ENVIRONMENTAL ASSESSMENT

KANSAS CITY PLANT KANSAS CITY, MISSOURI

MASTER

NOVEMBER 1977

U.S. DEPARTMENT OF ENERGY

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ASSISTANT SECRETARY FOR DEFENSE PROGRAMS

GENERAL STATEMENT

This environmental impact assessment was prepared by the Energy Research and Development Administration (ERDA) and assesses the environmental implications of the ongoing operations at the Kansas City Plant. Under the Department of Energy (DOE) Organization Act of 1977, ERDA was abolished on October 1, 1977, and DOE assumed the responsibility of the Plant. The Kansas City Plant was operated by ERDA by the Bendix Corporation under Contract EY-76-C-04-0613, who will continue operating the Plant for DOE.

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SECTION I: SUMMARY

The operations and possible impacts on the environment of the ERDA's Kansas City Plant of the Department of Energy (DOE) are subject to the provisions of the National Environmental Policy Act of 1969 (NEPA). This document has been prepared in accordance with *Title 10, Code of Federal Regulations, Part 711*.

The Kansas City Plant, a government-owned contractor-operated installation, was in operation 20 years before NEPA was enacted; consequently, most of the Plant existed before an environmental assessment was required. Since the enactment of NEPA, environmental evaluations of new projects have been made. This document extends the practice of considering the environmental aspects of federal actions to the entire Kansas City Plant.

The Kansas City Plant produces non-nuclear components for the for the national nuclear weapons program under a contract between the DOE, formerly the Energy Research and Development Administration (ERDA), and The Bendix Corporation of Southfield, Michigan. The Plant is located at Bannister Road and Troost Avenue in Kansas City, Missouri, 12 miles south of the city's center. Kansas City is the largest unit in the Standard Metropolitan Statistical Area (SMSA), an area that includes four counties in Missouri and two in Kansas and has a total population of 1.3 million people. The city has a diverse economic base and ranks high nationally in warehousing, automobile production, transportation services, agri-business, and consultant engineering services.

The Plant manufactures and assembles pieceparts and subassemblies which are shipped to other locations for subsequent assembly into nuclear weapons. The Plant also maintains a major engineering organization with supporting research and development capabilities to supplement manufacturing operations.

Operations at the ERDA Kansas City Plant do not include the processing of radioactive materials usually associated with nuclear weapons. Limited special radioactive sources and irradiated components common to most industry are handled on site but pose no environmental hazard because they are totally confined. These special sealed sources include reference standards for measurement and instrument calibration, radiography, laboratory measurement, and production inspection. Limited environmental monitoring is conducted to assure the integrity of confinement.

The Kansas City Plant shares a 300-acre Federal Complex with four other federal agencies. Most of the Plant's 2.5 million square feet of occupied space lies within two of the three major buildings in the Complex. The main building was built in 1942 to house an aircraft engine factory.

The Plant lies in a flood plain surrounded on three sides by small hills. Indian Creek, on the south side of the Plant, flows into the Blue River on the Plant's east side. Blue River joins the Missouri River 23 miles north of the Plant.

The Plant is the only heavy industry within the immediate vicinity. When the location was chosen in the early 1940's, the land was generally agricultural. Since then, growth and development have changed land use from agricultural to residential, light industrial, commercial, and recreational--all served by a network of major streets and highways.

There is a striking contrast between the Kansas City Plant and its surroundings, principally because the Plant is a major industry located away from the industrial district of the metropolitan area. This contrast puts the Plant in close contact with the surrounding residential population. Local reaction to the Plant has been favorable. The Plant is seldom referred to in news stories except in terms of its labor market impact.

Numerous community benefits are derived from the Kansas City Plant. It is one of the largest employers in the area and at times has been the largest employer. The Plant has nearly 5000 employees and an annual payroll of approximately \$66 million. An additional \$68 million are spent annually on Plant maintenance and operations, mostly in the Kansas City area. Charitable contributions, participation in equal opportunity employment, and encouragement of higher education all represent social benefits of the Plant.

Natural land functions have been altered as a result of the Plant and its flood protection system. As a result of a 1961 flood, the Army Corps of Engineers constructed a flood levee to protect the Federal Complex. The Plant also has had a secondary influence on the urbanization of the southern part of the Kansas City Metropolitan Area. Federal Complex land represents one-third of the industrial land in south Kansas City and will remain a significant portion of the future needs for industrial land in the area.

Air and water monitoring activities help assure that the Plant satisfies requirements for air and water discharges. Since no fissionable materials and no unconfined radioactive sources are used onsite, Plant operations do not present a radioactive release hazard. Air monitoring includes emission testing and upwind and downwind measurements of ambient air. Water discharges to Indian Creek and Blue River are monitored. Industrial wastewater is monitored and subjected to sedimentation and neutralization before it enters the city sanitary sewage system. An environmental protection program includes administrative procedures and containment features such as drain interceptors, dust collectors, and exhaust controls to reduce discharges to the environment.

Atmospheric discharges are kept in compliance with existing regulations, except for occasional visible emission from powerhouses which occurs when it is necessary to use oil rather

than natural gas for fuel. Particulate and sulphur dioxide emissions are combustion by-products from natural gas and fuel oil used in the powerhouses. Hydrocarbons, primarily from product cleaning operations, are the major air emissions from Plant manufacturing operations. Ambient air and stack emission monitoring have continued to provide data for assessing the environmental impact and directing air pollution control efforts.

The 3000 cars which enter and leave the Plant daily affect the atmosphere. Carpooling has been encouraged to conserve fuel and help reduce atmospheric pollution. Generally, Kansas City does not experience heavy air pollution--a direct consequence of good air movement patterns and the sparse distribution of heavy industry.

Water is discharged to local streams in accordance with a National Pollutant Discharge Elimination System (NPDES) permit issued by the Environmental Protection Agency. The permit (Appendix C) requires water entering the surface streams to be of intake water (drinking water) quality. Analysis of surface stream water samples does not reveal adverse effects attributable to Plant operations.

Plant discharges to the surface waters are continually monitored to assure adequate environmental protection. Discharges to Blue River and Indian Creek, which are defined as recreational streams in the southern part of Kansas City, are strictly controlled by federally approved water quality standards. These standards restrict any discharges to uncontaminated cooling waters. Improvements in the water quality of these streams affect the Missouri River, which is used as a drinking water supply downstream. Wastewater is also discharged from the plant into the city sanitary sewer system in accordance with an agreement with the Kansas City Pollution Control Board. Industrial process waters are routed to industrial waste lagoons before discharge into the city sewer.

The Plant shares sources of natural gas, electricity, water, and waste disposal sites with all of Kansas City. During periods of gas shortages, the Plant must curtail natural gas usage to sustain higher priority gas users such as homes and hospitals.

The off-site landfills used for Plant wastes are the same ones used for other municipal needs. Hazardous wastes are disposed of by commercial waste management contractors.

The Plant's normal relationship to the environment could be changed as a result of an accident. Possibly the most serious consequence from an accident would be the release of fuel oil to the local waterways as a result of a tornado rupturing the two on-site 400,000 gallon storage tanks and their containment dikes. The oil storage facilities are protected by existing dikes but a tornado could release oil to the environment if a rupture of the tanks and the dike occurred. Other accidents, such as a vehicular mishap, explosion, fire, flood, or earthquake, could occur at the Plant but would pose less serious threats to the environment. Emergency plans, spill response procedures, and projects to upgrade hazardous material storage areas are mitigating factors to reduce the environmental impact should such an accident occur.

There are unavoidable adverse environmental effects of the Plant attributable to past operations. In the past, there have been accidental discharges of polychlorinated biphenyls (PCB) to surface waters but the use of PCB in the Plant has been discontinued. A discussion of PCBs and their relationship to the environment is presented in Appendix A.

The national security importance of the Kansas City Plant precludes the alternative of discontinuing operations. Furthermore, a discontinuation of operations probably would not result in any lessening of the environmental impact because of the

currently minimal effect on the environment of the Plant's operations and the likely continued use of the Plant's facilities for industrial purposes. Reducing operations would possibly result in a proportionate lessening, but not a cessation, of the environmental effects. While the alternative of relocating Plant operations would be possible to achieve, there are no known reasons to justify the enormous costs involved. Relocating Plant operations would only result in transferring the environmental effects to the new location.

There are alternatives which could change the Plant's relationship to the environment: the volume of water discharged to the Blue River and Indian Creek could be reduced by recycling; the industrial waste content of sanitary sewer discharges could be lowered by treatment; and atmospheric releases could be reduced by incorporating additional industrial control devices. Several alternatives exist which could change the Plant's scale of operations or objectives. Weapon schedules, cost data, and trends in environmental regulations will determine the extent to which such alternatives are selected for use. In addition, factors such as changes in the Plant's scale of operations or objectives influence the effects the Plant has on the environment.

It should be recognized that much of the area of Kansas City where the ERDA Plant is located is committed to industrial activity. In view of this long term land use commitment, the Plant has not sacrificed any long-term productivity for the sake of short-term benefits. There are no indications that air, water, or land resources have been altered to the point of reducing their long-term productivity. It is expected that the land now occupied will continue to be used as an industrial site. In some ways, the changes made by the Kansas City Plant have actually enhanced the future urban usefulness of the land; a flood protection system, utility services, and roadways represent changes which will be valuable to the future requirements for industrial land.

Plant surroundings indicate the compatibility of the Plant and proposed land uses, policies, and controls. Parts of the Federal Complex have been transferred to private ownership and to local governmental agencies for use as public park lands.

The energy supplies consumed by the Plant are irreversible and irretrievable. Land, water, and cultural resources are used by the Plant, but their use does not represent a permanent commitment. The Plant provides productive employment for about 5000 people who contribute to the social and cultural development of the area.

The benefits of operating the Kansas City Plant are judged to outweigh the costs incurred. Evaluation of the environmental effects of existing operations at the Kansas City Plant suggests that activity should continue as required to support the national defense program.

SECTION II: BACKGROUND DETAILED DESCRIPTION

PLANT FUNCTIONS

The Kansas City Plant manufactures and assembles non-nuclear components for weapons in the national nuclear stockpile as one of the production facilities within the Energy Research and Development Administration's (ERDA) weapons complex administered by the Albuquerque (New Mexico) Operations Office. Views of the Kansas City Plant are shown in Figures 1 through 5.

The Bendix Corporation of Southfield, Michigan, operates the Kansas City Plant under a prime contract with ERDA. The contract is administered locally by an area office extension of the Albuquerque Operations Office.

The Kansas City Plant performs specialized tasks within the ERDA mission assignment and in coordination with other ERDA weapon-related facilities. Duties are assigned to the Plant in such a way as to minimize the duplication of production activities within the complex and keep related skills within or easily available to individual plants.

No operations directly involving radioactive materials or explosives normally associated with nuclear weapons are assigned to the Plant. The basic mission at Kansas City is the production or procurement of electrical, electronic, electromechanical, plastic, and non-fissionable metal components for nuclear weapons. This mission involves several technologies and brings together many manufacturing disciplines. Parts made at Kansas City are shipped elsewhere for final assembly into nuclear weapons.

Although the predominant activity at the Plant is directed toward weapons production for ERDA, the Plant also provides

Figure 1. Federal Complex Looking North at Urban Setting

Figure 2. Federal Complex and Area Features to the South

Figure 3. The Kansas City Plant Within the Federal Complex

Figure 4. Adjacent Area and Complex Features. Legacy Park is Former Complex Land.

Figure 5. The Major Structures at the Kansas City Plant

services to other agencies such as the Department of Defense, to the United Kingdom, and to non-weapon-related ERDA research laboratories in various energy research programs. The wide range of capabilities at Kansas City is available and readily applicable to energy research and energy production programs.

The principal areas of responsibility for all weapons production installations are spelled out by ERDA mission policy statements. Kansas City Plant responsibility lies in three general areas: mechanical, electrical, and plastic. Approximately 45 percent of the production effort at the Plant is directed toward mechanical products, 40 percent is directed toward electrical products, and 15 percent is directed toward plastic products.

LOCATION AND HISTORY

The Kansas City Plant occupies 113 acres of a 300 acre Federal Complex 12 miles south of downtown Kansas City, Missouri (Figure 6). The Plant is surrounded by commercial, recreational, and residential areas. Bannister Road (95th Street), Missouri Highway W, and Troost Avenue are the major streets feeding into the Federal Complex.

Before World War II, the site occupied by the Federal Complex was, according to contemporary accounts, a boggy river bottom amidst a suburban countryside.⁵⁰ Its only commercial usage, other than for growing corn, was as an automobile race track.⁵¹

In April 1942, the Navy asked the United Aircraft Corporation, the parent company of Pratt-Whitney, to find a site for a new factory that could build aircraft engines for the nation's war effort. The next month Senator Harry S. Truman announced that Kansas City had been chosen as the site for the new Pratt-Whitney Plant.

There were many reasons for the selection of Kansas City and the old race track site for the location of the new aircraft engine plant. Kansas City is near the geographic center of the United States and in World War II was considered safe from enemy air attacks. From an engineering point of view, the site was easy to work with: it was flat and relatively easy to excavate. The site also was near a major metropolitan area and had ready access to a large workforce.⁵¹

The land for the new plant, almost 400 acres of it, was quickly acquired from 30 landowners and the construction of the plant got underway.^{49, 50} Ground was broken on July 4, 1942.

Figure 6. The Kansas City Area.

Construction of the facility actually began in August, 1942, and in May, 1943, production began on the first Pratt-Whitney aircraft engine. The building was declared completed in October, 1943. The total cost of the building and equipment was \$85 million.

In the interests of wartime urgency, the Plant was constructed by a new assembly line technique that permitted the re-use of mobile forms for pouring concrete. The building, designed to minimize the use of steel which was in short supply during the war,⁵⁶ was the second largest aircraft engine plant in the world.⁵¹

The Plant ceased operations and the building was declared excess on September 24, 1945, just weeks after V-J Day.⁵² The building was turned over to the War Assets Administration. Several private and government operations were housed in the building temporarily, and the building was used as a warehouse by several local firms. In 1948, the War Assets Administration transferred the entire facility to the Department of the Navy. Shortly thereafter, the Navy leased part of the building to the Westinghouse Electric Company.^{53, 78}

Meanwhile, the organization of the Atomic Energy Commission on January 1, 1947, was destined to have a major impact on the old Pratt-Whitney aircraft plant. The AEC had begun work on the production of nuclear weapons and weapon components at a limited number of sites around the United States, but it was in need of a new plant for the production of electrical and mechanical components. Former defense plants in Chicago and St. Louis came under scrutiny, but the large plant at Kansas City proved the most attractive to the AEC and to The Bendix Corporation, which had been chosen to operate the new plant.¹⁰²

On November 29, 1948, the Atomic Energy Commission formally announced its selection of the Kansas City Plant as the site for

a new facility to be operated under a prime contract by The Bendix Corporation. Bendix subleased a large portion of the facility from Westinghouse Corporation, and operations at the plant began on April 21, 1949. By the end of 1949, employment had reached 1,240 persons. AEC operations began expanding into a greater portion of the main building, into outlying buildings, and into new buildings which had to be constructed. By 1964, more than 8,000 people were employed at the plant.

On April 30, 1961, the Westinghouse lease on the Federal property was cancelled and that portion of the facility occupied by Westinghouse was transferred to the General Services Administration. On July 1, 1962, the entire Federal Complex, exclusive of a 24-acre tract, was transferred to GSA with the agreement that the AEC would continue to use portions of the tract for its operation.⁷⁸ In February 1975 the Plant came under control of the Energy Research and Development Administration (ERDA) as a result of a government reorganization.

On October 1, 1976, the entire ERDA-occupied portion of the Federal Complex was transferred to the custody and control of ERDA through a memorandum of understanding with the General Services Administration.

The Department of Energy was activated on October 1, 1977, and the Kansas City Plant as part of the ERDA Complex was included in the new Department.

PHYSICAL DESCRIPTION

The Kansas City Plant maintains occupancy of its premises (Figure 7) through a memorandum of understanding between ERDA and the General Services Administration (GSA) under which ERDA is required to protect, preserve, maintain, and repair buildings, adjacent areas, and utilities.

The Federal Complex is served by two four-lane city-maintained streets: Troost Avenue on the west and Bannister Road on the south. Missouri Highway W, a four-lane divided highway, connects with Bannister Road at the southern edge of the Complex.

Within the Federal Complex, the ERDA Kansas City Plant is provided with parking for 4703 cars on 35 acres of paved parking lots (Figure 8).

The perimeter of the Plant is protected by an 8-foot-high chain link fence topped by three strands of barbed wire on slanted supports which separates the Plant from all other parts of the Federal Complex. Access to the Plant is through four guard houses on the perimeter. The Plant perimeter and the parking areas are thoroughly lighted and inspected on a routine basis to assure both Plant security and employee safety.

In 1961, the Blue River flooded the basement of the main building. Subsequently, the Corps of Engineers designed and constructed a levee to provide protection for the Federal Complex. Phase I, which has been completed, involved the construction of 880 feet of poured concrete flood wall and 6400 feet of earthen levee at a cost of \$2.8 million. There are four stop-log-gaps in the flood wall where the Missouri Pacific Railroad and an access

Figure 7. The Area Occupied by the ERDA Kansas City Plant at the Federal Complex

road penetrate the flood wall defenses. All of the drainage outfalls conducting storm water out of the enclosed area have been equipped with sluice or flap gates.⁴⁷

Phase I is expected to protect the Federal Complex to a flood level of 45 feet above gage zero on the Blue River. Phase II of the flood protection plan will cost an estimated \$800,000 and provide protection to the 50 foot level above gage zero on the Blue River. The construction timetable for Phase II has not yet been established.

The Federal Complex and the Kansas City Plant are totally dependent upon local utility companies. The Kansas City Power and Light Company provides electricity through two 161 kilovolt

Figure 8. ERDA Kansas City Plant Parking Areas

transmission lines. Water is supplied by the Kansas City Water Department through three mains, any one of which could, with limitations, supply the main building if service were interrupted in the other two.

The Gas Service Company supplies natural gas to the facility both on an interruptible and noninterruptible gas supply contract. Gas enters the Federal Complex at the two powerhouses. Number 6 fuel oil is purchased and stored on-site for use when gas service is interrupted. Limited noninterruptible gas service is available where backup fuel supplies cannot be used.

The Kansas City Plant (Figure 9) represents a \$250 to \$400 million replacement cost in facilities and equipment. It occupies 241,100 square feet of office space, and 1,925,100 square

Figure 9. Structures at the Kansas City Plant

feet of factory floor space, in what is known as the Main Manufacturing Building. The Plant thus occupies 2,166,200 square feet of the total of 4,016,000 square feet of floor space in the main building on the Federal Complex. This main building consists of one story with a mezzanine or partial second floor and a partial basement. The building is of reinforced concrete construction with exterior walls of brick with cinder block backing. The roof is reinforced concrete of arch and shell design, except the mezzanine roof, which is beam and slab design. The second floor and the first floor over the basement are of reinforced concrete flat slab construction. Column spacing is 40 feet by 40 feet on the first floor and the mezzanine, and 20 feet by 20 feet in the basement and under the mezzanine.

Table 1. Structures Occupied by the DOE Kansas City Plant

Code	Building	Area (ft ²)	Use
1	Office Building*	241,100	General office services
2	Main Manufacturing Building*	1,925,100	General manufacturing operations
3	Experimental Test Cells*		Technical laboratories
4	Test Cell Area*		Storage, maintenance
5	West Powerhouse	67,900	Chilled water and steam
6	Oil House	2,400	Grease, lubricating oil, and paint storage
7	Old Maintenance Building	22,800	Storage and material handling, cleaning, and reconditioning
8	Supervisory Control Building	1,800	Plant security headquarters
9	Plating Building	25,700	Metal plating activities
10	Chemical Storage Building	18,000	Chemicals and bottled gas storage
11	East Powerhouse	10,600	Chilled water and steam
12	Manufacturing Support Building	126,900	Quality, receiving inspection, and purchasing functions
13	Solid Waste Disposal Building	4,500	Compaction of solid wastes
14	Storage Tanks		Two 400,000 gallon fuel oil tanks
15	Polymer Building	12,100	Polymer production and foam mixing
16	Air Supported Storage Buildings	37,500	General storage
17	Resin Building	2,200	Resin laboratory
18	Kinematics Building	5,200	Quality products testing
19	Scrap Destruction Shed	1,200	Classified scrap destruction

*All these areas are located in the 2.2 million square foot main building.

Portions of the Main Manufacturing Building originally constructed as test cells are now used for storage, maintenance, and some technical laboratory operations. The other buildings occupied by the Kansas City Plant are described in Table 1. The code numbers in Table 1 correspond to the numbers on Figure 9.

MANUFACTURING OPERATIONS

The Kansas City Plant ships approximately 15,000 different types of products annually. Some are one of a kind, many are low volume development products, but the variety is significant. Nearly 14,000 pieces of capital equipment are used in manufacturing and inspection operations. These operations are carried out in 2.2 million square feet of floor space under one roof and 300,000 square feet in additional buildings. Many operations require special humidity, temperature, and air cleanliness controls.

The environmental impact of these operations is discussed in Section III. An overview of Kansas City Plant manufacturing operations is presented here, with emphasis on those operations considered important because of their potential environmental relationships.

The Kansas City Plant does not process radioactive materials--in contrast to the usual association of ERDA weapon installations with such materials. The Kansas City Plant mission includes work in electrical, mechanical, and plastic component and assembly manufacturing. Some special radioactive source materials are used on-site, but they pose no environmental hazard because they are totally confined. These special sealed sources include reference standards for measurement and instrument calibration, radiography, laboratory measurement, and production inspection. Operations at the Plant involve no significant hazardous explosives or toxic substances other than those discussed below. Class C explosives⁶⁷ are handled in manufacturing operations in a maximum quantity of 3 grams. Hazardous manufacturing materials are handled as discussed below in facilities incorporating adequate engineering design for personnel and environmental protection.

PLASTICS

Plastic manufacturing operations may pose an environmental concern because of the materials involved. Some of these materials require environmental controls for both personnel safety and for the safe disposal of waste effluents. (Specific materials which have been designated toxic and are handled accordingly are discussed in the Environmental Considerations portion of this section.) Plastic products include housings, electrical connectors, precision miniature parts, desiccants, structural supports, fillers, and filled plastics. Polystyrenes, polyurethanes, silicones, syntactics, and other plastic materials are processed, mixed, blended, molded, tested, impregnated, filament wound, and machined at the Kansas City Plant.

MECHANICAL

Mechanical products manufactured at the Kansas City Plant include an array of components and assemblies involving several distinct types of operations, including those discussed below. Adequate engineering controls are designed into work areas to assure both personnel safety and complete protection of the natural environment.

Products which require machining operations include cases, rings, housings, plates, covers, precision miniature gears, ratchets, pawls, rollers, and parts for valves, air motors, and switches. Processes include normal metal removing operations using stainless steel, aluminum, and titanium. Among the major machining equipment involved are machining centers, mills, and lathes.

Precision assembly work includes coded mechanical locking devices, high pressure valves, air motors, and rotary converters

as well as a variety of metal formed components and assemblies. The materials and processes involved, including pressing, hydroforming, welding, bonding, joining, and secondary machining, normally are not of environmental concern except in the area of solid waste disposal.

Numerous products require vapor degreasing, chemical and electromechanical cleaning, electroplating, etching, polishing, sandblasting, painting, and plastic coating. The many materials involved and waste disposal handling techniques are of concern environmentally.

ELECTRICAL

The miniature electronic components manufactured at Kansas City and the stringent ERDA quality requirements necessitate special facilities, special air cleanliness controls, and special handling techniques. Operations include the manufacture of electrical components such as cables, printed circuit boards, transformers, coils, and microelectronic devices. Processes include soldering, welding, molding, and assembly. Circuit board fabrication involves photo processing, plating, and etching materials requiring careful environmental control. Other processes are those common to electrical and electronic component manufacturing throughout American industry.

MANUFACTURING SUPPORT SERVICES

Many support operations are required to successfully accomplish the manufacturing mission of the Kansas City Plant, including quality assurance, automatic data processing, materials testing laboratories, and development fabrication shops.

ENVIRONMENTAL CONSIDERATIONS

Several manufacturing operations at the Kansas City Plant use toxic substances and other materials that could be cause for environmental concern if they were to be improperly released from the facility. Extensive precautions are taken to prevent such release.

Polychlorinated Biphenyls

Monsanto Chemical Company's Therminol FR-1 is a polychlorinated biphenyl (PCB) which was used as a heat transfer fluid in plastic molding operations. Therminol FR-1 was selected for use at the Kansas City Plant after a study had been made of several alternative materials. FR-1 was selected on the basis of its good fire resistant qualities and its operating characteristics. These same qualities have resulted in the basis for environmental concern regarding polychlorinated biphenyls.

Appendix A provides further information about polychlorinated biphenyls, their environmental significance, their chemical properties, and their history at the Plant. At the time the material was selected for use, there was no information to indicate concern about the toxic nature of FR-1 in the environment. Following the evolution of information regarding the environmental hazards associated with PCBs, a project was initiated to replace them in the plastic molding operations. The conversion project was completed in 1975.

Approximately 25,000 gallons of FR-1 were removed from the Plant as the systems using Therminol FR-1 were converted to a different heat transfer media which does not contain toxic additives. The conversion project included additional protective

Figure 10. Operations Using Heat Transfer Fluids at the ERDA Kansas City Plant

measures such as isolation valves, diking, and fire protection systems. The new material is Therminol 66, a terphenyl hydrocarbon compound.

Plastic molding operations using the heat transfer fluid are conducted as part of two central heating and cooling systems (Figure 10). Residual contamination in the operating systems remains evident and the operation of these two systems requires a continuing awareness of the danger surrounding the release of heat transfer fluid into the environment. Existing PCB concentrations in the operating systems are 2 to 3 percent. Low level concentrations of PCB are expected to persist in the operating system and in Plant wastewater systems until they are eliminated through attrition.

It is significant that past accidental spills of PCB material have contaminated Plant drainage systems. The extent of this contamination and the sewer systems involved are such that residual PCB has persisted in effluent discharge. Cleanup of these sewer systems has been attempted, but miles of different types and sizes of sewer line are involved and residual PCB remains evident. The residual material is discharged in both the sanitary and storm sewer systems in very low concentration--typically 1.0 part per billion. Containment actions have been taken to reduce the possibility of any discharge in the future.

The presence of PCB dielectric material continues in most electrical transformer and capacitor equipment. Approximately 26,000 gallons remain on-site in electrical equipment. The threat of environmental release of this material has been eliminated by complete confinement measures at all potential release locations.

Beryllium

A small beryllium machining facility exists at the Kansas City Plant but it currently is not in use. Beryllium does present an environmental concern because if it is not properly handled it can cause lung and skin damage (Appendix B). Plant operations in the past have included beryllium machining, drilling, and lapping in relatively small (500 gram) quantities, but these operations are not currently active. Work involving beryllium-containing alloys and other low-levels (less than two percent) of beryllium are conducted routinely at the Plant. Personnel protective measures, employee training, medical surveillance, and environmental controls--including proper ventilation--are used in the beryllium processing areas to ensure working conditions which comply with OSHA.

MOCA

The reactive organic material 4,4'-methylene bis-2-chloro-aniline is used in the fabrication and encapsulation of electronic assemblies. This material, better known as MOCA, is a curing agent for polyurethane rubber. As a suspected carcinogen, it requires special handling and environmental control measures which are provided in the Plant operations. Appendix B includes a description of MOCA and its suspected health hazards.

Isocyanates

Isocyanates are chemical compounds used extensively in the manufacture of polyurethane plastics. The greatest practical hazard in the use of isocyanates is from inhalation of their vapors. Of specific concern is toluene diisocyanate (TDI), which presents the greatest isocyanate hazard in the working environment. Every reasonable provision has been made at the Plant to protect employees and prevent releases from the manufacturing process. Health hazards associated with TDI are described in Appendix B.

Plating Materials

Surface treatment and plating operations involve approximately 50,000 gallons of acid and 10,000 gallons of alkalies each year. In addition, significant quantities of other materials such as ammonium persulfate, potassium, pyrophosphate, chromium salts, nickel sulfanate, ferric chloride, and sodium and copper cyanides are also used. Chromium and cyanide compounds have been designated toxic water pollutants by the EPA. Missouri Effluent Guidelines restrict water pollution by heavy metals, many of which are common to plating operations. Continuous attention is given to the handling and disposal of these materials. Waste from plating processes is disposed of by a commercial waste management firm.

Machining Materials

Machining operations involve the use of nearly 100,000 gallons of cutting oils and water soluble coolants each year to reduce friction and heat and to carry away metal cuttings. Hydraulically operated equipment requires nearly 20,000 gallons of oil annually to supply and replenish hydraulic systems. The necessary steps taken to assure disposal of these materials are discussed in the section titled Waste Disposal Impact.

Organics

Several operations including metal cleaning, circuit board production, and mechanical and electrical component production and assembly, use organic solvent or resin materials in significant quantities. Hydrocarbon solvents, including chlorinated materials such as trichloroethylene, methylene chloride, ketones, alcohols, and other solvents, are used in quantities representative of a large manufacturing facility. The environmental release of hydrocarbons from manufacturing operations is approximately 90,000 pounds per year. This requires that the Plant have continuing environmental assessment and control activities to assure environmental protection.

SUPPORT ACTIVITIES

Production at the Kansas City Plant is dependent upon a variety of support activities. Most of these activities, such as maintenance, food service, security, fire protection, accounting, and material conservation, are relatively common to industry and have no particular environmental significance. Others do have an environmental importance; they are discussed in the following pages--with emphasis on those factors which make them important.

INDUSTRIAL WASTEWATER SYSTEM

Effluents that cannot be discharged directly to either the sanitary sewer or storm sewer systems are directed into an industrial waste collection system consisting of ejectors which can pump into one of the two industrial wastewater lagoons and from there into the Federal Complex 24-inch sanitary sewer line. The industrial system takes diluted rinse waters from the plating department, from the photographic laboratory, from laboratory discharges in the manufacturing support building, from printed circuit manufacturing operations, from caustic and acid cleaning operations, and from materials engineering laboratories. An industrial wastewater grid system is being installed to collect additional future wastewaters for discharge to the lagoons. The average industrial wastewater flow to the lagoons is 750,000 gallons a day.⁹⁵

The lagoon system provides for dilution, sedimentation, and pH control of process waters. The pH of the lagoon discharges is constantly monitored and valving is programmed to recirculate the contents of the lagoons when the pH is outside the range of 6.0 to 10.0. Once the pH reaches the 6.0 to 10.0 range (in accordance

Figure 11. Storm Sewer Outfalls and Drainage Areas

with existing regulations), the valves are automatically opened and the discharge is allowed to flow into the sanitary sewer line. Concentrated chemicals are restricted from being discharged into the industrial waste system.

STORM SEWER SYSTEM

The Federal Complex is drained by a storm sewer system that flows into four outfalls, one of which discharges into the Blue River and three of which discharge into Indian Creek (Figure 11). Uncontaminated process cooling waters are discharged to the storm sewers. These four outfalls have been authorized under the

National Pollutant Discharge Elimination System (NPDES) by the Environmental Protection Agency. The discharge permit (Appendix C) specifies the effluent characteristics of Plant discharges.

The storm sewer system is designed to divert water to another outfall should one outfall be blocked. Since the outfalls take effluent away from the property, the pipes serving the system must pass through the flood protection system. Each outfall is equipped with a flap gate or sluice gate to prevent flood waters from backing into the Plant through the storm sewer system.

The lines leading to the four outfalls have been equipped to continuously measure and sample the flow and measure the temperature, specific conductance, and pH of the water being discharged. The permit to discharge requires that the Kansas City Plant make quarterly reports on water quality to the EPA. Figure 12 shows the monitoring equipment for Outfall 002.

SANITARY SEWER SYSTEM

The Federal Complex is served by a force-and-gravity sanitary sewer system that flows into a 24-inch gravity line which in turn enters the Kansas City, Missouri, sanitary sewer system at the northeast corner of the Complex. The city sanitary sewer system starts as a 42-inch diameter line which runs to the Blue River treatment plant.¹⁵

Within the Federal Complex the system consists of 12 sanitary wastewater ejectors inside the building and 9 ejectors connected with outside buildings. Industrial wastewater ejectors route discharge through the lagoons and ultimately into the 24-inch gravity sewer. There are seven ejectors connected to underground drain systems around basement fan rooms and to other types of foundation drains. All of the ejectors within the building pump their discharge into overhead lines that run north through the building to a gravity line.

Figure 12. Water Quality Monitoring Equipment Connected to Sewer Outfall 002

The 24-inch line serving the Federal Complex is more than adequate for all present loads. Flow is measured through a magnetic-type flow meter in a pump station at the northeast corner of the Complex. Under normal weather conditions, the city's 42-inch diameter sanitary line also is adequate. However, the city line has backflooded into the Complex line during periods of heavy rainfall. At the point where the Complex 24-inch line first enters the city sewer system, there also is a 30-inch gravity line that serves 3325 acres west of the Plant, a 20-inch pressure sewer line from the Dykes Branch pumping station on Indian Creek, and a 20-inch pressure sewer line from the Red Bridge pumping station on

the east side of the Missouri-Pacific railroad tracks approximately two blocks south of 95th Street. During extremely wet weather the flow from these three sewers is increased by infiltration and storm sewer connections.

The Kansas City Water Pollution Control Department is presently studying this backflooding problem. The city has repaired breaks to minimize infiltration and has checked for illegal storm drain connections. The long range solution to the problem may be construction of additional facilities in the Blue River Valley. One proposal favors the construction of an interceptor along the east side of the Blue River which would eliminate the Highway 71, Red Bridge, and Indian Creek pumping stations from feeding into the 42-inch line at the edge of the Federal Complex. Another proposal favors construction of a large pumping station and force main which would also eliminate the three pumping stations.

The Kansas City Plant completed a study contract with the same engineering firm (Black and Veatch, Consulting Engineers, Kansas City) which is working with the city, but there appears to be no immediate practical means of reducing the peak flow from the sewer system. Even if one of the options is settled upon, it still will be approximately five years before any new facilities can be made operational. To eliminate backflow into the Federal Complex, a pump station has been installed to provide a forced discharge from the Plant during peak flow periods.

POWERHOUSES

Steam for all the facilities on the Federal Complex comes from two powerhouses operated by the Kansas City Plant.

There are four steam boilers in the west powerhouse with a combined capacity of 400,000 pounds of steam per hour at 175 psi. The present peak demand is approximately 185,000 pounds per hour. During normal demand periods, two boilers are on line, one is on standby, and the remaining one is idle.

The west powerhouse (Figure 13) has a chilling capacity of about 9100 tons with a distributable capacity loss of less than 7 percent. Four chilled water units were installed in 1969; an additional four units were installed in 1971. Chilled water is provided to most of the buildings operated by the Kansas City Plant.

Most of the compressed air used within the Federal Complex is also furnished from the west powerhouse by steam driven air compressors.

The east powerhouse has a combined boiler capacity of 165,000 pounds per hour. Present peak demand is less than 100,000 pounds of steam. The east powerhouse has a chilled water capacity of about 5,000 tons, but possible future improvements in overall Plant efficiency and the chilled water system are being considered and may permit shutdown of the east powerhouse in a few years.

All of the boilers normally are fueled with natural gas purchased on an interruptable basis. The Federal Power Commission has established a priority system consisting of nine categories of users. The Kansas City Plant carries a Priority 8 which means the Plant experiences frequent gas curtailment and is expected to switch to stand-by fuel on less than an hour's notice. The Gas Service Company has notified the Plant to be prepared for increasing curtailments of natural gas service and the possibility of complete elimination of service.

Figure 13. The West Powerhouse at the Kansas City Plant

During periods of normal activity, the Plant uses 5 to 6 million cubic feet of gas per day. If operations are switched to Number 6 fuel oil, up to 40,000 gallons of oil per day are required to meet the needs of the Federal Complex. Each of the two powerhouses has its own cooling towers. A maximum of 45,000 gallons per minute can be circulated with normal evaporative losses of 1.5 percent of the total volume of water. The evaporated water enters the atmosphere as vapor and is very noticeable on days when the temperature is low and the humidity is high. This water vapor, although not detrimental to the atmosphere, is sometimes mistaken by local residents for possible air pollution.

SOLID WASTE DISPOSAL

Kansas City Plant solid waste disposal activities must consider national security in the disposal of classified records

and classified waste products. Prior to November 1969, all classified records were destroyed by burning. After this date, Kansas City, Missouri, air pollution control ordinances¹ prohibited the single chamber incinerator then in use at the Kansas City Plant. Two hammer mill machines were purchased and all classified records are now being destroyed in these machines.

A solid waste disposal facility was constructed to provide an economical and reliable system for processing solid waste for disposal. Solid waste is compacted in the facility and removed to a sanitary landfill. More than 200 cubic yards of collected waste can be compacted during one 8-hour period.

Solid waste from the Kansas City Plant for disposal in sanitary landfill meets the recommendations of the Metropolitan Planning Commission for the Kansas City region.⁸⁸ The Commission prepared a management plan in which they drew upon the expertise of waste management specialists who made a number of recommendations regarding the use of sanitary landfills.

Each day, the Kansas City Plant generates 42 cubic yards of compacted trash weighing between 10 and 15 tons. In addition, several 22 cubic yard open-top containers are periodically filled with rocks, lumber, and other heavy debris and hauled off as needed to sanitary landfills.

Toxic material wastes such as beryllium, mercury, PCB contaminated solids, and MOCA are collected following established personnel and environmental protective procedures. Special containers are provided for these wastes, personnel health and safety procedures are outlined, quantities are inventoried and verified, and collection and packaging is monitored. These wastes are disposed of at Nuclear Regulatory Commission regulated sites, ERDA operated sites, or through licensed waste disposal contractors.

CONCENTRATED LIQUID WASTE DISPOSAL

Concentrated liquid wastes are disposed of through Plant collection systems and contractor disposal off-site. The contractors are monitored by the Missouri Department of Natural Resources to assure acceptable environmental methods are used.

The concentrated liquid waste disposal facilities at the Plant include three 10,000 gallon underground storage tanks, each of which is equipped with a filtered dumping station. Each underground storage tank has a pump connected to a truck loading boom so the tanks can be emptied. There is one tank for water soluble coolants, one tank for waste oils, and a third tank for solvents and thinners.

In addition, the plant has three above-ground concentrated chemical storage tanks which are used as gathering points for waste from metal plating operations, printed circuit board fabrication operations, chemical milling operations, and caustic cleaning operations. These concentrated chemicals are accumulated under inventory control and are disposed of by contractors who remove and dispose of them under controlled conditions offsite. None of these concentrated chemical wastes is disposed of through the Plant sewer systems.

A special inventory and disposal procedure has been established for PCB contaminated wastes which are disposed of by licensed contractors.

UTILITIES

Electricity

A Kansas City Power and Light Company outdoor substation located west of the Main Manufacturing Building is supplied by two

Figure 14. Kansas City Plant Electrical Supply Lines

161 kilovolt lines and provides power to the Federal Complex. This substation consists of two 5,000 kilovolt-ampere transformers both of which are supplied by 161 kilovolt primary service. Each transformer supplies 13.8 kilovolt secondary service to the primary switching gear for the main building (Figure 14). This switching gear provides 13.8 kilovolt electrical service to the FAA and 30 roof-mounted and in-plant substations serving the Federal Complex.

Water

The Kansas City Water Department supplies the Federal Complex through three supply mains. One 16-inch main parallels the west side of the Federal Complex, one 24-inch main is on the east side

of the Manufacturing Support Building, and one 16-inch main is on the south side of the Main Manufacturing Building (Figure 15). A 16-inch supply line enters the main building at the northwest corner. A second 16-inch supply line connected to the 24-inch main enters the building on the north side. A 10-inch supply line from the south 16-inch main enters the building on the south side.

Natural Gas

Natural gas is supplied by the Gas Service Company through an 8-inch supply main which enters the property northwest of the west powerhouse and a second 8-inch supply main which enters the property at the southeast corner of the Main Manufacturing Building. One line supplies the west powerhouse and is the primary source of supply for the Main Manufacturing Building. The second line supplies the east powerhouse and a mold heating and cooling system as well as the Manufacturing Support Building (Figure 16).

Natural gas is supplied to the Federal Complex on both interruptible and non-interruptible contracts. Non-interruptible gas is purchased primarily for mold heating and cooling operations, cafeteria operations, laboratory operations, and other work where hardware is not readily adaptable to some other form of fuel.

Fuel Oil

Boilers in both the east and west powerhouses are fired with oil when natural gas is not available. The normal daily use of fuel oil when natural gas is unavailable is 35,000 gallons. The Kansas City Plant maintains enough fuel oil in storage on-site to permit operations for 50 continuous days.

The west powerhouse has two 250,000 gallon underground oil storage tanks, and the east powerhouse has two 15,000 gallon underground oil storage tanks. An additional 80,000 gallons of

Figure 15. Kansas City Plant Water Supply Lines

Number 5 fuel oil and 46,000 gallons of Number 2 fuel oil is stored in nine underground steel tanks approximately one half mile north of the east powerhouse. Immediately north of the underground tank farm are two 400,000 gallon steel above-ground tanks filled with Number 6 fuel oil (Figure 17). If oil is required from either of these locations, it must be hauled to the two powerhouses in tank trailers. Five thousand gallons of fuel oil can be transferred in less than two hours.

Fuel oil handling is governed by a Spill Prevention Control and Countermeasure (SPCC) plan⁹⁰ designed to complement existing laws, regulations, rules, standards, policies, and procedures,²⁷ and form a comprehensive spill prevention program. This plan specifically directs attention to oil pollution prevention at five locations (Figure 18): the west powerhouse, the east powerhouse,

Figure 16. Kansas City Plant Gas Supply Lines

the underground tank farm, the two 400,000 gallon above-ground tanks, and the GSA fuel storage area. The GSA area consists of six 10,000 gallon steel storage tanks which contain fuel oil.

CHEMICAL STORAGE

The Chemical Storage Building, occupied in September 1973, is the most recent storage structure to be completed at the Kansas City Plant. It is 80 feet wide and 225 feet long and has a rigid frame steel structure, a concrete floor, concrete block interior walls, and insulated steel panel exterior walls and roof.

Figure 17. Two 400,000 Gallon Diked Fuel Oil Storage Tanks
Located in the Northeast Portion of the Plant
Property

The building is compartmentalized with only one class of materials stored in each room. All of the materials used at the Kansas City Plant which require special storage conditions are kept in this building. Each room in the building was constructed as a separate cell and is equipped with smoke and heat venting, sloped floors, and a drain system from each room that leads into a sump, constructed of materials compatible with the chemicals used, on the outside of the building. Each sump will hold a minimum of 330 gallons of spilled liquid. These sumps are not connected to sewers but are equipped with high level indicators to show the presence of a liquid. Once liquids enter the sumps, they must be pumped out into special handling containers.

Figure 18. Oil Storage Areas Covered by the Spill Prevention Control and Countermeasure Plan. The Two 400,000 Gallon Oil Tanks Are Above Ground; Other Major Storage Tanks Are Underground.

Rooms in the chemical storage building are individually equipped with temperature and humidity controls, ventilation that extends to the floor, emergency exhaust systems, explosion proof electrical equipment, and extra hazard sprinklers. The quantities of materials stored in each room do not exceed National Fire Protection Association recommendations.⁶⁶ Where racks are used for storage, each level of rack is individually protected by sprinklers and all metal within each room is grounded. The exterior walls and the roof are designed to provide explosion venting.

The building is equipped with a number of cold boxes and walk-in coolers for the storage of materials that require temperatures or humidities beyond the range of normal air conditioning systems.

EXPLOSIVES STORAGE

The limited explosives at the Kansas City Plant are stored in an underground 12-foot diameter multiplate galvanized pipe with a concrete slab floor and a 3-foot earthfill above and behind the storage area. The front of the magazine has a walk-in door facing an unoccupied area of the Plant grounds and meets the requirements for a Class II explosive storage magazine.⁶⁹ This storage area was constructed in 1961 and is presently used for Class C explosives in a maximum quantity of 50 pounds. Class C explosives are defined as confined explosives in manufactured articles in "restricted quantities."⁶⁹

Explosive compatibility testing is conducted in a special facility within the main manufacturing building. One-fourth gram of raw high explosive is the maximum quantity used in these tests.

ENVIRONMENTAL MONITORING

The environmental monitoring program at the Kansas City Plant assures operational compliance with all applicable laws, regulations, and standards.^{32,22} Environmental monitoring of ambient air and surface water quality to determine facility impact, and effluent monitoring to assure compliance with emission standards, are routinely conducted.

Environmental monitoring activities are concerned with non-radioactive pollutants. Personnel monitoring is conducted to assure a working environment which meets established health and safety regulations.³⁴ Pollutant monitoring and reporting assures operational compliance with applicable federal, state, and local regulations and standards.

National Ambient Air Standards²¹ are used to determine operational impact by serving as bases of comparison for the ambient air concentrations at the Plant perimeter. Ambient air monitoring has included special testing for concentrations of sulphur dioxide, carbon monoxide, nitrogen dioxide, hydrocarbons, photochemical oxidants (as ozone), and suspended particulates. Point source effluent monitoring is conducted on powerhouse operations for concentrations of sulphur dioxide, nitrogen dioxide, and particulate matter.^{38,60}

Surface water environmental monitoring includes analyses of samples taken from Indian Creek and Blue River both upstream and downstream of the Plant. In addition, Plant effluents discharging to these streams through four outfalls are routinely monitored for some 50 parameters. The National Pollutant Discharge Elimination System²⁴ (NPDES) "permit to discharge" issued by the EPA limits Plant discharges to unpolluted cooling waters (Appendix C). The

NPDES permit also requires monitoring and quarterly reporting of total dissolved solids, pH, temperature, and flow for each of the four Plant outfalls.⁶⁸

Special monitoring considerations have been given to toxic and hazardous materials where an emission standard has been established. The National Emission Standards for Hazardous Air Pollutants²³ (NESHAP) regulations for beryllium machining operations have necessitated point source effluent monitoring. Environmental and effluent monitoring of polychlorinated biphenyls (PCB) is conducted routinely in light of the toxic nature of this material.²⁵ Administrative procedures also help assure proper handling of pesticides.^{29,35}

AIR MONITORING

The prime air pollution considerations at the Kansas City Plant are manufacturing operation emissions and the two steam-generating powerhouses. Manufacturing and laboratory areas which generate gaseous wastes are vented to the atmosphere. These wastes are primarily organic compounds, solvent fumes, plating exhaust effluents, and ammonia vapors from duplicating processes. Particulate emissions and sulphur and nitrogen oxides result from the powerhouse operations. Point source effluent dilution and control equipment is used to reduce discharge concentrations to acceptable levels.

An ambient air monitoring program at the Plant perimeter is used to assess contributions to regional air pollution. The most stringent standards, whether federal, state or local, are used for compliance comparison.

In addition, a comprehensive ambient air quality assessment conducted by Midwest Research Institute (MRI) has provided

information relative to the Plant's environmental impact.¹¹ The MRI project included field testing air quality at the Federal Complex fence line; analyzing, air quality modeling, and interpreting test results; and recommending the placement of permanent air quality monitoring stations. The assessment included tests with pollutant concentration samples taken simultaneously upwind and downwind to determine both background levels and Plant contributions. The study specified analysis of the ambient air samples for comparison with the National Ambient Air Quality Standards.

On the basis of this comprehensive assessment, Plant pollutant contributions have been determined to be relatively insignificant when compared to the ambient air standards. However, ambient testing has indicated significant hydrocarbon concentrations attributable to traffic levels in the area. The ambient air concentrations for hydrocarbons both upwind and downwind of the Plant often indicate high pollutant concentrations with respect to quality standards. Monitoring will be used to continue to assess the air conditions around the Plant.

The locations of the monitoring sites used during the MRI study and the locations of the permanent sites where ambient air monitoring equipment has been installed are shown in Figure 19. The ambient air monitoring stations provide the capability to continually assess the Plant's operational impact on the regional air quality. A city air quality monitoring station has been located at Bannister and Holmes Road, within a half mile of the Plant, to provide the city air quality office better information about pollutant levels near the Plant and to provide comparative data for Plant information. The city has found the air quality in the Plant area to be subjectively "good" and has not had any serious complaints of pollution because of the Plant.⁹³ The primary reason for the increased monitoring on the part of the city is the rise in pollutant levels from additional automobile traffic.

Figure 19. Air Monitoring Sites

Currently the contractor operates three high-volume air samplers located at the three air quality monitoring sites. Quantitative ambient air particulate concentrations are monitored weekly and compared to federal and local standards. Qualitative testing of the particulate matter is not performed.

Analysis of stack gases emitted from the Plant powerhouses has also been part of the continuing program to characterize the effect on air quality. Natural gas is the primary energy source at the powerhouses, but fuel oil is used when the natural gas supply is interrupted. Annual powerhouse emission evaluations indicate compliance with existing Kansas City air pollution ordinances¹ and State of Missouri regulations.³

The only effluent standard which applies to powerhouse operations is for the maximum allowable emission of particulate matter. During 1976 gas curtailment was at the 20 percent level, at which particulate emissions were 36 percent of allowable standards. No compliance problems are foreseen unless fuel oil becomes a primary source of the Plant's energy. The necessity to burn oil when natural gas is curtailed requires surveillance of visible emissions from the powerhouse.

Continuous monitoring during periods of fuel oil burning is provided in accordance with guidelines governing federal facilities and with a Kansas City ordinance restricting visible emissions. Photo-electric monitors are used to sense visible emissions and alert personnel. In addition, monitoring capabilities for sulphur and nitrogen oxides in the powerhouse stacks have been installed to support operational control and provide environmental information pertinent to Plant environmental impact.

Hazardous air pollutants which have been identified by the EPA, and for which emission standards (NESHAP) have been established, have been characterized. Plant beryllium operations have been identified to the EPA and required special air emission testing has been completed.⁵ Additional Plant impact is possible as additional NESHAP regulations are issued.

Specific monitoring programs for manufacturing operations effluents have not been required. Each operation has been assessed with respect to the ambient air monitoring program. A material balance survey of all operations has been used as the tool to best characterize these manufacturing emissions, with the ambient air monitoring program used to provide respective environmental information.

WATER MONITORING

The environmental and effluent water monitoring program for the Kansas City Plant is summarized in Table 2. The Plant water monitoring program is summarized annually as part of the ERDA environmental and effluent monitoring reporting activities for its facilities.¹⁹ Each of the wastewater handling systems is monitored for numerous pollutants (Table 3) and the analyses are compared to applicable standards. Water purchased from the Kansas City Water Department is analyzed as part of the monitoring program. Special water analyses of the test holes adjacent to the wastewater lagoons are conducted as necessary to assure that there has been no contamination of sub-surface water or soil. All analyses are conducted according to EPA-accepted techniques.⁹⁷

SANITARY AND INDUSTRIAL WASTE MONITORING

The Plant sanitary sewer system discharges to the Kansas City sanitary sewer system. Both Plant sanitary wastes and the discharges from the industrial wastewater lagoons are involved. The industrial lagoons are used to collect wastewaters which are not acceptable for discharge directly to the surface water streams. The lagoon system provides for neutralization, sedimentation, and dilution before discharge to the city sanitary sewer.

Sanitary and industrial waste system effluents have been monitored since the first lagoon began operation in 1964. The current monitoring points are shown in Figure 20. The sanitary system, including the discharge from the industrial waste lagoons, is monitored monthly for the parameters identified in the Kansas City ordinance⁴⁷ establishing criteria for discharges into the city sewer system (Table 3). The wastewater lagoon effluents discharged into the sanitary sewer are monitored primarily for heavy metal

Table 2. Water Monitoring Program

Subject Monitored	Purpose
Outfalls to Blue River and Indian Creek	To assure that effluents discharging to surface water via four Plant outfalls meet State of Missouri Effluent Guidelines and EPA discharge permit requirements.
Sanitary Discharge	To assure that effluent, which includes discharge from industrial wastewater lagoons to the municipal sewer, meets Kansas City ordinance for industrial wastes.
Stream Monitoring	To assess impact of Plant effluents on surface waters.
Water Purchased From Kansas City Water Department	To provide a base line evaluation of incoming potable water quality and types of dissolved materials.

concentrations. In addition, test wells around the wastewater lagoons (Figure 20), are monitored to assess the potential impact of lagoon operation on soil and sub-surface water quality.

OUTFALL MONITORING

The environmental monitoring program for Plant effluents discharged to Blue River and Indian Creek originally was established to characterize Plant wastewaters. Since 1971, the outfalls have been sampled and analyzed for some 50 parameters. Both the sampling (grab and composite) and the analyses have been modified as necessary to assure operational compliance to applicable regulations.

Table 3. Water Sampling and Analysis Program

Pollutant	Intake Water	Outfall Effluent	Sanitary Sewer	Lagoon Effluent	Surface Water
Algacides	T	T	-	M	T
1, Ammonia	T	T	-	M	T
Alkalinity	T	T	-	M	T
Bromide	T	T	-	-	T
2, Biochemical Oxygen Demand 5 day	-	M	M	M	T
1, Chemical Oxygen Demand	M	B	M	M	M
2, Chloride	M	M	T	-	T
2, Chlorinated Hydrocarbons	T	T	M	M	T
Color	T	T	-	-	-
3, 2, 1, Cyanide	M	M	M	M	T
1, Dissolved Oxygen	M	M	M	M	T
Sulfite	T	T	-	-	T
Surfactants	T	T	T	-	T
Total Organic Carbon	T	T	-	-	T
2, 1, Aluminum	M	M	T	-	-
Antimony	T	T	-	-	-
1, Arsenic	M	M	M	M	-
1, Barium	M	M	M	M	-
Beryllium	M	M	M	M	-
1, Boron	M	M	M	M	-
Calcium	T	T	-	M	-
3, 2, 1 Cadmium	M	M	M	M	-
2, 1 Chromium	M	B	M	M	M
2, 1, Cobalt	T	T	-	-	-
2, 1, Copper	M	B	M	M	M

Table 3 Continued. Water Sampling and Analysis Program

Pollutant	Intake Water	Outfall Effluent	Sanitary Sewer	Lagoon Effluent	Surface Water
2, 1, Iron	M	M	M	M	-
2, 1, Lead	M	M	M	M	-
Magnesium	T	T	T	M	-
Manganese	T	T	T	M	-
3, 1, Mercury	M	B	M	M	M
Molybdenum	T	T	T	M	-
Fluoride	T	T	T	-	T
Kjeldahl, Nitrogen	T	T	-	-	T
Nitrate	M	M	T	-	T
Nitrite	T	T	-	-	T
1, 2, Oil and Grease	M	M	M	M	T
Organic Nitrogen	T	T	-	-	T
P, 2, 1, pH	B	B	M	B	M
2, Phenols	M	M	M	M	T
Phosphorus	M	M	M	M	T
3, Poly- chlorinated Biphenyls	-	B	M	M	M
Silica Dissolved	M	B	-	-	-
P, Solids, Dissolved	B	B	M	M	M
1, Solids Settleable	-	B	M	-	M
2, Solids Suspended	M	B	M	M	T
1, Solids, Total	M	B	-	-	M
Solids, Volatile	T	T	-	-	T
2, Sulfate	M	M	T	-	T

Table 3 Continued. Water Sampling and Analysis Program

Pollutant	Intake Water	Outfall Effluent	Sanitary Sewer	Lagoon Effluent	Surface Water
2, Sulfide	T	T	T	-	T
2, 1, Nickel	M	M	M	M	-
Potassium	T	T	T	M	-
1, Selenium	T	T	T	-	-
1, Silver	M	M	M	M	M
Sodium	T	T	T	M	-
Thallium	T	T	-	-	-
2, Tin	T	T	T	M	-
Titantium	T	T	T	M	-
2, 1, Zinc	M	B	M	M	M
1, Alpha	T	T	T	T	T
1, Beta	T	T	T	T	T
Gamma	T	T	T	T	T
Tritium	T	T	T	T	T
Water Temperature	B	B	M	M	T

T = Triannually	P = NPDES Permit Requirement
M = Monthly	1 = Effluent Guidelines for Discharges to Surface Waters
B = Bimonthly	2 = Effluent Guidelines for Discharge to Sanitary Sewers
W = Weekly	3 = Identified as Toxic Pollutant by EPA
C = Continuously	

The EPA has issued an NPDES "permit to discharge" stipulating that effluents are limited to release of unpolluted cooling water to the surface water streams. The standard for unpolluted cooling water has been established by the State of Missouri⁶⁵ and the EPA has established an intake (drinking water standards¹⁶ in the case of the Kansas City Plant) water quality standard to meet these requirements. Therefore, routine monitoring includes sampling and analysis of both intake and outfall waters.

Figure 20. Industrial Waste Monitoring Points and Lagoon Test Well Locations .

The NPDES permit (Appendix C), the Missouri Effluent Guidelines,⁶³ and the parameters required as part of the Corps of Engineers application (subsequently, the NPDES permit application) are all used as the criteria for monitoring activities. The monitoring program includes daily, weekly, monthly, or quarterly surveillance of the characteristics listed in Table 3. Continuous flow measuring and monitoring of pH and temperature of the outfall effluents is required as part of the NPDES permit.

A continuing surveillance program includes sampling specific points upstream and downstream from the Plant on both Indian Creek and Blue River. This data characterizes water quality in relation to any potential facility impact.

Figure 21. Water Monitoring Points

SURFACE WATER MONITORING

Both Indian Creek and Blue River have been monitored for specific pollutant characteristics as dictated by Plant operations. Currently, the quality of water in these streams is monitored for the parameters listed in Table 3. The monitoring points are shown in Figure 21.

SOIL MONITORING

Specific soil tests have been performed when warranted, but the Kansas City Plant has no continuing soil monitoring program. Sampling and analyzing sediment and soil at the bottom of the industrial waste lagoons represent the type of special testing

which has periodically taken place. The primary objectives of these tests are to quantify heavy metal pollutant levels in the on-site system. Other monitoring activities have included core sampling near the underground fuel oil storage tanks to evaluate storage integrity.⁹⁶

BIOTIC MONITORING

Present monitoring activities do not include vegetation or animal life assessment with respect to Plant operations. Currently, biotic monitoring is not undertaken or considered necessary in light of the unlikely potential for environmental impact on plant and animal life.

BENEFITS

The Kansas City Plant makes a major contribution to the United States nuclear weapons defense program. In addition to its national defense role, the Kansas City Plant benefits the nation and the community in three other ways: through a technological spinoff program, through a significant economic impact on the people and institutions of the Kansas City area, and through a commitment to community social advancement.

NATIONAL DEFENSE AND TECHNOLOGY

The Kansas City Plant plays a significant role in America's national defense posture. Its basic mission is the production or procurement of electrical, electronic, electromechanical, plastic, and non-fissile metal components for nuclear weapons.

While the work performed at the Kansas City Plant is intended to enhance the nation's weaponry, the technical impact on American industry is significant. Approximately \$8 million annually is spent for improvements in manufacturing technology. These improvements are made available to the American industrial community through a technical spinoff program which results in the release of approximately 100 technical documents each year. These documents cover subjects as diversified as plastic molding and electronic component manufacturing.

ECONOMIC IMPACT

Because of its size and the nature of its operation the Kansas City Plant has a major economic impact on the area. With about 5000 employees, it is the fifth largest corporate employer

in Kansas City.⁵⁹ During its 28 years of operation, the Plant has contributed more than \$1.4 billion in wages and salaries to the Kansas City area economy.

The Plant currently operates with an annual budget of approximately \$81 million for salaries, \$43 million for purchased goods and services, and \$10 million for Plant and equipment improvements. Indications are that the Plant will continue to operate at approximately that level for the foreseeable future.

Each year, Plant employees pay \$660,000 in earnings taxes to the city of Kansas City. In addition, \$13 million annually is added to the local economy through the purchase of goods and services by the Plant. Area school districts receive approximately \$850,000 annually as a result of Kansas City Plant employees working on federal property.¹⁰⁰ The Kansas City Plant maintains an average bank balance of \$1 million, much of which is in minority-operated banks.

Because of its size and its relation to other federal operations in the area, the Kansas City Plant has been able to effectively use land and resources. The Kansas City Plant is part of a Federal Complex shared by five agencies. Sharing a relatively small land area permits maximum use of services such as powerhouses and utilities.

Because it is located away from the central Kansas City commercial district, the Plant has influenced the urbanization of south suburban Kansas City. Retail operations, highways, public transportation facilities, and residential areas have spread to the southern part of Kansas City, partially because of the Kansas City Plant.

Kansas City was originally selected as the site for the Plant because of the availability of a technically competent labor

force, and because of the proximity of a major metropolitan area capable of providing the variety of services demanded by a large scale operation. The community and the Plant are mutually dependent. The Plant needs the people and the services available in the Kansas City area. In turn, the location of the Plant in the metropolitan area has permitted expansion of area educational, financial, recreational, and social services.

Although the Kansas City Plant accounts for only about one percent of the total employment in the Kansas City area, it accounts for approximately five percent of the industrial employment.⁷⁴ That means that about 1 in 20 individuals in the Kansas City area employed in an industrial environment is employed at the Kansas City Plant. That means also that the Plant provides the Kansas City area with a broad based grouping of technically and scientifically oriented individuals who make a significant impact on the cultural and social aspects of the community.

COMMUNITY INVOLVEMENT

Forty percent of the salaried staff of the Kansas City Plant are college graduates. Each year, the Plant assists its employees in upgrading their educations at local educational institutions. Dozens of employees serve as advisors and instructors in local area educational institutions. Through its "summer hire" program, the Plant gives on-the-job training to numerous area high school students.

The Plant and its employees are heavily involved in the Savings Bond Program, the United Way Campaign, college building funds, and other community involvement projects. More than 40 employees are directly involved in Plant sponsored community betterment efforts.

The Kansas City Plant has been named "buyer of the year" by the Minority Business Exposition as a result of its emphasis on purchasing from local minority businesses. The Plant has a \$600,000 contract with a minority business firm which operates vending machines inside the Plant. Small businesses benefit from approximately \$20 million annually in Plant purchases.

The Kansas City Plant has provided occasional paid leaves of absence for up to nine months to employees who have been chosen to serve for non-profit, non-political, social organizations or activities. The Plant supports local science fairs, maintains Boy Scout merit badge counseling programs, sponsors career development programs and Explorer posts, maintains cooperative engineering programs with colleges, awards employees' children and minority children scholarships through the National Merit Scholarship Program, supports the national Junior Achievement program, and provides training to underemployed individuals.

The Kansas City Plant provides employment for handicapped individuals, including amputees, the mentally retarded, the deaf, and the blind.

The Kansas City Plant is also equipped to serve as an emergency operations center for the surrounding community. The Plant can house 19,710 people as a fallout shelter. A radiation monitoring team can assist in national emergencies and officials and employees are always on call to assist the local community.

THE FUTURE

The longer the Kansas City Plant remains at its present location, the greater will be its benefit to the area. The Plant represents a replacement cost investment of approximately \$250 to \$400 million

in facility and capital equipment. Even if the Plant should lose its national defense mission, the facility and equipment have potential applications in several areas of production and development, such as electronic instruments, plastic components, and mechanical devices. With such a versatile capacity, the Plant can enter several areas of operation other than national defense.

One possible area of involvement is energy research. Much of the work being done now has potential energy application, and there are capabilities available at the Plant which can be applied to energy research and development in coordination with the several ERDA research laboratories.

Future Plant operations will serve America's national defense posture, contribute materially to America's technological abilities, and provide significant social and economic impact on the community.

CHARACTERIZATION OF THE ENVIRONMENT
GENERAL AREA DESCRIPTION

The Kansas City Plant is located on a Federal Complex 12 miles south of downtown Kansas City, Missouri. The Complex is bordered on the west by Troost Avenue, a major north-south traffic artery for metropolitan Kansas City; on the north by land recently donated to Kansas City for Legacy Park, a wildlife refuge; on the east by the Blue River and the proposed Blue River Parkway; and on the south by Missouri Highway W and Indian Creek.

The Plant occupies 113 acres in the 300-acre Complex. The Complex is zoned for heavy industry, but the surrounding area is primarily residential with occasional light industrial and commercial usage. As a result, the Plant carries a high profile in the immediate community.

The Plant is within the incorporated limits of Kansas City, Missouri. The population of Kansas City in 1970 was 507,087.¹² The 1970 population of the Kansas City Standard Metropolitan Statistical Area (SMSA), which includes six counties in Missouri and Kansas (Figure 22), was 1,253,916, making it the twenty-sixth largest metropolitan area in the nation. The area is dotted with dozens of small urban communities which vary in population from hundreds of thousands down to hundreds (Appendix F).

The Kansas City area has long been known for its agricultural economic base and as a major midwestern trading center for agricultural commodities. The city also enjoys a strong and diversified industrial base. More than 500,000 people are employed in the Kansas City SMSA.¹² Most of the industrial employment in the area is in the central and northern parts of Kansas City. The Kansas City Plant is the major employer in the southern part of the city.

Figure 22. Population Totals by County in the Kansas City Standard Metropolitan Statistical Area

A heavily wooded bluff which overlooks the Plant on the north side joins another heavily wooded area on the east (Figures 23 and 24). The eastern area has been designated part of the Blue River Parkway Project while the area to the north has been designated a wildlife refuge and renamed Legacy Park.

The surface waters near the Federal Complex have been designated by the Missouri Clean Water Commission as recreational waters. Neither Indian Creek nor Blue River in the region of the Plant are to receive municipal or industrial waste other than unpolluted cooling water. The Blue River and its tributaries form a drainage basin of approximately 272 square miles.

Figure 23. The North Parking Lot at the Kansas City Plant
With Legacy Park on the Bluff in the Background

Figure 24. The Main Parking Lot Showing the Wooded Areas
East and Southeast of the Kansas City Plant

Figure 25. Corps of Engineers Channel Modifications on the Blue River and Indian Creek; Dashed Lines Show Old Channels

As a result of a 1961 flood which did considerable damage to the Federal Complex and to the Kansas City Plant, the Corps of Engineers has recently completed Phase I of a \$2.8 million flood protection system. The system involved the installation of a levee on the Blue River and modification of the channels of the Blue River and Indian Creek (Figure 25).

There are no known significant mineral or petroleum deposits on the Federal Complex and such deposits are rare in the immediate

area. Cement, stone, sand, and gravel are mined in the Blue River basin. The production of petroleum, natural gas, and clay have been recorded but they are of secondary importance.⁴⁵

Urbanization near the Plant is the subject of continuing study by many community and regulatory agencies. It should be noted, however, that while the Plant may have been a factor in the speed and timing of area urbanization, it is generally conceded that the area would be equally urbanized even if there were no Kansas City Plant.

HISTORICAL BACKGROUND

The Kansas City Plant was built on a flood plain, which until the Plant was built, was used primarily for farming. Before the Civil War, the area was part of the 34,000 acre "Black Bob" Shawnee Indian reservation.⁴⁴

The Indians were probably the first inhabitants of Middle America. The many Indian burial mounds in northwestern Missouri and eastern Kansas indicate a large Indian population in the area. No extensive studies have been made of these early Indian tribes, but surveys of the Greater Kansas City Area have not turned up any significant archaeological sites.⁴⁵

What is now the state of Missouri was included in the Louisiana Purchase of 1803 and the area was explored by Lewis and Clark on their expedition of 1804 to 1806. As the nation moved westward, Missouri became increasingly important in American history. Missouri became a state in 1821 and, until the admission of Texas in 1845, it was the westernmost state in the United States. As such, it was the jumping off point for expeditions into the western wilderness.

Kansas City was founded in 1830 in an area largely inhabited by Indian tribes such as the Delawares, Munsas, Stockbridges, Shawnees, Kaws, Kickapoos, Osages, Pottowatomies, Weas, and Peorias.⁴

The area grew in population and importance during the years between the founding of Kansas City in 1830 and the border wars triggered by the Kansas-Nebraska Act of 1854. The Battle of Westport in what is now Kansas City was one of the last battles of the Civil War and helped stop the Confederate attempt to spread its influence into the western United States.

The Kansas City Plant is located in Washington Township. The first two towns in the township were Hickman Mills, east of the Kansas City Plant, and New Santa Fe, near what is today 123rd Street and State Line Road. The town of Hickman Mills is now a part of Kansas City; New Santa Fe has vanished. The area in which the Plant is located was on both the William Becknell Trail and the Santa Fe Trail which crossed the Blue River at Red Bridge Road, about 20 blocks south of the Plant site.⁴⁴

Because of its proximity to the Blue River and Indian Creek, and the fact that it was frequently flooded, the Plant site itself remained unoccupied by any major structures until the late 1920's when an automobile race track was built on part of what is now the Federal Complex.

No archaeological inspection of the Federal Complex or the Kansas City Plant site is known to have been made. Because the area is extensively paved or otherwise surfaced, and nearly covered with buildings and other structures, opportunity for observing and identifying archaeologically important sites is virtually precluded.

LAND USE AND DEVELOPMENT

The Kansas City Plant is situated in an urbanized area characterized by single and multiple family dwellings, commercial establishments, industrial districts, and public use lands. (No attempt is made here to characterize the land use and development of the entire Kansas City area; only the immediate plant area is discussed.) Some rural characteristics are evident near the Plant but crop lands have been declining because of the rapidly expanding urban development.^{82, 89}

The Federal Complex in which the Kansas City Plant is located has been zoned for heavy industry (Figure 26). The property adjoining the Complex is zoned for residential use with isolated commercial tracts--except along the east and north sides which has been designated for public recreational and agricultural uses.

The urbanization of the area around the Kansas City Plant has led to improved highway transportation arteries. New highways have in turn led to an even faster urbanization of the area. Among the major traffic arteries serving the Plant (Figure 27) are Interstate Highway 435 which is part of the circumferential highway around the Metropolitan Area, Missouri Highway W which passes directly south of the Plant, U. S. Highway 71 which is a major north-south route east of the Federal Complex, and major north and south city streets such as Troost and Holmes. Proposed highway improvements include the Blue River Parkway Project and the South Midtown Freeway which will be an extension of U. S. Highway 71 and will provide direct freeway access to the downtown district from the vicinity of the Plant.

New commercial establishments continue to spring up along the major transportation arteries in the area and new housing

Figure 26. Zoning of Land Near the Kansas City Plant¹¹⁴

areas continue to be developed in the limited open land near the Plant. The growth of commercial enterprises in the region is expected to continue.

Swope Park is located just northeast of the Kansas City Plant (Figure 28). When the Blue River Parkway Project is completed, the Parkway will join with Swope Park to turn the area into one of the nation's largest metropolitan parks. Other public use lands, such as William Minor Park, are located within a few miles of the Plant.

Figure 27. Transportation Arteries Near the Kansas City Plant

Figure 28. Designated Park Areas Near the Kansas City Plant

Most of the other land adjacent to the Kansas City Plant is privately owned and it may be expected that this land will be developed both for residential and commercial usage in the years to come. Some of the land has, however, been set aside for recreational use. A youth baseball complex is located near the southeastern edge of the Federal Complex and the public use lands around the Plant are the setting of many community recreational endeavors.

DEMOGRAPHY: THE PEOPLE

POPULATION

The 1970 population of the Kansas City Standard Metropolitan Statistical Area (SMSA) was 1,253,916 (Figure 29).¹² The Kansas City SMSA consists of Cass, Clay, Jackson, and Platte counties in Missouri, and Johnson and Wyandotte counties in Kansas. The counties of Leavenworth in Kansas and Ray in Missouri are added to the SMSA to make up what is generally known as the Kansas City Metropolitan Region. The population of the Region is expected to grow to about 2.5 million by 1990.³⁷ The 1970 population was a 14.8 percent increase over the 1960 population.¹²

Population growth figures for the metropolitan area have been projected by many governmental and civic organizations, including the Bureau of Economic Analysis of the Department of Commerce, the Economic Research Service of the Department of Agriculture (OBERS), the Bureau of the Census, and the Mid America Regional Council (MARC). OBERS is an acronym which stands for the Office of Business Economics of the Department of Commerce and the Economic Research Service of the Department of Agriculture. The OBERS projections of population are much higher than the recently revised population projection of the Bureau of the Census. Because of this discrepancy in projections, the MARC and the Bureau of the Census Projection have been used rather than the OBERS projections.

The racial distribution of the 1970 population was 87 percent white, 12 percent black, and 1 percent other races. The median age in 1970 was 27.9 years.¹²

The projected urban growth of the area is expected to be determined by three factors: natural population growth, net

Figure 29 KANSAS CITY PLANT EMPLOYMENT

migration of populations in the metropolitan area, and economic conditions. Natural population growth is related to economic conditions and social attitudes toward family size. The migration is conventionally considered a positive factor with respect to the growth in employment opportunities. Table 4 shows three projections of the population, labor force, and employment in the Kansas City metropolitan area based on projections developed by local authorities.¹⁴

In 1970, 88 percent of the residents of the Kansas City SMSA lived in urbanized areas. The central city of the SMSA, Kansas City, Missouri, had an urban population of 501,859 and a total population of 507,087. The SMSA contained three other cities with urban populations greater than 50,000, including Kansas City, Kansas, with a population of 168,218, Independence, Missouri, with a population of 111,630, and Overland Park, Kansas, with a population of 79,034.⁴⁵ The region around the Kansas City Plant itself ranges from sparsely to densely populated (Figure 30).

EMPLOYMENT AND ECONOMY

The 1970 Kansas City SMSA employment total was 520,954.⁴⁵ The Kansas City employment distribution by major industry closely paralleled the distribution in the entire country (Table 5). Manufacturing, wholesale and retail trade, and services account for 70.3 percent of the total employment in the SMSA, which is close to the national average of 72.2 percent.

Further evidence of the diversified economy in the area is shown in the listing of the 10 largest employers: Federal Government, State and Local Government, Trans World Airlines, General Motors, The Kansas City Plant (ERDA), Western Electric, Hallmark Cards, Ford Motor Company, Armco Steel, and Sears, Roebuck and Company.⁶⁰

Table 4. Low, Middle, and High Growth
Projections for Kansas City SMSA
Population, Labor Force, and Employment

Year*	Population	Labor Force	Employment
1980			
Low	1,300,000	657,450	624,000
Middle	1,421,250	713,800	677,488
High	1,653,160	836,050	793,520
1990			
Low	1,396,590	706,290	670,360
Middle	1,663,760	841,410	798,604
High	2,052,900	1,038,210	958,390
2000			
Low	1,500,000	758,590	720,000
Middle	1,906,270	962,670	913,877
High	2,550,560	1,289,890	1,224,270

*Low growth projections were developed by the Kansas City District, U. S. Corps of Engineers; middle and high growth projections were developed by the Mid-America Regional Council.

The SMSA ranks significantly higher (6.8 percent) than the national average in terms of employment in the transportation industry. Kansas City ranks second nationwide in trucking volume and third in railroad handling. There are 12 major railroads operating in the region. The Missouri-Mississippi inland water system, the interstate highway network, and the new Kansas City International Airport are additional reasons for the transportation industry's strength in the area. Kansas City is one of 22 air centers defined as major traffic centers by the Federal Aviation Administration.³⁷

The mean family income in the Kansas City SMSA in 1970 was about \$1,000 greater than the nationwide mean family income.^{45, 91}

Figure 30. Population Densities Near the Kansas City Plant

Within the six county area of the SMSA there was considerable variation in mean family income between urban and suburban counties and among the various urban counties (Table 6).

Projected patterns of change in the employment composition of the Kansas City SMSA are similar to the patterns of change which have occurred in metropolitan areas around the United States. Table 7 shows that agriculture and mining are expected to decline in terms of employment. Employment in industry, which consists primarily of manufacturing and commodity distribution, is expected to increase numerically but to decrease as a percentage of the total employment. Employment in industry in the Kansas City SMSA⁴⁵ is expected to increase by more than 50 percent between 1970 and 2000. The substantial increase expected in

Table 5. Employment by Major Industry: Kansas City SMSA and United States (1970)¹⁴

Industry	U. S. (Percent)	SMSA (Percent)	SMSA Total
Agriculture, Forestry, and Fisheries	3.7	1.3	6,623
Mining	0.8	0.3	1,376
Construction	6.0	5.7	29,709
Manufacturing	25.9	22.8	118,450
Transportation	3.7	6.8	35,404
Communication and Public Utilities	3.1	3.1	16,367
Wholesale and Retail Trade	20.0	23.2	120,903
Finance, Insurance and Real Estate	5.0	6.4	33,510
Services	26.3	24.3	126,781
Public Administration	5.5	6.1	31,822
Totals	100.0	100.0	520,945

Table 6. Mean Family Income (1970)¹⁴

County	Mean Income	Number of Families
Cass	\$ 9,305	10,339
Wyandotte	9,912	48,149
Jackson	11,300	166,882
Clay	11,905	32,954
Platte	13,060	8,376
Johnson	15,762	57,759

Table 7. Projected Employment by Industrial Group for the Kansas City SMSA From 1970 to 2000¹⁴

Group	Employment Totals			Percent of Totals		
	1970	1980	2000	1970	1980	2000
Agriculture	6,794	5,500	4,655	1.2	0.8	0.5
Mining	676	460	434	0.1	0.1	0.1
Industry*	234,326	275,664	359,388	42.6	40.7	39.3
Retail Trade	85,482	108,179	147,076	15.5	16.0	16.1
Services**	105,650	140,805	200,880	19.2	20.8	22.0
Government	64,321	83,931	126,432	11.7	12.4	13.8
Unclassified	53,373	62,949	75,012	9.7	9.2	8.2
Totals	550,622	677,488	913,877			

*Industry includes construction, manufacturing, wholesale trade, transportation, communications, and public utilities.

**Services includes services and finances, insurance, and real estate.

retail trade employment is noteworthy because retail trade provides a significant fraction of total employment. Employment in service and in government are projected to increase more rapidly than total employment in the SMSA. Increases in total employment are projected to reflect substantial population increases and a very gradual increase in labor force participation rates.

GEOLOGY AND SEISMOLOGY

The geology of Missouri and Kansas reads like a geologic time scale. Almost every division of the time scale is represented (Figure 31). The Pre-Cambrian outcroppings of southeastern Missouri may be as much as four billion years old. The Ordovician rocks which form the larger part of the southern half of Missouri range in age from 400 to 500 million years.⁹⁴

Kansas City is located in the middle of a 150-mile-wide outcropping of Pennsylvanian rocks (about 300 million years old) which extends in a north-south direction through western Missouri and eastern Kansas (Figure 32). The area slopes gently toward the Forest City Basin of northwest Missouri. The average change in elevation in the Kansas City area is only 10 to 20 feet per mile.⁷⁰

During the Ice Age, glaciers extended southward into what is now northern Kansas City. These glaciers and the changes wrought by the melt runoff are responsible for the relatively flat topography of the area. Characteristic east-facing escarpments are held up by the resistant limestones in the Kansas City Group. One escarpment, the Bethany Falls, is particularly significant at Kansas City. The gentle slopes and lowlands intervening between the escarpments are largely underlain with shales in the Pleasanton and Kansas City Groups. Loess and patchy deposits of glacial till often conceal the beds immediately north and east of the Missouri River.

In general the Kansas City Group at Kansas City is composed of alternating limestones and shales. Sandstone is of minor importance in the sections at Kansas City but increases at the expense of limestones in southeastern Kansas.⁵⁹

Figure 31. General Geology Map of Missouri and Kansas

Coal beds are sparsely developed in the Kansas City Group at Kansas City but there are no significant deposits of minerals or oil in the Kansas City area.^{4 5}

The soils found in the general area tend to bear out the suggestion of cyclic deposits of rocks and sedimentation. The Kansas City Plant is built on the alluvial soil of the Blue River Flood Basin--soil described as deep, dark, clayey, and loamy. The area north of the Plant is covered by a thin, well-drained top soil which developed in loess, is somewhat rocky, and is underlain by limestone. The areas south and east of the Plant are covered by mixed prairie soils and rough shale and limestone soils. The latter is described as loamy with varying quantities of clay and silt.^{7 0} The average elevation of the Federal Complex (Figure 33) is 800 feet with relatively abrupt shifts in elevation both to the north and south of the Complex.

Figure 32. Generalized Stratigraphic Column of Rock Structure in the Kansas City Area

Figure 33. Elevation of the Land Near the Kansas City Plant

Figure 34. Earthquake Zone Risk Map. Kansas City is in the Next to Lowest Zone in the Nation; Zone 3 is the Most Subject to Damaging Earthquakes.¹⁰⁰

The area is relatively earthquake-free. The Director of the Missouri Geological Service at Rolla, Dr. Wallace C. Howe,⁹⁸ says past history indicates that the most severe earthquake likely in the area would register no more than V or VI on the Modified Mercalli Intensity Scale of 1931 (Table 8). Kansas City is located in Seismic Risk Zone 1, the next to lowest earthquake risk area in the United States as described in the Uniform Building Code (Figure 34).¹⁰⁸ The only earthquakes recorded in this century in the Kansas City area have rated no higher than 3.5 to 5 on the Richter Scale.¹⁰⁹

Table 8. Modified Mercalli Intensity Scale¹¹³

Rating	Effect
I	Not felt except by very few.
II	Felt only by a few; some suspended objects may swing.
III	Felt noticeably, but most people do not recognize it as an earthquake. Vibration like passing truck.
IV	During the day, felt indoors by many, outdoors by few. At night some awakened. Dishes rattle; walls make creaking sound; standing automobiles rock noticeably.
V	Felt by nearly everyone. Some dishes and windows broken. Some cracked plaster.
VI	Felt by all; many frightened and run outdoors. A few instances of fallen plaster or damaged chimneys.
VII	Everybody runs outdoors. Damage negligible in buildings of good design and construction, slight to moderate in well-built ordinary structures, considerable in poorly-built or badly-designed structures. Some chimneys broken. Noticed by people driving cars.
VIII	Damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly-built structures. Fall of chimneys, factory stacks, columns, monuments, and walls. Sand and mud ejected in small amounts.
IX	Damage considerable in specially designed structures; well designed frame structures thrown out of a plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked considerably. Underground pipes broken.
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed; ground badly cracked. Rails bent. Landslides considerable. Water slopped over banks.
XI	Few if any masonry structures remain standing. Bridges destroyed; broad fissures in ground; under-ground pipelines completely out of service. Earth slumps and land slips in soft ground.
XII	Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into air.

One of the most serious earthquakes in history struck the southern Missouri area near what is now New Madrid, Missouri in 1811. That earthquake changed the course of the Mississippi River and formed Reelfoot Lake in Tennessee.¹⁰³ Accounts of the earthquake written by the few inhabitants of the area at that time speak of the earth literally waving on the horizon, lakes and rivers being emptied of their waters and refilled moments later in massive floods, and of buildings and cattle being swallowed up by cracks that opened in the countryside. Only two deaths were confirmed as a result of the earthquake: in 1811 the area was occupied only by a few trappers, a few Indians, and a very few settlers.

There has been nothing in the last century to approximate the 1811 earthquake. Earthquakes in Missouri were recorded in 1895, 1931, 1935, 1939, 1948, 1952, 1961, 1965 and 1972, but the most serious damage in the Kansas City area has been a few broken windows and some cracked dishes.⁵⁵

HYDROLOGY: WATER RESOURCES

SURFACE WATER

There are three principal sources of surface water in the area around the Kansas City Plant: the Missouri River, the Blue River, and Indian Creek. Kansas City draws all of its drinking water from the Missouri River,⁶² and the Kansas City Plant relies on the city for its supply of water. The Plant draws no water from either the Blue River or Indian Creek, although it does discharge authorized wastewater to both.

The Missouri River

The Missouri River extends some 2400 miles from its headwaters along the Continental Divide in Montana and Wyoming to its confluence with the Mississippi River a few miles from St. Louis. The river has a drainage area of 529,000 square miles, about one-sixth of the United States, including about half of Missouri and all or parts of Montana, Wyoming, North and South Dakota, Nebraska, Colorado, Kansas, Minnesota, and Iowa.⁶²

By the time it reaches Kansas City, the Missouri River has drained 489,200 square miles. The average flow at Kansas City is 54,710 cubic feet per second. River flow extremes over a 67 year period range from a maximum of 573,000 cubic feet per second to a minimum of 1500 cubic feet per second.⁶²

The chemical quality of the water in the Missouri River is the result of mixing many types of water from hundreds of tributaries. In Missouri, the water generally is hard and moderately mineralized. The dissolved solid content of the water varies with stream flow and is higher during periods of low flow.

Turbidity of the water also varies with stream flow and it is higher during periods of high flow. The lower turbidity values generally occur during the winter months.⁶²

Blue River and Indian Creek

The Blue River, known locally as the Big Blue to distinguish it from the neighboring Little Blue River to the east, drains an area of 272 square miles, of which about 44 percent lies in Missouri (Figure 35). The river is formed by the confluence of Coffee Creek and Wolf Creek in southeast Johnson County, Kansas, and flows northeasterly to the state line where it enters the southwest corner of Jackson County and Kansas City, Missouri. From there, the Blue River meanders 37 miles in a northeasterly direction through the city before it joins the Missouri River.⁴⁵

Indian Creek, with a total drainage area of 77 square miles, enters Kansas City a short distance south of 103rd Street and State Line Road and flows in a generally easterly direction to join the Blue River about 0.4 mile south of Bannister Road.

The Blue River drains a large portion of the city of Kansas City, Missouri and a substantial portion of Johnson County, Kansas. The basin near the headwaters remains predominantly rural with scattered small communities. However, urbanization is rapidly approaching from the north. The Indian Creek drainage area is in a state of transition from agriculture to urban. Residential and commercial developments are springing up throughout the basin. Urbanization is nearly complete in the northern parts of the basin.

The Kansas City Plant is located entirely within the flood plain of the Blue River. The Blue River flood plain contains the

Figure 35. The Blue River Basin

full development cycle from rural to heavy industrial; the easy gradient of the plain is used by seven major railroads for access to Kansas City.

Records of gaging stations on the Blue River for a 31 year period show that the average discharge of the river is 141 cubic feet per second. The maximum discharge was 41,000 cubic feet per second on 13 September 1961. At times, there has been no flow on the river.⁴⁵

The principle use of the Blue River is for the discharge of industrial and municipal wastes. As the Blue River flows east from its headwaters and then northward through rural and suburban areas of Kansas, and into Missouri, water quality is seriously affected by the introduction of organic wastes from natural runoff, storm water overflow of sewers, and municipal and industrial waste treatment plants. There has been a steady deterioration of the water quality in the upper portions of the river during the last 20 to 30 years as commercial and residential developments extend south from Swope Park and west into Johnson County, Kansas.⁴⁶ The Kansas City Plant empties cooling water into Indian Creek at three points and into the Blue River at one point. The State of Missouri has long range plans for turning parts of the Blue River into public recreational areas--which explains the Missouri insistence that only cooling waters be released into the stream despite the pollution already present.

The development of numerous housing projects in the outlying suburban areas in recent years has resulted in overload of sewage treatment plants which subsequently has adversely affected water quality. Water quality has been characterized by low dissolved oxygen levels, extensive attached aquatic growth, and odors (Table 9).⁴⁵

Table 9. Summary of Water Quality Analysis of Indian Creek at 103rd Street Near Kansas City Plant¹¹¹

Quality	Maximum	Minimum	Average
Water Temperature (°F)	84	38	55
Dissolved Oxygen (mg/l)	8.7	4.6	6.5
NH3-N (mg/l)	10.00	1.50	4.90
NO2-N (mg/l)	0.960	0.120	0.340
NO3-N (mg/l)	6.20	0.40	2.50
PO4 (mg/l)	44.00	0.87	17.60
Coliform Bacteria (per 100 ml)	600,000	8,000	170,000
Fecal Strep Bacteria (per 100 ml)	84,000	180	11,600

There are a number of municipal waste water treatment facilities that discharge effluents into the Blue River on both the Kansas and Missouri sides of the state line. The type of treatment, the degree of treatment, the designed capacity equivalent, and other statistics vary for each. In the immediate vicinity of the Kansas City Plant, the Dykes Branch pumping station uses Indian Creek as an overflow outlet for treated (sedimentation and chlorination) sewage. Upstream in Leawood, Kansas, a publicly owned secondary sewage treatment plant discharges treated effluents to Indian Creek. Indeed, the Leawood plant is responsible for most of the flow in Indian Creek; upstream from Leawood there is flow in Indian Creek only about half the year.

Pollution materials in the runoff from urban areas in the basin vary according to the time of the year and type of land use. During the winter, salt and other chemicals used to treat

ice and snow will be washed into streams through storm sewers. Other sources of pollution include fertilizers, herbicides, and pesticides used on lawns, gardens, golf courses, parks, and cemeteries.

Flood Considerations

The Blue River is subject to frequent flooding because intense development, especially in the lower basin of the river, has caused even moderate floodflows to become a serious problem. Floodway capacity has been reduced to near ineffectiveness in many places by building construction at the channel edge, by inadequate bridging, and by indiscriminant land filling. The lower basin of the Blue River from the mouth to 23rd Street contains the greatest concentration of flood plain development.

Although the Blue River and Indian Creek leave their banks fairly often, the floodflow generally is into undeveloped land. The most serious flood in the recorded history of the Blue River occurred in September 1961. Nearly 8 inches of rain was measured unofficially near the southern extremities of the Blue River Basin in the 12 hours before the flood. The river rose very rapidly to 44.46 feet, 23 feet above flood stage, at the Bannister Road gage (Table 10). The water entered the Federal Complex and most of the Kansas City Plant. The Plant suffered about one-half million dollars in damage as a result of the flood. Total flood damage in the Kansas City area was about \$7.6 million.⁴⁰

As a result of the flood, federal and state officials focused fresh attention on the problems of flooding in the Blue River Basin. The Corps of Engineers constructed a \$2.8 million levee system to protect the Kansas City Plant. As a result of the project, the Kansas City Plant is expected to be protected from most foreseeable flood conditions.⁴⁷

Table 10. Recorded Flood Stages at
Bannister Road on the
Blue River⁴⁰

Date	Gage* (Feet)	Discharge (ft ³ /sec)
April 23, 1944	35.88	26,400
April 16, 1945	26.30	11,100
April 5, 1947	27.35	12,100
June 23, 1947	28.98	14,100
October 21, 1949	30.85	16,400
July 11, 1951	38.30	31,100
May 28, 1955	26.33	8,560
June 30, 1957	29.65	14,300
July 31, 1958	37.80	21,700
May 6, 1961	26.49	8,200
July 6, 1961	26.40	7,780
September 13, 1961	44.46	41,000
November 2, 1961	28.19	9,140
May 28, 1964	26.73	8,130
June 5, 1965	30.13	12,100
September 4, 1965	26.77	9,050
June 21, 1967	32.20	13,000
September 13, 1977	34.70	--

*Gage zero is 753.73 feet mean sea level;
flood stage is approximately 21 feet.

However, the levee system does not necessarily protect the roadway systems near the Plant and the Plant may expect to be affected in a moderate way by future floods. Personnel traveling to and from the Plant may be hampered by water covering low lying roadways, especially south and southeast of the Plant.

GROUND WATER

Great quantities of water are available from the ground water reservoirs in Missouri, but the distribution and quality of

ground water are such that not all parts of the state are equally fortunate.

The Kansas City area lies entirely within what is known as the Saline Ground Water Province.⁶² In this area, ground water supplies have a tendency to be contaminated by the high saline content of the ground. The source of the dissolved salts has not been isolated, but geologists believe the salts are derived from subsurface formations of marine origin.

Some usable ground water supplies are available in the area, mostly in the alluvium and glacial deposits in the northern part of the Saline Ground-Water Province. Independence, east of the Kansas City Plant, and North Kansas City both use water from wells drilled into the alluvium and glacial deposits. Some other cities in the area use surface water trapped during runoffs. Towns along the Missouri River, including Kansas City, treat and use river water.

A 235-foot well drilled on the Federal Complex property in 1969 did produce 2 to 3 gallons of water per minute from ground water reservoirs, but the well showed coliform contamination and water had to be chlorinated.

Although there are some ground water resources in the area, no extensive use is made of them. It is felt that any extensive attempt to tap ground water resources in the area probably would result in a decline of the water levels and that wells could easily run dry in a few years. This is especially true of wells drilled on the Federal Complex property. Because of the low permeability of the Pennsylvanian Strata, there normally is very little ground water movement either laterally or vertically. And there is very little absorption from the surface at the Federal

Complex Site. Most of the rain that falls on the Federal Complex eventually flows into the Blue River or Indian Creek rather than being allowed to soak into the ground.

WATER QUALITY

The general condition of the waters of the Indian Creek and Blue River Basin has been characterized by Midwest Research Institute⁴⁵ as varying from polluted near the mouth of the Blue River to moderately enriched at upstream stations. Plant nutrients (ammonia growth, nitrate nitrogen, and orthophosphate) are abundant for algae growth. During low water, warm weather periods, portions of the river system have been observed covered with microdiatoms.

Portions of the Blue River are unappealing. Flood plain businesses and the general population have covered much of the bank with the refuse of urban development. The effects of increasing urbanization and agricultural pressures continue to appear in the Indian Creek and Blue River waters. Environmentalists predict a continuing short-term deterioration of the quality of the water in both systems.

An MRI field study⁴⁵ in March, 1973, led to the following conclusions about the general water quality of the area near the Kansas City Plant.

- The water quality during periods of high water is almost homogeneous throughout the Blue River drainage.
- Many taxa of algae are transported readily from upstream to downstream sites throughout the Blue River drainage basin.

- Benthic macroinvertebrates drift during high water, but their composition at a given site is less subject to variation caused by high flow and is a reliable indicator of water quality.
- Channel modifications, such as that in the Blue River between 89th and 95th Streets (along the Federal Complex site), do not have apparent long-term effects on the biota. Although there are undoubtedly short-term effects, benthos and plankton species composition and abundance are similar in neighboring modified and unmodified stretches of the Blue River.
- Downstream portions of the Blue River were more polluted than upstream portions. Both macrobenthic animals and plankton organisms provided indications of the poor environmental conditions at downstream stations.

The MRI study did conclude, however, that much more extensive sampling work would be required before any good water quality characterization of the Blue River drainage could be made.

METEOROLOGY: THE WEATHER

Kansas City, near the geographical center of the United States, has a "modified continental climate," so called because there are no natural obstructions in the area to prevent the free sweep of air currents from all directions.⁵⁷

Some of the climatic features which might be expected at this latitude are obscured by the warm and cold air from source regions many hundreds of miles away. Moist air currents from the Gulf of Mexico sometimes vie with the desiccating winds from the semi-arid regions of the southwest to determine whether the Kansas City area will have flood or drought. There is often conflict between the warm, moist gulf currents and the cold, polar continental currents from the north. These factors are responsible for weather that is subject to rapid changes.

Early spring in Kansas City brings frequent and rapid weather fluctuations. The last freezing temperatures in the spring usually occur around April 7, although freezes have been recorded as late as May 6. Summer is characterized by warm days and mild nights with moderate humidities; July is considered the warmest month. Fall normally is mild and usually includes a period near the middle of the season which is characterized by mild, sunny days and cool nights. The first freezing temperatures of fall usually occur around October 26. Winters in Kansas City are not severely cold; January is the coldest month. Snowfalls as heavy as 10 inches or more are comparatively rare. Tables 11 through 13 summarize the weather conditions in the area.⁵⁷

Nearly 70 percent of the annual precipitation in the area occurs during the six months from April to September. More than 75 percent of the annual moisture normally falls during the

Table 11. Temperature, Rainfall, and Snowfall Data for the Kansas City Area

Month	Temperature*			Mean Rainfall (Inches)	Mean Snowfall (Inches)**
	Mean (°F)	Highest (°F)	Lowest (°F)		
Jan	29.8	73 (1967)	-13 (1977)	1.34	5.6
Feb	33.1	74 (1961)	-4 (1971)	1.47	4.0
Mar	43.3	87 (1966)	-1 (1962)	2.62	4.0
Apr	55.5	91 (1970)	25 (1970)	3.37	0.7
May	65.3	94 (1962)	34 (1961)	4.65	Trace
June	74.7	99 (1971)	47 (1969)	4.88	0.0
July	79.4	106 (1970)	52 (1971)	3.93	0.0
Aug	78.0	105 (1970)	50 (1967)	3.93	0.0
Sep	70.1	99 (1970)	40 (1967)	4.32	0.0
Oct	59.1	97 (1963)	28 (1969)	2.89	Trace
Nov	44.8	81 (1964)	7 (1964)	1.86	1.0
Dec	33.7	70 (1970)	-7 (1968)	1.46	4.5
Year	55.6	106***	-13†	36.71	19.8

*Records based on data from existing and comparable exposures.

Highest temperature ever recorded regardless of location was 113 in August 1936; lowest was -22 in February 1899.

**Includes ice pellets

***July 1970

†January 1977

growing season. Twenty-nine percent of the precipitation falls during the spring, 35 percent during the summer, 24 percent during the fall, and only 12 percent during the winter.

Although the weather in Kansas City generally may be described as moderate, there are periods of turbulent weather which may pose hazards to the Kansas City Plant.

Table 12. Wind Speed and Humidity Data for the Kansas City Area

Month	Wind Speeds			Relative Humidity (Percent)			
	Mean (mph)	Prevailing Direction	Fastest Mile			6 a.m.	6 p.m.
			mph	Direction	Year		
Jan	9.9	SSW	66	NE	1948	75	62
Feb	10.3	SSW	49	NW	1947	73	57
Mar	11.6	ENE	70	SW	1952	73	50
Apr	11.5	S	61	W	1953	72	47
May	10.4	S	68	SW	1950	77	51
June	10.0	S	68	NW	1952	82	56
July	8.9	S	70	NW	1936	79	53
Aug	8.8	S	72	NW	1941	80	52
Sept	9.1	S	50	NW	1951	82	57
Oct	9.1	S	56	W	1951	74	51
Nov	10.2	SSW	56	SW	1958	76	60
Dec	9.9	SSW	57	SW	1951	77	66
Year	10.0	S	72	NW	Aug 1941	77	55

TORNADOES

Missouri is considered a high tornado risk state and is located in a "tornado alley" which stretches northeasterly through Oklahoma, Missouri, Illinois, Indiana, Ohio, and Pennsylvania.¹⁰⁷

Tornadoes are caused by a collision between warm, moist air moving up from the south and cool, dry air moving in from the north and northwest. During the last 17 years, 68 tornadoes have struck within a 25 mile radius of Kansas City, but none have hit on land occupied by the Plant. Figure 36 shows the touchdown

Table 13. Kansas City Climate Summary (In Mean Number of Days)

Month	Clear	Partly Cloudy	Cloudy	Rain	Snow**	Thunder- storms	Heavy Fog
Jan	9	7	15	7	1	†	2
Feb	8	7	13	7	1	1	1
Mar	7	9	15	9	1	3	1
Apr	8	8	14	10	†	5	1
May	8	10	13	11	0	7	1
June	7	12	11	11	0	9	†
July	12	12	7	8	0	8	†
Aug	13	10	8	8	0	7	†
Sept	13	8	9	8	0	5	1
Oct	14	7	10	7	0	3	1
Nov	11	6	13	6	†	1	1
Dec	9	6	16	7	1	1	2
Year	119	102	144	98	6	50	12

†Less than one-half day

*0.01 inch or more

**1.0 inch or more, including ice pellets

point and the travel patterns of tornadoes which have hit the area. The dashed line which runs across the bottom of the area shows the path of the so-called Ruskin Heights tornado of 1957 which struck south of the Kansas City Plant and left a path of death and destruction unequalled in the history of the area.⁹⁹

The chances of a tornado scoring a direct hit on the Plant are one in 1300 according to statistics prepared by local meteorologists. The chances of the Plant suffering some damage from a tornado hitting in the area are one in 222.¹⁰⁴

Figure 36. Reported Tornado Touchdowns and Travel Points Within a 25-Mile Radius of Kansas City, Missouri; Dashed Line is Ruskin Heights Tornado of 1957, the Tornado Closest to Plant in 25 Years⁹⁹

Because of the close attention paid to tornado threats in the area, an extensive early warning system has been developed by local weather officials, and the Kansas City Plant has developed tornado protection plans to minimize the danger to Plant employees. Although it is impossible to predict accurately when and where tornadoes will strike, every precaution has been taken to ensure that the tornado threat to human life at the Plant is minimal.

THUNDERSTORMS

Thunderstorms which strike the Kansas City area often are severe and frequently precipitate other weather hazards (Figure 37).

According to weather bureau statistics, lightning precipitated by thunderstorms kills more people each year than either hurricanes or tornadoes. Each year there are some severe lightning strikes in the Kansas City area and although there have not been any direct lightning strikes on the Kansas City Plant property within recent years, lightning protection has been provided so that there is no threat to the facility.

HAIL

Hail often results from an intensively active thunderstorm system. Kansas City is located in an area subject to frequent hailstorms (Figure 38).

The Plant is subject to hail damage: a concentration of even small hailstones could do significant damage to glass surfaces or roofs. Hail also poses a danger to the Air Support Structures east of the Main Manufacturing Building. Fortunately, hailstones large enough to do significant damage are not common in the Kansas City area.

WIND

Wind poses one of the most severe continuing dangers to the Kansas City Plant. Missouri is considered a "high wind risk" state (Figure 39). Although the average wind speed in the Kansas City area is only 10 miles per hour (Figure 40), wind as strong

Figure 37. Thunderstorm Risk Map¹⁰⁶

as 72 miles an hour has been recorded. Unconfirmed gusts in excess of 100 miles an hour have been reported.⁵⁷

High winds pose a severe threat to the Plant itself. In addition to endangering the roof and some structural parts of the Main Manufacturing Building, high winds also pose a severe threat to the Air Support Structures east of the main building.

Figure 38. Hailstorm Frequency Map. Data Covers Only
Hailstones 3/4-Inch and Larger⁸⁷

SNOW

Only about 20 inches of snow falls in the Kansas City area during an average year. During the last 40 years, the amount of snow falling in the Kansas City area has ranged from a low of 5.5 inches to a high of 58.5 inches, an indication that winter weather in the Kansas City area is somewhat unpredictable.⁵⁷

The snow does not normally pose any danger to the Plant, although periods of heavy snowfall do pose hazards to plant

Figure 39. Wind Risk Map. Data Covers Only Winds of 50 Knots or Greater^{8 7}

personnel going to and from their homes. Kansas City and the surrounding suburban cities do provide adequate snow removal services to keep the major routes free of snow. The Kansas City Plant and the Federal Complex also have snow removal equipment to keep the parking lots and driveways free of snow accumulation.

ICE

During the winter months, snowfalls frequently are preceded by periods of freezing rain. The resulting ice coating poses

Figure 40. Wind Rose for Municipal Airport (Left) and Richards-Gebaur Air Force Base (Right). Municipal Airport is About 15 Miles North of the Plant; Richards-Gebaur Air Force Base is About 10 Miles South of the Plant.

severe hazards to human travel. The ice can also form on power lines and trees and damage area electrical services; in 1972, a severe ice storm did major damage to area trees and resulted in power outages to large sections of the city. Electrical power was out in some sections of the city for as long as a week.

Although Kansas City and the surrounding suburban cities do provide ice and snow removal services, the ice often strikes with such suddenness and with such severity that street crews cannot keep pace. Travel snarls during the periods of extreme weather are not uncommon. However, the ice rarely poses any significant structural threat to the Kansas City Plant.

AIR QUALITY

The unstable weather conditions in Middle America contribute to the relatively good ambient air quality of Kansas City in comparison to other major industrial cities. Industry in the Kansas City area undoubtedly pumps just as many pollutants into the air as industry in any city of this size. However, the rapid air movement in the area results in frequent and thorough dispersion of the pollutants and prevents a major air pollution problem.

Fall is the least favorable time of the year for the dispersion of air contaminants because fall generally is characterized by low wind speeds and high frequency of inversions. Yet, fall is not necessarily the season in which the greatest particulate pollution concentration will be measured.

Emissions from heavy use of fossil fuels during the winter and early spring make the early months of the year the most serious air pollution months. To offset this heavy air pollution,

however, is the fact that spring is the season of rapid weather changes typified by strong winds, low frequency of inversions, and high frequency of neutral stability.

Weather conditions during the summer are somewhat less variable than during the spring, but summer is also a season of unstable conditions during which inversions dissipate soon after sunrise. Although short build ups of air pollutants may occur in the winter time, build ups end as uncontaminated masses of cold air move through the area.

Kansas City air quality is rated as acceptable in most areas. On the basis of federal standards, Kansas City carries a Priority 3 in the sulphur dioxide, nitrogen dioxide, and hydrocarbon categories. Priority 3 means that Kansas City meets federal primary ambient air standards. At the same time, Kansas City falls into a Priority 1 in the categories of suspended particulates, carbon monoxide, and photo oxidants. Priority 1 means that Kansas City does not meet the primary air quality standards for these pollutants.²

BIOLOGY: FLORA AND FAUNA

The eastern boundary of the Kansas City Plant lies on the Blue River in an area described as having relatively few basic types of plant and animal communities.⁴⁵ The area does support some natural wildlife, and the eastern border of the plant site will be preserved as part of the Blue River Parkways project.

PLANT LIFE

The general topography of the region has resulted in relatively heterogeneous vegetation. Along streams in the area one will find black willow, silver maple, buckeye, American elm, slippery elm, black walnut, burr oak, and Kentucky coffeetree forming the greater part of the forest areas. Uplands and bluffs have various species of oaks and hickories.

Buckbrush is one of the more common under-shrubs, with hazelnut and wild blackberry also dominant. Black walnut, silver maple, cottonwood, and white ash are important in the establishment of a flood plain forest while American elderberry is found in the forest understory.

The flood plain forests in the area consist mostly of various willow species and cottonwood, with sandbar willow the first to become established on river banks. Common shrubs include roughleaf dogwood, indigo bush, buckbrush, smooth sumac, and wild plum. Elderberry is the principal shrub, although trumpet vine is also known. Successional species such as American elm, silver maple, American basswood, white ash, red ash, and box elder are found in the area as a result of high shade tolerance and an

ability to seed under mature cottonwood trees. The cottonwood-willow community is often invaded by box elder, silver maple, elm, ash, sycamore, and mulberry.

A 1902 survey of the flora of Johnson County, Kansas, lists 1141 species of plants which may have occurred around the turn of the century in the area around Kansas City. Today, it is believed that only slightly more than 400 plants species occur in the area (Appendix D).

There apparently are no singularly important plant species or botanical areas in the Blue River basin. According to a Midwest Research Institute survey, some rare and endangered species of plants may occur, but their presence or absence has not been verified.⁴⁵

AMPHIBIANS AND REPTILES

No intensive studies have been made of the amphibians and reptiles in the area around the Kansas City Plant. Information has been drawn from regional studies and from limited observations of actual sites. Sixty-seven species of amphibians and reptiles are considered likely to occur in the area: 4 salamanders, 15 frogs and toads, 12 turtles, 8 lizards, and 28 snakes (Appendix E).

No population estimates have been made of the amphibian and reptile population in the general area of the Plant.

A Midwest Research Institute study revealed that only one reptile, the western hog-nosed snake, appears on the endangered species list.⁴⁵ Seven other species rank as rare in Kansas and Missouri, but not nationally. These include the red milk snake,

the western smooth green snake, the northern red bellied snake, the spotted salamander, the northern spring peeper, the green frog, and the western massasauga.

MAMMALS

Few studies have been published of the native wild mammals in the general Kansas City area. However, a number of general studies of mammals of North America and of Kansas and Missouri have been published and from these it has been possible to develop a list of the mammals which potentially inhabit the area near the Kansas City Plant (Appendix E).

A field survey by MRI attempted to confirm the presence of these mammals in the general Blue River Basin. Of the 52 species listed, only 19 were actually confirmed to be present during the MRI survey. However, a far more intensive survey would be necessary before any conclusions can be drawn about the reliability either of the general information or of the MRI survey.

Of the 52 species of mammals listed, one, the spotted skunk, is listed as rare in Kansas and one, the river otter, is listed as extirpated in Kansas. Seven are considered endangered in Missouri. Four of the Missouri endangered species are bats, one of which, the Indiana bat, is on the national endangered species list. There is no available information on the abundance of the four species of bats in the Blue River Basin near the Kansas City Plant. The plains harvest mouse and the long-tailed weasel are considered rare in Missouri while the river otter is considered endangered. No specific information about the abundance of these three mammals is available.

It is interesting to note that the Blue River Basin near the Kansas City Plant is particularly suited to wild mammal life. Hunting there is expressly forbidden by various state and city laws.

BIRDS

A Midwest Research Institute study revealed that knowledge of the bird population in the general area of the Kansas City Plant is limited because of the lack of in-depth studies in recent years.⁴⁵ Only general references are available to indicate the makeup of the bird populations in the greater Kansas City area. Many of these references are dated and compiled from non-specific information.

However, reliable national range maps were used to compile a list of the resident, migrating, breeding, wintering, and occasional birds believed to be involved with the ecology of the area. Although the specific accuracy of these lists (Appendix E), cannot be relied upon, they do reflect the general species diversity of the area.

A study was made in June 1973 of the nesting pairs of birds in Swope Park, a 1757 acre park about 3 miles north of the Plant. It was found that 2547 pairs of nesting birds were making use of the park.

Approximately 250 acres of the park is flood plain with a dominant overstory of silver maple, cottonwood, sycamore, and black willow. Five-hundred-and-fifty-five bird pairs were found in this habitat, including the green heron, wood duck, phoebe, parula warbler, red winged blackbird, red headed woodpecker, and crow.

About 586 acres of the park is classified as upland forest with an oak, hickory, and elm overstory and 754 pairs of birds make use of this habitat, including the wood thrush, blue jay, red tailed hawk, and yellow billed cuckoo.

Among the species found both in the flood plain and the upland forest are the red bellied woodpecker, great crested flycatcher, black capped chickadee, tufted titmouse, white breasted nuthatch, ruby throated hummingbird, Carolina wren, and red eyed vireo.

The remaining 920 acres of the park consists of several habitats, including meadow, parkland (grass with mature trees), a golf course, a zoo, and a lake. Species such as the meadowlark, mourning dove, barn swallow, robin, and bluebird are found there.

Species not observed during the study but expected to nest in the general area of Swope Park include the sharp shinned hawk, Cooper's hawk, marsh hawk, pigeon hawk, screech owl, barn owl, night hawk, kingfisher, horned lark, purple martin, loggerhead shrike, white-eyed vireo, Bell's vireo, prothonotary warbler, worm eating warbler, oven bird, Louisiana waterthrush, yellow breasted chat, American redstart, orchard oriole, rose breasted grossbeak, dickcissel, grasshopper sparrow, and lark sparrow.

Three of the nine bird species listed as rare in Kansas have been sighted in the Kansas City area, including the red shouldered hawk, southern bald eagle, and osprey.

According to the Midwest Research Institute, nine bird species which have been observed in the Kansas City area are included on what is known as the Blue List--a list compiled by professional ornithologists as a warning that the survival of some birds is in jeopardy if the present ecological trend continues.⁴⁵ Those nine birds are the sharp shinned hawk, Cooper's

hawk, red shouldered hawk, Marsh hawk, Osprey, red headed woodpecker, Bewick's wren, eastern bluebird, and loggerhead shrike.

FISH

The most recent surveys of the fish in the Blue River and Indian Creek near the Kansas City Plant were conducted in April 1973 soon after a flood period had deposited tremendous amounts of runoff water in the two basins. As a result, some fish not normally found in either water system were reported (Appendix E).

In addition to the fish actually collected during the survey, seven other fish species are considered likely to be present because of their common occurrence in other waterways in the general area. Ten additional species are considered potentially present in the Blue River because they are known to be present in the Missouri River. Industrial pollution from sources other than the Kansas City Plant, however, probably discourages the migration of fish into the Blue River from the Missouri River and may be the reason none of these species were found during the survey.

None of the species of fish reported as being collected in the survey or suggested as possibly being present in the area is considered rare or endangered by either Kansas or Missouri.

SECTION III: ENVIRONMENTAL IMPACT LAND USE IMPACT

The Kansas City Plant is the only major industrial site in a portion of Kansas City devoted largely to residential, small commercial, and agricultural land usage. The Plant occupies the major portion of a 300-acre Federal Complex created in 1942 when the Department of the Navy built an aircraft engine plant. Operation of the Kansas City Plant has been an AEC (now ERDA) function since 1949.

The Plant's land use impact is only significant because of its size and location. As a significant industrial operation employing approximately 5,000 people within a major metropolitan and business population center, the Plant does have an impact, both on the land it occupies and on adjacent land as well.

In the case of the Kansas City Plant the most significant land impact results from the location of the Plant in a flood plain of the Blue River. Because of a 1961 flood, both the Blue River and Indian Creek were rerouted by the Corps of Engineers and their natural channels restricted by a major levee system. This rerouting can be regarded as an impact on the natural environment and can be considered to have upset the ecological balance of the Blue River and Indian Creek--although research has shown that no significant biotic differences have been noted.⁴⁵ A more complete assessment of land use impact in the Blue River Basin will be found in the Corps of Engineer's environmental impact statement written to support the proposed Blue River Basin projects.¹⁴

The Kansas City Plant does not have a significant effect on natural land drainage behavior. The subsurface rock formations in the area are relatively impermeable and limit absorption of

surface water. As a result, the pavement and structures at the Kansas City Plant have no observable impact on the subsurface water level.

Because of the naturally flat terrain of the Kansas City Plant (less than a 9 percent slope; see Figure 32), runoff of rainfall is not rapid and there is little likelihood of erosion to the ground cover. The Plant constructed the first wastewater lagoon on the federal property in 1963 and this lagoon does have some impact on the land it occupies. Sedimentation of heavy metals has occurred in this lagoon basin; however, leaching to surrounding soil has not been noted in the test holes drilled around the lagoon. The second lagoon was completed in 1976 and a similar land use impact is likely. Special precautions are taken to ensure that no dangerous chemicals are discharged into the lagoons and that the land itself is kept free of acids, chemicals, and other waste products which might have a detrimental impact on the land.

On-site soil has been slightly affected by the disposal of polychlorinated biphenyl contaminated rain water on the open ground adjacent to the Plant's industrial waste lagoons. Storm water collected in the diked areas provided for spill protection has routinely been handled in this manner. Any water which may be contaminated is analyzed before disposal. PCB concentration levels in the storm water have ranged from zero to approximately 100 parts per million. Costs for the off-site disposal of this water have been considered prohibitive in light of these concentrations. Soil samples have been taken from the disposal area and analyses of both top soil and samples at a 12-inch depth have shown concentrations of 1.14 parts per million and 0.61 part per million respectively. These concentrations do not indicate an adverse impact when compared to background soil concentration levels.⁷³ No standards exist for PCB concentrations in soil.

There has been some minor modification of the land within the Federal Complex during its 32 years of existence. A parking lot at the Internal Revenue Service building on the eastern edge of the Federal Complex was created from land originally used as a sanitary landfill. Some other land within the Federal Complex has been used for sanitary landfill but none has created a significant environmental impact.

Within the area occupied by the Kansas City Plant there has been land used for other disposal purposes. Approximately 53.5 cubic yards of trench space was used for the disposal of toxic waste in 1960. Lead oxide residue was buried on-site and covered by a concrete slab. The site does not require special attention in light of current operations at the Kansas City Plant. However, in the event the Plant site is ever converted to other uses, the area would have to be sampled and analyzed to determine what steps, if any, might be needed.

A portion of the Complex land is involved in easements to various utilities and transportation services. Water mains, railroad tracks, public roads, sewer lines, and electrical power lines cross portions of the Complex. Many of the easements were granted specifically to services provided to the Kansas City Plant. However, many others, such as easements granted to railroads, are essential to providing basic services to Metropolitan Kansas City. It is these easements which emphasize the difficulty of completely restoring the land to its natural flood plain state.

The Federal Complex was established in an area thought to be well away from urban centers. In the years that have followed, however, Kansas City has grown southward not only to meet but to engulf the once rural Federal Complex. The land around the Federal Complex has been commercially developed and what was once agricultural land is now valued in frontage feet rather than in

acres. That the area around the Federal Complex is rapidly being urbanized, that agricultural land is being turned into housing developments, and that wooded lots are becoming automobile dealerships and fast food restaurants are significant aspects of the Plant's impact. It could be said that this southward expansion of Kansas City would have occurred had there been no Kansas City Plant. But it also could be said that the southward expansion of Kansas City has been speeded by the existence of the Federal Complex and the Kansas City Plant.

One of the significant impacts of Kansas City Plant operations on off-site land is in the use of public landfills for solid waste disposal. Approximately 13,000 cubic yards of solid waste are moved to landfills each year, requiring the use of approximately one acre of land.^{88, 92} Landfills have received considerable attention recently from local planning agencies and it is expected that landfills will continue to be a subject for considerable attention and study.

Public transportation arteries have another significant impact on the Kansas City Plant off site. In conjunction with the Blue River and Indian Creek flood control project, Missouri Highway W was established immediately south of the Plant as an upgraded thoroughfare to replace Bannister Road. Part of the justification for the upgrading of the road was the traffic load imposed by the Kansas City Plant. However, the upgraded road has opened the entire area to further commercial and residential development.

The Federal Complex land is regarded by city planning officials as critical to the long-range industrial and commercial development of southern Kansas City. A plan prepared by city officials recommends that the land occupied by the Federal Complex continue to be used for industrial purposes and suggests that

nearly 2700 acres will be required by 1990 for industrial purposes in southern Kansas City. That means the Federal Complex now represents more than 10 percent of the total industrial land anticipated necessary for the southern part of the city. The Complex now represents 35 percent of the industrial land in Kansas City south of 85th Street and city studies show that the Federal Complex occupies an amount of industrial land that would be required by a community of 25,000 people. This is based on the statistic that 12 acres of industrial land generally are required for each 1000 people in a community.⁸⁹ It seems clear, then, that in the eyes of Kansas City planners, the Federal Complex will remain an industrial site and is considered a cornerstone of further industrial development in southern Kansas City.

Future changes in land use at the Plant and in the use of land surrounding the Plant are not expected to be significant. Most of the small amount of remaining unused space around the Plant is likely to remain unused because of topographic limitations (slopes over 10 percent). To the east-northeast one to two miles is the only relatively large space not currently being used or currently designated to some specific use. Municipal plans suggest that this broad area be used for future industrial or commercial purposes.⁸⁹ Because the Kansas City Plant is already an industrialized site, this potential future commitment of new industrial land will probably appear more reasonable to a land developer and therefore to area residents. To the west of the Plant there is a small area of unused land along Holmes Road. While some of this land has recently been put to commercial use, more general plans suggest development as residential areas.

Although the Kansas City Plant maintains a relatively high profile in the area it occupies, it has received little attention in comparison to other industrial sites in Greater Kansas City. Because the Plant is located in a residential area, it has received

more careful scrutiny by those who live in the vicinity than it would have received if it were located in the so-called industrial district. However, beyond the understandable interest in the Kansas City Plant on the part of its neighbors, there has been little public attention. In this light, the future land impact of the Plant appears to be an acceptable environmental cost.

WATER RESOURCES IMPACT

The water used at the Kansas City Plant (approximately 1.4 billion gallons a year) is supplied by the Kansas City, Missouri, Water Department. Plant consumption represents 2 percent of the existing capacity of the Kansas City Water Treatment Plant.¹¹⁰ The water is obtained from the Missouri River, treated, and supplied to the Plant. All of the water, except for that lost to the atmosphere, ultimately returns to the Missouri River either as a discharge to surface waters or to the city sewer system.

No impact is associated with the water lost to the atmosphere, primarily from the cooling towers. It has been gaged that 800,000 gallons a day is directly discharged to the sanitary sewer system; 750,000 gallons a day go through the industrial waste lagoons and ultimately into the sanitary sewer; and 2,380,000 gallons a day is distributed to four outfalls which discharge into the Blue River and Indian Creek.⁹⁵ Water conservation is a continuing goal. Water cooled equipment is shut down when possible. A major conservation results from shutdown of air conditioning on weekends.

SANITARY SEWER DISCHARGES

The water going to the sanitary sewer system has no direct environmental impact on the surface streams. This water is treated in the Kansas City Blue River Sewage Treatment Plant 23 miles north of the Plant where Blue River discharges into the Missouri River. Normal sanitary sewage plus water handled by the industrial waste lagoons all discharge to the sanitary sewer system. The quality of the water discharged is in accordance with an agreement with the Kansas City Pollution Control Board.⁷ State of Missouri Effluent

Guidelines⁶³ for municipal control of industrial waters are used to assess the sanitary effluent leaving the Plant. A comparison of monitored values for sanitary sewer effluent to limiting values is given in Table 14.

The combined sanitary and industrial waste effluent is evaluated monthly. The estimated total pollutants released to the environment are summarized annually as part of the ERDA Environmental Monitoring Program.³³ The impact of the discharge is considered acceptable on the basis of monitored results by both the Plant and the Kansas City Pollution Control Department which routinely checks the effluent entering the city sewer system.

Chlorinated solvents, which are restricted by the Kansas City Pollution Code for Commercial and Industrial Wastes,⁴⁸ have continued to show up in the sanitary effluent at a concentration of less than 0.01 milligram per liter. This concentration of chlorinated solvents apparently has not been reason for concern; the Kansas City Pollution Control Department routinely samples the sanitary effluent and has not noted any adverse impact on its treatment facilities. The analyses by the city have not been shared with the Plant, but similar samples have been evaluated independently. Metal pollutants which have been detected in the sanitary sewer result primarily from discharges from the industrial waste lagoons. Dilution of lagoon effluent by the water flow from normal sanitary sewage leaving the Plant results in acceptable concentration levels. Plant discharges do meet federal pretreatment standards²⁶ for wastewaters entering publicly owned treatment plants. Local pretreatment standards (based on federal guidelines³⁰) are yet to be identified.

INDUSTRIAL WASTEWATER DISCHARGES

The two industrial wastewater lagoons at the Kansas City Plant were designed and built to treat diluted industrial wastewaters.

Table 14. Pollutants Released to the Sanitary Sewer System in 1976

Parameter	Concentration*			Total Estimated Quantity Released During 1976 kg (lb)
	Combined Outfall Average	Standard	Percent of Standard	
pH (Units)	7.9	6.0-10.0	††	---
Temperature (°F)	69	150***	††	---
BOD,††† 5 day	71	300***	24	131,700 (289,700)
Chlorinated Hydrocarbons**	0.004	Restricted***	---	7 (15)
Cyanides	0.01	2***	0.5	19 (42)
Phenols	0.04	10***	0.4	74 (163)
Soluble Oils	6.2	100***	6	11,500 (25,300)
Sulfides	2.0	10***	20	3,700 (8,100)
Suspended Solids	97	400**	24	179,900 (395,800)
Boron	0.22	1.0†	22	410 (900)
Cadmium	0.002	2.0†	0.1	4 (9)
Chromium	0.122	10†	1.2	230 (510)
Copper	0.13	2.0†	6.5	240 (530)
Iron	0.8	15†	5.3	1,500 (3,300)
Lead	0.011	0.1†	11	20 (44)
Nickel	0.052	3.0†	1.7	96 (211)
Zinc	0.163	2.0†	8.1	300 (660)

*Concentration in mg/l except as noted

**Value includes PCBs at <0.0001 mg/l

***Kansas City Pollution Code for Commercial and Industrial Wastes

†Missouri Effluent Guidelines for Municipal Control of Industrial Wastes

††Within Standard

†††Biological Oxygen Demand

Concentrated wastes are not discharged to the lagoons; they are disposed of by licensed contractors. The lagoons provide a means for pH adjustment, sedimentation, and further dilution of wastewater before it is released to the sanitary sewer. The water is controlled to permit flow either to a discharge line or to recycle to lagoon inlets.

The pH of the water at the lagoon outlets is monitored to assure a range of 6.0 to 10.0. If the pH is above or below that range, the contents of the lagoons are retained until the pH reaches an acceptable level. If the pH does not reach an acceptable level within a reasonable time, chemicals can be added to speed the adjustment.

The most extensive evaluation of lagoon effluent has been a 7-day study conducted under contract by Black & Veatch Consulting Engineers of Kansas City.¹³ The study was completed in February 1974 and the results, as they compare to appropriate regulations, are shown in Table 15. Complete 1976 monitoring results are also shown in the table and reflect an annual average. The disparity in the actual lagoon parameters between the 7-day and annual averages reflects the differences between a short-term evaluation and a composite of one year's monthly analyses. Lagoon operating performance was assessed with respect to the regulatory requirements for discharging directly to the sanitary sewer. The actual impact is reduced by the approximately 2 to 1 dilution of the sanitary system discharge effluent. In addition, a toxicity test was run on the seven-day composites of inlets and outlets. This test was performed to determine any effects the sample might have on typical sewage microorganisms. The results showed no toxicity.

Water pollution control projects completed and underway will result in rerouting effluents from surface waters to the sanitary sewer system or to the industrial lagoon system. Projects have been directed to upgrading the industrial waste collection system. Improved wastewater handling facilities are being constructed, and ultimately, industrial wastewater will discharge to the industrial waste lagoon system and normal sanitary sewage will discharge to the sanitary sewer system.

The impact of discharges through the industrial waste lagoons and the sanitary sewer is reduced by treatment beyond the Plant. Pollutant levels have not resulted in any known problem for the Kansas City Pollution Control Department.

EPA identified toxic pollutants^{25,28} which are common to the industrial waste effluents include cyanide, cadmium, mercury, and polychlorinated biphenyls and their compounds. Based on current EPA pretreatment guidelines, the impact of these materials on the sanitary sewer system is not considered significant. PCB concentrations in discharges typically show a level of less than one part per billion. The extent of residual PCB contamination and their continued use in electrical equipment require a continued awareness and environmental monitoring for their potential presence in Plant effluents and the environment. The impact of PCBs is not significant when compared to background environmental concentrations, yet additional toxic materials regulations are anticipated to further define environmental protection criteria (Appendix A).

SURFACE WATER (STORM SEWER) DISCHARGES

The water discharged through four outfalls into Indian Creek and the Blue River (2.4 million gallons per day) has effluent characteristic limitations set by the NPDES Permit to Discharge, consistent with State of Missouri effluent guidelines and water quality standards.⁶⁵ Missouri water quality standards specify that Blue River and Indian Creek receive only "unpolluted cooling water" effluents. It should be noted, however, that these standards apply only to a segment of these surface streams; different standards apply both upstream and downstream of the Plant. The standards near the Plant indicate the residential and recreational nature of these streams. Other urban development

Table 15. Seven Day Industrial Waste Lagoon Effluent Data

Parameter	Average Lagoon Effluent During Black and Veatch Study (mg/l)	Average 1976 Lagoon Effluent (mg/l)	Kansas City Sewer Use Ordinance	Missouri Sewer Use Guidelines (mg/l)
Boron	0.025	0.45	--	1
Chromium	0.284	0.38	--	10
Copper	0.82	0.48	--	2
Cyanide	0.05	0.01	2 mg/l	2
Iron	4.2	1.1	--	15
Lead	10	0.01	--	0.1
Nickel	7.0	0.17	--	3
Oil and Grease	2.9	6.8	100 mg/l	100
Phenols	0.044	0.017	10 mg/l	0.5
Zinc	0.21	0.58	--	2
Cadmium	0.087	0.003	--	2
Chlorinated Solvents	0.004	0.001	0	--
Temperature	--	58°F	<150°F	--
pH	--	8.3	6-10	--
Mercury	0.0005	0.0006	--	--
PCB*	--	0.001	--	--
*Polychlorinated biphenyls				

downstream has been responsible for less stringent standards. The fact the streams cross a state line also results in different standards upstream.

Plant effluents discharged to the surface water through the storm sewer system are routinely monitored and analyzed. The NPDES

Permit to Discharge requires that effluents be limited to unpolluted cooling waters. Plant water pollution control projects have been a part of the abatement schedule required to satisfy the NPDES permit (Appendix C).

Permit requirements are consistent with state plans to improve water quality in the surface waters adjacent to the Plant so the full recreational benefits of these streams can be realized. Federally-approved state water quality standards apply to Indian Creek and the upper portions of the Blue River Valley from the Missouri-Kansas line to 59th Street in Kansas City, Missouri (the Kansas City Plant is located at 95th Street). The water quality standards include a "no discharge" criteria, limiting industrial discharges to unpolluted cooling water. Plant efforts to improve effluent quality will result in environmental improvements to surface waters. The existing stream water quality⁸⁵ does not now meet the recreational use quality, and it is this fact which has resulted in these stringent effluent standards. These standards essentially require the 1985 criteria for limiting industrial discharges as provided by the Water Pollution Control Act Amendments of 1972.

Calendar year 1976 monitoring results for typical effluents entering the surface waters are shown in Tables 16 and 17 and are compared to NPDES effluent and state effluent guideline criteria. The Missouri water quality standards, more stringent than the state effluent guidelines, are the basis for the NPDES permit requirements that the Plant effluents meet intake water quality with a maximum deviation of 10 percent. The NPDES permit standards shown in the tables apply to all discharges to the surface waters. The drinking water standards,¹⁶ which are representative of the intake water quality and the final NPDES permit effluent requirements, are also shown in the two tables.

A comparison of effluent concentrations to drinking water standards indicates that the discharges from the Plant have relatively little adverse impact on the streams. The total estimated quality of pollutants released to the streams is representative of ongoing annual quantities and of the same magnitude which would be expected for drinking water discharge. Pollution has been eliminated from the storm sewers by rerouting source waters to the industrial waste lagoons and the sanitary sewer system.

The NPDES permit to discharge was issued on February 26, 1974. Monitoring and water quality reports identifying total dissolved solids, pH, temperature, and flow for Plant effluents are required by the EPA and have been submitted on a quarterly basis since the NPDES permit was issued. Both limiting standards, which apply during the abatement period to improve water-sewer discharges, and final effluent requirements (intake water) are defined in the permit. Based on the discharge criteria established by the permit, both upstream and downstream, indicates an undetectable impact on water quality.

Two incidents of noncompliance with the NPDES regulatory requirements have occurred since this permit was issued. Both involved the accidental discharge of PCB material (Appendix A).

There is evidence of contamination from PCB discharges to the Plant sewer systems, both surface stream and municipal, before there was a knowledge of the environmental hazards related to PCB material. The highest level of reported PCB concentration in a Plant effluent entering the surface waters was 18.9 parts per million. Since PCBs are relatively insoluble in water, the result of the pure Therminol FR-1 entering surface waters was a significant environmental impact. The extent of this impact is not a matter of record. Neither these incidents nor the Plant effluents alone have resulted in the existing pollution of the Blue River and Indian Creek. The urban development in the area has

Table 16. Pollutants (Quality) Released to the Storm Sewer System in 1976

Parameter	Average Effluent Concentrations	Missouri Effluent Guidelines	NPDES Permit Standard	USPHS Drinking Water Standards (mg/l)	Total Estimated Quantity Released (kg)
BOD*	3.0 mg/l	20 mg/l	**	None	10,400
COD*	21 mg/l	100 mg/l	**	--	73,100
pH	8.5	6.5 - 9.0	6.5 - 9.0	--	--
Temperature	66°F	***	90°F		
Ammonia	0.7 mg/l	1.6 mg/l	1.5 mg/l	--	2,400
Cyanide	0.01 mg/l	0.02 mg/l	0.02 mg/l	0.01	35
Oil and Grease	2.6 mg/l	15 mg/l	15 mg/l	None	9,000
Dissolved Solids	385 mg/l	500 mg/l	420 mg/l	500	1,339,000
PCB*	<1 ppb	--	<1 ppb	--	0.4

*BOD is Biological Oxygen Demand; COD is Chemical Oxygen Demand; PCB is polychlorinated biphenyls

**Within Standard

***Not to raise stream conditions by more than 5°F according to Missouri Clean Water Commission 1973 Water Quality Standards

degraded the natural environment--including the quality of the water in the two streams.

The current impact of Plant operations involving PCB material has not been ecologically assessed (Appendix A). It can be concluded that the impact continues, but the impact has not been known to be detrimental to stream use or to downstream water supplies. The risk of any future impact from PCB manufacturing operations has been eliminated by discontinuing the use of Therminol FR-1. It is believed that the small residual PCB in the heat transfer molding systems will be attenuated gradually by attrition. Current PCB concentration levels in the discharges to the surface waters are not known to have any adverse environmental impact.

Table 17. Pollutants (Metallic) Released to the Storm Sewer System in 1976

Parameter	Average Effluent Concentration (mg/l)	Missouri Effluent Guidelines (mg/l)	NPDES Permit Standard (mg/l)	USPHS Drinking Water Standards (mg/l)	Total Estimated Quantity Released (kg)
Arsenic	<0.001	0.005	0.001	0.01	4
Aluminum	0.21	--	0.35	--	730
Barium	0.05	1.0	0.09	1.0	170
Beryllium	<0.001	--	0.001	--	4
Boron	0.21	1.0	0.30	1.0	730
Cadmium	<0.001	0.01	0.001	0.01	4
Chromium	0.016	1.0	0.02	0.05	55
Copper	0.03	0.02	0.03	1.0	100
Iron	1.8*	10.0	1.0	0.3	6,300
Lead	0.005	0.1	0.005	0.05	17
Mercury	0.0005	0.005	0.005	0.005	2
Nickel	0.022	0.80	0.03	--	77
Selenium	<0.001	0.01	0.001	0.01	4
Silver	0.004	0.05	0.009	0.05	14
Zinc	0.086	0.1	0.1	5.0	300

*Typical value was 0.4 mg/l and within standard

Plant efforts to improve storm sewer effluent quality began in 1968 with the elimination of discharges from the industrial waste lagoon into the Blue River. The impact of past Plant operations and other accidental discharges to the surface water quality cannot be quantified. Water quality surveys conducted by the EPA⁴⁶ and the Midwest Research Institute for the U. S. Army Corps of Engineers have resulted in a "polluted" label for the Blue River.¹⁴ A Missouri stream pollution survey⁸⁵ published in January 1974 concludes that the Blue River is "seriously polluted" over its entire 31-mile length. Indian Creek is also called "seriously

polluted" over its 3 miles in Missouri because of sewage effluents from Kansas as well as overflow from the Kansas City, Missouri, Dykes Branch Lift Station.

The fact that the Kansas City Plant effluents are generally of intake (drinking water) quality supports the conclusion of an insignificant impact resulting from current Plant discharges to the surface water resources. Minimal environmental impact on area water resources will be assured by a reasonable monitoring program and by the incorporation of all necessary controls by the Kansas City Plant.

The control of effluents to surface waters will eliminate any direct environmental impact interfaces which could be considered detrimental. Future actions will be taken as necessary to protect water resources. Efforts underway are directed toward meeting the national goal of reducing water pollutants.

ATMOSPHERIC IMPACT

Manufacturing operations at the Kansas City Plant involve materials common to most industrial, electronic, electrical, and mechanical manufacturing operations. Principal impacts include hydrocarbon emissions from manufacturing operations and sulphur dioxide, nitrogen dioxide, and particulate matter emissions from powerhouses which serve the entire Federal Complex.

The impact of Plant operations on local air quality has been evaluated as part of the Plant environmental monitoring program. This program included a Midwest Research Institute (MRI) project¹¹ to determine the impact of the Kansas City Plant on air quality by evaluating ambient air concentrations of the pollutants identified by the EPA for which national ambient air standards²¹ have been established.

Based on the environmental assessment data available at this time, the atmospheric impact of Plant operations can be characterized as having no known detrimental effects. The MRI ambient air assessment concludes that "pollutant emissions from the ERDA/Bendix facility do not have a major impact on air quality at the government property line relative to the air quality standards."¹¹

The MRI assessment included fence-line monitoring to qualify and quantify pollutant contributions compared to background pollution levels. This approach is consistent with various local air pollution control regulations which do not set specific stack emission rate standards except for particulate matter. The air monitoring program has been designed to assure compliance with existing regulations: the impact of the Plant has been judged on the basis of these regulations. Both upwind and downwind fence-line testing provide data for Plant contributions, regulatory

Table 18. MRI Ambient Air Test Data at the Kansas City Plant¹¹

Pollutant	Concentrations* ($\mu\text{g}/\text{m}^3$)			
	Primary Standard*	Average Downwind*	Average Facility Contribution**	Downwind Percent of Standard
SO ₂	555	88.5	42.5	15.9
Total Particulates	285	259.0	124.0	91.0
CO (in $\mu\text{g}/\text{m}^3$)	15	1.9	0.6	12.7
Photochemical Oxidant (as O ₃)	85	37.5	4.0	44.1
NO ₂	300	45.0	10.5	15.0
Nonmethane Hydrocarbons	135	120.0	83.0	89.0

*Six-hour average

**Difference between upwind and downwind measurements

compliance, and Plant impact. Although the alternative powerhouse fuel (No. 6 fuel oil) has a high sulfur content, sulfur dioxide emissions while fuel oil is being burned, are within fence-line standards used by Missouri. Table 18 summarizes the results of the MRI assessment.

The primary atmospheric pollutants released to the environment from manufacturing operations are organic materials; the most significant is the estimated 40,000 pounds of trichloroethylene which is released to the atmosphere each year. Other manufacturing discharges to the atmosphere are summarized in Table 19.⁷¹

The principal atmospheric impact comes from two powerhouses which serve the entire Federal Complex. The extent of the

Table 19. Manufacturing Discharges
to the Atmosphere⁷¹

Discharge	Pounds Per Year*
Trichloroethylene	40,000
Methylenechloride	5,000
1-1-1 Trichloroethane	10,000
Freons	10,000
Ketones	10,000
Alcohols	10,000
Toluene	3,000
Xylene	2,000
*Approximate quantities	

pollutants released from the two powerhouses has been quantified and is summarized in Table 20.^{38, 61}

The quantities of materials released to the ambient air have been reported to the Kansas City Air Pollution Control Division. The city, in its 1973 Status Report⁹³ has noted that the Kansas City Plant is in compliance with existing pollution regulations. Based on emission testing as it relates to fence-line monitoring, point source dilution of the powerhouse emissions is adequate. The only standard applicable to the actual emission rates is for particulate material from indirect heating sources (powerhouses).¹ The powerhouse particulate emissions are less than 1.0 pound per hour when burning natural gas, as compared to 15 to 30 pounds per hour when fuel oil is being consumed. Obviously, increasing natural gas curtailment will have an impact. Based on 1976 data, particulate emissions were approximately 36 percent of the standard, based on pounds per fuel heat capacity input.

Table 20. Pollutants Released From Powerhouses Annually

Pollutant	Estimated Quantity (kg)*	Percent Contribution	
		Natural Gas	Fuel Oil
SO ₂	365,000	1	99
NO ₂	195,000	35	65
Particulates	78,000	18	82
Hydrocarbons	30,000	80	20

*Based on 1976 fuel usage and MRI testing program¹¹

Visible emissions from the powerhouse stacks have on occasion exceeded local standards. On one occasion the west powerhouse operation was cited by the Kansas City Pollution Control Division as being in violation of the visible emissions ordinance.¹ As a result the Plant has established a continual environmental awareness program to make all responsible personnel sensitive to operational environmental requirements. Photoelectric monitors have been added to powerhouse stacks to aid in the control of visible emissions.

Fence-line data has provided the best comparison of background air quality data versus Plant contributions. Control strategy with respect to Plant operations has been based on the ambient air monitoring program.

The emission of potentially hazardous materials, including beryllium, polychlorinated biphenyls, lead, mercury, and other chemical compounds such as MOCA, has been minimized through the use of emission control equipment.

Engineering controls have also been established on operations (such as vapor degreasing) involving materials such as trichloroethylene. Requirements to exhaust the trichloroethylene operations adequately to protect personnel have resulted in larger quantities of it being released to the atmosphere in the past. Exhaust systems for those operations have been controlled through the installation of cold traps to reduce emissions.

An estimated 3,000 cars per day are directly associated with Kansas City Plant operations. An additional 1,000 or more cars are associated with other operations on the Federal Complex. The traffic load of Missouri Highway W, on the southern edge of the Plant, has been estimated as high as 20,000 cars per day by the Kansas City Traffic Department. Other main urban traffic arteries in the area also contribute to air pollution.

It is important to note that the background traffic and not the Plant itself is considered responsible for high hydrocarbon levels in the area. Traffic control plans for Kansas City have been studied, but there are now no control plans being pursued. Future control actions may be required with the Kansas City Plant as a participant in those actions.

ENERGY RESOURCE IMPACT

The Kansas City Plant, as part of the Federal Complex, buys all of its electrical power, which is produced by the use of fossil fuels, from the Kansas City Power and Light Company (KCP&L). The Federal Complex uses more than 150,000,000 kilowatt hours each year--enough electrical power to serve 21,000 Kansas City homes. The Plant's usage is approximately 80 percent of the Complex consumption and its peak demand was 28.1 megawatts in July 1976. The Plant is the area's second largest industrial consumer of electricity.

The use of electrical power will remain a resource impact, but the Plant does not have a significant impact (less than 2 percent) on the generating capacity of KCP&L. No power shortages have been recorded in the community.

Conservation efforts brought about by the national energy crisis have resulted in a reduction in electrical power consumption, except for the addition of new equipment. This has been accomplished through reduced lighting in several areas of the Plant, lower thermostat settings in the winter, higher thermostat settings during the summer, and more economical use of steam and electricity for refrigeration. The power saved has been enough to provide the annual electrical requirements of 5,000 average Kansas City homes. Conservation methods will continue to reduce electrical energy demands consistent with good engineering practices and conservation policies.

The Kansas City Plant buys all of its natural gas from the Gas Service Company in Kansas City, which in turn receives gas from fields in Texas, Oklahoma, and Kansas. The Plant purchases gas on an interruptible basis for the powerhouses and on a non-interruptible basis for services such as the cafeteria and the

air supported structures where backup fuel systems are not available. Number 6 fuel oil is consumed when gas service is curtailed in the powerhouses. In 1976, gas consumption was 1,422,819,000 cubic feet (1,466 billion BTU), while Number 6 fuel oil consumption was 2.65 million gallons (398 billion BTU).

The Kansas City Plant is the fifth largest industrial user of natural gas in the area serviced by the Gas Service Company. Because the Plant has a low priority, the Gas Service Company can immediately divert 5 to 6 million cubic feet of natural gas a day from the Plant to homes, hospitals, and schools during periods of heavy natural gas demand.

The natural gas consumed by the Plant each day is equivalent to that required to service 8,000 homes. As a result, the Kansas City Plant faces increased natural gas curtailment and a corresponding increase in the use of Number 6 fuel oil or possibly coal in the years ahead. Forecasts prepared by the Gas Service Company and regulatory agencies suggest that the curtailment may reach the 100 percent level by 1980. This increasing curtailment will require that alternate fuels be used for the powerhouses and probably that additional controls will be needed to reduce the volume of pollutants admitted to the atmosphere.

Conservation methods already implemented have resulted in a 13 percent reduction in the consumption of natural gas and an 11 percent reduction in the consumption of Number 6 fuel oil. Conservation methods have continued and energy resource requirements have been optimized. The savings in natural gas made available through conservation efforts could fill the yearly needs of 1,000 private homes in the Kansas City area. This conservation effort will continue.

WASTE DISPOSAL IMPACT

Waste disposal practices at the Kansas City Plant ensure that all wastes generated at the Plant are disposed of in compliance with existing federal, state, and local guidance.⁶⁴ Commercial or municipal landfills are used for the disposal of solid wastes as recommended by the Kansas City Metropolitan Planning Commission.⁸⁸

SOLID WASTE DISPOSAL

Solid waste material (10 to 15 tons daily of relatively inert wastes such as paper, metal, and wood, exclusive of hazardous waste and salvageable material discussed below)⁸⁰ is compacted in a solid waste handling facility on-site and removed by contractor to sanitary landfills. Classified material is destroyed by hammer mills before it is compacted. The compacted wastes are disposed of in municipal landfills.

LIQUID WASTE DISPOSAL

Liquid wastes, such as electroplating solution concentrates and machine tool coolants, are collected in tanks on-site and then removed by licensed contractors⁸¹ for eventual disposal off-site. Approximately 500 gallons of liquid waste are collected daily, including water soluble coolants, solvents, thinners, acids, alkali plating solutions, and hydraulic, cutting, and lubricating oils. These wastes are inventoried and contractors are required by contract to ensure that material disposal practices are in accordance with acceptable environmental methods.

HAZARDOUS WASTES DISPOSAL PRACTICES

Hazardous materials, including chemical wastes, are provided with special handling and disposal procedures to avoid potential environmental damage.

Polychlorinated Biphenyls

Waste PCB materials are accumulated in 55 gallon barrels and shipped to a licensed waste disposal contractor. The contractors which have been used include Monsanto Chemical Company, Sauget, Illinois; Chemtrol Pollution Services, Model City, New York; and Nuclear Engineering Company, Sheffield, Illinois. These contractors were selected on the basis of their ability to comply with federal and state laws. To date, some 4,000 barrels of PCB waste have been shipped to contractors for disposal. A history of PCB waste activities is summarized in Appendix A. Both the PCB material (Therminol FR-1) previously used as a heat transfer fluid and the new Therminol 66 replacement fluid are handled through special disposal practices maintained for PCB contaminated waste.

Rainwater potentially contaminated with PCB is disposed of either through the industrial wastewater lagoon system or in the special manner described earlier. Storm water collected in protective diked areas that may be potentially PCB contaminated is collected in special tanks and dumped on the ground adjacent to the Plant industrial waste lagoons. This practice is required only when water collects in the areas provided protection and contamination is evident. Any rainwater which appears to be contaminated by PCB material may be analyzed before it is handled in this way. Routine storm water is allowed to discharge to the industrial wastewater system. On-site disposal of rainwater is used when necessary to preclude off-site PCB discharge and is conducted in an area which does not permit runoff to the surface waters.

MOCA

MOCA waste is generated in solid form and accumulated in specially identified 55-gallon barrels. These barrels are stored on site until enough is gathered to justify shipping a truckload to a waste disposal firm in Texas. The MOCA is disposed of in Texas in a landfill certified by the Texas Water Quality Control Board.⁹

Mercury

Waste mercury and mercury-contaminated processing materials are generated both in liquid and solid forms. The solid waste is sealed in barrels; the liquid waste is dehydrated and then sealed in concrete. Both the liquid and solid waste is shipped to Los Alamos, New Mexico for burial at an ERDA landfill.

Beryllium

The Plant does not have any active machining operations which generate beryllium waste. However, 20 barrels of solid beryllium waste are now being held on site. Future disposal of this material is planned using an ERDA landfill or qualified contractor.

Pesticides

Waste pesticides are disposed of as chemical wastes and are turned over to a contracted disposal firm. The term *pesticides* includes all insecticides, miticides, fungicides, herbicides, rodenticides, and other chemicals used to control pests. Pesticide containers are thoroughly rinsed, rendered useless by puncturing, and then disposed in a sanitary landfill. Pesticide containers are not recycled.

SOCIOLOGICAL AND ECONOMIC IMPACT

The Kansas City Plant continues to have a favorable sociological and economic impact on the Kansas City area. The Plant represents a major industrial facility associated with the production of components for nuclear weapons and is located within a densely populated urban area. Public reaction to both the Plant and its operations is positive.

Sociologically and economically the Kansas City Plant has an impact on the distribution of resources, on income levels, and on the aesthetics, urbanization, growth patterns, educational structure, and welfare systems of the area. It also has a potential impact on the design of mass transit systems.

The most significant impact of the Plant is on the area economy. The jobs created by the Plant and the associated payroll income contribute to the local economy. Since operations began at the Plant, more than \$1.2 billion has been added to the local economy. At one time, the Kansas City Plant was the largest employer in the area with 8100 employees; the Plant now ranks fifth in the area with approximately 5000 employees.

The annual budget of the Kansas City Plant is approximately \$134 million; \$13 million of that amount is spent on construction goods and services obtained locally. Because of the government involvement in the Plant, contributions and transfers totaling \$1.5 million are made annually to local governments.

One measure of the total impact of Plant expenditures on the Kansas City area can be estimated by applying what economists call the "multiplier effect." According to the Kansas City

Department of Development, the \$79 million expenditure (approximately what the Kansas City Plant spends each year for salaries, construction, and local purchases) results in a \$167 million economic impact.*

The "multiplier effect" of the Kansas City Plant's expenditures can be expanded upon by considering that the source of the Plant's money is outside the local economy. This means the Plant's expenditures have a more positive effect than if the money were taken from local monetary sources. In terms of its effect on total wages and salaries paid, the Plant also is significant: it represents 2.5 percent of the annual Kansas City area payroll of \$2.7 billion.¹⁰¹

The concentration of nearly 5000 employees at the Kansas City Plant, in combination with several hundred employees at other installations on the Federal Complex, is of significance in any study of potential mass transit improvements. Employee residences are scattered throughout the metropolitan area (the maximum concentration is about 100 employees per square mile) and no unique mass transportation problem is associated with the Kansas City Plant's location.

The Kansas City Plant has made a significant impact on the general educational level of the area. The Kansas City Plant hires a large percentage of college graduates and it takes major steps to provide education assistance for employees, to provide assistance to local educational institutions, and to provide

*The "multiplier effect" suggests that an initial expenditure of any given amount has a multiple effect upon the level of area income. For example, a dollar expenditure in one industrial sector is spent and respent through the interaction of the initial sector with others. Given a time lag, the original dollar has the economic impact of several dollars.

scholarships and other encouragement to area high school students. Because of the emphasis the Plant has placed on improving the education of its employees, the general educational level of the entire area has benefited.

The Plant also has taken major steps to assist in meeting the needs of the society of the area through participation in fund raising programs, through positive actions in Plant hiring programs, through purchasing practices, and through direct assistance to area social and welfare programs.

The Kansas City Plant is a positive impact on the Kansas City area economically as well as socially. It has had an impact on the urbanization of the southern Kansas City area as well as an impact on the educational and welfare systems of the entire region.

CONSTRUCTION ACTIVITY IMPACT

Construction activity at the Kansas City Plant has been relatively heavy as a result of responding to the changing product mix and of maintaining adequate production and support capabilities. In the past, construction has been confined largely to the inside of the Main Manufacturing Building. The only recent significant construction outside an existing building has been an additional industrial waste lagoon, a project typical of many intended to improve the environmental posture of the Plant. Although the project converted vacant land to a new use, the impact is expected to be outweighed by an improved impact on water resources.

This section discusses only those projects which have a potential for affecting the environment. As with all construction plans, these are reviewed individually before they are implemented. Assessing the impact of these projects requires an assessment of the expected environmental improvement.

The conversion of Plant mold heating and cooling systems to a new heat transfer fluid has lessened the risk of additional PCBs entering the environment and has resulted in an improved system which includes extensive protective measures for containment of any spilled fluid. The adverse concerns associated with PCBs are more thoroughly discussed in Appendix A.

In other areas, planned construction will lessen the Plant's impact on the local surface waters by allowing only unpolluted cooling waters to enter Blue River and Indian Creek. Because unpolluted cooling waters are comparable in quality to the drinking water received by the Plant, the discharges will improve the water quality on that portion of the Blue River which flows from

95th Street north to 59th Street. That portion of the river will receive Plant waste water within the effluent standards set for recreational streams. These 36 blocks of the Blue River, from 95th to 59th Streets, are earmarked for recreational use; after that, the river becomes an industrial stream. In these 36 blocks, the Blue River flows through Swope Park, visited annually by 3.9 million people who will have an opportunity to experience any improvement this Plant makes in the water quality of the Blue River.⁴⁵

The probability of severe environmental impact will be reduced by increasing protection against oil spills. This construction project will not produce an automatic improvement to the environment, but it could avoid significant damage from a spill. The potential impact of an oil spill concerns the same 36 block portion of the Blue River noted above. Protecting the aesthetics of the river is just one valuable benefit of the project.

Other construction plans at the Plant can be characterized as neutral with respect to any environmental impact. No large scale production activities are planned which would result in new types of waste effluent or unusual changes in quantities of waste generated. The construction would demand material, energy, and labor resources; however, each are studied individually to determine the precautions necessary to avoid degradation of the environment.

Any new construction will naturally produce an impact on the local economy. This Plant demands unique construction crafts, which in turn offer an impetus to the maintenance of diversified and capable construction crafts in Kansas City. For example, Plant construction often requires the installation of special humidity, temperature, and air cleanliness controls. This requirement spurs the development of construction technology that can

have spinoff results in uses outside weapons production, most obviously in places like operating rooms of hospitals. Hospitals require sterile conditions similar to those developed for laminar flow clean room conditions in microelectronic production facilities at the Kansas City Plant.

ACCIDENTS

Several criteria have been used in the selection of the accidents postulated and analyzed in this section. First, an accident is considered to be of concern only if it has both a realistic possibility of occurring and the potential to harm the environment. In an effort to postulate realistic accidents, consideration was given to potential environmental impact, accident histories, and estimated probabilities.

In addition, those accidents which have the greatest probability of occurring at the Kansas City Plant do not, in general, pose a hazard to the environment. The quantities of hazardous materials, such as oil, PCBs, and chemical compounds, are protected to preclude accidental releases to the environment. Plant protective measures are extensive; potential property loss, employee hazards, and environmental threats are all considered when protective measures are taken. Efforts taken to reduce accidents have had the added benefit of reducing the potential environmental impact from accidents.

Some of the accidents postulated and analyzed here could be caused by natural events; others could result from Plant operations. In some instances, different causes lead to the same environmental threat. Multiple causes have been analyzed to point out the various possible combinations of cause and effect.

THE TORNADO THREAT

Kansas City is in the middle of a high tornado risk area. The chances of a tornado scoring a direct hit on the Kansas City Plant are one in every 222 years, but nothing can be done to

prevent a tornado from hitting the Plant despite the most advanced weather warning systems in the United States.

In the following discussion, a tornado is assumed to be the cause for two material release accidents postulated here. If a tornado should hit the Plant area, property damage could be severe, both on-site and off-site. Any environmental damage resulting from the involvement of the Plant probably would be secondary to the general destruction caused by a tornado.

OIL STORAGE TANKS RUPTURED BY A TORNADO

Description of Event

A tornado strikes the Plant and ruptures the above-ground fuel oil storage tanks at the northeast portion of the Plant site. Total rupture occurs in the two tanks, each of which holds 400,000 gallons of fuel oil. The earthen dikes around the tanks are also assumed ruptured (extremely improbable) and the tank contents are released, the oil flowing to the off-site environment. Most of the oil flows into nearby drainage ditches and ultimately enters the Blue River.

Background

Tornadoes are perhaps the only reasonable probable cause for a massive rupture of the oil storage tanks. The disruption caused by a tornado would make it difficult to take the normal safety precautions necessary to control a major oil spill. With 800,000 gallons of fuel oil stored above-ground in one location, there is a potential for a spill as well as a potential for damage to the environment. The terrain in the vicinity of the two tanks slopes to the northeast toward the Blue River, approximately one-half mile away. Numerous drainage ditches lace the area and all of the ditches ultimately discharge into the Blue River.

Environmental Impact

Extensive contamination of the Blue River and its banks could be expected. An oil slick could result and could continue downstream to the Missouri River, 22 miles away. Suffocation of aquatic life and damage to wildlife habitats could be expected.

Mitigating Factors

Precautions have been taken to reduce the probability of a spill and its environmental consequences. The dikes surrounding the tanks are designed to contain the contents of both tanks. A disaster such as a tornado would have to be of a magnitude to damage existing protective systems.

The amount of oil actually entering the waterways would be greatly reduced by containment actions. A Spill Prevention Containment and Countermeasure Plan is in effect and a spill response team would take whatever actions possible under the circumstances to protect the environment. Additional restraining dikes could be constructed quickly by using available earth moving equipment to stop or minimize the oil flow to the Blue River.

The affected area could be decontaminated by removing and replacing off-site and on-site soil. The oil slick could be skimmed from the surface waters using available or procured spill containment equipment. Existing emergency procedures establish priorities in manpower and equipment for any oil or hazardous material spill.

RELEASE OF CHEMICALS BY A TORNADO

Description of Event

A tornado dislodges roof-mounted electrical transformers and releases 300 gallons of PCB coolant-dielectric material. The Chemical Storage Building is structurally damaged and some of its contents are dislodged. The PCB material enters roof drains and flows through the storm sewer system into the Blue River and Indian Creek. Chemicals, such as acids, alkalies, solvents, and organic materials are lost from the Chemical Storage Building, which is built to isolate incompatible materials. Approximately 1500 gallons of acids and 2000 pounds of solid cyanide could be released.

Background

Electrical equipment containing PCB has been recognized as an environmental risk. There are roof-mounted electrical substations which involve PCB material. The Chemical Storage Building was recently constructed because of the hazards associated with the material stored there.

Environmental Impact

The effect of the spilled PCB on the environment depends on the amount released, the distance of dispersal, and weather conditions during the accident. Large quantities of PCB entering area waterways could have an adverse impact on the biotic and aquatic life of the waterways. The lower form of aquatic animals are the most sensitive to PCB damage. PCB concentrations have also been proven hazardous to the reproductive cycles of some birds.

Material from the Chemical Storage Building most likely would be dispersed into the atmosphere by the strong winds of the tornado. Winds would dilute the concentration of material during dispersal, but water contamination would be possible. Adverse environmental effects, including aquatic damage, would be possible should the chemicals enter the waterways. Short-term high concentrations might affect water quality; however no long-term impact would be expected. The most hazardous situation could arise as a result of disposition of concentrated materials near a residence. Cyanide and acid could combine by accident to yield cyanide gas, although this is highly unlikely. The cyanide gas, being poisonous, could require emergency actions.

Mitigating Factors

Spill pans and dikes beneath capacitors and transformers have been designed to contain the maximum amount of potential leakage. In addition, transformers are generally large enough and heavy enough (several tons) to resist disturbance by tornado force winds. Actions could be taken to construct roof dikes and seal roof drains to aid containment efforts. The Chemical Storage Building was built specifically to compartmentalize hazardous chemicals and to resist damage by winds, explosions and fire.

The general direction of movement of tornadoes in the Kansas City area is from the southwest toward the northeast. The land directly northeast of the Plant is largely vacant. Residential land use does not begin for more than 1.5 miles to the northeast of the Plant. This means that wreckage from a tornado striking the Plant would likely be deposited in currently vacant land. Any chemicals entering the waterways could be diluted to harmless levels.

CHEMICAL SPILL RESULTING FROM VEHICULAR ACCIDENT

Description of Event

A tank truck operated by a contractor and carrying concentrated plating wastes is involved in an accident on Plant property. The truck tank is ruptured and approximately 2000 gallons of concentrated plating wastes are released. The waste flows into the storm sewer system and ultimately enters the Blue River and Indian Creek.

Background

Approximately 5000 gallons of concentrated acid and alkaline liquid waste are generated as manufacturing by-products each month. These materials, including ferric chloride etch and sulfuric, nitric, hydrochloric, and chromic acid, are stored in specially designated areas. Vendors are contracted to remove, neutralize, and dispose of them. Approximately four loads of wastes are removed from the Plant each month; a typical load is 1000 to 2000 gallons.

Environmental Impact

While the precise liquids released would determine the environmental impact, it would be similar to that described in the oil spill incident earlier in this section. Even though acid discharges would be diluted by the normally high volume of water flowing through the storm sewer system, there still would be some biotic damage in both Indian Creek and the Blue River, and nearby flora and fauna might be damaged before the material is diluted.

Mitigating Factors

Parking and access areas are patrolled around the clock to assure immediate detection of a vehicular accident. Speed limits are strictly enforced. These precautions would reduce the chance of an accident involving a contractor operated tank truck and would ensure immediate reporting of such an accident. Restraining dikes could be provided quickly to minimize the quantity of chemicals reaching the surface waters of nearby streams. Once the spilled chemical has been identified, chemical neutralization and dilution would be used to minimize impact. The flow in both Indian Creek and the Blue River suggest rapid dilution of the discharged material and little permanent impact on the environment.

FIRE AND EXPLOSION

Description of Event

An explosion followed by a fire erupts as a result of ignition of Therminol 66 leaking from heating and cooling systems used for heat transfer fluids in polymer molding operations. Fire suppressant systems are activated and the hydrotherm area is drenched with a combination of water, halogenated hydrocarbons, and 1025 gallons of hot Therminol 66. Each of the two Therminol molding systems contains approximately 7000 gallons, but their design includes system isolation features such that a maximum of 1025 gallons of fluid would be lost in the event of a rupture. The explosion in the hydrotherm area destroys a wall separating it from the cyanide storage area of the plating building. Several of the chemicals stored there are dispersed by the force of the explosion.

Background

A fire or explosion does not necessarily constitute an environmental risk, but compounding these events under the conditions postulated offers potential off-site environmental impact. Beyond the damage done by the fire and explosion, Therminol and cyanide could be transported through the storm sewer system to local surface waters by the flushing action of the water used to control the fire. This would result in a chemical and petroleum spill similar to those postulated earlier.

Environmental Impact

Assuming that the entire 1025 gallons of Therminol 66 entered Indian Creek and Blue River, water animal life would be affected, physical and biological features of the local streams would be disrupted, and the aesthetic values of the local waterways would be damaged. Residual PCB in the heat transfer system might result in their release to the environment. However, since Therminol 66 is not toxic in itself, the spill would not be catastrophic to animal life in the local streams. Therminol 66 is biodegradable over many years and would not constitute a long-term hazard to the environment.

Cyanide is the most hazardous material in the chemical storage area, and although water used to fight the fire would probably dilute it, cyanide still poses a significant danger to the off-site environment. Other chemicals, such as acids and alkalines, are generally less hazardous because they can be neutralized to minimize significant environmental effects.

Mitigating Factors

Chemicals used in the area are segregated according to their reactive nature. Cyanides and alkalies are separated from acids

by a dike. The area is also protected by automatic sprinkler systems and other fire prevention and control measures.

A wire mesh wall on one side of the area and a sheet metal roof over the hydrotherm area helps relieve explosion pressures and minimizes potential damage to the adjacent storage area. The area is well ventilated and the accumulation of explosive levels of gas is highly unlikely.

Cleanup efforts, emergency diking, and other countermeasures would help cut down the volume of Therminol 66 actually entering the waterways. Environmental protection features include old drains which have been permanently sealed, spill retaining dikes around the fluid heating units, dikes around the fluid storage areas, sumps to intercept spills, and a 1000 gallon storm sewer interceptor equipped with oil skimming devices. In addition, the large volumes of water used to fight any fire in the area would dilute the Therminol 66 and minimize the environmental impact.

In the same manner, cyanides would be diluted before discharge to the storm sewers that empty to the surface waters. The maximum quantity of cyanide that likely could be involved is 100 kilograms. Assuming it was all released at the same time, the cyanide concentration in Indian Creek would be reduced within 4 minutes to levels not considered toxic to fish life--based on the normal stream flow.^{79, 112} Because the other materials are much less poisonous than cyanide, and because all the materials entering the storm sewer system would have been diluted by water, the chances of introducing harmful levels of chemicals to Indian Creek are very low.

FLOOD

Description of Event

Heavy rains strike the Kansas City Area and result in flood conditions on both Indian Creek and the Blue River. The flood control levee system near the Plant fails and the Plant is flooded. A container of mercury waste loses its contents into the flood water. Some mercury containers are located in an area which might flood, but they could be removed to higher ground should time allow. The containers are sealed and loss of their contents could only result from a rupture.

Background

A flood is the only natural catastrophe which has ever occurred at the Kansas City Plant. In 1961, the Blue River entered the Kansas City Plant and caused nearly a half-million dollars in damage.⁷⁷ An extensive flood control project was installed as a result. However, there are breaks in this levee system for the passage of roadways and sewer lines--breaks which require manual closing during flood conditions.

Environmental Impact

There was no recorded environmental impact from the Kansas City Plant as a result of the 1961 flood. There remains very little danger that the Kansas City Plant will contribute to the damage produced by a flood on the Blue River. However, leaking mercury could cause some biological damage despite the fact that the concentration level would dilute almost immediately.

Mitigating Factors

Even though the flood protection levee system can be breached to the extent that water could enter the Kansas City Plant, the levee system will protect most areas of the Plant from serious damage. Actions would be taken to move equipment and material to safer locations. The mercury and other hazardous material containers are positively sealed so that normal leakage would not be possible. A potential rupture and loss of contents of the containers could be prevented by safe movement to higher elevation in the event of a flood.

Should the Plant be totally inundated by flood waters, the impact on other areas of the city would be so severe that no impact from the Kansas City Plant would be considered significant.

In addition, the volume of water involved in a flood of the magnitude described would so thoroughly dilute any spilled hazardous chemicals that their environmental impact would hardly be detectable.

EARTHQUAKE

Description of Event

The Kansas City Plant is struck by an earthquake with a reading of VI on the Modified Mercalli Intensity Scale. The earthquake is felt by all Plant employees. Windows rattle and there are minor instances of cracked glass.

Background

The Kansas City area is in a very low earthquake risk area. The most serious earthquake ever recorded registered 3 on the

Richter Scale, and the damage reported corresponded to a reading of V on the Modified Mercalli Intensity Scale.

Environmental Impact

The Kansas City Plant is located in a building with a period of 0.06 seconds. (The period of a building is a parameter relating structural design to ability to withstand an earthquake.) A Mercalli intensity of VI would affect only buildings with periods greater than one second; therefore, the structure housing the Kansas City Plant is free from concern resulting from damage by an earthquake. Even if an earthquake caused damage to the Kansas City Plant, there is no conceivable environmental impact that would be different from those previously covered in this analysis.

Mitigating Factors

All building components at the Kansas City Plant, including the fire protection system piping, are designed to withstand potential earthquake damage.³⁶ This, combined with the low likelihood of earthquakes in the Kansas City area, makes environmental damage from an earthquake virtually nonexistent.

EMERGENCY PREPAREDNESS

The Kansas City Plant has formulated 10 emergency plans and 15 support plans for handling potential emergency situations. These plans have four purposes: to protect lives, property, and public safety; to maintain continuous executive direction; to maintain or quickly resume essential Plant operations; and to orient Kansas City Plant personnel and facilities to emergency, as well as post-emergency, duties.

Only those emergency and support plans pertinent to the accidents discussed earlier in this section will be presented here.

Weather Warning

The National Warning System (NAWAS), commercial AM and FM radio stations, the Municipalities Interstation Radio System, and the U. S. Department of Commerce radio network are all monitored by security personnel on a 24-hour-a-day basis. All four networks carry severe weather warning information. Such information can be transmitted to the proper Plant authorities within moments of its receipt in security headquarters.

Fire and Explosion

The control and handling of fires and explosions in the Plant are covered by an emergency plan. Another detailed plan outlines the responsibilities and actions of the Kansas City Plant's on-site fire department. If a fire cannot be controlled by Plant firemen, the Kansas City, Missouri Fire Department is called upon for assistance. At least once each year selected personnel from the Kansas City Fire Department are taken on a familiarization tour of the facility.

Four kinds of alarm systems (Gamewell, annunciator, notifier, and telephone) as well as five kinds of alarm devices (alarm boxes, sprinkler alarms, local bells, pyrotronic alarms, and rate-of-rise temperature detectors) are used at specific locations around the Plant to assist in the detection and reporting of fires. Fire protection personnel make routine patrols of the facility 24 hours a day.

Flood

A flood protection plan has been designed to establish the responsibilities of Kansas City Plant personnel, GSA personnel, and Corps of Engineers personnel. The plan covers flood emergency preparedness steps to be taken both for the Kansas City Plant and for the rest of the Federal Complex. In the event of a flood, a control center will be established in the Kansas City Plant to direct all actions for the Federal Complex.

Earthquake

In the event of an earthquake, a number of emergency plans could be invoked. An emergency utility shutdown plan would protect the Plant from damage from uncontrolled electrical, water, or gas utility lines. The fire protection plan could be instituted as needed. Severe weather warning systems and flood protection plans could help maintain communications and assist in surveying damage and protecting lives and property.

Generalized Emergency Plans

A number of support plans detail responsibilities and actions of the many diversified operations at the Kansas City Plant. Any of these plans can be brought to bear on any given emergency situation.

Fallout shelters could be used as a source of emergency supplies of food, water, sanitation kits, medical supplies, and radiation monitoring equipment.

Plant communications services could be utilized on an emergency basis. The Plant's complete medical facilities could

be converted to emergency use within moments. A financial plan has been written to provide emergency funds. Transportation, cafeteria services, and facilities repair are all covered under support plans.

In the case of air pollution alerts requiring action on the part of Kansas City Plant employees, either to reduce contributions to air pollution or to evacuate the Plant, actions would follow plans formulated as directed by Kansas City and the State of Missouri.

A Spill Prevention Containment and Countermeasure (SPCC) plan has been written to cover spill emergencies.

These plans and others similar to them can be combined to put the Kansas City Plant in a position to handle almost any emergency that may arise, either from natural or man made situations.

SECTION IV: UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

The reasonable use of available pollution control and resource conservation techniques results in the Kansas City Plant having very few unavoidable adverse impacts on the natural environment. The only unavoidable impacts from continued Plant operations are in the areas of land use, resource consumption, accident risks, and secondary atmospheric pollution.

Any adverse impact resulting from polychlorinated biphenyl (PCB) discharges continues, but will diminish as contamination previously deposited in sewer lines is attenuated by attrition. The replacement of Therminol FR-1 as the heat transfer fluid greatly reduced the risk of environmental release of PCB materials from process operations. Residual PCB concentrations of 2 percent to 3 percent remain evident in the operating systems. Protective measures provided to the operating systems, however, have further reduced the risk to the environment by providing isolation valves and dikes, and cleaning up previously contaminated use areas.

Attempts to mitigate the impact of the residual PCB contamination have included removal of sludge and flushing of the storm sewer system. Although continued flushing of the system is expected to reduce effluent concentration levels, low PCB levels (approximately one part per billion) in Plant effluents will probably continue for years. The use of PCBs in transformers will continue to pose an accident threat.

The adverse environmental effects of PCBs are discussed in Appendix A. The recommended safe level for the protection of all aquatic life is 0.01 parts per billion.⁷³ The existing Plant discharge level is typically one part per billion; however, no known ecological or human health effects are attributed to the Plant's discharge of PCB material.

By its presence, the Kansas City Plant will continue to alter the natural function of the Blue River flood plain. There is no known long-term harm to any biotic system; the impact is adverse only in terms of altering the natural land function as a flood plain. Flood protection and channel modification projects by the U. S. Army Corps of Engineers were accomplished in part to protect the Kansas City Plant. In comparison to the total alterations to the Blue River that have been made by all its metropolitan users, the Plant's impact is inconsequential.

Energy resources will continue to be consumed. Since natural gas is used for residential heating, its consumption by the Plant is a significant commitment of resources. This is especially true as natural gas becomes more costly and less plentiful. The use of some natural gas is unavoidable, but the total impact of this consumption can be altered by the use of more plentiful fuels. Oil is currently consumed as an alternate fuel, but it too is becoming more difficult to obtain. Coal is a plentiful resource which could be used as a substitute for natural gas to mitigate the extent of long-term energy commitments by the Plant. Coal has been studied for use as a fuel in Plant powerhouses, and a coal burning capability is included in the long-range contingency plans. Increased use of electrical refrigeration and heating also has been considered as an alternate to direct fossil fuel commitments for Plant energy.

The continued use of electrical energy resources is not expected to have a significant impact on the generating capacity of the Kansas City Power and Light Company. Projected growth figures for the utilities included growth figures for the entire service area. The projection was drawn up before recent conservation efforts were put into effect. These conservation efforts have created an even greater cushion between electrical supply and demand. However, it should be noted that fossil fuel commitments by the power utility are required for the generation of electrical power.

One secondary unavoidable impact is air pollution from motor vehicles. The magnitude of this impact will be reduced by improvements in automobile emission control technology and by greater use of public transportation and car pools by employees. There are alternatives (Section V) which could result in fewer unavoidable adverse impacts from Plant operations. The use of energy resources, the risks of accidents, and some pollution effects could be diminished by implementing some of these alternatives. The irreversible disturbance of the land would continue.

The specific land areas used for waste disposal also could be restored to their natural condition by soil removal and replacement. This would not involve a large land volume since on-site disposal has been very limited.

There have been no changes made in the Plant area during ERDA occupancy which could not be reversed to overcome any adverse environmental effects.

SECTION V: ALTERNATIVES

The major alternatives to the continued operation of the Kansas City Plant are to discontinue all operations and close the Plant or to relocate all operations to a new facility or to another ERDA facility. This section includes an examination of these two major alternatives plus the alternatives of reducing Plant operations, changing the basic Plant objectives, and improving Plant environmental controls. All of these alternatives can affect the environmental impact of the Kansas City Plant, although some only represent a displacement of that impact.

DISCONTINUE OPERATIONS

Part of ERDA's current mission is to support the national policy of maintaining an improved nuclear weapons stockpile. The Kansas City Plant is important to the fulfillment of that policy. Closing the Kansas City Plant would be detrimental to ERDA's overall mission and would have only limited net impact on the environment. Specifically, utilities and resource consumption would be discontinued and emission of air pollutants and discharge of wastewaters would be eliminated. At the same time, a net loss of about 5000 jobs would have a significant negative social and economic effect on the Kansas City area.

Operational accident threats which have a potential environmental impact would be eliminated by a shutdown, but other operations at the Federal Complex would continue to have their impact on the local environment. Should the entire Complex be vacated, it still is unlikely that the land would be returned to its original environmental state. The location and the industrial zoning of the land make it a likely candidate for continued industrial use.

RELOCATE OPERATIONS

Environmental protection is a mandate in the conduct of all ERDA programs, and moving the Plant from its present location or transferring operations to another ERDA facility would not result in a significant overall environmental improvement. Although a new Plant or a relocation of operations to a different Plant might result in improved environmental controls, the construction and operation of any new facilities at another site would have potentially similar effects on the environment.

The existing environmental effects are such that only slight gains would be expected in moving production from Kansas City to some other ERDA contractor. The significant potential adverse effects at the Plant are related to accident situations for which extensive mitigating measures to protect the environment have been instituted. Any reduced environmental effects realized at Kansas City by moving any or all operations would likely be offset by the same effects being created at the other location.

REDUCED PLANT OPERATIONS

Plant operations could be reduced by moving some manufacturing activities into the private sector--an alternative always under study as part of existing Plant policy. As each new product enters the production cycle, make-buy analyses are conducted to determine if the product should be made at the Plant or subcontracted to a private industry. When production within ERDA offers cost or other advantages, private suppliers normally are not considered. This is most commonly the case when the new product requires a capital investment either by ERDA or private industry.

A reduced Plant workload could reduce the Plant's environmental impact. However, the Plant's level of work is dependent on weapon systems schedules and requirements which are established by national policy.

DIFFERENT PLANT OBJECTIVES

This alternative could be accomplished by reducing the operations devoted to non-nuclear weapon component production and seeking new production assignments in the fields of energy research and development or in peaceful uses of atomic energy. It is believed that similar operations within the Plant, independent of mission, would not change the environmental impact. However, a reduction in manufacturing operations associated with a different Plant responsibility could reduce environmental interfaces. A change in Plant mission is not expected and existing environmental controls are adequate in light of current mission responsibilities.

IMPROVED ENVIRONMENTAL CONTROLS

Enhanced environmental controls at the present Plant are being installed without affecting the production mission. As a result, this alternative provides the most viable method of assuring continued operations with the greatest reduction in environmental impact. Pollution control systems and new pollution control management techniques are constantly being evaluated and implemented. Air and water monitoring systems will continue to be upgraded.

The Plant currently provides the necessary environmental controls to assure regulatory compliance. Further reduction of pollutants is possible, but cost benefit judgments are used to best determine alternatives such as those discussed below.

Elimination of Surface Water Discharges

The current Plant industrial discharges to Indian Creek and Blue River are monitored and controlled to meet regulatory standards and policies. The NPDES permit to discharge, issued by the EPA, requires that the industrial water discharge to these surface waters be of intake (drinking) water quality with an allowable variance of 10 percent. Abatement actions will assure that this requirement is met. However, eliminating all industrial discharges to surface waters is an alternative which would completely eliminate this environmental interface. This alternative will warrant continued attention because the quality of the water being discharged to the surface water lends itself to reuse and subsequent discharge through the industrial wastewater lagoon system.

Eliminating the discharge of all industrial effluent to surface waters and conserving water resources are consistent with national environmental protection and resource conservation policies and with long-range Plant contingency planning for water recycling. Cost information has not yet been established, but the environmental benefit is slight in view of the existing impact.

Water Treatment

Abatement actions have resulted in both the sanitary and storm sewer effluents being acceptable under existing regulatory requirements, but additional treatment of wastewater has been considered as a pollution control alternative. The pollutant

levels are considered insignificant in light of current standards, yet further reduction of pollutant concentrations could be realized through additional treatment. Abatement actions reducing effluent concentrations entering Blue River and Indian Creek to levels of intake (drinking) water quality make further treatment unnecessary. The sanitary sewer discharge, which now receives the effluents previously discharged to the surface waters, has increased. Pre-treatment of the industrial waters discharged to the industrial wastewater lagoons, and subsequently the sanitary sewer, is an alternative which could further reduce existing pollutant levels, although it would not result in a significant improvement to the Plant environment. The waste discharged to the sanitary sewer system eventually receives treatment by the Kansas City Pollution Control Department.

This alternative does become important should more stringent standards be established. The Kansas City Pollution Control Department is currently studying requirements which might establish pre-treatment standards of industrial wastes entering municipal sanitary sewer lines. Contingency plans have been formulated to establish pre-treatment capabilities for the additional removal of pollutants such as heavy metals in industrial discharges entering the sanitary sewer system. The estimated cost of the new capability is \$3 million.

Waste Water Recycling

All wastewaters discharged from the Plant to either the sanitary or storm sewer systems are in compliance with existing regulations; however, a wastewater recycling project has been considered as an alternative for improved water utilization. The wastewater lagoon system would be instrumental in providing the capability to segregate wastewaters not acceptable to recycling.

The pre-treatment and recycling projects could complement one another and increase recycling potential. Project costs have been estimated at \$2 million.

Air Pollution Control

Plant contributions to air pollution are within established regulatory standards, but the fact that the Plant is in a metropolitan area in which air quality is continually assessed is significant. Additional control of manufacturing and powerhouse pollutant emissions could lead to improvements in regional air quality. Plant efforts to reduce airborne emissions are consistent with the national goal of improving environmental conditions, particularly in relation to energy conservation measures. Existing air monitoring programs at the Plant do not indicate the need for additional industrial controls on the basis of existing standards.

The control of powerhouse emissions has been studied as part of the Plant's long-term contingency planning for increased curtailment of natural gas and the increased use of fuel oil. The cost of installing electrostatic precipitators to control powerhouse stack particulate emissions, reducing them by some 90 percent, has been estimated to exceed \$3 million. The control of other emissions, such as sulphur dioxide, would require additional incremental costs. Plans will continue to be made for the improvement of atmospheric emission monitoring systems and attendant air cleaning devices.

SECTION VI: RELATIONSHIP BETWEEN SHORT TERM USES
AND LONG TERM PRODUCTIVITY

There is no indication that the cumulative effect of this Plant on its environment has in any way diminished that environment's future productivity. In fact, in some respects, the Plant has served to enhance the future productivity of the local environment. The establishment of utility and transportation services, and the construction of a flood protection system, are improvements that may prove valuable to any later use of this land. Assuming that the most likely long term use of this property will be for industrial purposes, the environment has been made potentially more productive, and therefore, more valuable by the existence of the Kansas City Plant.

The Plant has had no long term productivity impact on air resources. The continued interface of this Plant with this feature of the environment is not expected to significantly change the impact made by the Plant.

The Plant's most serious cumulative impact on water resources has been the result of the discharge of polychlorinated biphenyl (PCB) material. The environmental impact of PCB material on the Plant sewer system and on area surface waters has been evaluated (Appendix A). Routine environmental monitoring is conducted, yet PCB effects on the biota have not been evaluated through ecological analysis. When compared to the environment to which the PCB material has been released, the relative impact of the material itself has been insignificant. Both the Blue River and Indian Creek have been extensively studied by the Environmental Protection Agency¹¹² and the Midwest Research Institute.⁴⁵ The findings by the two agencies have been summarized in the draft environmental impact statement for the Blue River Projects prepared by the U. S. Army Corps of Engineers in April 1974.¹⁴ The findings with respect

to water quality have been summarized in the Water Resources section of this report. The draft environmental impact statement states "As the Blue River flows east from its headwaters...into Missouri, water quality is seriously affected by the introduction of organic wastes from natural runoff, storm water overflow of sewers, and municipal and industrial waste-treatment plants."

Both Blue River and Indian Creek are polluted. Nearly all forms of aquatic life have been eliminated by toxic conditions introduced into the Blue River downstream of the Kansas City Plant. The water quality in the upper portions of the Blue River has steadily deteriorated during the last 25 years as commercial and residential developments have extended south past the Kansas City Plant and westward along Indian Creek and other tributaries of the Blue River. The development of numerous housing projects in recent years has resulted in an overloading of sewage treatment plants with a subsequent deterioration of water quality. The water quality of the Blue River has been characterized by low dissolved oxygen levels, extensive attached aquatic growths, and odors.⁴⁵

The cumulative effect of this Plant on this environment is not evident, yet the potential for an impact must be recognized. The emphasis on water pollution control measures since enactment of Water Pollution Control Act Amendments in 1972 has been directed at improvement of such streams as the Blue River and Indian Creek. The Kansas City Plant has adhered to all regulatory and environmental protection measures and it will continue to do so.

The Kansas City Plant is a manufacturing facility located amidst an area of Kansas City which does not have a concentration of industry. Therefore, this Plant has helped maintain a balanced economic structure. Any reduction in manufacturing operations

will detract from this balance. If this Plant or a similar industry were to discontinue operations, there would be a negative impact on the local economy.

SECTION VII: RELATIONSHIP OF PRESENT ACTION TO
LAND USE PLANS, POLICIES, AND CONTROLS

The present use of the land occupied by the Federal Complex, which includes the Kansas City Plant, is consistent with the plans and policies of the Kansas City Metropolitan Planning Commission.⁸³ The Complex land has been zoned to accommodate its operations and no change in land use plans is foreseen.

County and city plans to establish a parkway system adjacent to the Plant have been complemented by the U. S. Government's recent donation of land to the Kansas City Park Department. Cooperative planning on the part of the different governmental agencies occupying portions of the Federal Complex will continue to take land use plans into consideration. In addition, utility and service easements have been negotiated to the best advantage of the Plant, the Complex, and the community.

The location of the Plant has not resulted in any restrictions being placed on the zoning of the land around the Plant. Land adjoining the Plant is now zoned for agricultural purposes, for single and multiple family dwellings, for commercial purposes, and for light and heavy industries. Community land use within the immediate area of the Plant includes parks, recreation areas, a hospital, schools, a fire station, a golf driving range, a day care nursery, a number of churches, and a denominational community center of 20 acres that offers cultural, educational, and recreational facilities.

The presence of the Kansas City Plant does not in any known way conflict with the land use objectives of other members of the community.

SECTION VIII: IRREVERSIBLE AND IRRETRIEVABLE
COMMITMENTS OF RESOURCES

The Kansas City Plant, largely because of its size, is a major user of energy, labor, construction material, land, and water resources. However, few of these resources are irreversibly committed to the Plant. While the Plant operates there is a commitment of energy resources and water.

The land used by the Plant in no way represents an irreversible commitment. It could be used for virtually any need after current operations cease.

Both the materials used in production and plant labor resources represent irretrievable commitments. This is a positive contribution when considered on the basis of priorities which recognize the need for national defense. Labor used at this Plant represents a production capacity that could be diverted. However, it is not known to affect the potential uses of the natural environment within which this Plant operates.

Energy commitments at this Plant are significant. Enough natural gas is consumed to serve 8,000 private homes. The electricity used each year could service 21,000 private homes. Fuel oil is used at the rate of 2.5 million gallons per year; 6,000 gallons of gasoline is consumed each year. These energy resources are irretrievable.

The water used by the Plant is returned to its sources. All the water supplied to the Plant is taken from the Missouri River. Disposal of wastewater actually represents a recycling pattern back to the Missouri River, either by way of the Blue River or the sanitary sewer systems, which discharge into the Missouri River from municipal treatment facilities. Only the relatively minor

amount of water lost through evaporation or used for purposes such as irrigating lawns, represent a true consumption of water resources.

Energy and resource commitments are mitigated by conservation programs. Consumption of electrical energy and boilerhouse fossil fuels has been reduced. Conservation has resulted in enough natural gas to service 1000 homes and enough electricity to provide power to 5000 homes in the Kansas City service area. Labor is also a resource commitment which is administered to promote the efficiency of the Plant's national defense work.

SECTION IX: ENVIRONMENTAL TRADE-OFF ANALYSIS

The primary benefit resulting from the operation of the Kansas City Plant is the production of non-nuclear components for weapons in the national nuclear stockpile. Other benefits include energy- and weapon-related research and development work. The spinoff of technology from work at the Plant represents a major contribution to the scientific and technical community. Materials and processing development have contributed to the advancement of adhesives, surface finishing and coating, microelectronic assembly, and quality assurance testing technologies.

The Kansas City Plant is of significant benefit to the area economy. It provides job opportunities for about 5,000 people and an annual payroll of approximately \$80 million. The total economic impact on the area includes the local purchase of approximately \$13 million annually in services and construction goods. Social benefits to the community involve cash contributions to local organizations and volunteer work by Plant employees. The technical and professional expertise of Plant employees is also recognized as a community benefit.

Plant operations do represent a cost to the environment in terms of land use, commitment of resources, and effluent discharges to both the air and water. The costs resulting from accident risks and the use of hazardous materials are minimal. The most costly accident is judged to be an oil spill from a massive rupture of storage tanks. No large quantities of hazardous materials which could have significant environmental impact are processed in or used in processing at the Plant. The Plant requires continuing commitments of production materials, water, electricity, natural gas, and fuel oil. The Kansas City Plant occupies only a portion of the Federal Complex. This makes land use at the Kansas City Plant a secondary resource commitment.

The return of Plant land to its natural environment is unlikely, based both on long-term plans by local agencies designating the area as industrial land and on the fact that returning the land to its natural environment would be prohibitive in terms of cost. It is also likely that any industrial use of the land now occupied by the Kansas City Plant would result in a cost to the environment quite similar to the cost incurred by the Kansas City Plant.

No known long-term commitments to the environment have resulted from the operation of the Plant during the last 28 years. The cost to the environment has been minimal in comparison to the benefits derived from operations. The following analysis of the cost versus the benefits of the alternatives (Section V) supports this judgment.

Discontinuing operations at the Kansas City Plant eliminates all the beneficial impacts of the Plant while resulting in elimination of only the ongoing environmental impacts. This would not reduce the minor irreversible impacts of land alteration and the lingering effects on the environment as a result of past operations. The mission of the Plant is to provide facilities and operations in support of the national defense program. Because discontinuing Plant operations would adversely affect an active part of the nuclear weapons program, this alternative is not considered feasible. The existing benefits, in terms of both economics and national security, are greater than the existing environmental cost.

Building a new plant in a location other than the present one has conceivable environmental and long-term monetary benefits. However, only when the Plant becomes intolerably inefficient and incapable of being upgraded will relocation be an attractive alternative.

Studies to date show no economic advantage to constructing a new facility or relocating certain assigned responsibilities to other ERDA facilities. Establishing all operations at new, complete facilities or by transfer to existing ERDA sites is estimated to require one-time cost of \$250 to \$400 million. The expected monetary savings and reduced environmental impact of these relocations do not justify a decision to implement them. A new facility would require new land and other incremental resource commitments. The only reductions in environmental impact would be in such areas as reduced discharge to surface waters and greater distance from urban areas. Operations easily adaptable to other plants such as machining, are not high environmental risks at this site; therefore, only slight improvements would be attainable. Furthermore, any design improvements in a new plant could be implemented at the existing site with less cost. A relocation, therefore, could only reduce the environmental impact and not completely eliminate it.

Special studies have been made with regard to reducing the size of production operations at the Kansas City Plant. Reduced operations could reduce pollution discharges as well as cut down resource consumption. However, significant reductions in Plant operations would conflict with existing national defense plans and could jeopardize current Plant responsibilities.

Some reduction in operations could be achieved by purchasing products from private industry. Each new product is carefully analyzed to determine whether its components should be made in the Kansas City Plant or purchased from some outside supplier. Those produced at the Kansas City Plant are not normally available from the private sector, a consequence of unusual designs, low production rates, and unusual quality standards often displayed by weapon component production. Those products most likely to be

purchased from the private sector do not represent a significant hazard to the environment. In addition, obtaining services elsewhere could involve an unusual burden in material movement, cost-time delays, and damage to expensive assemblies.

There is no significant environmental benefit to be derived from changing Plant objectives. Although the Plant is easily adaptable to energy research work, the cost-versus-environmental-impact relationship remains approximately the same as it is under current weapon production activities. Reduced manufacturing activities associated with a different Plant objective could result in environmental improvements. However, a change in Plant activities is not consistent with current Plant responsibilities.

Environmental controls are constantly being improved to maintain operations within applicable regulatory standards. Reasonable additional contributions to the protection of the environment will continue to be made. However, the benefits gained are constantly weighed against the actual costs to the environment. Major alternatives which have environmental significance include elimination of industrial surface water discharges, treatment of industrial waste discharges, recycling water, and adding further air pollution controls. Environmental protection is always a basic consideration in the conduct of Plant operations, and every effort is made to balance cost and environmental benefit.

The comparison of benefits-versus-costs for existing operations with reasonable alternatives (Table 1) to those operations suggest that activity at the Kansas City Plant should continue as required to support the national defense program.

Table 1. Cost Benefit Comparison

Alternative	Cost	Benefit
Discontinue Operations	Loss of defense capabilities and economic and social benefits; funds for Plant shutdown	Cessation of ongoing minor environmental impacts, elimination of the risk of potential accident effects, and elimination of use of fossil fuels and production materials
Relocate Operations	Large one-time monetary cost, disruption of production schedule, and new resource commitments	Possible minor reduction of operating environmental impacts resulting from change of location and incorporation of latest technology
Reduce Operations	Proportionate reductions in defense capabilities and economic and social benefits	Proportionate reduction in resource consumption, environmental impacts, and risk of potential accident effects
Improve Environmental Controls	Increase expenditures for pollution control equipment and energy to operate it	Improved resource utilization, even less environmental impacts from normal operations, and less potential for accident effects

SECTION X: APPENDICES

Appendix A

POLYCHLORINATED BIPHENYLS

DESCRIPTION OF MATERIAL

Polychlorinated biphenyls (PCBs) are light, straw colored, mobile, and slightly viscous liquids with typical phenol odor and a certain percentage of chlorine. The characteristics of PCBs which make them useful to industry include miscibility with most organic solvents, strong resistance to both acidic and basic hydrolysis, general inertness, low water solubility, and high dielectric strength. PCBs have proved to be excellent high temperature heat transfer fluids in closed systems. Their stability makes it difficult to destroy them: a 2-second exposure to a temperature over 2000°F is required. The largest single use of PCBs is as a coolant or dielectric for electrical transformers.

The properties that make PCBs industrially useful are the same properties that cause them to persist in the environment. Although they have been available commercially for 40 years, the compounds were not discovered in the environment until 1966 in Sweden and 1967 in the United States. In the environment, PCBs and DDT are quite similar and almost equally difficult to distinguish by analytical techniques. PCBs are not found in the ecosystem as extensively as DDT and are not as concentrated because they get into the environment accidentally while DDT is spread deliberately.⁴⁶

PCBs have been under close scrutiny in recent years by scientists concerned with their effects on the environment. They are accumulated by organisms and their chronic effects are considered hazardous. Lower life forms concentrate PCBs to very high levels. Some kinds of wildlife that feed off the lower life forms have been affected drastically by this material. The environmental impact of PCBs is shown through their detection in several locations around the world.

Damage to the liver from excessive exposure appears to be the chief toxic effect on man. PCB materials are eye irritants, they dry and crack the skin, and they cause skin lesions known as chloracne.

Studies of animals indicate that acute (short term) toxicity is not significant. Shellfish, oysters, and shrimp are the most sensitive to PCBs on a short term basis. Chronic (long term) effects on fowl are serious, primarily because PCBs can trigger the formation of thin-shelled eggs.⁷⁵

PCBs reach the environment in several ways. Landfills receive the largest amount. An estimated 300,000 tons of PCB material have been disposed of in U. S. landfills during the last 40 years. Oceans are also primary sinks for PCBs in the environment. One or more PCB compounds have been detected in all environmental media, and in many organisms. In air and water away from immediate sources of waste discharge, PCB levels are low (parts per trillion) in air, and only slightly more prevalent (parts per billion) in fresh water. Soil or bottom sediments underwater contain a few parts per billion. It is postulated that little or no PCBs will be found in ground water, since the PCBs probably would be trapped or absorbed in soil particles.^{73, 75}

Only a relatively small amount of PCB material is required to contaminate a large part of the biota. For example, 10 tons would be considered sufficient to contaminate the entire population of the United States to a level of one part per million. PCB hazards are intensified by the magnification that takes place within the environment. When food containing PCBs is consumed by an organism, the PCBs are retained in the lipids of that organism. Because of the concentration of PCBs at each food level within a food chain, the concentration may become magnified by a factor of 10 to 100 at each step. Aquatic food chains involving such top predators as birds and mammals do accumulate PCB levels 100 million times higher than those in the ambient water.⁷⁵

Specific studies have been undertaken to determine the toxic nature of PCBs. Acute toxicity studies show that PCBs are not a severe problem. In tests with guinea pigs, mice, rabbits, and rats, all animals survived exposure to PCB (Aroclor 1242)* vapors to a level of 1.83 parts per million for 7 hours during each of 17 out of 24 days. Other reports on experiments with trout show PCBs to be toxic at 96 hour- TL_{50} ** at concentrations of 1.17 to 60 parts per million. Bluegill are more sensitive to PCBs with the 96 hour- TL_{50} at 0.278 parts per million compared to 0.008 parts per million for DDT.⁶⁹

Residue in the brains of birds killed by PCBs measure in the hundreds of parts per million. Most shrimp will die as a result of a 20 day exposure to a concentration of 5 parts per billion. Exposure to 5 parts per billion of Aroclor 1254 caused mortality of two species of fish in 14 to 45 days. PCBs are toxic to some aquatic invertebrates at levels as low as 1 part per billion in ambient water.

*Aroclor 1242 is a Monsanto trade name for a PCB. The first two digits in the number indicate the hydrocarbon type and the last two digits give the weight percent of chlorine.

** TL_{50} (also expressed as lethal dose, or LD_{50}) is the dose of a chemical substance which is expected to cause the death of 50 percent of an entire population of an experimental animal specie.

Human health hazards have been analyzed as a result of documented exposures of 1001 Japanese to salad oil contaminated with up to 2000 parts per million of PCBs. The exposure occurred in Yusho, Japan, in 1968. The minimum estimated toxic intake for humans is 200 micrograms per kilogram per day. The American Conference of Governmental Industrial Hygienists has set a threshold limit value of 1 milligram per cubic meter for occupational exposure to vapors of Aroclor 1242 (chlorodiphenyl-42 percent chlorine).¹⁰⁵

PCBs have been shown to accumulate in fish and aquatic invertebrates to levels of 75,000 times that present in the water (up to 200,000 times in selected tissues), and to be accumulated from concentrations as low as 0.06 parts per billion. To prevent levels in fish from reaching the 5 parts per million established by the Food and Drug Administration (FDA) as the interim action level for fish as human food, concentrations in water would have to be less than 0.07 part per billion or, to allow some safety factor, 0.01 part per billion. This level should be sufficiently low so that fish and shellfish would not be adversely affected.

Channel catfish taken from the Missouri River in 1971 showed a PCB concentration of 1.7 parts per million in the edible section. Catfish taken from the Mississippi River between the mouth of the Missouri River and the mouth of the Ohio River showed 4.4 parts per million PCB concentration in the edible portions. Downstream from the mouth of the Ohio River, concentrations of 9.0 parts per million have been recorded.⁸⁵

The major manufacturer of polychlorinated biphenyls in the United States has been the Monsanto Chemical Company. Monsanto has held a patent on a PCB material known as Therminol FR-1, which contains 42 percent chlorine, since 1932. In 1971, Monsanto announced that it would discontinue the sale of Therminol FR-1 for heat transfer uses since it had learned that polychlorinated biphenyls have an adverse environmental effect. In 1976, Monsanto announced they were discontinuing manufacture of all PCB materials in accordance with the Toxic Substances Control Act of 1976.

PCBS AT THE KANSAS CITY PLANT

The Kansas City Plant used Therminol FR-1 as a heat transfer fluid in its mold heating and cooling operations and polymer laboratory operations between 1966 and 1975. When use began at the Kansas City Plant, there was no indication of an environmental concern associated with polychlorinated biphenyls.^{10,18} Therminol FR-1 was a most attractive heat transfer fluid for Kansas City Plant operations because of its fire resistance and its thermal stability.

Once Monsanto Chemical Company announced in 1971 that an environmental problem did exist with Therminol FR-1 and that it

would discontinue sale of the heat transfer fluid, the Kansas City Plant began several actions which culminated in the selection of and conversion to a new heat transfer fluid.^{39, 43, 58}

There are three systems in service at the Kansas City Plant which have used PCBs as a heat transfer fluid. These systems were converted to another fluid in 1975. One of the three systems has a fluid capacity of 6500 gallons and involves approximately 4700 feet of piping. The second system has a capacity of 7400 gallons and involves approximately 3500 feet of piping. The third system is a resin pilot plant that holds about 125 gallons.

When the first Therminol system became operational, Therminol waste was disposed of in the same manner as other oils and cutting fluids. It was collected and stored on-site for pickup and disposal in a local landfill by a licensed contractor. Material spilled was picked up with absorbent material and hauled off-site for burial in a local landfill. In all cases, the selection of the landfill to be used for disposal was left to the contractor.

In 1969, a failure occurred in an expansion joint in the distribution system and approximately 1500 gallons of Therminol FR-1 were lost to a graveled area underlaid by dirt. An estimated 900 gallons was lost to a storm sewer which discharged into Indian Creek. Six hundred gallons soaked into the dirt and gravel. The dirt and gravel were removed and buried in a landfill. Removal of PCB pools from the water was performed; however, sampling and monitoring of the outfall effluent was not performed since PCB impact on the environment was not known to be a matter of concern at that time.

The first awareness of a PCB impact on the environment developed early in 1970 when Monsanto Chemical Company notified the Kansas City Plant of its concern over the environmental impact of polychlorinated biphenyls.⁸³

Intensified, off-site water sampling activities were started immediately. Employees were instructed in more stringent controls in handling the materials; written procedures were prepared to help control PCBs. Floor drains or outdoor surfaces where it was considered possible that spilled fluid could reach the storm sewers were either blocked or diked. Disposal of solid and liquid PCB contaminated waste material became a primary concern and approved contractors were sought.

In 1972, a series of incidents resulted in the accidental release of approximately 1100 gallons of PCB. All within the span of one week a 2-inch hot oil line ruptured, a heat exchanger developed two leaks, and a vent line ruptured. Less than 23 gallons of the PCB material reached the surface water streams in the area. The balance of 1077 gallons was absorbed or collected and turned over to a licensed contractor for disposal in a landfill. Monitoring of the outfall where all of the spilled PCB was discharged into the stream was started and continued until the

system was back in operation. The highest PCB concentration was found to be 18.9 parts per million.

In January 1973, an equipment failure resulted in the release of 500 gallons of PCB, of which 467 gallons were recovered. Increased sampling at Outfall 001 was started immediately and continued through the day at 3-hour intervals. The dissolved Therminol concentration never exceeded the 580 parts per billion level.

In February 1974, with the issuance of the National Pollutant Discharge Elimination System (NPDES) permit, the Kansas City Plant became limited in its discharges of PCB through the outfalls to a maximum of 1 part per billion at Outfalls 001, 003, and 004, and to 10 parts per billion at Outfall 002.

On June 21, 1974, it was noted that the PCB concentration had risen to 7.2 parts per billion at Outfall 001. The normal reported level is less than 1 part per billion. The incident was reported to the EPA as required by the NPDES permit. Investigation revealed that during a heat exchanger repair, a small quantity (5 to 10 gallons) of heat transfer fluid had sprayed from the system and was deposited on gravel outside a diked area. This material was cleaned up immediately, with no apparent PCB release. Continued investigation revealed that discharge from an oil separator previously contaminated with PCBs was the cause of the increased PCBs at the outfall. Under normal operating conditions, the valve which allowed the discharge would be closed and no water would discharge. This error was corrected and the outfall was sampled daily until the value dropped below the 1 part per billion specified in the NPDES permit.

Another incident requiring the notification of the EPA as a result of the NPDES requirement was discovered on July 16, 1974. On July 3, the PCB level had risen to 12 parts per billion at Outfall 002. Investigation revealed that there had been a cleanup crew working in the vicinity of a PCB contaminated wastewater area. There were drains located adjacent to the area being cleaned and some of the PCB entered the storm sewer at this location. On July 19, these drains were plugged and daily sampling was started and continued until the levels were below the 10 parts per billion specified in the NPDES permit.

PCB monitoring of Plant effluents indicates that concentration levels continue at approximately 1.0 ppb.

Therminol FR-1 does not behave like oil or petroleum products. The specific gravity is heavier than water. There is no normal oil slick. Therminol collects wherever it can settle out in low places, even though the water flow may be turbulent. This accounts for the slow dissipation of spilled PCB. Attempts have been made to clean up the storm sewer system discharging to Outfall 002. Starting at the north end of the 48-inch pipe, material in the storm sewer was moved from one manhole to another with a fire hose

and the heavier Therminol was pumped out of the deeper manholes as this material was moved through the pipe.

A search for a heat transfer fluid to replace Therminol FR-1 was begun early in 1972,³⁹ very shortly after the Monsanto Chemical Company notified the Kansas City Plant that Therminol FR-1 would no longer be available. Thirty-three different fluids made or marketed by 21 companies were studied to objectively identify the most suitable replacement fluid. Therminol 66, also manufactured by Monsanto Chemical Company, was selected as the most suitable replacement fluid. The conversion from Therminol FR-1 to Therminol 66, a modified terphenyl, was completed in 1975. This conversion will remove from the premises the greatest potential hazard for environmental degradation.

A study of Therminol FR-1 loss⁵⁸ was completed in February 1972. A hazards analysis study was prepared in March 1972.⁴³ In the same month, an investigation of records determined the total quantities of Therminol FR-1 purchased, on hand, reclaimed, lost to the environment, or disposed of to dump sites. At that time, it was determined that 11,657 gallons of Therminol FR-1 had been disposed of in landfills and approximately 973 gallons had inadvertently been lost to surface water streams. At that time, disposal of wastes, both liquid and solid, became subject to handling by specialized disposal contractors who were well aware of the environmental concerns for PCBs. Total accountability began in April 1972 and since that date, the Kansas City Plant has shipped approximately 4000 barrels of solid waste. These studies resulted in the preparation of a Safety Analysis Report.⁷⁶

In 1976, the EPA conducted a nationwide survey in an attempt to assess the extent of environmental problems associated with the use of PCB. The following information was provided in response to the survey.

EPA SURVEY OF PCB USAGE OF FEDERAL FACILITIES

PCB Uses

The use of polychlorinated biphenyl (PCB) materials at the Kansas City Plant is currently limited to closed systems such as transformers and capacitors. An undetermined amount of PCB material is also contained in carbonless copy paper. The only manufacturing operation which used PCB material was the plastic molding operations. Therminol FR-1, a PCB material manufactured by Monsanto Chemical Company, was used as a heat transfer fluid in two production facilities and a resin pilot plant. A conversion project was completed in 1975 replacing Therminol FR-1 with a non-PCB material, Therminol 66; although a residual amount of FR-1 remains in the systems.

The total amount of material in electrical apparatus is approximately 329,000 pounds (26,300 gallons). The total amount of Therminol FR-1 used in the plastic molding operations was approximately 175,000 pounds (14,000 gallons) prior to material substitution. The conversion project was initiated to reduce the environmental risks associated with PCBs and completed in late 1975. All Therminol FR-1 (PCBs) was removed from the site in early 1976.

The PCB materials used in electrical equipment are Pyranol (General Electric Company) and Inerteen (Westinghouse Electric Corporation).

Environmental Controls

All use areas where PCB compounds are located have been provided with diking or other secondary containment to control spills. The Therminol plastic molding equipment and production areas are diked, with area drains sealed and process water controlled. Substations containing transformers have been provided with diking and are included in a preventive maintenance program which includes fluid inventory control. Capacitor banks located throughout the Plant have been provided with containment catch trays to contain spills. Procedures do exist for routine inspection of all areas where PCB materials are used. All plant wastewaters are routinely monitored and evaluated for any contamination from these sources.

Written procedures for the use and handling of PCB compounds provide instructions for the proper handling and disposition of materials. A surveillance function does exist whereby use, storage, and disposal of PCB compounds is overseen by Environmental Protection personnel.

Waste Disposal

A procedure and accountability system exists for the identification of PCB waste materials. PCB compounds are disposed by either shipment to Monsanto Chemical Company in Sauget, Illinois, or to Chem-Trol Pollution Services, Incorporated in Model City, New York. PCB containing materials procured and disposed by the Kansas City Plant have included Therminol FR-1, contaminated Therminol 66 (contaminated with Therminol FR-1), Pyranol and Inverteen. Other waste materials disposed from this facility have included contaminated oils, contaminated waters, contaminated soil, and miscellaneous contaminated scrap wastes. Waste carbonless paper is not currently segregated for disposal.

Methods of disposal, whether incineration or landfill, have been evaluated to assure that they are environmentally acceptable and meet applicable regulations.

Training

Environmental Protection, Engineering, Maintenance, and Production personnel have been made aware of the hazards involved with PCBs. Procedures for handling and controlling materials and equipment have been developed.

Environmental Monitoring

An environmental monitoring program has been developed to routinely assess Plant effluents and receiving surface waters for PCB concentrations. Discharges to receiver waters (Indian Creek and Blue River) are authorized by the National Pollutant Discharge Elimination System under Permit Number MO-0004863. PCB concentrations in Plant effluents are normally in the 1 to 10 part per billion range.

Discharges to the Kansas City Missouri sanitary sewer are also monitored for PCB concentrations. Detection level concentrations are evident and are routinely recorded.

Environmental monitoring in the receiving waters both upstream and downstream indicates a maximum concentration to be less than one part per billion. Past ambient air monitoring conducted both upwind and downwind of plant operations indicated typical chlorodiphenyl concentrations of less than $10 \mu\text{g}/\text{m}^3$. Routine ambient air monitoring was discontinued when increased air emission controls of PCB operations resulted in nondetectable concentration levels.

PCB concentration in Plant wastewater discharges remain as a result of the persistence of residual PCBs from spill incidents prior to environmental controls. Residual contamination in both storm sewers and industrial waste lines have resulted in continued PCB detection at approximately 1 part per billion even though attempts have been made to cleanup storm sewer systems by flushing and pumping out manholes. The PCB concentrations are expected to be reduced only through attrition.

Procedures

Procedures do exist for the use, handling, transporting, and disposal of PCB compounds. Manuals for the servicing and maintenance of equipment such as capacitors and transformers containing PCBs are provided by the electrical equipment supply companies. Formal procedures for the disposal of electrical equipment have not been developed; but such equipment has been returned to the supplier as a matter of course since PCBs have been identified as an environmental concern.

Table A-1. PCBs Used by Government Agencies and Contractors

Use	Currently in Use	Additions (1975)	Annual Losses	Individual Units in Service
Transformers				
In Buildings	n/a			
Transportation	n/a			
Industrial Facilities	320,200*	780*	800*	61
Large Capacitors (<2 lb)				
Electrical Systems	n/a			
Industrial Facilities	9.050	None	Nil	71 (banks)
Other	n/a			
Small Capacitors				
Consumer Items	n/a			
Industrial Facilities	None			
Other	n/a			
Open System Uses				
Hydraulic Systems	n/a			
Lubricants	n/a			
Heat Transfer	None†			
Investment Casting Wax	n/a			
Other	n/a			
Paper Products				
Carbonless Copy Paper				
Unused Supplies				
8½ by 11 inch	250**	500**	500**	n/a
Adding Machine Tape	120***	120***	40***	n/a
Adhesives on Boxes	n/a			
Other	n/a			

*Pounds

**Reams

***Rolls

†Conversion project completed in 1975 replacing 175,000 pounds of Therminol FR-1 (PCB) with Therminol 66 (non-PCB) material

An inventory control program was established in 1972 for the control of all PCB materials. Records of purchased materials, use inventories, operational and spill losses, and waste materials are routinely maintained. Equipment inventories do exist for items such as transformers and capacitors. Preventive maintenance schedules include servicing such equipment. The disposal of PCB containing equipment is overseen by Environmental Protection personnel.

Appendix B

MATERIAL DESCRIPTIONS

BERYLLIUM

Beryllium is a grayish-white hard, light metal. It has been used in the United States since the 1920's as an alloy with copper and other metals. Beryllium is used in industry predominantly in three forms: beryllium metal, beryllium alloys, and beryllium oxide.

Beryllium has been defined as a hazardous air pollutant pursuant to the Clean Air Act of 1970. The proven effects of airborne beryllium materials on human health include both acute and chronic lethal inhalation effects, as well as skin and conjunctival effects.⁸⁶ Insufficient data is available to incriminate beryllium as a human carcinogen, but the lack of any mechanism for the total elimination of beryllium body burdens, and a resulting possible long residence time, may enhance the opportunity for cancer induction.

In 1949 when it became apparent that beryllium was a toxic material, the ERDA adopted a limit of 0.01 micrograms of beryllium per cubic meter of air averaged over a 30-day period as the maximum allowable concentration of beryllium in community air. The ERDA health and safety requirements have continued to apply to all ERDA-owned facilities, some of which fabricate and assemble beryllium parts.

No reported cases of prime beryllium disease have occurred as a result of community exposure since the implementation of the ERDA guideline, and a Committee on Toxicology of the National Academy of Sciences has concluded that the ERDA guideline represents a safe level of exposure.

Accordingly, the Environmental Protection Agency has determined that in order to provide an ample margin of safety to protect the human health from beryllium, sources of beryllium dust, fume, or mist emissions into the atmosphere should be controlled to ensure that ambient concentrations do not exceed 0.01 micrograms per cubic meter over a 30-day average.²³

The Kansas City Plant has no operations dealing with beryllium or beryllium alloys containing more than 5 percent beryllium (as defined in the National Emission Standards for Hazardous Air Pollutants). In all operations dealing with beryllium processing, protection has been provided in the form of fume hoods, glove boxes, negative pressure work areas, and high efficiency filtration

systems. Beryllium source testing was performed by Midwest Research Institute on effluent stacks while beryllium machining operations were taking place.⁵ These tests showed a discharge rate of less than 1 microgram per day, as compared to the EPA standard of 10 grams per day.

MOCA⁸⁴

MOCA, a DuPont product, is a diamine curing agent for isocyanate containing polymers. MOCA chemical composition is 4,4-methylene-bis-(2-chloraniline); usually it is in pellet form, yellow to light tan-grey in color, has a slight odor, and melts between 212-228°F. MOCA is heated and melted for use as a curing agent for Adiprene. MOCA can also be dissolved as a powder in the heated liquid Adiprene polymer or dispersed in an anhydrous fluid which is compatible with the Adiprene polymer.

MOCA shows the general toxicity characteristics of aromatic amines and may, if taken into the body, produce cyanosis. The approximate lethal dose for rats is 1,000 milligrams per kilogram. Tests have provided carcinogenic (cancer producing) data for MOCA. A high incidence of liver cancer was observed in rats, but studies using dogs have shown no clinical evidence of malignancy.

The DuPont Company's experience with MOCA has been reported extensively. MOCA has been detected in the urine of operators and mechanics in their manufacturing areas. It was concluded that skin absorption from direct contact was a major source of absorption. Medical surveillance of personnel representing 230 man-years of exposure by 31 people has detected no manifest signs of symptoms from MOCA exposure during a 16-year manufacturing history. Although no tumors have been observed to date, it is recognized that neither the group size nor the time period are large enough to permit a significant conclusion. MOCA has not been known to produce dermatitis in humans; however, in laboratory tests it did produce mild irritation to the skin of guinea pigs. There was no evidence of allergic sensitization.

ISOCYANATES

Isocyanate chemicals, usually in liquid form, are reacted with liquid polyol resin components in the manufacture of polyurethane plastics. The general growth in the use of polyurethane materials has created a wide variety of isocyanates. Several types of diisocyanates and polymeric isocyanates have been characterized as toxic.

With polyurethane systems, the hazard arises principally from the isocyanate component and the hazardous vapors. Inhalation of isocyanate vapors can produce severe irritation of the mucous membranes in nose, throat, and lungs. Short exposure of humans to concentration of isocyanate vapor at or near the ceiling value has caused progressive disabling illnesses characterized by breathlessness, chest discomfort, and reduced pulmonary function. Massive exposure to high concentrations has caused, within minutes, irritation to the trachea and larynx and severe coughing spasms. Massive exposure may also lead to bronchitis, bronchial spasms, or pulmonary edema (chemical pneumonitis). About 0.5 to 1.5 percent of the population can become sensitized to isocyanates. In these sensitized individuals, exposure to minute concentrations of isocyanates considerably below the ceiling level may lead to asthmatic attacks and respiratory distress. Isocyanates can also be harmful to delicate eye tissue, and can react with skin protein and tissue moisture to cause reddening, swelling, and blistering of an exposed skin area.

Animal experience indicates that the toxicity of isocyanates when ingested, is not very high. From these experiments, it is believed that ingestion of isocyanates probably would not be harmful to humans, but could result in severe irritation and probably corrosive action on the mouth and stomach tissue because of the dehydrating effect.

Toluene diisocyanate and other polymeric isocyanates are classified as Class III B combustible materials by the National Fire Protection Association (NFPA) and are not considered serious fire hazards. However, isocyanates will burn. Under fire conditions, isocyanates generate irritating and hazardous isocyanate vapors and toxic fumes, including carbon monoxide, oxides of nitrogen, and traces of hydrogen sulphide. Self contained breathing apparatus in addition to protection clothing should be worn in the event of a fire or major isocyanate spill.

To reduce potential health, fire and environmental hazards, fabrication operations at the Kansas City Plant are conducted in areas specifically set up and reserved for isocyanate operations. Exclusive polyurethane manufacturing areas are provided with adequate ventilation, monitoring, and filtering systems to assure proper protection.

Appendix C

NPDES PERMIT TO DISCHARGE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VII
1735 BALTIMORE - ROOM 249
KANSAS CITY, MISSOURI 64108

February 26, 1974

NPDES No: MO 0004863

Name and Location: U.S. Atomic Energy Commission
Kansas City, Missouri

Receiving Water: Big Blue River and Indian
Creek

Mr. B. W. Colston
Area Manager
U.S. Atomic Energy Commission
P.O. Box 202
Kansas City, Missouri 64141

Dear Mr. Colston:

Pursuant to Section 402 of the Federal Water Pollution Control Act Amendments of 1972, we have issued and are enclosing your National Pollutant Discharge Elimination System (NPDES) Authorization to Discharge from your above-referenced facility into the Big Blue River and Indian Creek.

Your NPDES Authorization to Discharge includes general and special conditions which must be followed to remain in compliance with the requirements of the Federal Water Pollution Control Act Amendments of 1972. Monitoring reports prescribed in the special conditions are required on a periodic basis. Ten copies of the necessary report forms are enclosed. Questions and requests for additional monitoring reports should be directed to the Federal Activities Section, Environmental Evaluation Branch, 816-374-2725.

We appreciate the Commission's interest and cooperation in this program.

Very truly yours,

A handwritten signature in cursive script, reading "Jerome H. Svore".

Jerome H. Svore
Regional Administrator

Enclosures

No. MO-0004863
Application No. 2SB OXR 3 000082

**AUTHORIZATION TO DISCHARGE UNDER THE
NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM**

In compliance with the provisions of the Federal Water Pollution Control Act, as amended,
(33 U.S.C. 1251 et. seq; the "Act"), the United States Atomic Energy Commission

is authorized to discharge from a facility located at the Kansas City Area Office, Kansas
City, Missouri,

to receiving waters named the Big Blue River and Indian Creek

in accordance with effluent limitations, monitoring requirements and other conditions set forth
in Parts I, II, and III hereof.

This permit shall become effective on February 26, 1974

This permit and the authorization to discharge shall expire at midnight, five years from the
effective date on February 25, 1979

Signed this 26 day of February, 1974

Jerome H. Svore
Regional Administrator
U.S. Environmental Protection Agency
Region VII

Permit No. MO-0004863

PART I

A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. During the period beginning on the effective date of this permit and lasting until October 31, 1974, discharges from outfalls 001, 002, 003, and 004 shall be limited to the discharge contents and levels specified on the permit application dated February 21, 1973*, except as modified by Attachment I hereto. During this period, the effluent characteristics specified in Part I, A.2 shall be monitored at the frequency specified.
2. During the period beginning October 31, 1974, and lasting until the date of expiration of this permit, discharges from outfall 001, 002, 003, and 004 shall be limited to "unpolluted" cooling water as defined in Part I, B.3. The parameters to be monitored are specified below and shall be limited to the daily maximum concentration of the intake water characteristics at the time the effluent characteristics are monitored with an allowance for a maximum variance of ten (10) percent.

<u>Effluent Characteristic</u>	<u>Monitoring Requirements</u>	
	<u>Measurement Frequency</u>	<u>Sample Type</u>
Total Dissolved Solids	twice/month	8 hour composite
pH	twice/month	grab
Temperature	twice/month	grab
*Flow	continuous	- -

*See "Other Requirements" in Part III, No. 1.

3. Effluents shall not elevate or depress the average cross sectional temperature of the stream more than 5° F. The stream temperature shall not exceed 90° F. due to effluents.
4. After October 31, 1974, the discharges from all outfalls shall contain neither visible foam nor visible floating solids in other than trace amounts, exclusive of such solids which result from surface runoff waters.
5. The discharges from all outfalls shall contain not more than 0.1/ml/liter of settleable solids, exclusive of settleable solids which result from surface runoff waters.
6. Samples taken in compliance with the requirements specified above shall be taken in each outfall before entering the receiving waters.

*The permit application, which is a part of the permit, has not been included in this appendix. It is on file with the EPA.

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Permit No. 0004863

7. Test Procedures

Test procedures for the analysis of pollutants shall conform to regulations published pursuant to Section 304(g) of the Act, under which such procedures may be required.

8. Recording of Results

For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall record the following information:

- a. The exact place, date, and time of sampling;
- b. The dates the analyses were performed;
- c. The person(s) who performed the analyses;
- d. The analytical techniques or methods used, and
- e. The results of all required analyses.

9. Additional Monitoring by Permittee

If the permittee monitors any pollutant at the location(s) designated herein more frequently than required by this permit, using approved analytical methods as specified above, the results of such monitoring shall be included in the calculation and reporting of the values required in the Discharge Monitoring Report Form (EPA No. 3320.-1). Such increased frequency shall also be indicated.

10. Records Retention

All records and information resulting from the monitoring activities required by this permit, including all records of analyses performed and calibration and maintenance of instrumentation and recordings from continuous monitoring instrumentation shall be retained for a minimum of three (3) years, or longer if requested by the Regional Administrator.

B. MONITORING AND REPORTING

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

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Permit No. 0004863

2. Reporting

Monitoring results obtained during the previous three months shall be summarized and reported on a Discharge Monitoring Report Form (EPA No. 3320.1) postmarked no later than the 28th day of the month following the completed reporting period. The first report is due on April 28, 1974. Duplicate signed copies of these, and all other reports required herein, shall be submitted to the Regional Administrator at the following address:

U. S. Environmental Protection Agency
ATTN: Federal Activities Section
1735 Baltimore, Room 249
Kansas City, Missouri 64108

3. Definitions

- a. The "daily average" discharge means the total discharge by weight or concentration during a calendar month divided by the number of days in the month that the production or commercial facility was operating. Where less than daily sampling is required by this permit, the daily average discharge shall be determined by the summation of the measured daily discharges by weight or concentration divided by the number of days during the calendar month when the measurements were made.
- b. The "daily maximum" concentration means the maximum value not to be exceeded for any permit parameter during any calendar day. The value shall be obtained by the specified monitoring method.
- c. Cooling Water:

Unpolluted: Water used for cooling purposes which has no direct contact with any raw material, intermediate, or final product and which does not contain a level of contaminants detectably higher than that of intake water.

Polluted: Water used for cooling purposes which may become contaminated whether through the use of water treatment chemicals used for corrosion inhibitors or biocides, or by direct contact with process materials and/or wastewater.

Permit No. MO-0004863

C. SCHEDULE OF COMPLIANCE

1. The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:
 - a. Completion of Final Plans by the effective date of the permit.
 - b. Commencement of Construction by March 31, 1974.
 - c. Report of Construction Progress by June 30, 1974.
 - d. Completion of Construction by October 31, 1974.
 - e. Attainment of Operation Level by October 31, 1974.
2. No later than fourteen (14) calendar days following a date identified in the above schedule of compliance, the permittee shall submit either a report of progress or, in the case of specific actions being required by identified dates, a written notice of compliance or noncompliance. In the latter case, the notice shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

PART II

A. MANAGEMENT REQUIREMENTS

1. Change in Discharge

All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit at a level in excess of that authorized shall constitute a violation of the permit. Any anticipated facility expansions, production increases, or process modifications which will result in new, different, or increased discharges of pollutants must be reported by submission of a new NPDES application or, if such changes will not violate the effluent limitations specified in this permit, by notice to the Regional Administrator of such changes. Following such notice, the permit may be modified to specify and limit any pollutants not previously limited.

2. Noncompliance Notification

If, for any reason, the permittee does not comply with or will be unable to comply with any effluent limitation specified in

this permit, the permittee shall provide the Regional Administrator with the following information, in writing, within five (5) days of becoming aware of such condition:

- a. A description of the discharge and cause of noncompliance; and
- b. The period of noncompliance, including exact dates and times; or, if not corrected, the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate and prevent recurrence of the noncomplying discharge.

3. Facilities Operation

The permittee shall at all times maintain in good working order and operate as efficiently as possible all treatment or control facilities or systems installed or used by the permittee to achieve compliance with the terms and conditions of this permit.

4. Adverse Impact

The permittee shall take all reasonable steps to minimize any adverse impact to navigable waters resulting from noncompliance with any effluent limitations specified in this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

5. Bypassing

Any diversion from or bypass of facilities necessary to maintain compliance with the terms and conditions of this permit is prohibited, except (i) where unavoidable to prevent loss of life or severe property damage, or (ii) where excessive storm drainage or runoff would damage any facilities necessary for compliance with the effluent limitations and prohibitions of this permit. The permittee shall promptly notify the Regional Administrator in writing of each such diversion or bypass.

6. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed from or resulting from treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering navigable waters.

7. Power Failures

In order to maintain compliance with the effluent limitations and

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prohibition of this permit, the permittee shall either:

- a. In accordance with the Schedule of Compliance contained in Part I, provide an alternative power source sufficient to operate the wastewater control facilities;

or/ if no date for implementation appears in Part I,

- b. Halt, reduce or otherwise control production and/or all discharges upon the reduction, loss, or failure of one or more of the primary sources of power to the wastewater control facilities.

B. RESPONSIBILITIES

1. Right of Entry

The permittee shall allow the Regional Administrator, or his authorized representative, upon the presentation of credentials and subject to applicable security laws and regulations:

- a. To enter upon the permittee's premises where an effluent source is located or in which any records are required to be kept under the terms and conditions of this permit; and,
- b. At reasonable times to have access to and copy any records required to be kept under the terms and conditions of this permit; to inspect any monitoring equipment or monitoring method required in this permit; and to sample any discharge of pollutants.

2. Transfer of Ownership or Control

In the event of any change in control or ownership of facilities from which the authorized discharges emanate, the permittee shall notify the succeeding owner or controller of the existence of this permit by letter, a copy of which shall be forwarded to the Regional Administrator.

3. Availability of Reports

Except for data determined to be confidential under Section 308 of the Act, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the office of the Regional Administrator. As required by the Act, effluent data shall not be considered confidential. Knowingly making any false statement on any such report may result in the

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imposition of criminal penalties as provided for in Section 309 of the Act.

4. Permit Modification

After notice and opportunity for a hearing, this permit may be modified, suspended, or revoked in whole or in part during its term for cause including, but not limited to, the following:

- a. Violation of any terms or conditions of this permit;
- b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or
- c. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

5. Toxic Pollutants

Notwithstanding Part II, B-4 above, if a toxic effluent standard for prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit shall be revised or modified in accordance with the toxic effluent standard or prohibition and the permittee so notified.

6. Civil and Criminal Liability

Except as provided in permit conditions on "Bypassing (Part II, A-5) and "Power Failures" (Part II, A-7), nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance, whether or not such noncompliance is due to factors beyond his control, such as accidents, equipment breakdowns, or labor disputes.

7. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act.

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Permit No. MO-0004863

8. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal State or local laws or regulations.

9. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

PART III

OTHER REQUIREMENTS

1. A flow measurement for discharges from all outfalls shall be made on a continuous basis after April 30, 1974. During the period from the effective date of this permit to April 30, 1974, the flow measurement requirement for all outfalls will be on a quarterly, 7-day average basis.
2. The frequency of analysis and the parameters to be analyzed may be reduced as determined by the Regional Administrator if the analysis continually shows that the effluent limitations are being met.

Attachment I

Page 1 of 8

OUTFALL 001

<u>Parameter</u>	<u>Daily Maximum Concentration (mg/L)</u>
Alkalinity	250
B.O.D.	20
Chemical Oxygen Demand	100
Total Solids	1500
Dissolved Solids	1000
Suspended Solids	200
Total Volatile Solids	200
Ammonia	20
Kjeldahl Nitrogen	20
Nitrate (asN)	7
Phosphorus - Total (as P)	0.5
Total Organic Carbon	120
Nitrite (as N)	0.5
Phosphorus - Ortho	0.5
Sulfate	350
Sulfide	2
Bromide	1.5
Chloride	75
Cyanide	0.02
Aluminum - Total	0.13
Antimony - Total	1
Arsenic - Total	0.02
Barium - Total	0.15

Attachment I

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OUTFALL 001

<u>Parameter</u>	<u>Daily Maximum Concentration (mg/L)</u>
Beryllium - Total	0.04
Boron - Total	0.5
Cadmium - Total	0.02
Calcium - Total	120
Chromium - Total	0.45
Copper - Total	0.75
Iron - Total	10
Lead - Total	0.1
Magnesium - Total	25
Manganese - Total	2
Mercury - Total	0.005
Molybdenum - Total	0.15
Nickel - Total	0.25
Potassium - Total	25
Silver - Total	0.08
Sodium - Total	100
Thallium - Total	1.5
Tin - Total	0.3
Titanium - Total	0.15
Zinc - Total	1
Oil and Grease	15
Phenols	0.04
Surfactants	0.12
Chlorinated Hydrocarbons	0.02
Arochlor	1ppb

Attachment I

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OUTFALL 002

<u>Parameter</u>	<u>Daily Maximum Concentration (mg/L)</u>
B.O.D.	10
Chemical Oxygen Demand	125
Total Solids	1000
Total Dissolved Solids	750
Suspended Solids	150
Total Volatile Solids	230
Ammonia	2.5
Nitrate	5.0
Total Organic Carbon	250
Nitrite (as N)	0.75
Phosphorus - Ortho	0.5
Sulfate	300
Sulfide	2
Bromide	1.2
Chloride	75
Cyanide	0.02
Aluminum - Total	0.15
Antimony - Total	1
Barium - Total	0.15
Beryllium - Total	.04
Boron - Total	0.4
Cadmium - Total	0.01
Calcium - Total	100

Attachment I

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OUTFALL 002

<u>Parameter</u>	<u>Daily Maximum Concentration (mg/L)</u>
Copper - Total	1
Iron - Total	10
Lead - Total	0.1
Magnesium - Total	15
Manganese - Total	0.15
Mercury - Total	0.005
Molybdenum - Total	0.15
Nickel - Total	0.3
Potassium - Total	25
Silver - Total	0.75
Sodium - Total	150
Thallium - Total	1.5
Tin - Total	0.3
Titanium - Total	0.15
Zinc - Total	1
Oil and Grease	15
Chlorinated Hydrocarbons	0.01
Arochlor	10 ppb

Attachment I

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OUTFALL J03

<u>Parameter</u>	<u>Daily Maximum Concentration (mg/L)</u>
Alkalinity	300
B.O.D.	15
Total Solids	1500
Suspended Solids	250
Total Volatile Solids	300
Ammonia (as N)	1.5
Kjeldahl Nitrogen	2.5
Nitrate (as N)	5
Nitrite (as N)	0.5
Sulfide	2
Bromide	1
Cyanide	0.02
Aluminum - Total	0.15
Antimony - Total	1
Beryllium - Total	0.04
Cadmium - Total	0.025
Copper - Total	0.6
Iron - Total	10
Lead - Total	0.2
Magnesium - Total	20
Manganese - Total	0.15
Mercury - Total	0.005
Molybdenum - Total	0.15

Attachment I

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OUTFALL 003

<u>Parameter</u>	<u>Daily Maximum Concentration (mg/L)</u>
Nickel - Total	0.3
Potassium - Total	30
Silver - Total	0.4
Sodium - Total	400
Thallium - Total	1
Tin - Total	0.3
Titanium - Total	0.15
Zinc - Total	2
Oil and Grease	15
Phenols	0.04
Chlorinated Hydrocarbons	0.025
Arochlor	1 ppb

Attachment I

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OUTFALL 004

<u>Parameter</u>	<u>Daily Maximum Concentration (mg/L)</u>
Alkalinity	250
B.O.D.	2.5
Total Solids	2000
Total Dissolved Solids	2000
Suspended Solids	75
Total Volatile Solids	250
Ammonia (as N)	1.5
Kjeldahl Nitrogen	1.5
Nitrate (as N)	5
Phosphorus - Total (as P)	1.5
Nitrite (as N)	0.04
Organic Nitrogen	1.5
Phosphorus - Ortho	0.75
Sulfate	750
Sulfide	2
Bromide	20
Chloride	500
Cyanide	0.4
Fluoride	0.75
Antimony - Total	1
Barium - Total	0.15
Cadmium - Total	0.08
Calcium - Total	150
Chromium - Total	0.025

Attachment I

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OUTFALL 004

<u>Parameter</u>	<u>Daily Maximum Concentration (mg/L)</u>
Copper - Total	0.2
Iron - Total	10
Lead - Total	0.08
Magnesium - Total	20
Manganese - Total	1
Mercury - Total	0.005
Nickel - Total	0.08
Potassium - Total	25
Silver - Total	0.25
Sodium - Total	300
Thallium - Total	1
Tin - Total	0.3
Titanium - Total	0.15
Zinc - Total	0.5
Oil and Grease	30
Phenols	0.1
Chlorinated Hydrocarbons	0.05
Arochlor	1 ppb

Appendix D

PLANT SPECIES IN PHYLA PTERIDOPHYTA AND
SPERMATOPHYTA IN JOHNSON COUNTY, KANSAS*

Grape fern	Bermudagrass
Brittle bladderfern	Orchardgrass
American maidenhairfern	Stout woodreed
Sensitive fern	Crabgrass
Shortbeak arrowhead	Virginia wild rye
Common arrowhead	Lacegrass
Red cedar	Stinkgrass
Common cattail	Teal lovegrass
Daylily	Carolina lovegrass
Atlantic camas	Purple lovegrass
Wild onion	Barnyardgrass
White fawnlily	Goosegrass
Bristly greenbriar	Nodding wild rye
Tharp spiderwort	Cluster fescue
Inland rush	Meadow fescue
Torrey rush	Foxtail barley
Indian jackinthepulpit	Little barley
Drug sweetflag	Fowl mannagrass
Frank sedge	Italian ryegrass
Fox sedge	Salt meadowgrass
Low flatsedge	Common witchgrass
Slender flatsedge	Scribner panicum
False nutgrass	Fall panicum
Yellow nutgrass	Huachuca panicum
Green bulrush	Early panicum
Rusty bulrush	Switchgrass
Whip razorsedge	Timothy
Winter bentgrass	Yellow bristle grass
Redtop bentgrass	Green bristle grass
Big bluestem	Prairie wedgescale
Little bluestem	Prairie cordgrass
Sideoats grama	Johnsongrass
Prairie threeawn	Tall dropseed
Japanese brome	False redtop
Cheat	Eastern gamagrass

*Species as presented in Reference 45.

Goldstargrass
Blackberry lily
Wild yam
Putty root orchid
Early coral root orchid

Yellow lady's slipper orchid
Prairie white fringed orchid
Showy orchid
Pawpaw
Virginia anemone

Large yellow lady's slipper
Dwarf larkspur
Atlantic isopyrum
Common mayapple
Common moonseed

American lotus
Flower of an hour
Prickly sida
Cupseed
Velvetleaf

Common mallow
Narrowleaf globemallow
Red elm
Rock elm
Slippery elm (same as red elm)

American elm
Hop tree
American buckeye
American linden
Osage orange

Red mulberry
Woodnettle
Common hackberry
Hemp (Marijuana)
Pellitory

Clearweed
Violet woodsorrel
Common yellow oxalis
Grooved flax
Common flax

Norton snapweed
Slender copperleaf
Tree of heaven
Wooly croton
Oneseed croton

Prickly ash
Flowering spurge
Spreading euphorbia
Missouri spurge
Serpent euphorbia

Painted euphorbia
Upright euphorbia
Spotted euphorbia
Toothed euphorbia
Snow-on-the-mountain

Nettleleaf noseburn
Dwarf St. Johnswort
Spotted St. Johnswort
Woolpod violet
Butterfly violet

Dutchmans-breeches
Golden corydalis
Charlock
Black mustard
Nasturtium

Virginia pepperweed
Pitchers sandwort
Sleepy silene
Starry silene
Bouncingbet

Common corncockle
Peach-leaved willow
Carolina willow
Sandbar willow
Brittle willow

Dwarf prairie willow
Ward willow
Common purslane
Black willow
Tall nettle

Eastern cottonwood
Common pokeberry
Tumbleweed
Rough pigweed
Slim pigweed

Waterhemp
Lambquarters
Wormseed goosefoot
Pitseed goosefoot
Goosefoot

Slimleaf goosefoot
Mapleleaf goosefoot
Smartweed
Climbing buckwheat
Erect buckwheat

Prostrate knotweed
Marshpepper smartweed
Curltop smartweed
Pennsylvania smartweed
Bushy knotweed

Ladysthumb smartweed
Dotted smartweed
Pale dock
Curled dock
Red sorrel

Prairie four-o'clock
Fringed loosestrife
Bottlebrush plantain
Buckhorn plantain
Paleseed plantain

Blackseed plantain
Field bindweed
Hedge bindweed
Prairie phlox
Persimmon

Cluster dodder
Ivyleaf morningglory
Bigroot morningglory
Common morningglory
Jimsonweed

Rough marblesseed
Stickseed
Clammy groundcherry
Taperleaf groundcherry
Prairie groundcherry

Horsenettle
Buffalobur nightshade
White ash
Green ash
Blue ash

Prairie dogbane
Prairie milkweed
Green milkweed
Swamp milkweed
Kansas milkweed

Butterfly milkweed
Purple milkweed
Sullivant milkweed
Whorled milkweed
Slender gerardia

Sharpwing monkeyflower
Alleghany monkeyflower
Oakleech
Pedicularis
Smooth penstemon

Tube penstemon
Earleaf gerardia
Flannel muellin
Culversphysic
Trumpet creeper

Catalpa
Maryland figwort
Blue verbena
White verbena
Bigbract verbena

Narrowleaf verbena
Rose verbena
Wooly verbena
Fringeleaf ruellia
Catnip gianthyssop

American bugleweed
Field mint
Wildbergamot bee balm
Ground ivy
Catnip

Common motherwort
Bee balm
Slender mountainmint
Woods mountainmint
Pitcher sage

Lanceleaf sage
Sideflowering skullcap
American germander
Common selfheal
Many flower agrimony

Downy agrimony
Wild strawberry
White avens
Norwegian cinquefoil
Oldfield cinquefoil

Climbing Prairie rose
Redleaf rose
Arkansas rose
Highbush blackberry
Dewberry

Black raspberry
Prairie crabapple
Inch plum
Black cherry
Wild plum

Downy hawthorn
Illinois bundleflower
Kentucky coffeetree
Wild Senna
Eastern redbud

Honey locust
Leadplant
Indigobush amorphia
Partridge pea
Southern hogpeanut

Groundplum milkvetch
Canada milkvetch
Atlantic wildindigo
Plains wildindigo
Blue wildindigo

Panicled tickclover
Largeflower tickclover
Canada tickclover
Hoary tickclover
Illinois tickclover

Roundhead lespedeza
Violet lespedeza
Alfalfa
Purple prairieclover
White prairieclover

White sweetclover
Yellow sweetclover
Manyflower scurfpea
Silverleaf scurfpea
Smoothseed wildbean

Trailing wildbean
Pencil flower
Black locust
Penthorum
Purple ammannia

Red clover
White clover
Missouri gooseberry
Sycamore
Winged lythrum

Broadleaf circaea
Biennial gaura
Marsh seedbox
Bristly--common eveningprimrose
White eveningprimrose

Stenosiphon
Bigroot pricklypear
Jerseytea ceanothus
Inland ceanothus
False grape

Winter grape
Frost grape
Riverbank grape
Wild grape
Thicket creeper

Virginia creeper
Wahoo
Lanceleaf buckthorn
American bittersweet
Ohio buckeye

Smooth sumac
Aromatic sumac
Frameleaf sumac
Poison ivy
Raccoon grape

Pignut hickory
Bitternut hickory
Shagbark hickory
Kingnut hickory
Black hickory

Mockernut hickory
Boxelder maple
Silver maple
Sugar maple
Black maple

Ironwood
Red oak
Post oak
Shingle oak
Chinquapin oak

Black oak
Bur oak
Swamp white oak
White oak
Hazelnut

Black walnut
Butternut
Spreading chervil
Waterhemlock
Honeywort

Wild carrot
Botton snakeroot eryngo
Carrotleaf lomatium
Polytaenia
Roughleaf dogwood

Pale dogwood
Rough buttonweed
Canada sanicle
Water parsnip
Earthweed bedstraw

Shining bedstraw
Common buttonbush
Buckbrush
Blackhaw viburnum
American bellflower

American elderberry
Tiny bluets
Common horse gentian
Bigblue lobelia
Slimpod venuslookingglass

Clasping venuslookingglass
Coreopsis beggarticks
Devils beggarticks
Wingstem
Finger coreopsis

Pale echinacea
Common sunflower
Blacksomson echinacea
Sawtooth sunflower
Hairy sunflower

Willowleaf sunflower
Stiff sunflower
Rough heliopsis
Sweet coneflower
Black-eyed susan

Cutleaf coneflower
Compass plant
Cup resinweed
Grayhead prairieconeflower
Upright prairieconeflower

Brown-eyed susan
Common ragweed
Western ragweed
Giant ragweed
Prairie dogweed

Cocklebur
Common sneezeweed
Field pussytoes
Heath aster
Aromatic aster

Broomweed
Annual fleabane
Fleabane
Canada fleabane
Daisy fleabane

Bushy goldenrod
Stiff goldenrod
November goldenrod
Canada goldenrod
Missouri goldenrod

Elmleaf goldenrod
Ironweed
Inland ironweed
Falseboneset
Dotted gayfeather

Narrowleaf gayfeather
Thickspike gayfeather
Tall gayfeather
Scaly gayfeather
Tall eupatorium

Spotted jeoppyeweed
Late eupatorium
Boneset
Mayweed
Common sagewort

Common yarrow
Pale indianplantain
Bull thistle
Tall thistle
Smaller burdock

Longbeard hawkweed
Prickly lettuce
Florida lettuce
Canada lettuce
Prickly sowthistle

Smooth dandelion
Vegetable-oyster salsify

Appendix E

FISH, REPTILES, AMPHIBIANS, MAMMALS, AND BIRDS
FOUND NEAR THE KANSAS CITY PLANT*

FISH COLLECTED IN THE BLUE RIVER AND TRIBUTARIES

Stoneroller	Yellow bullhead
Golden shiner	Slender madtom
Red shiner	Green sunfish
Sand shiner	Orangespotted sunfish
Redfin shiner	Bluegill
Suckermouth minnow	Hybrid sunfish
Bluntnose minnow	Largemouth bass
Fathead minnow	White crappie
Creek chub	Johnny darter
White sucker	Orangethroat darter
Black bullhead	Logperch

FISH LIKELY PRESENT (BUT NOT COLLECTED) IN THE BLUE RIVER

Carp	Stonecat
River carpsucker	Flathead catfish
Smallmouth buffalo	Freshwater drum
Channel catfish	

OTHER SPECIES OF FISH THAT MAY BE PRESENT IN THE BLUE RIVER

Longnose gar	Bigmouth buffalo
Shortnose gar	Black buffalo
Gizzard shad	Shorthead red horse
Goldeye	White bass
Emerald shiner	Black crappie

AMPHIBIANS AND REPTILES POTENTIALLY INHABITING THE AREA NEAR THE
KANSAS CITY PLANT

Spotted salamander	Great plains toad
Small-mouthed salamander	American toad
Eastern tiger salamander	Rocky Mountain toad
Mudpuppy	Fowler's toad
Plains spadefoot toad	Blanchard's cricket frog

* Rare and endangered species are designated by an MO or KS following the name. Missouri (MO) rare and endangered species are from a list published by the Missouri Conservation Commission in September 1972. Kansas (KS) rare and endangered species are from a list published by the Cooperative Extension Service of Kansas State University in March 1974.

Western chorus frog	Western slender grass lizard
Northern spring peeper	Western worm snake
Eastern gray tree frog	Prairie ring-neck snake
Northern crayfish frog, MO	Eastern hog-nosed snake
Bullfrog	Western hog-nosed snake, MO
Green frog, KS	Rough green snake
Pickerel frog, KS	Western smooth green snake, MO, KS
Leopard frog	Eastern yellow-bellied racer
Western narrow-mouthed toad	Great plains rat snake
Stinkpot turtle	Black rat snake
Mississippi mud turtle	Bullsnake
Common snapping turtle	Prairie king snake
Three-toed box turtle	Speckled king snake
Ornate box turtle	Red milk snake
Map turtle	Northern flat-headed snake
Mississippi map turtle	Blotched water snake
Ouachita map turtle	Graham's water snake
Western painted turtle	Northern red-bellied snake
Red-eared turtle	Diamond-backed water snake
Smooth soft-shelled turtle	Northern water snake
Western spiny soft-shelled turtle	Western earth snake
Eastern collared lizard	Western plains garter snake
Northern fence lizard	Red-sided garter snake
Ground skink	Western ribbon snake
Northern prairie skink	Northern lined snake
Great plains skink	Northern copperhead*
Five-lined skink	Timber rattlesnake*
Six-lined racerunner	Western massauga*, MO

MAMMALS POTENTIALLY INHABITING THE AREA NEAR THE KANSAS CITY PLANT

Opposum	Hairy bat
Short-tailed shrew	Red bat
Little short-tailed shrew	Brazilian free-tailed bat, KS
Eastern mole	Eastern cottontail
Indiana bat	Black-tailed jackrabbit, MO
Small-footed myotis, KS	Eastern gray squirrel
Gray bat	Eastern fox squirrel
Keen's bat	Woodchuck, KS
Big myotis	13-lined ground squirrel
Eastern pipistrelle	Franklin's ground squirrel, MO, KS
Big brown bat	Chipmunk
Evening bat	Southern flying squirrel, KS
Silvery-haired bat	Plains pocket gopher

*Poisonous

Beaver
 Plains harvest mouse, MO
 Western harvest mouse
 Deer mouse
 Wood's mouse
 Hispid cotton rat
 Eastern wood rat
 Muskrat
 Lemming mouse, KS
 Pine vole
 Prairie vole
 House mouse
 Norway rat

Meadow jumping mouse
 Coyote
 Gray fox
 Red fox
 Raccoon
 Long-tailed weasel, MO
 Mink
 Badger
 Striped skunk
 Spotted skunk, MO, KS
 River otter, MO, KS
 Bobcat, KS
 White-tailed deer

RESIDENT BIRDS FOUND NEAR THE KANSAS CITY PLANT

Great blue heron
 Canada goose
 Mallard
 Hooded merganser
 Turkey vulture
 Sharp-shinned hawk
 Cooper's hawk
 Red-tailed hawk
 Red-shouldered hawk, MO, KS
 Bald eagle, MO, KS
 Marsh hawk
 Sparrow hawk
 Great prairie chicken, MO
 Bobwhite
 Ringed-necked pheasant
 Rock dove
 Mourning dove
 Screech owl
 Great-horned owl
 Burrowing owl, MO, KS
 Long-eared owl, MO
 Short-eared owl
 Saw-whet owl, MO
 Barred owl
 Belted kingfisher
 Yellow-shafted flicker
 Pileated woodpecker
 Red-bellied woodpecker
 Red-headed woodpecker
 Yellow-bellied sapsucker

Hairy woodpecker
 Downy woodpecker
 Horned lark
 Blue jay
 Common crow
 Black-capped chickadee
 Tufted titmouse
 White-breasted nuthatch
 Berwick's wren
 Carolina wren
 Long-billed marsh wren, MO
 Short-billed marsh wren, MO
 Mockingbird
 Robin
 Eastern bluebird
 Cedar waxwing
 Loggerhead shrike
 Starling
 House sparrow
 Eastern meadowlark
 Red-winged blackbird
 Brewer's blackbird
 Common grackle
 Cardinal
 Pine siskin
 American goldfinch
 Rufous-sided towhee
 Field sparrow
 Song sparrow

BREEDING BIRDS FOUND NEAR THE KANSAS CITY PLANT

Pied-billed grebe	Cliff swallow, MO
Great heron	Purple martin
Common egret	House wren
Black-crowned night heron	Catbird
Yellow-crowned night heron	Brown thrasher
Least bittern	Wood thrush
American bittern, KS	Blue-gray gnatcatcher
White-faced ibis	White-eyed vireo
Trumpeter swan	Bell's vireo
Blue-winged teal	Yellow-throated vireo
Wood duck	Solitary vireo
Broad-winged hawk	Red-eyed vireo
Swainson's hawk	Warbling vireo
King rail, MO, KS	Black-and-white warbler
Virginia rail, MO, KS	Prothonotary warbler
Sora	Worm-eating warbler, KS
Common gallinule, MO, KS	Parula warbler
American coot	Yellow warbler, KS
Killdeer	Blue-winged warbler, KS
American woodcock	Yellow-throated warbler, KS
Upland plover	Cerulean warbler, KS
Spotted sandpiper	Prairie warbler, KS
Least tern, MO, KS	Ovenbird
Forster's tern, KS	Louisiana water thrush
Caspian tern	Kentucky warbler
Black tern, KS	Yellowthroat
Yellow-billed cuckoo	Yellow-breasted chat
Black-billed cuckoo, MO	American redstart
Barn owl, MO	Western meadowlark
Chuck-will's widow	Baltimore oriole
Whip-poor-will, KS	Brown-headed cowbird
Night hawk	Scarlet tanager
Chimney swift	Summer tanager
Ruby-throated hummingbird	Rose-breasted grosbeak
Eastern kingbird	Blue grosbeak
Western kingbird, MO	Indigo bunting
Great-crested flycatcher	Dickcissel
Eastern phoebe	Lark bunting
Acadian flycatcher	Savannah sparrow
Least flycatcher	Grasshopper sparrow
Eastern wood pewee	Henslow's sparrow, MO, KS
Tree swallow, KS	Vesper sparrow
Bank swallow	Lark sparrow
Rough-winged swallow	Chipping sparrow
Barn swallow	

WINTERING BIRDS FOUND NEAR THE KANSAS CITY PLANT

White-fronted goose
 Snow goose
 Black duck
 Pintail
 Green-winged teal
 Common goldeneye
 Bufflehead
 Common merganser
 Goshawk
 Harlan's hawk
 Rough-legged hawk
 Golden eagle, MO
 Peregrine falcon, MO, KS
 Common snipe
 Red-breasted nuthatch
 Brown creeper
 Winter wren
 Golden-crowned kinglet
 Ruby-crowned kinglet
 Bohemian waxwing
 Northern shrike
 Myrtle warbler
 Evening grosbeak
 Purple finch
 Slate-colored junco
 Tree sparrow
 Harris' sparrow
 White-crowned sparrow
 White-throated sparrow
 Fox sparrow
 Lincoln's sparrow

Swamp sparrow
 Smith's longspur
 Lapland longspur
 Louisiana heron
 Wood ibis
 White ibis
 Roseate spoonbill
 Brant
 Mottled duck, KS
 European widgeon
 American widgeon
 Shoveler
 Barrow's goldeneye
 Harlequin duck
 King eider
 White-winged scoter
 Surf scoter
 Common scoter
 Oldsquaw
 Purple gallinule
 Black-billed magpie
 Pinon jay
 Clark's nutcracker
 Carolina chickadee
 Hooded warbler, MO, KS
 Common redpoll
 Red crossbill
 White-winged crossbill
 Oregon junco
 Snow bunting

MIGRANT-TRANSIENT BIRDS FOUND NEAR THE KANSAS CITY PLANT

Common loon
 Red-throated loon
 Red-necked grebe
 Horned grebe
 White pelican
 Blue goose
 Gadwall
 Redhead
 Ring-necked duck
 Canvasback
 Greater scaup
 Lesser scaup
 Ruddy duck

Red-breasted merganser
 Pigeon hawk, MO
 Sandhill crane, MO
 Yellow rail
 Black rail, KS
 Semipalmated plover
 Piping plover
 Solitary sandpiper
 Greater yellowlegs
 White-rumped sandpiper
 Baird's sandpiper
 Lease sandpiper
 Short-billed dowitcher

Long-billed dowitcher
 Semipalmated sandpiper
 Buff-breasted sandpiper
 Hudsonian godwit
 American golden plover
 Black-bellied plover
 Western sandpiper
 Lesser yellowlegs
 Stilt sandpiper
 Ruddy turnstone
 Pectoral sandpiper
 Dunlin
 Sanderling
 Wilson's phalarope, KS
 American avocet
 Blacknecked stilt
 Pomarine jaeger
 Parasitic jaeger
 Ring-billed gull
 Franklin's gull
 Bonaparte's gull
 Herring gull
 Common tern
 Olive-sided flycatcher
 Yellow-bellied flycatcher
 Traill's flycatcher
 Hermit thrush
 Swainson's thrush
 Gray checked thrush

Veery
 Water pipit
 Sprague's pipit
 Philadelphia vireo
 Orange-crowned warbler
 Tennessee warbler
 Golden-winged warbler
 Black-throated green warbler
 Magnolia warbler
 Nashville warbler
 Blackburnian warbler
 Chestnut-sided warbler
 Bay-breasted warbler
 Blackpoll warbler
 Pine warbler
 Palm warbler
 Northern water thrush
 Connecticut warbler
 Mourning warbler
 Wilson's warbler
 Canada warbler
 Bobolink, MO, KS
 Rusty blackbird
 Sharp-tailed sparrow
 Le Conte's sparrow
 Clay-colored sparrow
 McCown's longspur
 Chestnut-collared longspur

OCCASIONAL BIRDS FOUND NEAR THE KANSAS CITY PLANT

Eared grebe
 Western grebe

White pelican
 Little blue heron, KS

Appendix F

1970 POPULATION AND RANK OF ALL INCORPORATED PLACES
IN THE KANSAS CITY METROPOLITAN AREA

<u>Rank</u>	<u>City</u>	<u>County</u>	<u>Population</u>
1	Kansas City MO	Jackson, Clay and Platte	507,330
2	Kansas City KS	Wyandotte	168,213
3	Independence MO	Jackson and Clay	111,630
4	Overland Park KS	Johnson	79,034
5	Raytown MO	Jackson	33,306
6	Prairie Village KS	Johnson	28,138
7	Leavenworth KS	Leavenworth	25,147
8	Gladstone MO	Clay	23,422
9	Shawnee KS	Johnson	20,482
10	Olathe KS	Johnson	17,917
11	Grandview MO	Jackson	17,457
12	Lee's Summit MO	Jackson	16,230
13	Liberty MO	Clay	13,704
14	Belton MO	Cass	12,179
15	Merriam KS	Johnson	10,851
16	Leawood KS	Johnson	10,349
17	Roeland Park KS	Johnson	9,974
18	Excelsior Springs MO	Clay and Ray	9,411
19	Mission KS	Johnson	8,376
20	Blue Springs MO	Jackson	6,779
21	Lenexa KS	Johnson	5,242
22	North Kansas City MO	Clay	5,183
23	Fairway KS	Johnson	5,133
24	Richmond MO	Ray	4,948
25	Harrisonville MO	Cass	4,928
26	Sugar Creek MO	Jackson and Clay	4,755
27	Mission Hills KS	Johnson	4,177
28	Lansing KS	Leavenworth	3,797
29	Bonner Springs KS	Wyandotte	3,662
30	Pleasant Hill MO	Cass	3,396
31	Westwood KS	Johnson	2,329
32	Riverside MO	Platte	2,123
33	Oak Grove MO	Jackson	2,025
34	Platte City MO	Platte	2,022
35	Claycomo MO	Clay	1,841

36	DeSoto KS	Johnson	1,839
37	Gardner KS	Johnson	1,839
38	Lake Lotawana MO	Jackson	1,786
39	Smithville MO	Clay	1,785
40	Tonganoxie KS	Leavenworth	1,717
41	Buckner MO	Jackson	1,695
42	Pleasant Valley MO	Clay	1,535
43	Blue Summit MO	Jackson	1,283
44	Weston MO	Platte	1,267
45	Parkville MO	Platte	1,253
46	Spring Hill KS	Johnson	1,186
47	Lake Waukomis MO	Platte	1,105
48	Lawson MO	Ray and Clay	1,034
49	Kearney MO	Clay	984
50	Greenwood MO	Jackson	925
51	Orrick MO	Ray	883
52	Lake Tapawingo MO	Jackson	867
53	Weatherby Lake MO	Platte	832
54	Basehor KS	Leavenworth	724
55	Drexel MO	Cass and Bates	723
56	Grain Valley MO	Jackson	709
57	Peculiar MO	Cass	705
58	Hardin MO	Ray	683
59	Garden City MO	Cass	633
60	Edwardsville KS	Wyandotte	619
61	Raymore MO	Cass	587
62	Northmoor MO	Platte	562
63	Dearborn MO	Platte	543
64	Oakview MO	Clay	541
65	Archie MO	Cass	525
66	Edgerton KS	Johnson	513
67	Avondale MO	Clay	512
68	Glenaire MO	Clay	505
69	Platte Woods MO	Platte	484
70	Edgerton MO	Platte	477
71	Henrietta MO	Ray	466
72	Easton KS	Leavenworth	435
73	Lake Winnebago MO	Cass	432
74	Freeman MO	Cass	417
75	Westwood Hills KS	Johnson	414

76	Countryside KS	Johnson	403
77	Tarsney Lakes MO	Jackson	401
78	Missouri City MO	Clay	375
79	Wood Heights MO	Ray	362
80	Houston Lake MO	Platte	338
81	Mosby MO	Clay	337
82	Linwood KS	Leavenworth	323
83	Holt MO	Clay and Clinton	319
84	Oakwood Park MO	Clay	295
85	Creighton MO	Cass	294
86	Camden MO	Ray	286
87	Levasy MO	Jackson	283
88	Sibley MO	Jackson	279
89	Birmingham MO	Clay	266
90	Cleveland MO	Cass	256
91	East Lynne MO	Cass	255
92	Tracy MO	Platte	252
93	Mission Woods KS	Johnson	242
94	Unity Village MO	Jackson	242
95	Camden Point MO	Platte	227
96	Rayville MO	Ray	202
97	Lone Jack MO	Jackson	199
98	Strasburg MO	Cass	181
99	Farley MO	Platte	174
100	Oakwood Manor MO	Clay	170
101	Oakwood MO	Clay	163
102	Oaks MO	Clay	162
103	Prathersville MO	Clay	153
104	Fleming MO	Ray	152
105	Ferrelview MO	Platte	140
106	Elmira MO	Ray	124
107	Westline MO	Cass	114
108	Randolph MO	Clay	106
109	Vibbard MO	Ray	89
110	Gunn City MO	Cass	71

Appendix G

REFERENCES

- 1 "Air Pollution Control Code," Chapter 18, Article III, of the Code of General Ordinances of Kansas City, Missouri.
- 2 Air Quality--KCMR: A Summary of Problems and Programs. Kansas City: Mid-America Regional Council, June 1973.
- 3 Air Quality Standards and Air Pollution Control Regulations for the Kansas City Metropolitan Area. Kansas City: Missouri Air Conservation Commission, Revised August 23, 1972.
- 4 Brown, A. Theodore. Frontier Community: Kansas City to 1870. Columbia: University of Missouri Press, 1963.
- 5 Constant, Paul C. Beryllium Source Testing at Bendix Kansas City. Kansas City: Midwest Research Institute (MRI Project 3447-E[P]), June 25, 1973.
- 6 Correspondence of February 22, 1973 from Chemtrol Pollution Services, Incorporated, Model City, New York, to the Bendix Corporation, Kansas City.
- 7 Correspondence from the City of Kansas City, Missouri, constituting Permit No. 74 issued pursuant to city ordinance authorizing discharge of waste to city sewers, June 1968. Letter was addressed to E. G. Lamar, Kansas City Area Office, USAEC, and was signed by Barrett E. Benson, Kansas City Division of Industrial Wastes.
- 8 Correspondence has been received from the Gas Service Company on numerous occasions regarding the availability of natural gas supplies. Meetings were held with Gas Service Company representatives on November 3, 1970 and January 7, 1974.
- 9 Correspondence of December 17, 1974 from Nuclear Engineering Company, Incorporated, Walnut Creek, California (writing for its subsidiary Texas Ecologists of Houston) to the Bendix Corporation, Kansas City.
- 10 Correspondence from J. S. Zimmerman of Underwriter's Laboratories (Chicago) to Richard Davis of the Monsanto Chemical Company, November 6, 1963, which says, in part, "Examination and tests have been completed on samples of your 'Therminol FR-1', 'Therminol FR-2', and 'Therminol FR-3' listed under our Reexamination Service. The samples were selected for follow-up services by our inspector on May 21, 1963 at Anniston, Ala. Results of tests conducted here comply with the provisions of the Reexamination Service procedure applying to the product."

- 11 Cowherd, Chatten Jr. Assessment of Ambient Air Quality in the Vicinity of the AEC/Bendix Facility. Kansas City: Midwest Research Institute (MRI Project 3447-C[M]), January 31, 1974.
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