic Energy Commission. IE Inspection Report No. 070-1193/75-08. June 2-5, 1975. pp. 3, 6.

[30] Interview with worker #52.

[31] Atomic Energy Commission. Inspection Report, August 3-6, 1970. p. 4.

[32] _____. October (December) 22, 1970 inspection report. Noncompliance sheet.

[33] Ibid.

[34] _____. Letter to Mr. Parker S. Dunn, K-M Vice-President, November 10, 1972. p. 1.

[35] _____. RO Inspection Report Nos. 070-925/73-02 and 070-1193/73-02. February 12-16, 1973. p. 4.

[36] Atomic Energy Commission. RO Inspection Report Nos. 070-925/73-04 and 070-1193/73-05. June 18-22, 1973. p. 6.

[37] _____. September 17-21 and 26, 1973, op. cit. p. 3.

[38] Kerr-McGee Nuclear Corporation. Correspondence to Mr. James G. Keppler, Atomic Energy Commission. January 4, 1974. p. 1.

[39] Atomic Energy Commission. February 12-16, 1973, op. cit., p. 3.

[40] Ibid.

[41] Ibid., p. 4.

[42] _____. June 18-22, 1973. op. cit., p. 6.

[43] _____. RO Inspection Report Nos. 070-925/74-03, 070-1193/74-05 and 040-7308/74-02. May 20, 1974. p. 2.

[44] _____. RO Inspection Report Nos. 070-925/74-01, 070-1193/74-01, 040-7308/74-01. February 11-15, 1974. p. 8.

[45] Nuclear Regulatory Commission. IE Inspection Report Nos. 070-925/75-01 and 070-1193/75-02. February 3-7, 1973. p. 12
_____. IE Inspection Report No. 070-1193/75-05. April 14-17, 1975. p. 5.

[46] Nuclear Regulatory Commission. IE Inspection Report No. 070-1193/75-03, March 3-5, 1975. p. 9.
_____. April 14-17, 1975, op. cit., pg. 12.

[47] _____. IE Inspection Report No. 070-1193/75-03. March 3-5, 1975. p. 6-7.

[48] Ibid.

[49] _____. April 14-17, 1975, op. cit., p. 8.

[50] _____. IE Inspection Report No. 070-1193/75-06. May 20-22, 1975. p. 8.

[51] _____. IE Inspection Report Nos. 070-1193/75-15 and 070-925/75-05. November 3-7, 1975. pp. 7, 9, 14.

[52] Interview with worker #70.

[53] Interview with worker #69.

[54] Nuclear Regulatory Commission. March 3-5, 1975. op. cit. p. 8.

[55] Ibid., p. 3.

[56] _____. May 20-22, 1975, op. cit. p. 8.

[57] Ibid., pg. 3.

[58] _____, February 3-7, 1975, op. cit., p. 7.

[59] _____., March 3-5, 1975. op. cit., p. 2.

[60] _____. IE Inspection Report No. 070-1193/75-09. July 14-15, 1975. p. 2.

[61] _____. May 20-22, 1975, op. cit. p. 7.

[62] _____. April 14-17, 1975, op. cit., p. 2.

[63] Ibid., pp. 2-3.

[64] Interview with worker #67.

[65] Atomic Energy Commission. June 18-22, 1973, op. cit. pp. 3-4.

[66] _____. Enclosure to a letter to Mr. Parker S. Dunn, K-M Vice-President. March 26, 1973.

[67] _____. RO Inspection Report Nos. 070-925/74-01, 070-1193/74-01 and 040-7308/74-01. February 11-15, 1974. p. 6.

[68] Nuclear Regulatory Commission. June 2-5, 1975, op. cit., p. 2.

[69] Atomic Energy Commission. Division of Compliance Monthly Report. August 31, 1970.

[70] Interview with worker #57.

[71] Atomic Energy Commission. February 11-15, 1974, op. cit., p. 20.

[72] 10 Code of Federal Regulations, Part 20.

[73] Nuclear Regulatory Commission. February 3-7, 1975, op. cit., p. 17.

OFF-SITE CONTAMINATIONS

Many workers would leave the plant contaminated because they would not check themselves, according to an interviewed worker. They would spread their contamination all over town and bring it into their homes. Some comments from the workers were "If it doesn't stain my shoes what do I care?" and "You can't see the stuff." He explained that as K-M began to cut corners to save money, they got rid of their well-paid, intelligent workers and hired anyone from off the street at less pay.[1]

Restaurant Incident

On April 17, 1972, an operator and two maintenance men became contaminated while replacing a pump in a glove box in the wet ceramic area. The maintenance men left the plant--without adequately checking themselves--and went to a local restaurant. The operator found he was contaminated when he left the process area, so the two maintenance men were checked upon their return to the plant. They showed contamination on hands, face, hair, and personal effects greater than 100,000 disintegrations per minute per 60 square centimeters. Several spots of contamination were found in a personal vehicle used by the men. Even though one man's wallet had shown contamination, K-M did not go to the cafe to check the cash register money, lunch counter or utensils used by the workers.[2]

One of the reasons K-M failed to check off-site contamination at the restaurant was ". . . the possible risk to the public did not appear to justify subjecting the business establishment to interference with its activity."[3]

Karen Silkwood Contamination Incident

On November 5, 1974, Karen Silkwood, an activist in the Oil, Chemical and Atomic Worker's Union (OCAW) and an elected member of the union collective

bargaining team, discovered she had become contaminated at work. She went through decontamination procedures and was placed on a bioassay program for the following five days. On November 6, she arrived at the plant and spent an hour on paperwork before leaving to attend a union negotiating meeting. She detected contamination on her hands during routine monitoring before leaving the area. The health physics office partially decontaminated her and asked her to return there before going home. At her request, a health physics technician checked her locker at the plant and her personal car, but no contamination was found.[4]

The next morning, November 7, Silkwood reported directly to the health physics office for a nasal smear, bringing bioassay sample along with her. Contamination at 22,000 disintegrations per minute was found from nasal smears.[5] She was decontaminated, and her car and locker were again checked, but essentially no contamination was found.[6] Several hours later, health physics personnel accompanied her to her apartment in Edmond, Oklahoma.

The health physics personnel were dressed in protective gear, similar to moon suits, and wore respirators. They discovered contamination throughout the apartment, primarily in the bathroom, kitchen, and Karen's bedroom. The highest contamination levels found were 400,000 disintegrations per minute on a package of cheese and bologna in the refrigerator and 100,000 disintegrations per minute on the toilet seat. Silkwood's roommate and fellow K-M worker, Sherri Ellis, was also contaminated.[7]

A few hours later, K-M personnel returned to the apartment and loaded twelve 55-gallon drums with contaminated objects from the apartment.[8] The AEC was unable to determine how the Silkwood apartment became contaminated.

Ms. Silkwood and Ms. Ellis were interviewed by K-M legal representatives on the day the apartment contamination was discovered. Silkwood was not

seen by a medical consultant until November 9.[9] AEC medical consultant, Dr. Neil Wald, later commented that the K-M medical consultant's location in another state made it difficult to provide adequate medical advice. He also noted that the lack of local availability of any means of in-vivo assessment of plutonium and americium internal contamination was a major drawback in managing contaminated individuals at K-M.[10] (Both of these problems had been pointed out to K-M and the AEC after the March 1973, fire which contaminated seven individuals.)[11]

Ms. Silkwood, Ms. Ellis, and a third person present in the apartment the evening before the contamination was discovered were sent to Los Alamos Scientific Laboratory for evaluation of their radiation exposures. They returned to Oklahoma November 12, 1974.[12]

The following day, November 13, Ms. Silkwood was killed in a one-car accident after attending a union meeting in Crescent, Oklahoma. According to an OCAW representative, Ms. Silkwood was enroute to a meeting with David Burnham, a reporter from the New York Times, and a national OCAW official on the night she was killed. She was carrying information about falsification of quality assurance records associated with manufacture of the FFTF fuel. The OCAW employed a private investigator who stated he found evidence that Silkwood's car had been struck from the rear.[13]

An AEC status report on the Silkwood contamination incident concluded the contamination had not occurred at the Cimarron facility, and plutonium had not been accidentally removed from the plant. They found "intentional removal of milligram quantities of plutonium from the facility" and "an intentional contamination incident" consistent with the investigation and bio-analysis results.[14]

W.J. Shelley, director of regulation and control for K-M Nuclear Corporation wrote to the AEC on January 2, 1975 regarding the Silkwood apartment

contamination incident. He stated, "The most reasonable explanation seems to be that the gastrointestinal contamination was caused by self-administration by Employee 'A'." (Karen Silkwood).[15] Critics have charged such an explanation could only be "reasonable" to those seeking to protect Kerr-McGee Corporation, especially against liability for allowing plutonium to leave its licensed facility.[16]

NOTES

[1]Interview with worker #57.

[2]Atomic Energy Commission. Region III Files Memorandum: allegations--Kerr-McGee Corporation. September 13, 1973. p. 1.
_____. RO Inspection Report Nos. 070-925/73-05 and 070-1193/73-06. September 17-21 and 26, 1973. pp. 6, 23-24.

[3]W.J. Shelley. K-M Corporation letter to Mr. James G. Keppler, AEC. Attachment. November 30, 1973. p. 3.

[4]Atomic Energy Commission. RO Investigation Report No. 74-09. November 8-December 4, 1974. p. 3.

[5]_____. Note to files: Kerr-McGee Contamination Incident. November 14, 1974. p. 4.

[6]_____. November 8-December 4, 1974, op. cit., p. 3.

[7]Ibid., p. 10.

[8]Ibid., p. 20.

[9]Ibid., p. 12.

[10]Neil Wald. op. cit., p. 9.

[11]_____. Summary report to U.S. AEC. February 20, 1974. "Evaluation of biomedical aspects of the Kerr-McGee incident of March 5, 1973." p. 1.

[12]Atomic Energy Commision. November 8-December 4, 1974, op. cit., Appendix N.

[13]Kerr-McGee Contamination Incident: a summary of the significant findings of the investigation of the Kerr-McGee incident during the period November 11-15, 1974. p. 1.

[14]A.J. Chapman, M.D. Chief Medical Examiners Office. Kerr-McGee Plutonium Facility contamination incident. December 6, 1974. p. 1.

[15]W.J. Shelley. K-M letter to Donald F. Knuth, U.S. AEC. January 2, 1975. p. 3.

[16]Anthony Mazzocchi. OCAW letter to J. Davis, U.S. NRC and attachment on developments relating to the death of Karen Silkwood. January 27, 1975. NOTE: Karen Silkwood's family filed suit in Federal District Court November 5, 1976, against Kerr-McGee Corporation for the plutonium contamination of Karen Silkwood and her home.

HEALTH

The NRC admits they cannot keep toxic radioactive material contained: "Operations involving plutonium must be conducted with the strictest controls in order to minimize the release of materials. It is not possible, however, to assure complete containment at all times and it is expected that on occasion small amounts of material may escape from containment and cause contamination."[1]

On March 13, 1970, a fuel facilities inspector commented, "Our experience to date indicates that Kerr-McGee will make little effort to establish or enforce procedural limits lower than the maximums legally imposed by Part 20 or by license conditions."[2] The inspector commented that the manual of health and safety standards submitted by K-M set liberal criteria that should be made more restrictive.

Monitoring Exposures

The inspector suggested plutonium workers be checked monthly, rather than quarterly. He advised that: 1) state "work restriction" levels were too high; 2) investigations regarding contamination should be initiated at lower levels of contamination; and 3) individuals exposed in excess of 40 times maximum permissible concentration per hour be restricted to work in no exposure area, rather than low exposure areas. He further indicated that proposed low exposure areas should have plutonium levels less than 30-50 disintegrations per minute per 100 square centimeters rather than the specified 500 disintegrations per minute per 100 square centimeters.[3] These liberal criteria were never changed.

During a May 1970 inspection, several plutonium exposure incidents came to the attention of inspectors, although K-M had not reported the incidents. Urine tests had not been conducted for any of the exposed workers. K-M staff maintained that urine samples were not necessary; the next routine check was

adequate.[4] A worker exposed to plutonium will begin excreting it almost immediately. Thus, adequate worker protection requires procuring urine samples immediately after suspected exposures and throughout the following few days.

A December, 1970, AEC report noted that radiation levels and exposures had increased in recent months. Radon levels had been as high as 54 disintegrations per minute.[5] The pulse height analysis used by K-M to distinguish radon from plutonium on high samples was not sensitive enough for concentrations below two and one-half times the maximum permissible concentration.[6]

On January 18, 1971, 22 employees were exposed to excessive radiation levels. When several alarms sounded, alarm points were adjusted upwards and the source of the problem was not search for until 60-90 minutes later.[7]

Dr. Sternhagen, K-M's medical consultant for environmental health, left Oklahoma City in the Fall of 1972. Instead of replacing him, Sternhagen was retained by K-M in the consultant position. K-M claimed he normally would be within one-hour's flying time to their facilities.[8]

Although an incident occurred about 7:00 a.m. on March 5, 1973, exposing seven workers, Dr. Sternhagen was not contacted until March 6.[9] A chelating agent, DTPA, is used to help flush radioactive material from a person's system after an exposure. K-M's supply of DTPA was depleted March 5, and although an order had been placed March 6, it had not yet arrived by March 9.[10]

An AEC consultant's report regarding the March fire from Dr. Roger Caldwell, Ph.D. at the University of Pittsburgh, revealed errors had probably occurred that underestimated total alpha activity in the filter media. He stated, "The potential exposure data for affected personnel made by Kerr-McGee in their April 3 letter does not appear to be based on bioassay data as was claimed, but rather on estimated times of exposure to the aerosol

concentrations. . . this exercise does not appear to have much relevance to actual exposures."[11]

Dr. Caldwell concluded, "Kerr-McGee was not well prepared to handle some technical aspects of this emergency. This appears to the author to be the consequence of not having a professionally qualified health physicist on the staff."[12] Fecal samples, vital for estimating the magnitude of single inhalations from accidental exposures, were not collected during the week following the fire. Only one employee was sampled satisfactorily. Caldwell stated K-M needed improved employee discipline regarding bioassay and were glad to cooperate once they understood the utility of such procedures. He noted K-M needed in-vivo lung counting capability closer to the facility so exposures could be assessed on a more timely basis.

Incidents Endangering Worker Safety

One worker was shifted from the uranium plant, where he had earlier received one week of training, to the more dangerous plutonium plant without any additional training. When he first started at the plutonium plant he felt that the conditions were good, but progressively worsened as K-M tightened up to keep their profits high. It was in a "sorry" condition when he left there. In the beginning he could go into a room and trust that it was not "hot" (radioactive) but, toward the end, he couldn't trust that at all. Floors, equipment, clothes, and protective coverings were continually hot.[13]

One worker described an incident not found in the AEC reports. He was bagging some waste in the plutonium plant when the seam ripped up the side of the plastic bag holding the plutonium waste. He twisted the bag around a bit to contain the rest of the waste and then put his respirator on. He was without a respirator for 3-5 minutes, and afterwards, had to immediately change his overalls because his clothing was hot.[14]

There were many careless people working at the plant. One worker never monitored himself when he left a room, and would track plutonium all over the plant. If it was on his hands, all the doors would be contaminated. A worker reporting this problem had to paint over a floor because the careless worker walked across it with contaminated shoes.[15]

The desire to "save time" sometimes led to unsafe practices, according to an interviewed worker. The workers hated towear the respirators because they were "uncomfortable" and it took too much time to go and put them on and have the health physics people come down to check the area out. Respirators were required whenever there was a glove change in the box area. So, the workers would turn the boxes away from the monitors and change the gloves quickly, without putting on their respirators. When workers bagged the waste from glove boxes, one worker might "stand guard" to make sure no one was around, especially health physics personnel, and the work crew would quickly, without respirators, bag the waste and save time.[16]

If a worker became too "hot," he would be transferred to the warehouse or the dry end of the production line. Many people did not want to go there because it was "boring." Sometimes, a worker with a badge registering too much radiation exposure might wear the badge of another worker that measured a lower exposure.[17] Some contaminated workers would go home with gloves or other protective coverings on them because only so much skin can be scrubbed away at a time. Decontamination would be resumed when the skin was no longer raw.[18]

Leaks and spills happened all the time in the uranium plant, at least once a shift, according to one worker. All the operators were contaminated at one time or another. A lot of radioactive uranium mixed with ammonium hydroxide would spill onto the floor and seep through the cracks and

eventually into the ground beneath the plant. There was liquid uranium on the floor caught between the dikes (mounds on the floor to catch spills) quite often, and this worker was involved in many leaks without a respirator.[19]

At one time, workers could smoke cigarettes and eat lunch in the production area at the uranium plant. Those practices were later changed by AEC guidelines.[20]

A worker at the uranium plant was working on a line or pump where there was a leak from above and the liquid hit his back. His back was burned a little bit, but he was not sure if it was liquid uranium or something else. He simply took a shower to wash it off and did not see the company doctor. He said no one put a monitor to his back to check him for contamination.[21]

Another worker said that most of the workers in the lab knew how deadly plutonium was because they had more education and training than the production workers. He felt production line workers did not really know the dangers of plutonium and felt it was a big joke to work with it. He believed everyone at the plutonium plant ingested plutonium at one time or another.[22]

One worker tore his glove at the plutonium plant; instead of calling the health physics office, he laughed. He called out to the other workers saying, "Hey, look at this." Then he moved his hand around inside the glove box totally unprotected. This worker was later transferred to the uranium plant to keep him away from the hot areas.[23]

In late 1974, according to an interviewed worker, there was an explosion in a glove box which sent airborne plutonium into a room where a worker was exposed. Although the incident should have been reported to the AEC, it was not. Furthermore, no one knew why the explosion occurred. The worker explained that this was just one incident of many at the plant.[24]

Another worker explained that when rooms were hot, instead of decontaminating them, workers would wear their repirators. The worker recalled wearing a respirator for a ten-day period in Spring 1975.[25] Another worker said production always came first for K-M and the employees had to work with respirators on until they found time to clean up the spills.[26]

Records for the period from April 21 through May 12, 1975, showed 62 occasions when at least one air sample in a room exceeded allowable limits.[27] Workers were exposed to airborne concentrations of plutonium 4-6 times the maximum permissible concentrations on April 18, 1975, although each worker's exposure was kept below the limit that would have to be reported to the AEC.[28]

A May 1975 AEC inspection revealed that K-M workers were not wearing finger rings intended to reveal radiation exposures to body extremities. "The apparent failure of employees to wear assigned finger rings was further verified during review of January-March records which showed that the measured extremity exposure for over one-half the employees assigned monitoring equipment was less than the dose measured on the control badge located outside the process area."[29]

While workers were given body scans to determine internal contamination, they apparently were not informed of the results.[30]

One worker decontaminated after working with an instrument that measured contamination at 120 K was informed later that it was accidentally marked 10 times less than it should have been. She had to undergo the decontamination process a second time. She was told that the contamination was so little that "she could have put her finger in her mouth and nothing would happen, it wasn't enough to hurt her."[31]

NOTES

[1]Donald F. Knuth. U.S. NRC letter to Ms. Connie Taylor. May 14, 1975. p. 2.

[2]G.P. Coryell. Comments on "Manual for health and safety standards" (Appendix F). Submitted by Kerr-McGee for plutonium license. Docket No. 70-1193, to J.R. Roeder, AEC. March 13, 1970. p. 2.

[3]Ibid., p. 1-2.

[4]U.S. Atomic Energy Commission. Inspection Report. May 13-14, 1970. p. 9.

[5]_____. Inspection Report. December 8-10, 1970. pp. 10-11.

[6]_____. Inspection Report. April 19-21, 1971. p. 7.

[7]_____. Compliance Investigation Report: release of plutonium nitrate solution. September 8, 1971. p. 1.

[8]_____. RO Inspection Report Nos. 070-925/72-03 and 070-1193/72-03. October 19-20, 1972. p. 5.

[9]_____. RO Inspection Report No. 070-1193/73-04. March 7-8, 13-14, 28-29, 1973. pp. 9-11.

[10]Ibid., p. 4.

[11]Roger Caldwell. Consulting report: Evaluation of employee exposures from the March 5, 1973 fire at the K-M plutonium plant. June 25, 1973. p. 6.

[12]Ibid.

[13]Interview with worker #50.

[14]Interview with worker #61.

[15]Ibid.

[16]Interview with worker #68.

[17]Ibid.

[18]Interview with worker #67.

[19]Interview with worker #52.

[21]Interview with worker #66.

[22]Interview with worker #64.

[23]Interview with worker #54.

[24]Interview with worker #50.

[25]Interview with worker #54.

[26]Interview with worker #57.

[27]Nuclear Regulatory Commission. May 20-22, 1975, op. cit., p. 11.

[28]Ibid.

[29]Ibid., p. 10.

[30]Interview with worker #52.

[31]Interview with worker #53.

CONGRESSIONAL HEARINGS

A special inspection was conducted November 21-22 and December 5-6, 1975, to investigate OCAW Union charges that K-M failed to: 1) educate and train workers; 2) keep exposures as low as practicable; and 3) take proper hygienic precautions and adequately monitor worker exposure. Investigators found three violations.[1] They listed examples provided by OCAW workers and assigned numbers to each. Twenty out of 29 charges were wholy or partially substantiated.[2] If the investigators could not prove the allegations, they reported the charges as not substantiated. In many instances, K-M management statements that incidents had not occurred outweighed prior statements made by workers. For example:

> For this Report, the inspectors relied heavily on management to evaluate the union reports of problems at the plant. In a situation in which workers were reprimanded for leaving a work area due to pressure changes in the room, only the supervisor was interviewed. Only management members were present at the meeting when the investigators explained the status of the investigation on November 22.[3]

Anthony Mazzocchi, OCAW vice-president, testified before Congress regarding the AEC report:

> The AEC chose to undercut the workers' concerns by finding faults and discrepancies with detailed verbal information that was presented solely as background material and not as specific allegations nor as specific legal violations. . . . For example, allegation number one is 'Kerr-McGee has about 60 percent workforce turnover annually.' The AEC determined that the figure was only 35 percent, but they included management and supervisory people who have a lower turnover rate, while we only intended the turnover rate to refer to the bargaining unit. The real point here is not whether Kerr-McGee's turnover rate is a violation of a regulation or the license (which it was never intended to be), but that a turnover rate of such proportions should put a heavy emphasis on proper training, as much of the workforce will lack extensive experience as found in many other plants. That emphasis on training was not and still is not evident at Kerr-McGee.[4]

NOTES

[1]Atomic Energy Commission. RO Investigation Report Nos. 070-925/74-05, 070-1193/74-10 and 040-7308/74-03. November 21-22, December 5-6, 1974. pp. 2-3.

[2]Nelson and Tucker. op. cit., p. 229.

[3]Ibid., pp. 231-232.

[4]Anthony Mazzocchi. Statement before the Subcommittee on Energy and Environment of the Committee on Small Business. U.S. House of Representatives. April 26, 1976. p. 97.

INSPECTIONS

AEC Files

Even before the K-M plutonium plant opened, there was a hint of the problems which were going to face inspectors. A fuel facilities inspector reported on December 11, 1969, ". . . there is evident reluctance to voluntarily submit written material to the AEC."[1]

K-M was cited for failure to immediately notify the AEC regarding an incident which occurred June 28, 1971, involving six workers overexposed to plutonium. The AEC report stated that "While Valentine provided us with the official explanation regarding broad scope interpretation of 'loss of facility,' we remain convinced that they knew better than that and were deliberately delaying notification until they had completed their own review and evaluation."[2]

The AEC inspectors were also concerned with the discrepancy in stories received from different K-M employees. The head of health physics and the technical director of health and safety claimed no one entered room 127 when it became contaminated June 28, but two other workers stated they entered the room that morning before precautionary measures were taken.[3] Supervisors may have been interested in hiding unsafe activites from the AEC inspectors.

During a closeout meeting between AEC inspectors and K-M personnel on January 16, 1973, K-M assured inspectors that drums of solvents being kept too close to the perimeter fence would be moved. The AEC inspectors did not report it as noncompliance since they were assured the drums were going to be moved. A report dated February 16, 1973, indicated the drums had not been moved as promised.[4]

Ilene and Gaylord Younghein of the Sierra Club reviewed AEC Public Records at the Guthrie, Oklahoma Public Library after receiving a telephone call about

follows in part:

> We are furious because Mr. Finn and Mr. Ridgway (of the AEC) gave us a public-relations type picture of a well conducted operation at Cimarron; one that held no unusual safety hazards for the employees. This is in sharp contrast to the general conditions that they reported in their inspection of the Cimarron Plant on June 18-22, 1973. In that report we noted seven new violations, three significant new problems and comments that six previously reported violations were still unresolved. Further, on page 8 under Management Interview it read: '. . . The inspector discussed the violations. He stated that most of the violations indicated a lack of concern for following procedures and posted limits and also an absence of management audit of performance of employees and enforcing compliance with the procedures.'
>
> This situation seems to typify the conflict that some of your personnel have been telling the public the unvarnished truth and promoting nuclear power. . . . It has now become so very obvious why we received the telephone calls from the anonymous workers at the plutonium plant. Incident after incident--report after report--words after words, and no improvement occurred. Apparently it was 'no big deal' to management. In view of all of the foregoing, the workers called us out of concern, frustration, and a feeling of powerlessness.[5]

The Youngheins also pointed out that the plant was licensed before K-M had responded to all the questions needed for an Environmental Impact Statement. They were appalled by the number of plutonium contamination incidents and the many violations documented in AEC reports. They were also concerned about the loss of qualified staff people.[6]

In a letter to the Youngheins dated January 11, 1974, the AEC admitted there were problems at K-M. A letter from James G. Keppler, Regional Director for Regulatory Operations in Region III of the AEC stated that ". . . as a result of the deficiencies identified by our inspection program during the past year, we met with Mr. McGee and other corporate management representatives on November 2, 1973, to discuss our concerns in this regard and the need for improving the quality of operations of the Cimarron facility.[7]

The October 19, 25-26 and November 2, 1973 inspection report indicated that five terminated individuals had not been replaced. Although some functions were undertaken by outside consultants, the AEC informed K-M

"that organizational losses were considered to be a factor in weakening the overall management control of operations at the plant."[8]

Despite statements that the AEC found no serious problems or unsafe practices at the K-M plant, AEC's Region III Director James Keppler met with Dean A. McGee, Chairman of the Board of Kerr-McGee Corporation, on January 7, 1975 to discuss problems at the Cimarron facility. AEC records show that the following items were discussed:

A. Reason for Meeting

i) Serious management control problems.

ii) Points of concern that were subjective i.e., gut reactions without true substantiation.

B. Items

i) No evidence that anyone in Kerr-McGee management outside of the plant was concerned with what was happening at the Cimarron Plant.

ii) Very concerned that Kerr-McGee management are not committed to ALAP on exposures e.g., have not replaced professional H.P.'s lost several years ago. Contamination incidents get short shrift if no limits are exceeded.

iii) Equipment used in plant is archaic, prone to breakdown or enhance contamination problem, e.g. slot boxes.

iv) The large number of procedural errors is the result of one or more of the following: personnel turnover, inadequate training or lack of supervision.

v) The "plutonium hold-up problem" has not received attention from the proper level of Kerr-McGee management.

vi) The company's public relations program deserves review.[9]

Several letters requesting that the Cimarron Facility be closed were sent to the AEC by Oklahoma citizens in early 1975. A form letter was drafted by the regional office and sent to headquarters for review. An agency memo to files stated, "Headquarters review (including OGC) felt the

proposed reply was 'defensive' and that they did not consider the letters from the public as warranting a reply."[10] (emphasis added)

An NRC memo dated June 25, 1975, states, "The attitude expressed by the licensee (K-M) that they are meeting the requirements of current license renewal applications rather than the approved license conditions gives cause for concern. The licensee was forcefully told by all the inspectors that they must meet the currently approved license conditions.[11]

A May 1975 report showed workers were not wearing finger rings needed to record exposures to the extremities.[12] The next NRC inspection did not occur until November 1975. The inspector stated that 10 employees selected from various crews and shifts were issued a ring for each hand. Apparently the NRC inspector only reviewed the health physics records to determine the finger ring exposures recorded, instead of determining whether the finger rings were actually being worn.[13] The problem noted earlier was that workers were not wearing finger rings. Issuance to a token number of employees did not really meet the requirements.

Workers always knew when the AEC inspectors would come for inspection, according to several workers.[14] There was no such thing as a "spot" inspection. They would fix up the plant and have everything all cleaned up by the time the inspectors came to make their official report.[15]

A former supervisor explained only certain incidents were "reportable" to the AEC. An incident that stopped production and shut down a portion of the plant for 24 hours was reportable, and the AEC had to be called right away. But, if you could "Mickey Mouse" around that, it need not be reported. K-M kept up production even when a serious leak or spill occurred; sparing only a few workers to begin clean-up. Production should have been halted so everyone could work on the clean-up process, but workers were required to wear respirators instead.[16]

One worker felt that Kerr-McGee was "crooked as a snake" in dealing with the AEC and falsifying reports. He said "You know, every place of work there is some lying and cheating going on, and it was no different at K-M." He said that the AEC was not notified of a lot of incidents that should have reported. When there was an accident, K-M would wait a long time, if they did report it, and downplay the error and contamination exposure.[17]

AEC inspectors were present when a shipment of plutonium came in for unloading at K-M. The plutonium would be piped from the truck to K-M storage tanks. Along the pipes there would be some leaks, so barrels were placed underneath the leaks to catch the excess. When these barrels were emptied at the end of the delivery, K-M was supposed to weigh it and pay for the amount in it before putting it in their tanks. When the AEC inspector took a coffee break, K-M would take the barrels and dump it into their tanks without the inspector knowing and thus, not have to pay for it. In liquid form, plutonium costs $21,500 per pound.[18]

K-M usually had too much uranium trash stored around the plant. When AEC inspectors were coming, workers took the trash to the dump and left it there until the inspection was over. Then, the trash was brought back, although they were only allowed to have a smaller amount of uranium trash on the premises at one time.

OSHA Inspections

OSHA inspected the K-M facility in August 1972 and found 23 OSHA regulation violations. Reinspected in January 1975, 52 violations, including three repeated violations from the prior inspection, were discovered.[19] According to a worker, when OSHA inspected the K-M plant in 1975, OSHA issued a citation on the respirators that the AEC claimed were okay.[20]

NOTES

[1]Atomic Energy Commission. G.P. Coryell memo to J.R. Roeder thru Boyce H. Grier, K-M Corporation. Cover letter to prelicense inspection. December 11, 1969.

[2]_____. G.P. Coyell memo to G.W. Roy. Compliance investigation report. September 8, 1971. p. 1.

[3]Ibid.

[4]_____. Cover letter to V.J. D'Amico from J.A. Hind. RO Inspection Report No. 070-1193/73-01. February 16, 1973. p. 1.

[5]Ilene and Gaylord Younghein. Correspondence to AEC. October 9, 1973. pp. 1, 3.

[5]W.G. Shelley. Attachment: plutonium plant standard operating procedures, to Ken Ridgway. October 13, 1973. pp. 3-5.

[6]James G. Keppler. Letter to Mr. and Mrs. Gaylord Younghein. January 11, 1974. p. 2.

[7]Atomic Energy Commission. RO Inspection Report Nos. 070-925/73-06 and 070-193/73-07. October 19, 25-26, November 2, 1973. p. 3.

[8]George Smith. "Summary of AEC and K-M meeting relative to the Karen Silkwood contamination incident investigation and the OCAW allegations investigation." January 29, 1975. pp. 3-4.

[9]James G. Keppler. NRC Files: letters from members of public regarding K-M. March 20, 1975.

[10]W.W. Kinney. NRC memo: inspector's evaluation of K-M Nuclear Corporation. June 25, 1975.

[11]Nuclear Regulatory Commission. May 20-22, 1975, op. cit., p. 10.

[12]_____. November 3-7, 1975. op. cit., pp. 4, 17-18.

[13]Interview with workers #52, 67, 70, 71.

[14]Interview with worker #69.

[15]Interview with worker #71.

[16]Interview with worker #67.

[17]Interview with worker #64.

[18]Interview with worker #67.

[19]Nuclear Regulatory Commission. Memo: K-M inspections OSHA and NRC and OCA. March 20, 1975. p. 1.

[20]Interview with worker #71.

QUALITY CONTROL

A review of the K-M license renewal submission of August 30, 1974, revealed the Quality Assurance Criteria were inadequate in regard to "description of the quality assurance program to be applied to the design, fabrication, construction, testing, and operation of the structures, systems and components of the plant."[1] Environmentalists expressed concern about the integrity of the fuel rods produced at the plant.[2] The AEC and its successor, ERDA, conducted inquiries into the quality control at K-M.[3]

The first report indicated several areas for concern, including the touching up of negatives of the rods with a black magic marker by at least one worker and a large number of chemical tests performed by another worker who allegedly had access to the answers sought.[4] Kerr-McGee instructed the inspectors about mid-1974 to stop examining all sides of the fuel rods and, instead, toinspect them without picking them up individually. Although visual inspection of only one-half the fuel rod was required, a former K-M employee said such inspection was not adequate.[5,6] The former practice of visually checking all sides allowed workers to see defects that might be missed under the new procedure.

A November 22, 1974 AEC memo stated, "There have been numerous criticality safety violation in the past two years, indicative of a lack of effective management control.[7] The Commission appointed a five-member task force to examine the quality of the K-M fuel rods on December 10, 1974.[8] Two members of the task force worked for companies with multi-million dollar investments in the FFTF project, and the other three worked for government or industrial employers with an investment in breeder technology.[9] The task force was aware of a K-M threat demanding that it be cleared of all allegations.[10]

Inspectors check end-cap welds on zirconium alloy rods containing nuclear fuel pellets prior to installation of the rods in a fuel assembly. Each rod contains about 200 one-ounce pellets and can supply the energy needed to generate enough electricity to meet annual residential requirements of about 200 people. A Westinghouse photo; courtesy of U.S. Department of Energy.

Completed nuclear fuel rods undergo a final visual inspection by an employee. With the aid of a computer, color and number coded labels at the end of each rod allow quality control personnel to trace the origin of zirconium in the rod. Each rod contains uranium dioxide fuel pellets and, in a nuclear power plant, can produce as much energy as more than 200 tons of coal. A Westinghouse photo by Jack Merhaut; courtesy of U.S. Department of Energy.

Radiographic and visual test methods were used to examine 56 fuel pins at the request of the task force, Next, two fuel pins were sectioned, thus examining four welds, two on each fuel pin. One of the four sections revealed a "large anomaly that extended from the end cap material into the weld zone."[11] Subsequent examinations suggested that "the anomaly was not a condition produced by a welding process," however, "no conclusion could be made on the origin of the anomaly."[12] The report does not indicate any effort to further examine fuel rods by the sectioning process.

NOTES

[1]Atomic Energy Commisstion. K.R. Ridgway correspondence and attachment to H.D. Thornburg. Kerr-McGee plutonium license renewal comments. October 8, 1974. p. 2.

[2]_____. G.P. Coryell memo to G.W. Roy. Compliance investigation report. September 8, 1971. p. 1.

[3]Ibid.

[4]Interview with worker #64.
Energy Research and Development Administration, op. cit., p. 28.

[5]Energy Research and Development Administration, op. cit., pp. 38-39.

[6]Interview with worker #56.

[7]Atomic Energy Commission. November 22, 1974 memo.

[8]General Accounting Office, op. cit., p. 11.

[9]Ibid.

[10]Ibid.

[11]Ibid.

[12]Battelle Pacific Northwest Laboratories. Report of findings from independent evaluation of FFTF fuel pins in lot KM-233. Prepared for U.S. ERDA under Contract AT(45-1):1830. June 20, 1975. pp. iii, 29.

SECURITY AND MATERIAL UNACCOUNTED FOR

The plant inventory as of December 1, 1970 was 161 kilograms of plutonium and 986 kilograms of depleted uranium.[1] This inventory violated license requirements, inasmuch as K-M was only allowed to possess 700 kilograms of depleted uranium at any one time. This was a repeated problem from September 1970 on.[2] Although details were withheld from public inspection, cover letters indicated that K-M failed to comply with the physical protection requirements of the license on several occasions, including: January 14-16, 1973,[3] March 16, 1973,[4] March 11-13, 1974,[5] May 6-9, 1974,[6] July 23-25, 1974,[7] August 21-23, 1974,[8] September 11, 1974,[9] February 18-22, 1975,[10] March 6-12, 1975,[11] and May 20-22, 1975.[12]

Security

A Kerr-McGee investigator explored a possible diversion of nuclear material by a plant employee, but he could not verify the possible diversion. A worker had reported a conversation with a neighbor in the Spring of 1974. The neighbor indicated her children had some pellets around the house for awhile, about 1970.[13] Interviews with various employees failed to verify the claim, although it had become clear to the interviewees that it would not be advisable to admit possession.

During an AEC interview with plant manager Morgan Moore and other K-M officials, "Moore agreed that conditions at both the uranium and plutonium plants three or four years ago were such that it would have been entirely possible for an employee working in those plants to remove a small quantity of pellets."[14]

Interviews with workers confirmed that security was lax and removing materials from the plants would not be difficult. Although none of the interviewees was sure plutonium or uranium was being smuggled out, they gave examples of how it might be done: plutonium nitrate could be carried out

in a five gallon container;[15] there were no scanners monitoring plutonium as one left the plant or workers stationed at the door to check for plutonium.[16] Others mentioned that waste barrels could be filled with pilfered plutonium. Guards would automatically shut-off monitors if the employee moving the barrels told the guards that wastes were being loaded. Once outside the plant the material could be thrown over the fence and picked up later.[17] The plutonium lab would be another place to remove pellets, according to one worker. The pellets could be put in a plastic bag, thrown out the windo, and picked up later by the smuggler.[18]

In fact, about 25 low-enriched uranium dioxide pellets and pellet fragments were discovered on the ground near the Safeguards Office Building outside the uranium plant on December 16, 1974. The AEC was not notified of the incident until the following day, all the pellets were not recovered until December 18. The material in the pellets was from a current production lot, and the AEC concluded that the pellets had been intentionally thrown outside the uranium building.[19] A worker related another incident about lax uranium plant security in an interview: a uranium production worker took a pellet of uranium to his son, who brought it to his school to the teacher and students.[20] This incident is not noted in AEC or K-M files.

Material Unaccounted For

Kerr-McGee had difficulty accounting for all of its plutonium. AEC files indicate that production was shut down to seek plutonium material unaccounted for (MUF) on several occasions, including March 1, October 2 and December 1, 1974.[21] A letter to K-M from AEC's regional director dated April 25, 1974, states, "As discussed with you during the March 21 meeting, it is imperative that appropriate steps be taken to assure compliance with the LEMUF value contained in your Operating License."[22] LEMUF refers

to the allowable material unaccounted for under the AEC license. The LEMUF permitted by condition of the license is 1.8 kilograms for each two-month period and 2.0 kilograms during any six-month period.[23]

An AEC memo dated November 24, 1974 states the following:

> The September inventory indicated a MUF loss of 8.5 Kgs. Pu ± 1.8 kgs. Pu. The magnitude of this loss resulted in an immediate new inventory. The October inventory resulted in a MUF gain of 8.8 kgs. Pu ± 2.0 kgs. Pu. This results in a net MUF gain of 0.3 kgs. Pu. which is within the LEMUF specification of 1.8 kgs. Pu. The September and October ending inventories were 281 Kgs. Pu and 296 kgs. Pu, respectively. Of the 818 kgs. Pu MUF gain resulting from the October inventory, Kerr-McGee contributed 8.3 kgs. Pu. to more precise measurement techniques (chemical and nondestructive) and 0.5 kg. Pu missed from the September inventory.[24]

In December 1974, National Public Radio reported that 44-66 pounds of plutonium were unaccounted for at the K-M plant in Oklahoma.[25]

A draft letter to K-M from the AEC regarding K-M's high MUF figures states, "As you are aware from the provisions of the letter sent to you on December 31, 1974, the sanctions available to the Nuclear Regulatory Commission in the exercise of our regulatory responsibilities include administrative actions in the form of written notices of violation, civil monetary penalties, and orders pertaining to the modification, suspension or revocation of licenses."[26] Records indicate that despite constant MUF problems at K-M, no financial penalties were ever assessed against it.

An employee related an incident during an interview concerning K-M's chronic MUF problem. K-M processed a Canadian shipment of plutonium (the employee was not sure if there was a record on this shipment). Canada only got back about one-half the plutonium it sent and was not happy about it. The worker speculated that K-M may have used the other one-half of the Canadian plutonium to make up for plant shortages.[27]

NOTES

[1]Atomic Energy Commission. Inspection Report. December 8-10, 1970. p. 6.

[2]Ibid. Listing of items in noncompliance. p. 3.

[3]_____. R.E. Kruesi letter to M. Moore (K-M). March 2, 1973. p. 1.

[4]_____. Erick L. May, Jr. memo to files. April 18, 1973.

[5]_____. J.G. Keppler letter to M. Moore. April 12, 1974.

[6]_____. May 31, 1974.

[7]_____. August 22, 1974.

[8]_____. September 26, 1974.

[9]_____. October 2, 1974.

[10]Nuclear Regulatory Commission. J.A. Hind letter to W.J. Shelley. March 19, 1975.

[11]_____. J.A. Hind letter to M. Moore. April 24, 1975.

[12]_____. J.A. Hind letter to W.J. Shelley. June 12, 1975.

[13]Atomic Energy Commission. G.A. Phillip memo. Possible theft of SNM. June 5, 1974. pp. 1, 3.

[14]Ibid., p. 1.

[15]Interview with worker #57.

[16]Interview with worker #64.

[17]Interview with worker #67.

[18]Interview with worker #64.

[19]Nuclear Regulatory Commission. RO Investigation Report No. 74-06. December 19-20, 1974. (Cover letter March 5, 1975). pp. 2-4.

[20]Interview with worker #52.

[21]Atomic Energy Commission. Peck memo to J.A. Hind. Comments on K-M summary report, invetories of February and March 1974. April 2, 1974. p. 1.
_____. J.G. Keppler letter to P. Dunn. October 2, 1974.

[22] _____. J.G. Keppler letter to W.J. Shelley. April 25, 1974.

[23] _____. J.G. Davis memo to J.G. Keppler. January 3, 1975.

[24] _____. J.A. Hind memo to H.D. Thornburg. November 25, 1974.

[25] "Plutonium missing at production unit of K-M Corp." Wall Street Journal. December 30, 1974.

[26] Nuclear Regulatory Commission. Draft letter from J.G. Keppler to R.T. Zitting. January 21, 1975. p. 2.

[27] Interview with worker #67.

WORKER CONDITIONS IN KERR-McGEE MINING AND MILLING

The fuel fabrication plants were not the only facilities where K-M workers faced health hazards from ionizing radiation. Uranium miners also faced radiation hazards in underground uranium mines. In 1967, K-M employed approximately 555 miners and technical and supervisory personnel in underground uranium mines.[1] K-M representatives protested proposed regulations to reduce radiation exposures in underground mines at Congressional hearings in 1967, arguing they could not meet the proposed standard and that low levels of radiation were not necessarily harmful.[2]

Airborne radon gas, present in uranium mines, created a larger threat to miners' health than the immediate physical hazards faced daily by the miners. Radon decays, producing a series of isotopes called "radon daughters."[3] These radioactive particles pose a danger to living organisms because they ionize in living cells. Ionization changes the atomic structure of atoms in cells, including the genetic material. The miners inhaled radon gas, and radon daughters lodged in their lungs. In many cases, lung cancer later developed.[4]

European studies show that between 50-75 percent of Nineteenth Century pitchblend miners died from lung cancer. Europeans found cancer dangers could be reduced by ventilating the mines for the price of about one percent of the mines' total operating cost.[5]

"The lack of ventilation was the biggest problem back at that time." according to miner Leroy Nahkai of Red Rock. "Kerr-McGee didn't have any vent lines to blow all that radioactive contaminated air out of the tunnels. I found out later that they should have had fans in the mines, but we didn't know much about uranium mining when we started."[6]

Dr. LuVerne Husen, director of the Shiprock Public Health Service described the Cove K-M operations as ". . . a get rich scheme that took advantage of Navajo miners who didn't know what radioactivity was or anything about its

Miners are installing hydraulic roof jacks for temporary support of the roof of a working place. Nets (on roof) and mats (on wall) are installed to prevent falling and slabbing rock. They are held in place by roof-bolts. Photo courtesy of Department of Energy.

hazards."[7]

"They chased us in there like we were slaves," according to one miner. "I remember that it used to be so dusty that we were always spitting up black stuff and how when we went home we all had headaches from breathing all that contamination!"[8] But miners suffered more than headaches. Twenty-five of the 100 miners of the Red Rock Navajo Chapter have already died of cancer, and more are feared dying.[9] In addition to lung cancer, the miners suffer from chronic bronchosis, emphesema, pulmonary fibrosis, and other non-malignant respiratory problems.[10] Kerr-McGee refuses to voluntarily pay worker's compensation to any of the mines' victims.

Inadequate precautions were taken in 1969, when the Cove uranium mines were closed, to prohibit small children from entering the abandoned shafts.[11] Storm runoff from a K-M abandoned refuse dump for impure uranium and slag, and the inadequately closed mine contaminate a nearby water supply. Livestock drinking the water and children playing in the water have developed skin sores.[12]

NOTES

[1] Radiation exposure of uranium mines: hearings before the Subcommittee on Research, Development and Radiation of the Joint Committee on Atomic Energy. 90th Congress, 1st session., Pt. 1. 486(1967).

[2] Ibid. pp. 484-499.

[3] Tom Barry. "The Navajo lung cancer widows." The Navajo Times. August 24, 1978. p. B-14.

[4] Ibid.

[5] Ibid. p. B-13.

[6] Ibid.

[7] Ibid.

[8] Ibid., p. B-14.

[9] Ibid., p. B-13.

[10] _____. "Red Rock widows seek compensation." The Navajo Times. September 7, 1978. p. B-9.

[11] Ibid.

[12] Ibid.

CONCLUSION

The Kerr-McGee Cimarron Facility record of operations substantiates allegations by federal agencies and the Oil, Chemical and Atomic Workers, representing K-M production line personnel, against the K-M Nuclear Corporation of inadequate training, repeated license violations and near-total disregard for worker safety. It is also evident that the AEC/NRC failed to take disciplinary action against the Corporation when these serious violations were repeatedly noted.

Kerr-McGee was authorized by the AEC to possess and use plutonium at its Cimarron Plant. Uranium was used to produce pellets for light water reactor fuel fabrication. Both are radioactive, and low levels of radiation can cause cancer. K-M had a contract, until 1975, with the Westinghouse Hanford Company for fabricating plutonium-bearing fuel rods for the FFTF. The AEC had the power to force compliance with license health and safety regulations, or to level disciplinary action against the plant.

The 1969 AEC prelicense inspection report called for 160 hours of classroom/on-the-job training. By 1974, the K-M license renewal application included only 20 hours for radiation safety training. The AEC noted this training deficiency in its inspections, but failed to force K-M to improve the program. K-M training classes were held when a sufficient number of new employees were available to make the class "practical." Thus, new workers were placed on the production line for days or weeks without proper training.

Inadequate training increases chances for employee accidents and injuries--one worker fatality was caused in part by poorly trained personnel. One hundred thirty-eight workers were overexposed in 40 reported contamination incidents. A number of these contaminations were attributed to untrained or poorly trained employees. See Appendix 2 for more detailed information about these incidents.

Safety procedure violations noted by the AEC indicated a lack of corporate concern for following procedures and posted limits and enforcing as low as practicable (ALAP) exposure levels. Records show:

1. no in-house fire fighting training or emergency procedures;
2. failure to retain a full-time in-house health physicist for the operating life of the plant;
3. faulty filtering and monitoring devices;
4. grossly inadequate clean-up procedures and practices;
5. improper labeling and storage of highly radioactive wastes;
6. improper shipment of leaking radioactive waste containers;
7. lax security measures; and
8. inadequate design, fabrication, construction, testing and plant component Quality Assurance Criteria descriptions.

Westinghouse representatives wrote approximately 60 discrepancy reports to Kerr-McGee. These deficiences were oriented toward noncompliance with procedures, specifications or the contract. Interviews with former workers and internal memoranda concerning serious MUF problems, off-site contaminations and pollution further indicate K-M noncompliance with its license. K-M clearly jeopardized not only the health and safety of workers, but members of the community as well.

Repeated license violations and hostile company managers were noted by the AEC for several years, yet the Commission did little except point out violations to K-M. For example, as late as July 1975, the NRC noted, ". . . the relatively large number of noncompliance items identified by our augmented inspection effort (14 noncompliance items during 4 health and safety inspections . . .) is indicative of the need for additional improvement in certain management controls. . . ."[1]

ment in certain management controls. . . ."[1]

The Atomic Energy Commission responsibility to ensure safe operating procedures was apparently pre-empted by its desire to promote nuclear technologies. Fortunately, the expiration of K-M's contract closed the plant down; but it does not excuse the AEC/NRC's failure to fulfill its mandate to enforce license regulations designed to protect the health and safety of workers and the general public.

NOTES

[1] J.G. Davis. NRC memo re. Kerr-McGee intensified inspection program docket no. 70-1193. July 29, 1975.

APPENDIX ONE

Work Accomplished as of December 1978

Work under the grant included establishing files on all workers identified and developing questionnaires and interview formats for co-operating workers. Working conditions at the K-M facility were evaluated through government records and worker interviews.

Two lists of employees at the plant in 1972 and 1974 were obtained, totaling 348 names. Only 50 of the 254 workers at the plant in 1972 were still employed there in 1974. Fifty-eight additional workers were identified through union contracts, research of AEC/NRC records, and personal interviews with former workers.

Letters inviting participation in the Environmental Policy Institute's (EPI) Worker Health Follow-up Study were sent to all identified workers at their last known address. The Post Office returned about 140 letters. Thirty-two workers responded they were interested in participating in the project and two sought additional information. The wife of a former worker wrote that he was deceased, and five responded that they were not interested in participating.

Telephone directories for Oklahoma City and small towns within a 70-mile radius of Oklahoma City were checked for listing on workers whose letters were returned or who had not responded to the first mailing. City directories available at the Library of Congress were also consulted. EPI's local project consultants, who were former Oil, Chemical and Atomic workers Union representatives, also sought names and addresses of K-M employees who had moved.

Shortly after EPI mailed the first letters to the workers, Kerr-McGee Corporation sent a letter to workers designed to discourage participation in the study (see page 83). The Corporation subpoenaed Kitty Tucker, project director, in regard to litigation involving the contamination of Karen Silk-

KERR-McGEE CORPORATION
KERR-McGEE BUILDING • OKLAHOMA CITY, OKLAHOMA 73102

August 20, 1977

MORGAN MOORE
PRESIDENT

Dear Former Cimarron Employee:

You may have recently received correspondence from a Ms. Kitty Tucker who represents herself to be the project coordinator of a Washington, D.C. organization known as the Environmental Policy Institute. That correspondence requests your cooperation in a project to locate those persons who worked at Kerr-McGee's Cimarron Facility and solicits your participation in a study seeking information about the time which you spent working at the Cimarron Facility, possible exposure or contamination incidents while you worked there, and your general state of health at this time.

You should be aware that Ms. Tucker is, or has been, the President and a member of the Board of Directors of an organization known as Supporters of Silkwood, Inc. That organization has published several newsletters concerning Karen Silkwood, her activities at the Cimarron Facility, and her death. Representatives of that organization have supported the pending litigation brought by Karen Silkwood's father and her former husband against Kerr-McGee and several of its officers, directors and employees, and have encouraged contributions to help finance that litigation. Moreover, the principal attorney for the plaintiffs in that suit is, or has been, an officer and director of Supporters of Silkwood, Inc. Ms. Tucker, apparently a resident of Washington, D.C., has appeared in Oklahoma to solicit support for the activities of Supporters of Silkwood, Inc.

You should also be aware that the Environmental Policy Institute is not an agency of the United States Government.

We do not know the purpose of the Environmental Policy Institute, nor do we know the purpose of the study referred to in Ms. Tucker's letter; however, we felt that we should advise you, as an employee or former employee of Kerr-McGee Corporation or Kerr-McGee Nuclear Corporation, of the matters set forth above.

If you have any questions regarding this matter, please contact Mr. Wayne Norwood at the Cimarron Facility, Crescent, Oklahoma, 232-5471.

Very truly yours,

Morgan Moore

Morgan Moore, President
Kerr-McGee Nuclear Corporation

wood at her apartment. Attorneys representing Ms. Tucker advised her that any personal knowledge she had of workers participating in the study might have to be revealed under depositions, although no documents need be produced without a separate subpoena to EPI. They advised discontinuing work on the project until K-M intentions became clear, as the depositions had already revealed a pattern of harassment and intimidation of persons concerned with the Silkwood case and health and safety at the plant.[1]

Workers agreeing to participate in the follow-up were sent a brief questionnaire about their current state of health. In Spring 1978, a brochure on the danger signs of cancer and a booklet "The Cancer Story," provided by the U.S. Department of Health, Education, and Welfare were sent to the participants.

Two interviewers began personal, in-depth interviews with participating workers in Summer 1978. Twenty-two interviews were completed in July and August.

Experts in the field of radiological health, Dr. Donald Geeseman and Dr. Dean Abrahamson of the University of Minnesota, were consulted. Both had gone to Oklahoma at the request of the OCAW Union to teach Cimarron workers about plutonium and other radioactive materials. Recent literature on ionizing radiation health impacts was reviewed, including works by Drs. Thomas Mancuso, Alice Stewart, George Kneale, Irwin Bross, John Gofman, Helen Caldicott, and Ernest Sternglass. Hanford Environmental Health Foundation records were obtained and studied. That Foundation maintains the National Transuranium Registry, which follows workers exposed to plutonium. The K-M Corporation refused to participate in the Registry.

All available government reports from the AEC and NRC were reviewed to gather information about problems identified by government inspectors at the K-M facility. Approximately 2,000 pages of documents were reviewed. Every

reported radiation contamination incident was extracted, and the number of workers involved in each incident determined. Forty radiation contamination incidents were reported, involving 139 workers. The names of 104 persons involved in the incidents were ascertained through consultation with local union consultants and other parties interested in this project.

Future Plans

Contact will be maintained with cooperating workers through letters to the workers at least twice a year. Workers experiencing health problems will be asked to sign medical release forms so their medical records can be reviewed by an appropriate health professional. Further interviews with workers wishing to cooperate but not residing in the Oklahoma City area or who have only recently learned of the study should be contacted.

NOTES

[1] Howard Kohn. "Karen Silkwood was right in plutonium scandal." The Rolling Stone. October 20, 1977. pp. 50-53.

APPENDIX TWO

REPORTED CONTAMINATION INCIDENTS AT K-M FACILITY

Year	No. of Incidents	No. of Exposures
1970	9	28
1971	5	38
1972	4	13
1973	5	15[a]
1974	13	30
1975	6[b]	8[c]
TOTAL	42	132

[a]Does not include numbers of exposed workers for an incident occurring 12/1/73.
[b]Includes an incident without a recorded date.
[c]Does not include numbers of exposed workers for an incident occurring 4/7/75.

The above figure indicates the number of contamination incidents and people exposed at the Kerr-McGee Crescent, Oklahoma facility. On the following pages, each of these incidents are described in detail, and as available, the radiation doses received by victims are noted.

INFORMATION CONCERNING RADIATION INCIDENTS

Incident	Description	Exposure[a]
1	On the morning of May 8, 1970, a worker was overexposed while wiping up an oil and plutonium spill from a pump motor. A leaky valve gasket on a tank inlet line caused the spill.	
2	On May 11, 1970, an incident occurred when a supervisor was contaminated while lying on his back to repair a leaky valve and piping. The plutonium may have leaked into his protective clothing while he was on the floor.	
3	On April 21, 1970, two people were overexposed when a bag placed inside a fiber pack ruptured, releasing a small amount of plutonium.	
4	In May, 1970, eight employees were overexposed to concentrations of airborne radioactive material in excess of 10 CFR 20 from an unknown source.	
5	On July 7, 1970, air filter samples indicated airborne plutonium during routine wet plutonium work in slot box "W." Apparently, turbulance in the normal air flow pattern through the slot opening in the box carried the plutonium outside the box, overexposing 6 workers.	1--2.6 MPC
6	From July 13-15, 1970, the air filter again detected airborne plutonium under the same conditions as on July 7. This time, three workers were contaminated.	1--1.5 MPC 2--1.3 MPC

7	On August 7, 1970, two workers were exposed to high airborne radioactivity in the wet ceramic area (room 128). A glove at the exit end of the calciner failed at the retainer ring, and the radioactivity escaped to the outside.	2--1.2 MPC
8	On August 11, 1970, three workers were contaminated by a leaky storage tank valve in the scrap recovery area (behind glovebox 2B in room BO-1).	1--1.7 MPC 2--2.3 MPC
9	On October 20, 1970, a contaminated glovebox in the scrap recovery area (room BO-1) resulted in the overexposure of two workers.	1--15.8 MPC 1-- 2.7 MPC
10	On January 18, 1971, 22 employees were exposed to high airborne levels of radiation when an initial alarm failed to alert workers that glove box (2C in room BO-2) filters were partially plugged. As negative pressure was lost in the glove box, and radiation escaped to the outside.	1--18.3 MPC 5--10.0 MPC 16--<10 MPC
11	On April 19, 1971, an employee not familiar with procedures allowed the pressure in a storage tank to become too high. The tank vented and the released radiation contaminated 3 employees.	3--38 MPC
12	On June 16, 1971, as a result of operator error and improper piping design, six employees were exposed to liquids containing plutonium leaking from a chemical addition funnel on top of a glove box.	5--3.0 MPC
13	On June 28, 1971, plutonium-bearing liquids leaked from a chemical addition funnel on top of a glove box during the transfer of plutonium nitrate from a wall storage tank. Improper piping design and the failure to valve off the funnel drain line led to the overexposure of 5 workers.	3--123 MPC

14	Two workers were exposed on November 23, 1971, when their glove box gloves (on Box 5A, room 128) deteriorated from chemical atmosphere exposures and plutonium escaped to the outside.	2--1.15 MPC
15	On February 24, 1972, two employees were exposed (in room BO-2) while removing some valve handles. Contamination on the handles, that had been fixed by paint, was released into the air during the removal process.	2--6.6 MPC
16	Six employees were overexposed by an unknown source on June 21. 1972. during a glove box window change operation.	4--2.5-2.9 MPC 2--.4 MPC
17	On November 11, 1972, two employees were overexposed when a glove they were using was punctured by a sharp instrument allowing airborne plutonium to escape.	1--8 MPC
18	Seven workers were exposed on March 5, 1973, when a fire broke out while they were removing plutonium contaminated waste materials from a glove box. Radio frequency emissions from a sealer may have caused spontaneous combustion of highly nitrated and degraded resin wastes. The released plutonium was detected in both the wet ceramic and scrap recovery areas.	1--283 MPC 1--2.4 MPC 1--195 MPC 1--.5 MPC 1--.2 MPC
19	Faulty air flow problems in a glovebox on July 10, 1973, exposed one worker to highly radioactive airborne particles.	1--1.3 MPC
20	On April 17, 1972, an operator and two maintenance men were contaminated while replacing a pump in a glove box in the wet ceramic area. The maintenance men left the plant site before the operator discovered, curing a routine survey, that he was contaminated due to a glove failure. The maintenance men, who did not undergo an adequate survey before leaving the plant, were also contaminated.	

21	External contamination on a box seam (in room 128) on November 1, 1973, overexposed seven workers to airborne plutonium while using the glove boxes (8 and 10).	1--1.6 MPC 4--1.2-1.6 MPC 2--1.2 MPC
22	Two employees were exposed to airborne plutonium on November 29, 1973. One worker discovered a one inch slit in the glove (on box 2 in room 127) but not until after a second employee had entered the area without a respirator.	1--1.5 MPC
23	On December 1, 1973, electrical arcing between a bare flexible copper power strip and the bed of the dielectronic sealer burned a hole in a glove box bag (on glove box #26 in room BO-1) releasing airborne plutonium. An unknown number of operators, wearing respirators, were in the room at the time.	
24	On February 10, 1974, a vacuum gauge was blown out of its O-ring retainer during backfilling with nitrogen following pellet out-gassing. Two employees working there at the time donned respirators, left the area, contacted plant health physics personnel, and the room was posted. The two workers were exposed despite their actions.	2--1.4 MPC
25	On February 13, 1974, an employee discovered a hole in the glove box glove he was using (room 128, box 5A) while changing out a pump. Three employees were exposed.	
26	On January 5, 1974, an employee (working at glove box 14) jabbed a piece of screen wire through his glove into his left forefinger.	
27	On May 21, 1974, a defective glove box (room 128, glove box 8-10) contaminated the employee working with it.	1--2.4 MPC

28	A defective glove box glove led to the contamination of 5 employees on August 21, 1974. An employee noticed a dime-sized hole in the glove box glove he was using when the continuous air sampler alarm sounded.	5--2.9 MPC
29	Three people on the late shift were exposed to an unknown source of contamination before high air samples of radioactive particles were discovered on the morning of July 31, 1974.	
30	On November 5, 1974, a worker discovered contamination during a routine survey. Air sample filter papers showed no airborne activity, but the insides of the glove box gloves the emploee used showed signs of contamination from an unspecified source.	
31	On November 6, 1974, the same worker found contamination on herself during a routine exit survey. The source of contamination was not found.	
32	On November 7, 1974, the worker's apartment was found to be the source of contamination of the worker and two other people. Highest counts were found on cheese and cold cuts in the refrigerator.	
33	During the early morning hours of November 14, 1974, a worker discovered a hole in the glove box he was using after rubbing his lips and nose with his contaminated gloved hand.	1--1.8 MPC
34	On the evening of November 17, 1974, four overexposed employees evacuated the area (room 127) when the automatic alarm sounded. The alarm may have been triggered by overpressurization of a glove box being purged too fast with an inert gas.	4--4.2 MPC
35	On December 17, 1974, the left hand of a clerk was contaminated with plutonium leaking from a package of waste in the ion exchange area.	

36	Four workers were exposed to an estimated half gallon of liquid containing plutonium on December 17, 1974. The liquid leaked from a dissolver well of a glove box through a thermocouple connection which had been inserted into an opening in the dissolver well wall and never fastened in place by the equipment supplier.	4--1.3 MPCa 2--140 MPChrs 2--53 MPChrs
37	On March 23, 1975, a can inside some plastic bagged material exposed three workers carrying the containers when it cut through the plastic and released plutonium near an air sampler.	3--12 MPCa
38	On February 27, 1975, an employee installing a new column on a broken ion exchange column got a sliver of contaminated glass in his finger. The contaminated glass was left from an earlier (apparently inadequate) clean-up operation.	
39	During a bag-out operation on April 7, 1975, arching--attributable to a metal can in the bag located too close to the area being sealed--made a hole in the bag. An unknown number of people were in the room after the hole was patched, without respirators, when the air monitor sounded.	
40	Someone had positive nasal smears after being exposed to plutonium at the plant.	
41	On October 21, 1975, at least 2 workers were exposed while assaying a bag containing contaminated furnace boats. The bag ruptured after falling off a laboratory jackstand.	
42	A worker's finger was cut by contaminated wire on October 24, 1975.	

[a]MPC = maximum permissible concentration.

MPCa equals MPC averaged.
MPChrs equals MPC hours.

APPENDIX THREE

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON 20545

January 9, 1975

Mr. George F. Murphy, Jr.
Acting Executive Director
Joint Committee on Atomic Energy
Congress of the United States

Dear Mr. Murphy:

As was promised during our January 6, 1975 meeting in your office, please find enclosed a copy of summaries of the 11 quality assurance and/or technical audits that were conducted by the Hanford Engineering Development Laboratory (operated by Westinghouse) at the Kerr-McGee plant during the period October 1972 to November 1974.

Sincerely,

T. A. Nemzek, Director
Division of Reactor Research
and Development

Enclosure:
Summaries of Audits

FUELS QUALITY ASSURANCE
Date November 20, 1974
Subject SUMMARY OF AUDITS CONDUCTED BY HEDL AT KERR MC GEE DURING THE PERIOD OCTOBER, 1972 TO NOVEMBER, 1974

Hanford Engineering Development Laboratory

To: D. L. Garland

cc: File/LB CA Burgess JF Williams
LH Rice EA Evans

Attached are summaries of 11 quality assurance and/or technical audits conducted by HEDL at the Kerr McGee plant during the period October, 1972 to November, 1974.

Type of audit and date performed were as follows:

Type	Date
Process	October, 1972
General Quality Assurance/ Technical	November, 1972
Welding, Special Process	November, 1972
General, Technical	November, 1972
Technical, Localized Pellet Contamination,"White Spot" Problem	July, 1973
Technical, Localized Pellet Contamination,"White Spot" Problem	August, 1973
Quality Assurance, Fuel Pellet Process Specification, KM-NP-30-2	November, 1973
General, Technical	February, 1974
Quality Assurance, Inspection of Driver Fuel Pin KM-NP-18-39	June, 1974
Quality Assurance, Fired Fuel Pellet Control, KM-NU-18-49	July, 1974
General Quality Assurance/ Technical	November, 1974

In addition, numerous routine audits were conducted by the HEDL QAR and reviews were made at Kerr McGee to identify and obtain resolutions to problems as noted in the summary. Follow-up reviews by HEDL indicate that corrective action was taken as noted in the summary.
Our review of the details of the audits reveal nothing which would support allegations of falsification of quality records by Kerr McGee.

J. F. Williams, Manager
Supplier Engineering

H. C. Powers, Manager
Fuels Quality Assurance

HGP:lb

SUBJECT

TECHNICAL AUDIT - October 4, 1972

Operations audited were co-precipitation, milling and blending, slugging, and pressing.

Action Taken:

Kerr McGee agreed to begin recording weight of powder charged into the ball mill.

SUBJECT

Q.A. AUDIT BY WESTINGHOUSE HANFORD, NOVEMBER 27 - DECEMBER 1, 1972

Highlights

Quality Assurance deficiencies requiring corrective actions were identified in procurement, source surveillance, receiving inspection, control of measurement/test equipment and standards, material identification and control, special process control, control of processes, selection and control of material archives, and internal audits. A brief summary of the findings and corrective actions by Kerr McGee is as follows:

Procurement

Findings: Deficiencies were noted in acceptable source lists, QA approval of procurement documents, pre-award audits, subcontractor calibration requirements, source surveillance procedures, documentation and release of received hardware items, storage of received hardware items, and in corrective action with suppliers.

Corrective Action: *Corrective actions were taken to correct these deficiencies.*

Control of Measurement/Test Equipment and Standards

Findings: Deficiencies were noted in traceability of calibration standards, calibration procedures, lack of calibration of some inspection equipment, and in auditing of the calibration system.

Corrective Action: *Corrective actions were taken to correct these deficiencies.*

Special Process Control

Findings: Deficiencies were noted in radiography techniques, radiograph identification, in the control of the radiography process, and in the effectivity dates of radiography personnel.

Corrective Action: *Corrective actions were taken to correct these deficiencies.*

Material Identification & Control

Findings: Deficiencies were noted in cleanliness control of cladding tubes, in lack of indication of inspection status of some materials, handling and cleanliness controls, in identification records of hardware components, and in control to prevent inadvertant mixing of recycle and master blended coprecipitation materials.

Corrective Action: *Corrective actions were taken to correct these deficiencies.*

Control of Processes

Findings: Deficiencies were noted in control of the fuel pellet sintering process and in lack of conformance to process specifications for producing coprecipitation and fuel pellet products.

Corrective Action: *Corrective actions were taken to correct these deficiencies.*

Material Archive Control

Findings: Deficiencies were noted in the storage of metallic hardware and uranium oxide archives.

Corrective Action: *Corrective actions were taken to correct these deficiencies.*

Audits

Findings: Audit schedules did not include audits of the calibration program and solution blending and coprecipitation processes. No personnel had been trained to audit or perform surveillance of solution blending and coprecipitation process.

Corrective Action: *Corrective actions were taken to correct these deficiencies.*

SUBJECT

SPECIAL PROCESS AUDIT OF WELDING QUALIFICATION, NOVEMBER 1972

Highlights

An audit was made by the Westinghouse QAR of Kerr McGee weld qualification efforts.

Findings: Deficiencies were noted in metallic hardware quality, in calibration of weld control equipment, and in calibration of the helium leak detector.

Corrective Action: *Corrective action was taken.*

SUBJECT

TECHNICAL AUDIT - *November 7, 1972*

Reviewed pellet homogeneity qualification, insulator pellet fabrication, pre-production qualification status, weld qualification status, gas tagging status, inconel overchecks by subcontractor, calibration standards, and fissile content.

Actions Taken:

HEDL provided marked up copies of plenum spacer and end cap drawings.

Kerr McGee agreed to check analytical method of inconel reflector subcontractor and obtain necessary corrective action.

HEDL and Kerr McGee agreed to a follow-on meeting to discuss contract implications of a shortage in analytical chemistry calibration standards. Note: The shortage of standards was subsequently overcome.

SUBJECT

TECHNICAL AUDIT - July 24 - 27, 1973

Review potential sources of localized pellet contamination "white spot" problem.

Findings:

Deionized water used for nitric acid, aqueous ammonia, and UNH dilution was found to contain significant amounts of solid residues when distilled. Head tanks contained visible settled solids. The water supply tank had evidently experienced entry of concrete dust and other settled materials washed into the tank from an overhead leak during building modifications. Other potential sources of contaminant entry during aqueous processing included the ph electrode pot which had been reported as plugged with broken glass; the viton (R) stator of the Moyno pump; gooseneck tank vents open to hood air without filters; and polypropylene felt filters for $ADU\text{-}Pu(OH)_4$ collection open to hood air. Bottom interiors of sinter boats show evidence of joining of pellets to boat bottoms. Pellets required mechanical breaking of pellet-to-boat bonds.

Action Taken:

Water supply tanks manually cleaned.

Will use distilled water on next production lot (200 KG).

Main water supply tank covered.

Glass shards cleaned out and screen to be installed between $ADU\text{-}Pu(OH)_4$ slurry pump suction and ph electrode pot.

Plan to burnish Mo boats to remove residues.

Installation of catch pan over open hopper feeding dried powder mill.

SUBJECT:

TECHNICAL AUDIT - August 1 - 3, 1973

Review potential sources of localized pellet contamination "white spot" problem.

Findings:

Much volatile material is released to the glove box during sintering. Filtering and cleaning areas are just above entering trays (boats). Flakes are widely dispersed in glove box. Small "furnace whiskers" are evident on interior baffles. Startup from banking at 1400 °C always deposits flakes on trays. Internal reflux of volatile impurities could be a prime source of the problem.

SUBJECT

NOVEMBER 1973 *AUDIT OF KM-NP-30-2, "PROCESS SPECIFICATION FOR FFTF MIXED OXIDE FUEL PELLETS"*

Highlights

A mini-audit was performed by the Westinghouse QAR to assess Kerr McGee compliance to this process specification.

Findings: Eight deficiencies were noted relative to compliance with the specification.

Corrective Action: *Corrective action was taken to prevent further non-compliance.*

SUBJECT

TECHNICAL AUDIT - February 14 - 15, 1974

Findings:

Some instruments were not under calibration control or calibration was not current.

Some apparent potential for oil back diffusion from mechanical pum to vacuum storage containers.

One procedure did not have signature approval.

Inadequate control of miscellaneous materials in process line.

Potential for errors in recorded fuel column weights due to the fact that glove box operator must remove hands from glove box to record gross and tare weights (length of time between weighing and recording is excessive and distractions do occur).

Action Taken:

Corrective action commitments obtained on all findings. Roller micrometer not yet under the calibration control system.

SUBJECT

JUNE 1974 *AUDIT OF KM-NP-18-39, REV. 2, "INSPECTION PROCEDURE FOR THE FFTF DRIVER FUEL PIN", ATTACHMENT #1, "TAG GAS PIERCING" AND ATTACHMENT #2, "INSPECTION OF TAG GAS CAPSULE LOADING"*

Highlights

A mini-audit was performed by the Westinghouse QAR to assess Kerr McGee compliance to this inspection procedure.

Findings: Sixteen deficiencies were noted with respect to fuel pin inspection procedure.

Corrective Action: *Corrective action was taken by making needed procedure revisions or by correcting the noncompliance with current procedure.*

SUBJECT

JULY 1974 AUDIT OF KM-NU-18-49, REV. 4, "FIRED FUEL PELLET CONTROL"

Highlights

A mini-audit was performed by the Westinghouse QAR to assess Kerr McGee compliance to this control procedure.

Findings: Four minor deficiencies were noted with the way sintered fuel pellet density control sheets were being established.

Corrective Action: *Corrective actions were taken.*

SUBJECT

DRAFT AUDIT FINDINGS OF NOVEMBER 13, 14, and 15, *1974 - AUDIT OF KERR MC GEE*

Findings:

- A major alumina contamination problem was found in the pellet processing operation. Alumina powder was being used to prevent bonding of boat to-boat contact surfaces by Kerr McGee without HEDL approval.
- Poor control over glove box cleanliness was cited.
- Material control was found unsatisfactory in some areas.
- Some practices used for segregation and quality status identification of nonconforming fuel pins, pellets, and gas tag capsules were inadequate.
- Two procedures did not adequately detail the information required to perform the operation. One out-of-date procedure was found in use. Two process control procedures were not correctly implemented.
- Occasional poor radiograph film quality caused by processing and development techniques was found. Additional radiographs were being taken when this occurred.
- A corrective action request had not been issued to a key supplier that had caused a significant quality problem (cladding inclusions). No open purchase order existed with that supplier at the time of the audit.

Corrective Action:

The findings were reviewed with Kerr McGee management on November 15, 1974 and found to be accurate. Kerr McGee agreed to evaluate causes and provide a report within 30 days of receipt of formal audit report, detailing corrective actions taken or planned. The HEDL QA Representative at Kerr McGee reports that immediate remedial action has been taken by Kerr McGee to eliminate the alumina contamination, which was considered to be the most important finding on this audit.

SUBJECT

ROUTINE SURVEILLANCE AUDITS OF PROCESS AND PRODUCT

Highlights

During the course of the Kerr McGee contract approximately 60 discrepancy reports have been written by the Westinghouse QAR to Kerr McGee.

Findings: The findings presented in these reports have covered a broad range of process and inspection deficiencies. These deficiencies have been oriented toward noncompliance with procedures, specifications or the contract.

Corrective Action: *Kerr McGee has taken required corrective actions.*

SUBJECT

OTHER REVIEWS AND DISCUSSIONS AT KERR MC GEE

March 28, 29, 1972

General discussions of data acquisition system, process specifications and operating procedures, equipment status, and facility status.

May 10, 11, 1972

Review and discussions of pellet process parametric studies, fuel pin hardware procurement, equipment status.

June 14, 15, 1972

Review of documentation submittals, equipment and facility status, hardware procurement status, UO_2 feed material, UO_2 process specification, and fuel pellet fabrication process.

February 5 - 9, 1973

Review of schedule, pressing, sintering, grinding, data cards, gas tag process, weld qualification, fuel pellet process specification.

Findings:

- No process control charts in use for sintered pellet dimensional control although samples were being taken.
- Dusty looking substance was being vented from the inlet end of the sintering furnace and loosely depositing on glove box walls directly above green pellets.
- PVC coated SS wire was being used to push pellets through grinder.

Action Taken:

Use of PVC coated wire was discontinued.

April 4, 1973

Review of welding, pellet total gas content, gas tagging, interpretation of visual inspection acceptance criteria and areas for potential further delays.

Findings:

Pellet gas content out of specification.

Action Taken:

Kerr McGee replaced N_2-H_2 cover gas in sintering with A-H_2.

KERR-McGEE NUCLEAR CORPORATION
P.O. BOX 315 • CRESCENT, OKLAHOMA 73028

APPENDIX FOUR

March 25, 1975

R. G. Page, Acting Director
Division of Safeguards
Office of Nuclear Material
Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 2055

Dear Mr. Page:

Attached is a revision to Enclosure A of the progress report submitted to you on January 31, 1975. There was a clerical error on the last three inventory periods in the six month period section of the enclosure.

The MUF for these three periods were mis-stated by 4800 grams. These numbers were revised along with the % of additions and removals for the inventory period of February to July. All remaining numbers in the enclosure remain the same.

Very truly yours,

R C Janka

R.C. Janka, Manager
Administration & Accounting

RCJ/vs

Enclosure

cc: Jack Rind

3/25/75

ENCLOSURE A

Inventory Period	MUF gm Pu	LEMUF	LEMUF with NDA
3/8/74	9,931	2,383	-
4/2/74	2,681	2,104	-
5/2/74	2,268	1,154	-
7/2/74	3,357	1,617	-
9/2/74	8,501	1,850	-
10/15/74	2,681	1,818	2,000
12/15/74	990	1,697	2,009
1/ /75		1,020	1,241

This is an excerpt from the Enclosure mentioned in the cover letter. The copy was very poor and not all of it could be deciphered.

CUMULATIVE LEMUF SIX-MONTH PERIOD

Inventory Period	MUF	LEMUF	% of Additions	% of Removals
October 1974 to January 1975	7,092	1,315	0.87	0.73
September to December 1974	2,409	1,903	0.78	0.71
May to October 1974	817	1,921	0.66	0.70
to September 1974	6,	2,464	1.	0.
February to July 1974	49	3,082	50	1.
December 1973 to May 1974	3,569	2,714	1.18	2.08

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