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MANHATTAN DISTRICT HISTORY

BOOK I - GENERAL

VOLUME 12 - CLINTON ENGINEER WORKS

CENTRAL [redacted] UTILITIES

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MANHATTAN DISTRICT HISTORY

BOOK I - GENERAL

VOLUME 12 - CLINTON ENGINEER WORKS, CENTRAL FACILITIES

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FOREWORD

This volume of the Manhattan District History has been prepared to describe the purpose, design, construction, development, cost, and functions of the Central Facilities of the Clinton Engineer Works, Oak Ridge, Tennessee.

Although the Central Facilities are described at length and in detail in this volume, they may be identified briefly as embracing the non-industrial features of the Clinton Engineer Works, existing only to provide the facilities and services more or less common to American urban life. As the Central Facilities exist separately and apart from the industrial plants, they cannot be described logically in connection with the manufacturing plants. The Central Facilities are highly important auxiliaries to the manufacturing plants, for without the services and facilities supplied, the resident population necessary for manning the plants could not be maintained.

The text of the history of the Central Facilities is divided into three major parts: A - General Introduction, B - Town of Oak Ridge, and C - Area Facilities. With reference to this arrangement, the community of Oak Ridge may, in general, be considered to consist of all the Central Facilities, although many facilities, i.e., the electrical, water, sewerage, communications, roads and streets, transportation, and security systems, extend beyond what are considered to be the town limits, but exist to serve the residents of the town.

This history of the Central Facilities has been carried through 31 December 1946, the day before the properties and activities of the Manhattan District were transferred to the Atomic Energy Commission.

Although the Clinton Engineer Works Area and the town of Oak Ridge both are roughly rectangular in shape and lie on a northeast - southwest axis, most maps in use on the Area have been adjusted to a military grid; thus, for example, the word "north", as generally used in this volume, indicates a true northwest direction and the word "west" a true southwest direction.

28 March 1947

MANHATTAN DISTRICT HISTORY

BOOK I - GENERAL

VOLUME 12 - CLINTON ENGINEER WORKS, CENTRAL FACILITIES

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MANHATTAN DISTRICT HISTORY

BOOK I - GENERAL

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SUMMARY

PART A - GENERAL INTRODUCTION

1. Description. - The Clinton Engineer Works, lying approximately equally in Anderson and Roane Counties, Tennessee, consists of industrial plants, utilities, and the town of Oak Ridge. The town was designed to provide community services and facilities necessary to the operation of the industrial plants. The entire installation is owned by the United States and is confined in a 93 square miles Government-owned reservation of rectangular shape. Oak Ridge and its chief components, i.e., housing, stores and shops, schools, medical services, roads and streets, internal security and public safety, and water, sewerage, electrical, communications, recreational, and transportation systems, are known as the Central Facilities, managed directly or through contractors by the Facilities and Service Division.

Population of CEW, concentrated chiefly in Oak Ridge, reached a peak of about 75,000 in the summer of 1945. The employment peak of 82,000 was reached in May 1945. Thereafter, population and employment declined steadily, and at the end of 1946 population was 42,465 and employment was 28,737. The CEW and the Central Facilities date from the fall of 1942, and in the subsequent process of development of CEW, Oak Ridge became Tennessee's fifth city, by population, CEW the second largest consumer of Tennessee Valley Authority electricity, and the area motor transportation system the largest in the southeastern United States. Oak Ridge

developed in three broad phases, each based on a resident population which was progressively estimated to reach eventual peaks of 13,000, 42,000, and 66,000. Before the engagement of a town operating company in the fall of 1943, the town and its utilities were operated either directly by Government personnel or by Stone & Webster Engineering Corporation. Beginning in 1945, operation of the town facilities were gradually given over to specialized operators. The nature of CEW, a closed military area, inhabited mainly by a civilian population, has posed problems peculiar to the installation. Among these has been the necessity of providing certain community and municipal and other governmental services in an area in which it has not been possible to establish the normal machinery of local government. Thus these services have been provided by the Government, acting through various administrative organizations of the Manhattan District, most recently the Facilities and Service Division, which has supervised the town operating company and other contractors. The Chief of the Facilities and Service Division is, therefore, a Town Manager. Town administration and operation have required the construction of numerous buildings for administrative and service uses; these buildings, plus certain miscellaneous features in the area, were constructed at a cost of $5,119,890.26.

2. Site Selection and Preparation. - The nature of the Manhattan District Project imposed certain basic requirements in site selection, particularly as it was first desired to place all of the major production plants in the same general area. Requirements which eliminated many locations included: geographical and strategical considerations, as it was desired that the area be between the Allegheny and Rocky Mountains; an originally estimated land area of not less than 200 square miles; an esti-

mated 100,000 to 150,000 kw of electric power; a supply of 370,000 gallons of water per minute for industrial uses alone; transportation to handle the great quantities of materials and supplies which would be required; topography which would facilitate security control and the reduction of radiation hazards and permit minimum excavation; space for a town; a local labor supply; and reasonable land values, as acquisition in fee would be necessary in the interest of security. Sites considered included several in the Tennessee Valley, two near Chicago, one near Shasta Dam in California, and several in the State of Washington where one major plant eventually was built. The site selected for OEW, the major Manhattan District installation, is an area that eventually covered nearly 60,000 acres. The region was abundantly supplied with electric power from the TVA system and with water from the Clinch River and possessed desirable features with regard to topography, drainage, soil constitution, climate, and rail transportation. There was a local labor supply, and the land could be acquired at a reasonable cost. After approval of the site by Major General L. R. Groves, acquisition was effected by the Real Estate Branch of the Ohio River Division of the Corps of Engineers. Preparation of the site for construction of the Central Facilities was performed at a cost of $1,659,179,59; later permanent site improvement, mostly erosion control, was performed at a cost of $413,618.83.

3. Basic Considerations. - The design, construction, and operation of the Central Facilities were authorized by the President after he had approved, on 17 June 1942, the report of Drs. Conant and Bush recommending creation of what was to become the Manhattan Project. Shortly thereafter, General Groves was appointed officer in charge of the Manhattan Project.

Initial planning for the Central Facilities was performed by Stone & Webster in Boston, but in February 1943, Stone & Webster was relieved of planning, except for the utility systems, and the firm of Skidmore, Owings & Merrill, Architect-Engineer, was engaged to perform planning and design work for the town; Skidmore, Owings & Merrill was subsequently reengaged for planning and design in connection with the first and second expansions of the town, in the fall of 1943 and the spring of 1945, respectively. Supervision of Stone & Webster and Skidmore, Owings & Merrill planning and design work and liaison between the contractors and between planning and construction units were performed by various units of the Manhattan District, they being, successively, the Town Management Division until April 1943; the Central Facilities Planning Unit until the completion of the first Skidmore, Owings & Merrill contract in the summer of 1943; and, beginning in September 1943, the Central Facilities Division, which was then organized and made responsible for the design, construction, operation, and management of the Central Facilities.

Initial operation of the Central Facilities was planned by the Town Management Division, but the first facilities were actually operated, beginning in June 1943, by the Central Facilities Operating Division, which, with the Planning Unit, had succeeded the Town Management Division in April. Responsibility for operation of the town facilities was assumed by the Central Facilities Division, when, in September 1943, the Division was created and Roane-Anderson Company was engaged to operate the facilities under the supervision of the Division. The outstanding factors which colored planning, construction, and operation in the period of development included the necessity of safeguarding the security of the

project and revelation of only a minimum of detail necessary to planning and construction, an urgency of construction resulting in simple design, extensive use of prefabricated materials, attempts to develop "off-area" housing so as to minimize "on-site" construction, and the enlistment of aid from other organizations and forces, including TVA, whose experience in housing and work in development of the CEW power system were invaluable. Other forces aiding the development of Oak Ridge were: the Federal Housing Agency and the Federal Public Housing Authority, which rendered great service in solving the housing problem both within and without the reservation; the Federal Works Agency in connection with school funds; the State of Tennessee in matters of access roads and law enforcement; and nearby counties and municipalities in such matters as schools, access roads, off-area housing, transportation, labor supply, and shopping facilities.

PART B - TOWN OF OAK RIDGE

4. Planning and Design. - Plans for the development of Oak Ridge were drawn on the basis of meeting only essential requirements. Initially it was planned to provide semi-permanent housing for operating personnel, and trailers and hutments for construction personnel and for complete on-site construction. It was found, however, that operating personnel could, to an extent, be housed in temporary or portable quarters. The first planning program called for over 3,000 family quarters, several apartment buildings and dormitories, and numerous trailers, along with community facilities and services, including schools, a hospital, communications, cafeterias, shopping centers, religious and recreational establishments, and fire and police protection. The second phase, planned in 1943,

developed along similar lines but on a far greater scale. Because plant operators, late in 1944, revised their estimates of personnel needs, a third program of planning and construction was instituted. In addition, there was some relatively minor planning in connection with improvements in 1946. Aside from simple design, the factors bearing most heavily on planning were minimization of construction costs, use of non-critical materials, and non-use of labor crafts more critically needed in plant construction. Town planning, too, took into full consideration the fact that the town and its features, while essential, were to serve merely to facilitate operation of the industrial plants; it was this consideration that permitted Stone & Webster to be relieved of the town planning so that the firm could devote maximum efforts to plant design. In order to obtain the best possible town design under the existing limitations, the John B. Pierce Foundation was retained to advise and develop plans on housing. However, the Pierce Foundation was primarily a research organization, and it was for this reason that Skidmore, Owings & Merrill was retained in February 1943 to furnish architect-engineer services for the town, the Pierce Foundation remaining a consultant. The costs incurred under the three contracts with Skidmore, Owings & Merrill ~~was~~ were $2,361,060. The Pierce Foundation contract cost $5,000.

5. Construction. - Site preparation, before construction of Oak Ridge, was begun in October 1942 when Stone & Webster construction personnel arrived at CEW. Forces were increased rapidly in an effort to accomplish construction in the least possible period of time. In general, town construction continued without slackening until April 1944, when construction forces reached a peak of over 15,000 and then declined un-

til the completion of authorized construction in November 1944. The construction forces returned in smaller numbers in January 1945 in connection with the third major construction program. In the main, construction was performed by lump-sum or unit-price contractors engaged after competitive bidding, although this procedure necessarily was sometimes modified by considerations arising from the urgency for speed. To permit the meeting of any contingency, a flexible contract organization was developed whereby managerial responsibility for construction was placed with Stone & Webster, who, through 1944, under a cost-plus-a-fixed-fee contract, either performed major construction or supervised that performed by other contractors. For work in connection with the Central Facilities, Stone & Webster earned a fixed-fee of $636,278.00. Stone & Webster did not participate in later construction, which was supervised directly by the Facilities and Service Division. The labor supply problem in construction was partially solved by getting as many contractors as possible on the job, leaving each to exploit his own labor supply sources. Prime contractors, in turn, awarded numerous subcontracts. While labor recruiters ranged over wide areas, heroic efforts were made by contractors and Government personnel to procure materials and have them on the job when required. The total available cost of construction of the Central Facilities, including estimated costs of $5,216,202.90, was $107,161,290.48.

6. Operations. - The operation of the Central Facilities has been characterized by certain major considerations, among them: provision for essential yet minimum services; the necessity for attracting and holding personnel, sometimes requiring the grant of subsidies for certain non-profit operations, as in the cases of the dormitories and the bus system;

and the necessity for guarding project security. When the first dormitories, cafeterias, stores, and the laundry were completed in the summer of 1943, they were placed in operation by Government forces, but it soon became apparent that the variety of the town facilities would require the engagement of a contractor to operate the greater part of both the revenue producing and non-revenue producing activities and facilities. Negotiations resulted in the formation and the engagement, in September 1943, of Roane-Anderson Company, a subsidiary of Turner Construction Company, to operate such facilities as the Government might designate. The transfer to Roane-Anderson of operations and facilities, including the laundry, cafeterias, transportation, and the water, sewerage, electrical, and heating systems, extended over a period of several months. The operation of other facilities was assumed as they were completed. In the operation of the hospital, schools, and public safety forces, the company was given only limited responsibility. The cost-plus-a-fixed-fee contract with Roane-Anderson gave the company a fee of $25,000 per month, later reduced to $14,000, and provided that, generally, the company be reimbursed to the extent of the excess of expenditures over revenue. Through 31 December 1946, the company's gross reimbursable expenditures totaled approximately $70,500,000, less revenue of approximately $25,900,000. In 1945, a number of major activities, including bus transportation, housing, and commercial facilities generally, were transferred to specialized operators.

7. Housing. - Housing is the largest single feature of the Central Facilities, its cost - over $57,000,000 - being more than all other features combined. Housing, like other major features of the Central Facili-

ties, was planned and constructed in three major phases which eventually resulted in the construction, erection, or acquisition of 3,050 cemesto-type family units, all constructed in the first program, at a cost of $18,502,471.82; 375 multi-family type houses, containing 1,000 family units, constructed in the second program, at a cost of $4,628,483.28; 3,373 prefabricated houses, each a one-family unit, of designs borrowed from TVA or based on TVA designs, erected in the second and third housing programs, at a cost of $13,572,164.86, including a contract termination cost of $125,794.80; 52 apartment units constructed from hutment parts, costing $155,785.09; 477 demountable houses, containing 970 family units, acquired from the FPHA and erected in the second housing program, at a cost of $2,660,662.57; 375 prefabricated houses known as Victory Cottages, containing 750 family units, acquired, assembled, and erected in 1945, at a cost of $954,582.92; three large apartment buildings, together containing 113 units, constructed in the first building program, at a cost of $703,612.17; 46 large two-story, "H" shaped and 43 "S" shaped dormitories, together containing over 5,000 single rooms, over 3,000 double rooms, and 228 rooms for married couples, constructed in the first, second, and third programs, at a combined cost of $10,718,790.05; seven trailer camps with a capacity of approximately 4,000 trailers, developed at a cost of $1,303,696.14; over 2,000 hutments, in several areas developed at a cost $1,883,912.55; a large military cantonment costing $601,645.78; and 122 apartment units, converted from existing dormitory rooms in 1946, at an approximate cost (incomplete with respect to some minor items) of $271,148.20. Furniture for initial furnishing of housing units cost an estimated $1,780,456.44. Practically all Oak Ridge housing was designed

by Skidmore, Owings & Merrill, while the bulk of construction was performed by Stone & Webster forces or by other contractors supervised by them.

During the period of direct town operations by Government forces, housing assignments, administration, rentals, and services were handled by the Central Facilities Operating Division and, after September 1943, by the Central Facilities Division, except that trailer and hutment camps were operated by Stone & Webster. In December 1943, housing management, except for trailers and hutments, was transferred to Roane-Anderson, and trailers and hutments were transferred the following May. The management of family dwelling units (cemesto, multi-family, and prefabricated type housing), dormitories, apartments, trailer camps, and hutment apartments, was assumed by Roane-Anderson subcontractors in the summer of 1945, and the hutment areas and the Victory Cottages (for colored occupancy) in January 1946. The number of family-type quarters available has never been sufficient to supply the demand; consequently assignments have been based on quotas assigned major operating groups. Rent for houses has been based on fair charges for utilities, service, maintenance, and amortization; rents for trailers, hutments, and dormitory rooms have been based not only on fair charges for services, but also on the best interest of the project in retaining certain types of personnel.

8. Commercial Facilities. - In general, the commercial facilities at Oak Ridge are those establishments required to furnish the daily necessities of the residents. In comparison with the facilities of other communities, they are fewer in number and offer fewer luxury items for sale. The Oak Ridge commercial facilities are grouped in neighborhood

shopping centers and commercial areas. The commercial facilities are based on plans developed by Stone & Webster and modified by Skidmore, Owings & Merrill. The first of the three planning programs provided for a town center (Jackson Square) of six buildings housing such varied commercial facilities as drugstores, super markets, a department store, a telegraph office, and a florist shop; three neighborhood store groups, each containing a super market, a drug store, a barber shop, and a shoe repair shop; and a laundry (near Jackson Square), two cafeterias, and an automobile service station. The first expansion of the town brought about the development of Grove Center (an area similar to Jackson Square), two additional neighborhood shopping centers, three more cafeterias, another laundry, and a dry cleaning plant. In addition, small commercial areas were developed near the trailer and hutment camps. In 1945 there was further development of commercial facilities along lines previously described, in connection with the last major expansion of the town. Construction of commercial facilities through 1944 was performed by Stone & Webster forces and by other contractors supervised by them and that in 1945 and after by contractors supervised directly by Government personnel. Commercial facilities were operated by Government forces or by concessionaires under contract with the Government until after the engagement of Roane-Anderson Company. After Roane-Anderson assumed responsibility for town operation, contracts with concessionaires were cancelled, and subcontracts between the company and concessionaires were negotiated. Roane-Anderson operated some major commercial facilities, including the cafeterias, the laundries, the Guest House, and the telegraph office, directly for a long period; however, the telegraph service was

turned over to Western Union in November 1944, and subcontracts were negotiated with specialized operators for the cafeterias in the summer of 1945, for the laundries in October 1945, and the Guest House in January 1946. Banking service at Oak Ridge began with establishment, in the summer of 1943, of the Oak Ridge Facility of the Hamilton National Bank of Knoxville. In the vast majority of commercial enterprises, e.g., shops and stores, monthly revenues consisting of fixed percentages of gross receipts are paid to the Government as rent. Other individuals and enterprises pay flat monthly space rentals. Through 31 December 1946 the total gross sales of concessionaires returning a percentage of receipts to the Government was $50,115,781.01. During the same period, the total revenue to the Government, in the form of percentages of gross receipts and space and equipment rentals, was $2,605,167.12. The cost of construction of the Oak Ridge commercial facilities, including $860,417.66 in estimated or approximate costs, was $4,968,030.59.[3]

9. School System. - The Oak Ridge school system is based on the firm policy that the community be provided with educational standards of the highest order. Thus, while allowing the schools to become part of the Anderson County school system, the District established far higher standard for the schools within CEW; in turn, the District supported the county in obtaining Lanham Act funds so as to sustain such standards, and, in addition, aside from providing the physical school facilities, supplemented Lanham Act funds with allocations of District funds. For all useful purposes, the Oak Ridge school system has been operated as a part of the District organization. Of the 12 schools - 10 elementary, one junior high, and one high school - three had their origin in buildings acquired

with the reservation, and one of these was enlarged several times, and another was replaced entirely. During the period of development there was severe congestion while the construction forces were still present. The design of the new buildings was consistent with that of adjacent housing. Locations were determined by the density of population in the areas to be served. The elementary schools have between nine and 23 classrooms, kindergarten, art, and music rooms and libraries. Gymnasiums are found in most schools, and cafeterias in some. The high school and junior high school have 30 and 54 classrooms, respectively, and are provided with art, music, and home economics rooms, shops, science rooms, and laboratories. In floor space, the schools vary between 26,200 and 135,350 square feet. The cost of construction of the schools was $3,864,346.80, including estimated costs of $200,000. At the end of 1946, there were 5,366 children enrolled in the elementary schools, 1,216 in the junior high school, and 746 in the high school. There was a total of 285 teachers, plus principals, librarians, counselors, specialists, visiting teachers, and administrative and maintenance personnel.

10. Medical Facilities and Services. - The first medical service at OEW was provided through the Stone & Webster Field Hospital which provided first aid and emergency treatment; the critically ill were sent to hospitals off the reservation. The Medical Service Building, later converted to other uses, was completed in the summer of 1943 as the first District medical installation. The rapid growth of Oak Ridge, together with the inadequacy of medical and dental facilities in the nearby areas, led to the construction and establishment of complete hospital and dental services; the hospital, consisting of the initially constructed building

and three additions, eventually had a total of 313 beds. In addition, an Out-Patient Wing, designed to receive 6,000 persons per month, was added. Dental services were established in the Dental Clinic, erected near the Hospital. The construction costs of all medical and dental facilities eventually totaled $1,829,640.01, including estimated costs of $5,000. Prior to March 1946, professional medical service was provided by District medical officers, but, beginning in that month, the medical officers were gradually replaced by civilian doctors; the Out-Patient Wing was renamed the Medical Arts Building, and office space therein was provided on a flat rental basis. Dentists, prior to April 1946, were retained on a salary basis, but, during April, their status, like that of doctors, was changed to that of private practitioners. Business management of the medical facilities has always been a Roane-Anderson responsibility. Other agencies concerned with medical services and related activities are: the Oak Ridge Department of Public Health, which functions in a manner similar to a municipal health department, as a unit of the Department of Public Welfare of the Facilities and Service Division; the Veterinary Service; the Department of Psychiatry, which provides professional psychiatric treatment; the Medical Social Service, concerned with social problems of the sick; the Medical Emergency Disaster Program, held ready for action during disasters; and the Oak Ridge Health Association, a non-profit group insurance and hospitalization organization.

11. Social and Welfare Facilities and Services. - Beyond material necessities, numerous facilities for recreation, worship, and social services are available to Oak Ridge residents. The District has encouraged beneficial social services and organizations, and, although interfering

with their operations as little as possible, has maintained necessary control through certain District officials. The recreation and welfare activities are mainly those of the Oak Ridge Recreation & Welfare Association, a non-profit organization operating under a grant of authority from the District Engineer. The activities and major facilities of the Association include: six motion picture theaters; recreation centers in Middletown Center, Grove Center, Jefferson Circle, the Town Center, and Gamble Valley; soda fountains; snack bars; taverns; athletic fields; outdoor dances; library service; sponsorship of athletic and hobby clubs; and the sponsorship of a weekly newspaper. Through funds produced from its revenue producing activities, the Association is able to sustain its non-revenue-producing activities. Religious activities are centered in two Army type chapels and other buildings made available for the purpose. Other social and welfare forces include the Red Cross, the Oak Ridge Welfare Service, the Juvenile Department, nurseries, family social services, and the Council of Social Agencies and its Advisory Board. The theaters, chapels, and major recreational facilities were constructed at a cost of $1,060,966.94.

PART C - AREA FACILITIES

12. Electrical System. - Because of the physical layout of the electric power system at CEW and the whole method of operation, it is not feasible to consider separately the system as it relates to the Central Facilities; it was built and is operated as a unit serving all the electrical requirements of CEW, of which those of the Central Facilities constitute a small part. The basic electrical requirements of CEW of abundant and continuous sources of power led, more than any other requirement, to the building of CEW in the TVA Area. For the most part, CEW's need for

electric power was met by extending the TVA power system into the CEW area and integrating it with the project's needs. The system was constructed jointly by TVA and the Manhattan District. The demand for power increased until in August 1945, the peak month, 200,000,000 kilowatt hours were consumed.

In July 1943, after construction of a 154 kv tap to TVA's Norris-Watts Bar transmission line, Elza No. 1 substation was the first major internal features of the permanent power system to be completed. Located near the center of load requirements, Elza No. 1 was constructed as the center of the Norris-Watts Bar loop, which was designed to supply the Electromagnetic Plant, and was the original switching station and terminal for high voltage lines. Elza No. 2 substation, the terminal center for a 154 kv line from Fort Loudoun Dam, was built to meet increasing demands by the Electromagnetic Process, and from it four 154 kv lines were extended into the process area. Elza No. 1 and Elza No. 2 are connected, tying the two stations into sources of power at Norris, Watts Bar, and Fort Loudoun. Oak Ridge is supplied from Elza No. 1 through three interconnected 15,000 kva 154/13.8 transformers. Power in the Diffusion Plant Area in the western part of the CEW area is supplied through a steam plant, connections with Elza No. 1 and Elza No. 2, a 154 kv line from Fort Loudoun, a loop of the Watts Bar-Norris 154 kv line, and two interconnected substations. When it became evident in 1945 that existing facilities would be inadequate for an increased load of 145,000 kw expected in February 1946, plans for expansion of CEW power facilities and strengthening of the TVA system, so as to provide four 154 kv lines to CEW and three separate sources of power to each of four principal substations, were made. CEW's work consisted of

numerous interconnections, installations, and loops; TVA's work consisted of relocation of equipment and construction of a main transmission line. The contracts with TVA have covered an extensive range of matters in connection with the supply of electric power, but concerned chiefly with temporary power supply, construction, and permanent power supply. The main power supply contract with TVA for furnishing permanent service was effective 1 October 1943, and, through 31 December 1946, over $14,000,000 worth of power was furnished under this contract.

The Norris-Watts Bar connection, which involved cutting the existing 154 kv line and building two 154 kv tap lines from the cuts through a switching station, was constructed jointly by TVA and Stone & Webster in the spring of 1943, at a cost of $151,064.79. The original substation and control house at Elza No. 1 were constructed by Stone & Webster at a cost of $928,342.72; an addition cost an estimated $101,879.63. Elza No. 2 substation, originally costing $514,940.71, likewise was constructed by Stone & Webster; an addition cost approximately $168,104. A 154 kv line from Fort Loudoun to Elza No. 2 and a tie line between Elza No. 1 and Elza No. 2 substations, necessitated by expansion in the Electromagnetic Plant Area, were constructed by TVA in the spring of 1944, at a total cost of $398,357.43. A 154 kv line from Fort Loudoun to K-25 was necessitated by the construction of the Thermal Diffusion Process Plant, which, in operation, because it would require great quantities of steam, would reduce the generating capacity of the steam plant. Construction, which cost $256,829.08, was performed by TVA in the fall of 1944. As a part of an overall plan to strengthen the K-27 Area (an extension of the Diffusion Plant Area), a Watts Bar-Norris loop into the area was completed

by TVA in December 1945, at a cost of ~~$16,600~~ 15,913.12. A 154 kv tie line between the K-25 and K-27 substations, another phase of the plan to strengthen K-27, was added at the same time by TVA and by A. S. Schulman Electrical Company, at a total cost of $39,620.52.

To meet anticipated load requirements at the Clinton Laboratories, a 13.8 kv line from the K-25 Steam Plant to Clinton Laboratories was constructed to supplement an existing 12.5 kv line from Lenoir City; construction, by TVA, was accomplished in the summer of 1943 at a cost of $44,548.09. Power for testing purposes in the Thermal Diffusion Plant Area was originally supplied from temporary circuits from the K-25 Steam Plant, but this service was replaced in 1945 with a permanent 13.8 kv service connected to the K-25 switchhouse. The steam generating plant in the K-25 Area has a 238,000 kw capacity. The high voltage, 120,000 kva capacity K-25 substation receives 154 kv, constant frequency power from TVA. Two 154 kv lines, one from Fort Loudoun and one from Elza No. 1, enter the K-25 Area, and a third primary source is available through a tie line with the K-27 substation. A substation in the K-27 Area was built after it was estimated that plant expansion would require 120,000 additional kw by January 1946. The K-27 installation consists of a 154 kv switchyard, busses, switching equipment, three incoming 154 kv power lines, distribution equipment, and lines forming a loop from the Watts Bar-Norris 154 kv line; altogether, there are three independent sources of power at K-27, two direct from TVA and one through the K-25 substation. Work in the K-25 and K-27 Areas, including the substations and related work, but not the steam plant, cost in excess of $5,000,000 and was performed chiefly by A. S. Schulman.

In 1946, TVA, to strengthen its supply facilities, added a 154 kv line between Norris and Cherokee Dams, at no cost to the War Department. Of a total 157,265,000 kwh of received and generated power distributed to the entire CEW during December 1946, 13,498,000 kwh were distributed to Oak Ridge; of the 4,599,933,000 kwh distributed to CEW from October 1943 through December 1946, 315,833,000 kwh were distributed to the town. The cost of power received from TVA and that generated by CEW from October 1943 through December 1946 was $18,349,729.22. In December 1946 alone the cost was $522,586.98. TVA's bill for December 1946 was $480,190.50. For the period October 1943 to December 1946, inclusive, TVA's bill was $14,086,753.40. The construction of the CEW electrical system cost in excess of $9,000,000, of which not more than $2,000,000 is assignable to the Central Facilities. Operation and maintenance of 154 kv lines up to substation inclosures are performed by TVA. Stone & Webster operated and maintained the substations, feeders, and interconnecting lines until Roane-Anderson assumed these functions. Although Roane-Anderson still operates and maintains the system with Oak Ridge, operation and maintenance of the remainder of the CEW system were transferred to the CEW Electric Power Division in November 1945. Electrical facilities, including the steam plant and substations within the restricted plant areas, are operated and maintained by the plant operators.

13. Water Supply System. - The Central Water Supply System was built as a single installation to supply the town of Oak Ridge and the Electromagnetic Plant; it does not supply other major industrial areas. The major features of the system include a 28 million gallons per day pumping plant, a 17.5 mgd filtration plant, two reservoirs with respective

capacities of 4.0 mg and 3.0 mg, two supplementary reservoirs and three elevated tanks with a combined capacity of 3.4 mg, booster pumping stations, and distribution mains and other lines. Preliminary plans to obtain water from wells were abandoned when investigations revealed that the Clinch River was the only dependable and adequate source of raw water. Between November 1942 and March 1943, while some water was obtained from wells and other water was brought in on trucks, a temporary system was constructed. Construction of the permanent system, whose major features, before expansion, consisted of a 12 mgd pumping plant, a 9.0 mgd filtration plant, a 4.0 mg and 1.2 mg reservoirs, a 4.0 mgd booster pumping station, plus lines and supplementary tanks, was started in March 1943 and completed the following November. The first expansion of the permanent system, begun in November 1943 as a result of increases in the size of the town and the Electromagnetic Plant, brought about an increase in the capacity of the pumping station to 20 mgd, an increase in the capacity of the filtration plant to 12.5 mgd, the addition of a 2.0 mg reservoir, and the addition and increase in capacities of distribution lines. Additional town and plant growth brought about the addition, in 1945, of a 3.0 mg reservoir, extensive distribution lines, and a control tank; in addition, the pumping station was increased to a maximum capacity of 28 mgd and the filtration and treatment plant to 17.5 mgd. The water supply system was designed by Stone & Webster and Skidmore, Owings & Merrill; construction work was accomplished chiefly by Stone & Webster forces and other contractors supervised by them. The cost of construction of the system eventually totaled $8,342,803.18, including estimated costs of $12,503.08. The water system was operated by Stone & Webster until 29 November 1943,

when it was taken over for operation by Roane-Anderson. Oak Ridge filtered water meets the standards of purity established by the U. S. Public Health Service.

14. Sewerage System. - The sewerage system is a single installation serving Oak Ridge and the Electromagnetic Plant Area; it consists of treatment plants having a combined capacity of 5.5 mgd, pumping facilities, and an extensive collection system of 130 miles of mains and almost 8,000 service connections. Complete treatment is accomplished by a 2.0 mgd, gravity-fed activated sludge plant which serves the Clinch River watershed. Primary treatment only is provided by a 3.5 mgd, gravity-fed plant which serves the Electromagnetic Plant Area and the western part of Oak Ridge. Eventual discharge is into the Clinch River. Because the town, as originally planned, lay almost entirely in the Clinch River watershed, the original sewerage system was designed to permit flow by gravity from most of the town to the activated-sludge treatment plant, but pumps and force mains were required for collection from the plant area and the western part of the town. In the fall of 1943, the growth of CEW required additional treatment and collection facilities to serve the plant area and the western part of the town; consequently, a primary treatment plant and collection features were built for the Poplar Creek watershed, and the necessity of pumping sewage from that area to the activated sludge plant was eliminated. The sewerage system was designed by Stone & Webster and Skidmore, Owings & Merrill; construction work was performed chiefly by Stone & Webster forces and by other contractors under their supervision. Construction costs of the entire sewerage system totaled $6,013,976.77, including estimated costs of $14,677.52. The system was operated by Stone

& Webster until 29 November 1943 when this responsibility was transferred to Roane-Anderson.

15. Communications. - The first telephone at CEW was installed in December 1942; the first switchboard was placed in operation the following month. The subsequent rapid growth of the town and the industrial areas necessitated the construction of a telephone building in the town area and the installation therein, in March 1943, of a three position switchboard and, by the following fall, of 10 more switchboard positions. After the growth of Oak Ridge required that the manual system be abandoned, the town, in September 1944, was cut over to the dial system which was centered in a new, larger building. The dial system grew to include approximately 4,100 telephones in July 1945, but, in addition, manual switchboards were installed at the Hospital and the Dental Clinic and in connection with the fire reporting system. Residential and commercial service has always been limited to individuals whose duties required such services; at the end of 1946, there were approximately 3,500 such connections, plus approximately 150 pay stations and public telephones. At the end of 1946, the town was being served by a 4,400 line switchboard, and the Clinton Laboratories, the Electromagnetic Plant, Diffusion Plant, and Administrative Areas by switchboards having respective capacities of 450, 1,400, 1,600, and 1,050 lines. In lieu of mileage charges, the Government paid 75 percent of all outside plant construction costs for permanent facilities, and 100 percent of all costs incurred in placing temporary plant, replacing and relocating all types of plant, repairing damaged plant, placing supporting structures in all areas, underground ducts, and manholes, and the construction of telephone buildings. The total costs under 75 percent billing, which were

construction costs incurred in lieu of operational and service costs, were approximately $600,000. One-hundred percent construction costs in the town and Central Facilities area were $307,593.04. In November 1946, the Government, which previously had been the only subscriber to telephone service on the area, surrendered responsibility for operation of commercial service at Oak Ridge to the Southern Bell Telephone and Telegraph Company and rented Government-owned equipment and structures to the company. Thereafter that part of the system was operated by the company as a commercial enterprise. Telegraph service was established at Oak Ridge in the spring of 1943.

16. Roads, Streets, Walks, and Bridges. - The selection of an isolated area for the site of CEW resulted in the selection of an area itself almost bereft of roads and, also, one largely without access roads. The construction of three widely separated manufacturing areas and the town of Oak Ridge made roads and streets a matter of great urgency. Ultimate development brought about the construction or improvement to a point of use of approximately 300 miles of roads and streets at CEW, including approximately 87 miles in Oak Ridge. In addition, there were major programs in connection with the construction and improvement of access roads and bridges and the construction of walks, curbs, gutters, and parking areas. First work centered on the improvement of existing secondary roads, but severe traffic congestion, within and without the area, led to construction of entirely new roads in the area and, in the summer of 1944, to the paving of some Oak Ridge streets. Also, there was extensive construction of wood and crushed stone walks and some construction of concrete curbs and gutters. The major portion of all work before 1945 was performed by

Stone & Webster. Some new construction of roads and streets was performed in 1945, and, during that year, after completion of most CEW construction, it became feasible to institute a large-scale paving program justified on resultant elimination of maintenance of unpaved features.

In 1946, in order to reduce various maintenance costs in the town further, it was decided to add concrete curbs and gutters, to place bituminous concrete over certain existing pavements, and to replace certain existing walks with concrete or bituminous concrete sidewalks; in addition, single surface treatment was applied to other town streets, and two main area roads were improved. Maintenance of area roads and town streets was performed by Stone & Webster until the latter part of 1943 when this function was assumed by Roane-Anderson. In the matter of access roads, no originally existing road approached adequacy in relation to traffic volume and weight, and it was late in 1943, when approximately 20,000 cars entered and left the area daily, before it was possible to improve the access road situation. The access road program eventually resulted in the construction of new roads, directly by the Manhattan District, in the early spring of 1944, from Gallaher Bridge to U. S. Highway 70 and from the Diffusion Plant Area to Tennessee State Highway 61 at Blair; the construction, in 1944 and 1945, of a new road, 13.37 miles in length, from Solway Bridge toward Knoxville, with the use of Public Roads Administration funds; the improvement, by the Tennessee State Highway Department, of a road leading south from White Wing Ferry; the widening, in 1945 and 1946, by the State Highway Department, of U. S. Highway 25W from Knoxville into Anderson County; the construction and improvement, in 1945 and 1946, by the State and the District, using PRA funds, of a road from CEW to Clinton; the improve-

ment, in 1945, with PRA funds, of a road connecting CEW with U. S. Highway 25W; and the relocation, in 1946, of a part of State Highway 61. Access roads which are part of the State highway system are maintained by the State, but it has usually been necessary for CEW, using PRA funds, to maintain other access roads. Because CEW is bounded on three sides by a river, bridges are important access features. Exclusive use of two existing bridges was obtained under contract, and two additional bridges, one of them an ingenious float-type formed by two large oil barges, were constructed by the District. The total cost to the District for construction and improvement of roads, streets, walks, culverts, bridges, curbs, gutters, and parking areas was $8,680,749.35, including an estimated $72,000 for the two bridges. Of the total amount, less that spent for the bridges, $8,265,779.22 were spent within the area and $342,970.13 on the two access roads constructed with District funds.

17. Railroad System. - The railroads at CEW comprise two systems - the Central System, connected with the Louisville & Nashville Railroad and serving Oak Ridge and the Electromagnetic Plant Area, and the K-25 System, connected with the Southern Railway and serving the Diffusion Plant Area. The two systems are not connected. The Central System consists of approximately 37 miles of trackage, plus other features. As no railroad entered the CEW reservation before it was acquired, it was concluded that rail facilities would be required to handle the huge volumes of equipment and materials. Plans to connect with the Louisville & Nashville at Elza were made, and grading was begun on 2 November 1942. Construction of the project main line was started on 7 December 1942 and was completed the following April; other trackage was completed in the

summer of 1944. Cost of construction of the Central System was $1,592,281.80. Rolling stock and mobile equipment valued at $239,000 were acquired by transfer of accountability. The Central System was operated and maintained by Stone & Webster until 29 October 1944 and by Roane-Anderson until 1 July 1946 when the Louisville & Nashville assumed responsibility for operations and maintenance. During the Stone & Webster period of operations, 38,586[68] freight cars were received from the Louisville & Nashville; Roane-Anderson handled 20,211 cars, and the Louisville & Nashville, between 1 July 1946 and 31 December 1946, handled 4,020 cars. The net cost of operations and maintenance incurred by Roane-Anderson was $612,609.44; under the Louisville & Nashville contract, between 1 July 1946 and 31 December 1946, the cost of operations and maintenance was estimated to be $130,640.91.

18. Passenger Transportation Service. - From the outset, construction contractors experienced difficulty in maintaining sufficient labor forces in the absence of mass transportation facilities. Although extensive use was made of private cars and Government-owned vehicles, major contractors at CEW found it necessary to engage other contractors to provide employee commutation service to CEW; trucks and Government-owned busses for service to work sites were used within the area. Not until the latter part of 1944 was equipment, obtained through the Transportation Corps, procured in quantities commensurate with the need. Early in 1944 all bus services were placed under Roane-Anderson Company, and a division of the company was established to operate the bus lines within CEW and to manage the off-area service through subsidy contracts with carriers. In February 1945, operation of the area bus system and the supervision of the off-

area system were transferred to American Industrial Transit under a contract which, in addition to providing for the payment of a fixed fee per month to the operator, provided for the payment of a graduated incentive fee based on the unit costs per mile of operations.

The area bus system had its origins in truck and bus hauls between clock alleys and work sites. Bus service in the town and to the plant areas was established in the fall of 1943, and a terminal system, to facilitate the interchange of traffic, was established early in 1944. In February 1944, a charge of five cents was instituted on town busses. In the summer of 1944, a charge was extended to include work routes, and the fare for all area bus routes was fixed uniformly at 10 cents or the sale of five tokens for 30 cents. The off-area bus service had its origins in contracts made by major contractors at [redacted] with carriers to provide commutation service to [redacted] for employees, the employee and employer each paying one-half of the fare. Under the subsidy contracts negotiated with carriers by Roane-Anderson, operators were paid fixed rates per mile; passengers paid part of the costs by the purchase of weekly commutation tickets for $1.50. By June 1945, approximately 50 contract bus routes, some extending as far as 90 miles, had been established. Off-area subsidy contracts were modified or cancelled as the need for service changed, and by 1 September 1946, all such contracts had been terminated. In addition to the off-area subsidy contract service, an extensive off-area service, operated in the orthodox commercial manner, was developed by carriers, with lines to Chattanooga, Knoxville, Nashville, and numerous smaller communities. Under AIT management, from February 1945 through December 1946, the area and off-area contract bus services required total cash disbursements

of nearly $10,000,000; cash receipts totaled approximately $3,500,000. In December 1946, the gross cost of the area system was approximately $200,000, and revenue was almost $82,000. The monthly subsidy for the off-area contract system reached its peak in May 1945, the net cost of operations being approximately $289,000 that month. Much of the operating loss of the bus system was eliminated with termination of the off-area subsidy contracts. Rail commutation service for employees was provided during 1943 and 1944 by a shuttle train, between Knoxville and CEW, operated by the Louisville & Nashville Railroad, under contract with Stone & Webster. Private automobiles have always carried substantial numbers of employees to and from CEW daily and at one time numbered almost 25,000 vehicles daily. Emphasis was placed on car sharing, and numerous incentives for car sharing were developed before the end of hostilities. The cost of construction of bus transportation facilities, e.g., Jefferson Terminal, loading lanes, and repair shops, but not including Central Terminal, which was constructed for other purposes, was $355,665.03.

19. Security System. - Because of the extreme importance of CEW in the prosecution of the war, it was essential that there be established an extensive security system to protect the plants, their auxiliaries, and the resident population from enemy activity, internal disorder, and natural hazards. The system embraces activities, outside the restricted plant areas, relating to a guard service, fire and police protection, and general community safety. The police and guard forces at CEW date from 1 February 1943, when a unit, consisting of two persons, was organized. The police and guards were made members of the Auxiliary Military Police in September 1943. As the project grew and the protective needs changed,

there were numerous administrative reorganizations, but, in general guard and security functions and police protection were carried forward in the same general organization until March 1945; in that month, a Security Force was formed and, in turn, was divided into the Police Department and the Protective Unit, the latter being responsible for gate control and protection of installations. A Military Police Detachment, which had been acquired in 1944 for guard duty, was incorporated into the Protective Unit. Also in 1945, the police and guard functions were transferred to the Facilities and Service Division. The last reorganization in 1946 created a CEW Security Force and a Police Department. The Security Force was formed by the Military Police Detachment, responsible for perimeter defense and special security details; the Guard Detachment, responsible for protection of vital installations and control of visitors; and a Pass and Identification Section. The Police Department was made responsible for police coverage, including traffic control and investigation of violations of the law. At the end of 1946, personnel of the Security Force totaled 466, including watchmen, and that of the Police Department 153. Practically all civilian guard and police personnel are paid through Roane-Anderson Company whose estimated annual expenditures for salaries of the Guard Detachment and the Police Department, plus certain items of supply, are $823,818. Cost of construction of facilities assigned to the police and guard forces was $131,034.44. The Fire Department was organized on 1 February 1943, and, during the construction period, was responsible for protection service both in the town and the industrial areas, although separate fire protection systems eventually were established within the plant areas. The Fire Department is a major unit of the Department of

Public Safety. It is organized into Fire Prevention, Service and Records, and Fire Protection Sections. The Fire Protection Section consists of two battalions, one composed of ten companies in Oak Ridge and one composed of two companies in the western part of CEW. There is an elaborate alarm system and an intensive fire prevention program. There is an average of less than two fires every 24 hours, and there have been few major fires in Oak Ridge. In 1945, the per capita fire loss was $2.66. In 1946, there were 520 fires and a per capita loss of $0.58. At the end of 1946, personnel of the Fire Department numbered 172, nearly all paid through Roane-Anderson, whose estimated annual expenditures for salaries, plus certain items of supply, are $510,000. The total available cost of construction of fire stations built as separate installations was $81,763.98.

As the population of Oak Ridge increased, it became impracticable for security personnel to refer to the civil authorities all offenses against the law and to dispose of violations of administrative regulations. Consequently there was created, in July 1944, a Review Board consisting of commissioned military personnel to dispose of violations of administrative regulations and to act as an intermediary between the District and the civil authorities with respect to persons offending against the law, and by consent of the civil authorities of Roane and Anderson Counties, the agency which screened charges and referred cases to the civil authorities if charges appeared justified. In April 1946, much of the discretionary authority of the Review Board was placed in the hands of ranking police officers, under the supervision of a Law Advisor, who became the Board's sole member. The election of Justices of the Peace in August 1946 to serve at Oak Ridge made it possible to refer cases involving probable

violations directly to those officials instead of turning the accused directly over to a sheriff after probability of a violation was established. The Review Board has never undertaken to act as a judicial body, but merely as the District Engineer's agent in clearing from the reservation persons violating the law and in recommending administrative actions in other cases. Other activities in connection with security and public safety include accident investigation, driver training and testing, safety lane inspections, and education in community safety practices, including fire prevention.

MANHATTAN DISTRICT HISTORY

BOOK I - GENERAL

VOLUME 12 - CLINTON ENGINEER WORKS, CENTRAL FACILITIES

PART A - GENERAL INTRODUCTION

SECTION 1 - DESCRIPTION

1-1. Scope. - The Clinton Engineer Works project is comprised of four industrial plants (one a "stand-by" plant), and a town together with utilities, roads, railroads, and related facilities and services. Those facilities which serve all of the plants or which operate for the project as a whole under central control are designated the CEW Central Facilities. They are administered by a central organization known as the Facilities and Service Division. Before the spring of 1945, the Division was known as the Central Facilities Division. In general, these facilities may be defined as those at CEW which are outside the restricted areas of the industrial plants. This volume is concerned with the planning, construction and operation of the Central Facilities.

1-2. Purpose. - The purpose of the Central Facilities is to provide an integrated and adequate system of necessary industrial and community facilities to implement the successful operation of the industrial plants while maintaining the security of isolation which was a primary factor in determining the location of the project (See Sec. 2).

1-3. Location. - The CEW reservation is located in eastern Tennessee with its land area lying in approximately equal portions in the southwestern part of Anderson County and the northeastern part of Roane County (See Apps. B-1 and B-2 for maps). It is approximately 15 miles by direct line or 24 miles by road west of Knoxville, Tennessee, the nearest siz-

able city.

1-4. Access. - Access to the reservation is provided by seven entrances which are connected to surrounding major highways (See Apps. B-2 and B-10). From the northeast, Elza Gate is reached via Tennessee State Highway 61 which connects with U. S. Highway 25W at Clinton, Tennessee. From the east, Edgemoor Gate is reached via Edgemoor Road which connects with U. S. Highway 25W between Clinton and Knoxville, and Solway Gate is reached via Solway Road which connects with several county roads extending to U. S. Highway 25W and to U. S. Highways 11 and 70 southwest of Knoxville. Access from the south, through White Wing Gate, is via a county road from U. S. Highways 11 and 70, and from the west and south through Gallaher Gate, via a road from U. S. Highway 70 at a point east of Kingston, Tennessee. From the north and west two gates are reached by roads connecting with State Highway 61 at the towns of Blair and Oliver Springs. There are freight connections with two railroads (See Secs. 17 and 18).

1-5. Facilities Involved. - The CEW facilities and service installations consist of the town of Oak Ridge which provides housing (See Sec. 7), commercial (See Sec. 8), educational (See Sec. 9), medical (See Sec. 10), recreational (See Sec. 11), and other essential services for project workers residing on the reservation; utility systems which serve the industrial plants and the town (See Secs. 13 and 14); communication systems for telephone and telegraph services (See Sec. 15); a road system for travel throughout the reservation (See Sec. 16); an electrical system (See Sec. 12); a railroad system to transport the huge quantities of materials used in building and operating the project (See Sec. 17); an extensive passenger transportation system to serve workers living on or off the reservation

(See Sec. 18); and a security system to guard the entire project from sabotage, espionage, disorder, and natural hazards (See Sec. 19). All facilities are Government-owned and are administered under the supervision of the Facilities and Service Division of the District. Operation of individual facilities is performed largely by contractors employed for that specific purpose. These features and activities are discussed in detail in other sections of this volume.

1-6. Size. - CEW is located on a Government-owned reservation, having an area of about 60,000 acres or 93 square miles (See App. B-3). The reservation is roughly rectangular in shape having a length of about 16 miles on a northeast-southwest axis and a width of about seven miles. The town of Oak Ridge which occupies the northeastern corner of the reservation is about seven miles long and one to two miles wide, comprising an area of about eight square miles.

1-7. Population. - The total population of Oak Ridge on 1 June 1945, was about 61,000. In addition to the Oak Ridge population, there were approximately 14,000 persons living at Happy Valley community, a construction camp in the Diffusion Plant (K-25) Area. While Happy Valley was not considered a part of the Central Facilities Area, the additional population there directly affected the Central Facilities, as the residents were served by such major facilities as the school and passenger transportation systems and the stores of the Oak Ridge commercial areas. It may be seen from the chart (App. C-1) that the population of Oak Ridge steadily increased from the inception of the project, reaching a peak of approximately 61,000 in August 1945, not including Happy Valley. ~~During the same period~~ The CEW employment figures rose to a peak of 82,000 in May 1945.

By early 1946, the total population at CEW had practically levelled off to about 47,000, including employees' families, and employment had dropped to 37,000. On 31 December 1946, population was 42,465, and employment was 28,737 (See Apps. C-1 and C-2).

1-8. Development. - The size and scope of CEW and the facilities and services organization grew almost beyond comprehension after the initial conception of the project in the fall of 1942. In the space of less than three years the narrow valleys and wooded ridges were transformed into the fifth largest city, by population, in Tennessee. The power system which draws the most of its electricity from the Tennessee Valley Authority is the second largest single customer served by the TVA. The thousands of workers have been transported to and from work by the largest motor transit system in the southeast United States. The development of the service organization and especially the town of Oak Ridge evolved in three broad phases. Planning for the first phase was initiated in the fall of 1942 and evolved in the spring of 1943 to a community of about 13,000 residents. The second phase, initiated in the fall of 1943, provided for a population of about 42,000; and the third, initiated in the spring of 1945, provided for a population of 66,000. The method of operation of the facilities has changed to keep pace with the demands of the project. At first the town of Oak Ridge was operated directly by officers and civilian employees of the Manhattan Engineer District while the initial operation of utilities was handled by Stone & Webster Engineering Corporation, who also supervised most of the construction. To conduct the operation of the growing community, the services of a town operating company were procured. Thus, beginning in the

fall of 1943, operations of a major part of the Central Facilities became the responsibility of the Roane-Anderson Company, the operating contractor (See Sec. 6). By 1945 these operations were sufficiently stabilized to permit negotiations with specialized firms for operation of major facilities separately. In February 1945, the operation of the area bus system was assumed by the American Industrial Transit (See Par. 18-3e). By 27 August 1945, specialized operators had been engaged for the cafeterias, dormitories, and family housing units (See Secs. 7 and 8).

1-9. Municipal Administration, Services, and Facilities.

a. General. - The nature of CEW has posed problems of administration and service which are peculiar to the installation. The fact that CEW is in a closed military reservation, inhabited chiefly by a civilian population, and in which military security measures are enforced, raises numerous problems of governmental administration and community service in which there are no precedents. These factors have made it impossible for anything resembling county or township government to exist throughout the reservation or for a municipal government to exist in Oak Ridge, a large community to which the laws of incorporation are inapplicable, although sovereignty over the reservation has not been transferred to the United States. On the other hand, it has been necessary for the Government to provide, in the interest of efficient construction and production and the public safety, welfare, and health, the municipal and other services found in an ordinary community. These have been provided directly by the Government or the Government acting through contractors. To accomplish this, the Town Management Division, the Central Facilities Division, and the Facilities and Service Division have planned, con-

structed, and actively managed the town of Oak Ridge and the Central Facilities. With due consideration given the factors of sovereignty, Government ownership and supervision, and the necessity of safeguarding security, the Chief of the Facilities and Service Division may be said to approximate the status of a city manager. A major portion of the present responsibility of the Division is supervision of Roane-Anderson and AIT.

b. Development. - The administration of CEW has been closely controlled by the District Engineer since the inception of the Manhattan District. Control was first exercised through the Area Engineer and then by the Deputy District Engineer and Executive Officer for CEW, successively. Actual administration was in the hands of the Town Manager whose office developed into that of Central Facilities Operations Officer after Roane-Anderson Company was engaged (Also see Par. 3-6b).

c. Administrative and Service Buildings. - Numerous buildings were necessary to house the various administrative and service facilities and activities in connection with planning, construction, maintenance, and operation of Oak Ridge and the Central Facilities. These buildings, most of which are only semi-permanent, were planned and constructed ~~either~~ by Stone & Webster, or by other contractors or ~~that company's subcontractors, or by~~ subcontractors ~~Roane-Anderson~~, at a cost of $5,119,890.26 (Apps. A-193, A-196, and A-306 to A-313). A list of buildings required for direct municipal administration and services and constructed for those purposes, plus certain miscellaneous facilities, is appended (App. C-11).

SECTION 2 - SITE SELECTION AND PREPARATION

2-1. General. - The nature of the Manhattan District Project imposed certain basic requirements which had to be met in locating and selecting a satisfactory site. In order to achieve the most rapid and economical construction and to afford maximum coordination and control of effort, it was desired to locate all four of the full scale production plants (pile, electromagnetic, gas diffusion and centrifuge) then under consideration at one site. As hereinafter noted, after the selection of the site, decisions were made to discard one of the types of production plant (centrifuge) and to locate another (pile) elsewhere, but the requirements of all four influenced the considerations throughout the process of selection. A number of other changes in requirements - both major and minor - occurred during development and construction; the requirements described in this section, however, include only those which were anticipated before final selection was made. Factors which had to be considered in the selection and automatically eliminated innumerable possible locations were land area, power supply, water supply, land value, topography, transportation, labor supply, and housing. Prior to the selection of the present Clinton Engineer Works reservation several other possible sites were considered and investigated in Tennessee, the neighborhood of Chicago, Illinois, near Shasta Dam in California, and in the areas around Grand Coulee and Bonneville Dams in the State of Washington.

2-2. Requirements.

a. Location. - It was desired to find a location between the Alleghany and Rocky Mountains so that the installation would be secure from enemy attack on the sea coasts and relatively inaccessible to

hostile air raids.

b. Area. - An area of not less than 200 square miles was determined to be necessary in order to provide for adequate separation of the four plants and the housing area; the area required for Clinton Engineer Works alone was reduced before final selection to about 90 square miles.

c. Power. - The overall power requirements for the project were originally estimated at 100,000 to 150,000 kw from a dependable source, preferably two sources, of generation. Because of the difficulty of obtaining materials and the cost of erecting heavy transmission lines, a location near the source of power was desirable. Power requirements for the four main plants were later estimated as follows:

(1) Electromagnetic. - Power requirements for the electromagnetic process were estimated at 30,000 kw of power.

(2) Gas Diffusion. - The diffusion plant required an estimated 50,000 kw of power.

(3) Pile. - The pile process required an estimated 10,000 to 50,000 kw of power.

(4) Centrifuge. - Power requirements for the centrifuge process, which was subsequently discarded, were estimated at 50,000 kw of power.

d. Water Supply. - Early estimates of the water requirements indicated a demand for 370,000 gpm for cooling and process water plus that needed for housing and sanitary uses. Water requirements for the individual plants were as follows:

(1) Electromagnetic. - The electromagnetic plant re-

quired an estimated 15,000 gallons of process and cooling water per minute.

(2) Gas Diffusion. - The gas diffusion process required an estimated 27,000 gpm plus sanitary and drinking purposes.

(3) Pile. - Process and cooling water requirements for the pile process were estimated at 300,000 gpm.

(4) Centrifuge. - Water requirements for the centrifuge process were estimated at 27,000 gpm.

e. Transportation. - The large quantities of construction materials and supplies needed required that the plants be near a railroad. Good passenger connections would facilitate the general work of the District, which was spread over the entire nation. Good access roads were required to transport freight and labor.

f. Land Values. - The tight security control which was required forced acquisition in fee of all construction areas, it thus being necessary to find land which could be purchased reasonably, otherwise the cost of acquiring so large an area would have been prohibitive.

g. Topography. - For reasons of security and as an added safety precaution, it was desirable that the individual plant sites and townsite area should be separated from each other by intervening ridges. The radiation hazards incident to the operation of the pile plant made it mandatory that a safety distance of at least a four mile radius surrounding the plant be provided, preferably with intervening ridges. An area bounded by natural barriers such as rivers and ridges would assist immeasurably in affording security control. The valleys needed gentle slopes for building areas to minimize excavation. It was necessary that

the soil substrata provide a satisfactory foundation without requiring excessive rock excavation.

h. Town Site. - Building space for a townsite to house and serve approximately 5,000 people was determined to be necessary.

i. Labor Supply. - The project required large numbers of common and semi-skilled labor and had to be located in an area to which highly trained scientific personnel could be attracted.

2-3. Previous Investigations.

a. General. - Prior to the establishment of the Manhattan District to manage the project, the Office of Scientific Research and Development had made some preliminary studies and investigations to determine possible plant site locations (See App. A-140).

b. Sites in TVA Area. - As the centrifuge and diffusion processes were the most advanced at this time, and as the power requirements of these processes were of primary importance, it was suggested that the site be located within the area supplied with power by the Tennessee Valley Authority. In cooperation with the TVA it was determined that several locations were indicated where the required 150,000 kw could be supplied (See App. A-141).

(1) Norris Dam and Watts Bar. - The vicinity of the 154 kv line between Norris Dam and Watts Bar.

(2) Chickamauga Dam. - The vicinity of the 154 kv line above or below Chickamauga Dam.

(3) Pickwick and Memphis. - The vicinity of the transmission lines between Pickwick and Memphis.

(4) Watts Bar and Center Hill. - The area between Watts

Bar and Center Hill served by the planned 154 kv line connecting Watts Bar with Nashville. After an inspection of these sites, the most promising from the standpoint of power, water, and accessibility was suggested by OSRD to be an area on the west side of the Clinch River, approximately nine miles down stream from Clinton, just off Highway 61 (See App. A-141). This area is within the limits of CEW reservation as finally established.

c. Sites in Chicago Area. - The OSRD also considered areas in Illinois near Chicago as possible sites for the pile process plant (See App. A-142).

2-4. Sites Considered.

a. General. - As soon as the Manhattan District took over the project, studies were undertaken and investigations made in order to select a site which best suited the needs of the project. The previous surveys which had been made by OSRD were reviewed and additional sites were investigated.

b. Illinois. - Two sites in the vicinity of Chicago were inspected, but were found to be too small for the location of the full scale plants (See Apps. A-142 and A-144). Subsequently, one of these sites was procured for use in connection with research and the building of a pilot plant for the pile process.

c. California. - A site near Shasta Dam in California was inspected but was rejected because it was nearer the coast than desired and was not so suitable for building as the TVA area.

d. Washington. - Several areas in the State of Washington were studied and inspected, because of the availability of large amounts of power from Bonneville and Grand Coulee Dams. These sites were re-

jected for the site of the main plants because of the long transmission lines necessary and because the area was adjacent to the west coast, which at that time was threatened by the enemy. Eventually, however, the main plant for the pile process was located near Pasco, Washington, (See Land Acquisition, Hanford Engineer Works, Book IV, Volume 4).

e. TVA Area. - Sites throughout the TVA area were investigated with particular emphasis on the area which had previously been recommended by OSRD (See Apps. A-139 and A-143).

2-5. Selection of CEW Site.

a. Location. - The site selected for CEW reservation is generally in the shape of a rectangle with the long axis extending southwest from Elza, Tennessee. The site is bounded on the northeast, southeast, and southwest by the Clinch River and on the northwest by Black Oak Ridge (See Apps. B-1 and B-2). It is approximately sixteen miles long and seven miles wide. The original site as finally selected contained 56,200 acres. The acreage was later increased in small increments to 58,799 ~~59,545~~ acres, after final selection, to provide additional security belts and access road rights-of-way (See App. B-3). Principal cities or towns in the region are as follows:

CITY OR TOWN	HIGHWAY DISTANCE FROM OAK RIDGE (ADM. AREA) (Miles)	POPULATION (1940)
Knoxville	24.0	111,580
Clinton	8.9	2,761
Harriman	24.6	5,620
Oliver Springs	7.6	855
Kingston	22.2	827

CITY OR TOWN (cont'd.)	HIGHWAY DISTANCE (cont'd.) FROM OAK RIDGE (ADM. AREA) (Miles)	POPULATION (cont'd.) (1940)
Rockwood	34.0	3,981
Lake City	23.0	1,520

b. Power. - Power was available from the TVA with a 154 kv line crossing the site, and from other sources nearby which could be connected by building new transmission lines.

c. Water Supply. - Ample water supply was available from the Clinch River, although it required purification before use.

d. Topography. - The area consists of a series of parallel ridges and valleys running in a northeast-southwest direction (See App. B-3). The valleys are generally narrow, ranging from approximately one-quarter to one-half mile wide, with a few locations wider or narrower. The ridges are generally from two to three hundred feet high above the valleys, ranging from one to one and one-half miles from crest to crest, and are covered with scrub timber. There are few cross connections between the valleys, although an occasional saddle or narrow cross valley occurs. The ridge along the northwest boundary of the site is particularly rugged.

e. Drainage. - Natural drainage is by means of small streams down the sides of the ridges, and creeks in the valleys, draining into the Clinch River at the northeast and southwest ends of the site. The valley elevations are for the most part about 800 feet above sea level, but in some places approach 900 to 1,000, while the pool level of the Watts Bar Dam on the Clinch River is 745, thus assuring adequate drainage conditions.

f. Geology. - Underlying the site are portions of a series of northeastward trending formations, consisting of limestones, dolomite, shale, and sandstone. Within the area there are several major faults and the geology is consequently somewhat complicated. The surface soil is essentially clayey or cherty in its nature, with the overburden varying from a few inches to more than fifty feet.

g. Climate. - The climate is, generally, quite mild, with a mean annual temperature of 59° F in January to 75° F in July. The area has a heavy rainfall of approximately 50 inches per year, with an average monthly minimum of 2.6 inches in October and an average maximum of 5.6 inches in March.

h. Transportation. - The site is near two railroads, the Louisville and Nashville on the northeast, and the Southern on the northeast and southwest. The area was served by numerous roads, although they required considerable improvement before they were adequate for the heavy construction traffic.

i. Local Population. - The native population was largely of English or Scotch-Irish stock. Most of the residents were unskilled in the mechanical trades.

j. Appraisal, Selection, and Acquisition. - Gross appraisals of the area ultimately selected were made by the Ohio River Division of the Corps of Engineers. They indicated an estimated cost of $3,516,700 A for the procurement of approximately 57,500 acres (See App. A-145). Final approval of the selection was given by Major General L. R. Groves, after personal inspection of the area (App. A-228). Acquisition of the required site was performed by the Real Estate Branch of the Ohio River Divi-

sion, under the general direction of the Manhattan District (A complete description of this work is given in Book I, Volume 10, of the Manhattan District History).

2-6. Site Preparation.

a. Initial Work. - Extensive work was required in connection with general site preparation in the town and the Central Facilities area prior to construction. This work was performed by Stone & Webster Engineering Corporation and by Harrison Construction Company under Stone & Webster supervision (App. A-221; also Pages 162 to 173 of App. A-193). General site preparation, with costs thereof, consisted of the following:

Removal of existing structures and utilities	$ 150,349.97
Clearing and grubbing	254,043.29
Site grading	733,813.77
Drainage	285,691.30
Fencing	173,386.84
Guard towers	22,097.60
Landscaping	39,796.82
Total	$ 1,659,179.59

b. Later Work. - The grading of slopes incident to the construction of buildings, streets, and utilities in the town resulted in extensive finger and channel erosion in many areas. In March 1946, a program for clean-up, drainage, erosion control, and seeding and sprigging in the vicinity of town buildings was initiated. First priority was given the construction of berm and terrace ditches. Upon the completion of grading, terraces were seeded. Drainage around buildings was improved through the installation of half tile and underground drains.

The areas adjacent to the tile lines was graded, top-soiled, fertilized, and seeded to provide drainage from the building foundations and to prevent further erosion. This erosion control program was still in progress at the end of 1946. Through 31 December 1946, the cost was $13,618.83 (Apps. A-286, A-302, and A-303; also see Par. 16-31).

SECTION 3 - BASIC CONSIDERATIONS

3-1. Authorizations.

a. General. - The design, construction, and operation of the Central Facilities at the Clinton Engineer Works were authorized by the President of the United States under the authority vested in him by the First War Powers Act (App. A-208; also see Book I, Vol. 1).

b. Specific.

(1) Report of 13 June 1942. - On 17 June 1942, the President approved a report of 13 June 1942, submitted by Dr. James B. Conant, Chairman of the National Defense Research Council, and Dr. Vannevar Bush, Director of the Office of Scientific Research and Development (See App. A-1). This report presented the results of a study made to determine the advisability of carrying on what later became the Manhattan District Project, the consequences involved, and the results to be obtained. It had been approved previously by the Vice President, the Secretary of War, and the Army Chief of Staff. It contained the following recommendation in regard to those features which are now classified as Central Facilities at CEW:

"...that a site or sites be selected and acquired with proper consideration for power requirements, and an immediate start be made on construction of the necessary fencing, housing, utilities, and other facilities required...."

(2) Delegation of Authority. - By memorandum dated 17 September 1942, from the Commanding General, Army Service Forces, to the Chief of Engineers, Major General (then Colonel) L. R. Groves was appointed officer in charge of the Manhattan ~~engineer~~ District or the

DSM (Development of Substitute Materials) Project, as it was known for
A reasons of security ~~(See App. A-2)~~. On 10 June 1944, General Groves delegated to the District Engineer, Manhattan District, authority in connection with work assigned to and coming within the jurisdiction of the Manhattan District (See App. A-3).

(3) Appointment of the Military Policy Committee. - The Top Policy Committee, designated by the President to have determination of general policy in the project, appointed a Military Policy Com-
B mittee by memorandum, dated 23 September 1942, to consider and plan military policy relating to the DSM Project, covering production, strategic and tactical problems, and research and development relating thereto. By the same memorandum, General Groves was named to sit with the committee as executive officer to carry out the policies that were determined (See App. A-4). The Military Policy Committee in conferences held
C on 22 and 23 January 1944 at CEW agreed that it was essential to provide additional housing (App. A-5).

3-2. Security. - The necessity for safeguarding the military security of the project affected all phases of the planning, construction, and operation of the Central Facilities. It was a major factor in the
D selection of the site (See ~~Book I, Vol. 10~~ Sec. 2), which was entirely undeveloped insofar as industrial and municipal facilities were concerned. It precluded the revelation to officials of surrounding municipalities or other Government agencies of the probable ultimate employee or resident totals. It necessitated the establishment of the project guard service early in the construction program and further necessitated that special measures be taken in practically all fields of activity in connection

with the operation of the project.

3-3. Speed. - The urgency of the project was such as to necessitate the utmost speed in completing the design and construction of all phases. To this end simple designs were used for all structures, the construction work was spread among a large number of contractors, and the use of prefabricated construction was thoroughly developed. It was recognized, however, that the town was an auxiliary to the process plants and construction labor in the critical crafts was yielded to the plants when necessary.

3-4. Off-Area Development. - In order to hold construction of housing and service facilities to a minimum, every reasonable attempt was made to develop off-area housing through cooperation with local government and Federal housing agencies. Thus, before additional project construction was authorized, a survey was made in each case to determine if the construction could be avoided by an off-area development program.

3-5. Relationship with Other Interests. - The District has received invaluable assistance from outside agencies in developing the Central Facilities. Where consistent with security, and when feasible, it has been the policy to solicit the aid of established local organizations in order to avoid unnecessary duplication of effort and to maintain the best possible relationships with local interests. A few of the more important contributions were made by the agencies named below. Direct references to many others appear throughout the text.

a. The Tennessee Valley Authority. - From the first stages of planning, the Tennessee Valley Authority has been an important factor in the location and scope of the project. TVA furnished much of the origi-

nal data for site selection and has given utmost cooperation in the design, construction, and operation of connections with the TVA power system which serves CEW. Another contribution by TVA to the success of CEW was the design for prefabricated housing which forms a large part of the family dwelling units in the town.

b. Federal Housing Agencies. - The Federal Housing Agency and the Federal Public Housing Authority were of great assistance in solving the housing problem. The establishment and control of housing projects in the communities surrounding the reservation materially reduced the number of quarters which had to be constructed. The Federal agencies furnished trailers and demountable houses from as far north as New York and as far south as Florida.

c. Federal Works Agency. - Funds for operation of the Oak Ridge schools were obtained by Anderson and Roane Counties, supported by the District, through the Federal Works Agency.

d. State of Tennessee. - Considerable assistance was received from the State of Tennessee in the prosecution of the access road program, in planning for the schools, and in law enforcement.

e. County Governments. - The CEW reservation lies wholly in Anderson and Roane Counties with its southern boundary contiguous to Knox and Loudon Counties of the State of Tennessee. The size of the project, in area, number of workers, and resident population, required considerable cooperation with the county governments in connection with access roads, schools, off-area housing, and other problems which developed from the impact of so large an activity being built and manned in a sparsely populated area.

f. Municipalities. - The nearby towns of Knoxville, Clinton, Oliver Springs, Harriman, Loudon, and others were helpful in the solution of housing, transportation, shopping, and labor procurement problems.

3-6. Organization.

a. General. - The organization in charge of planning, constructing, and operating the Central Facilities at CEW has gone through several stages of development to keep pace with the overall development of the project and the size of the Central Facilities. Starting as a relatively small activity, it has expanded to the point where the Facilities and Service Division is one of the major divisions of the District organization. The development at various stages is indicated in the organization charts appended (Apps. C-17 to C-22).

b. Planning. - The initial planning of the Central Facilities, including commercial facilities, housing, and the power, water, sewerage, and road facilities, was performed by Stone & Webster Engineering Corporation, in its design offices at Boston, Massachusetts (Page 5 of App. A-193). Stone & Webster design work for the Central Facilities was supervised for the District Engineer by the Area Engineer in Boston (App. C-17). In February 1943, Stone & Webster was relieved of town design, most particularly housing, and the firm of Skidmore, Owings & Merrill, Architect-Engineer, was engaged to complete the planning for the town, with the exception of utilities (App. A-16; also see Par. 4-4b). Planning of the utility systems and the construction of all facilities remained Stone & Webster responsibilities. The design work of Skidmore, Owings & Merrill was supervised at the District Office in New York City

until April 1943 by the District Town Management Division, which also was responsible for planning for eventual town operation and management (App. C-17). In a general administrative reorganisation of the District in April, the Town Management Division was abolished, and a Central Facilities Planning Unit and a Central Facilities Operating Division were created. The Planning Unit became responsible for supervision of Skidmore, Owings & Merrill and for coordination of Skidmore, Owings & Merrill design and Stone & Webster construction, acting as the liaison agency between Boston, New York, and CEW (Apps. A-72 and C-21). The design contract with Skidmore, Owings & Merrill (Apps. A-16 and A-30) was completed during the summer and the Planning Unit ceased to function. The Central Facilities Operating Division was created as the agency responsible for direct operation of the facilities at CEW (Apps. A-72 and C-21), and, although the old Town Management Division was not continued by the April reorganization, the Operating Division was generally known as the Town Management Division (App. A-187). It was this Division which, in June 1943, through the Town Manager, opened the first facilities at CEW (See Par. 8-9), and operated them until the creation of the Central Facilities Division and the engagement of Roane-Anderson Company (See Par. 1-8 and Sec. 6). As a part of the reorganisation which took place, in September 1943, with execution of a second contract with Skidmore, Owings & Merrill, for the first expansion of the town (Apps. A-8 and A-17), and the execution of a contract with Roane-Anderson Company, for town operation (App. A-24; also see Sec. 6), the Town Management - Central Facilities Operating Division and the Construction Division ~~(See Par. 3-6b)~~ were replaced by the Central Facilities Division. The new Divi-

sion was made responsible to the District Engineer for operation, management, construction, supervision, and other work in connection with the Central Facilities, including supervision, through the Division Engineering Branch, of design work performed by Skidmore, Owings & Merrill under the firm's second contract (Apps. A-17 and C-18). In the second expansion of the town, in the spring of 1945, Skidmore, Owings & Merrill, supervised by the Construction Branch of the Central Facilities Division, designed housing and related structures (Apps. A-18 and C-19). Planning for extensions to the water supply system was performed by Stone & Webster at Boston (App. C-19 and Page 31 of App. A-193). Plans and specifications for road and street improvement in 1945 were prepared by the Utilities and Maintenance Branch of the Central Facilities Division (App. A-256).

c. Construction. - An Area Engineer Office was established in Tennessee in the fall of 1942 to supervise all construction at CEW, including the construction of the Central Facilities by Stone & Webster. Construction was supervised by the Area Office (App. C-17) until the early summer 1943, when the Construction Division, created in the April reorganisation, was organised to supervise all construction work on the project at CEW (Apps. A-72 and C-21). Responsibility for supervision of construction passed from the Construction Division to the Central Facilities Division when the latter was organised in September. Stone & Webster construction work in the first expansion program, instituted in the fall of 1943 and extending into 1944, was supervised by the Division's Construction Branch (See App. C-18). Stone & Webster did not participate directly in the 1945 expansion, and other prime contractors were super-

vised directly by the Division (App. C-19; also see Sec. 5).

d. Central Facilities Advisory Committee. - Assistance in determining overall requirements, and the consequent formulation of basic policies regarding the extent and operation of the Central Facilities, was rendered by the Central Facilities Advisory Committee, formed after the organization of the Central Facilities Division. The Committee, which functioned into 1945 as special staff of the Division Chief, was made up of representatives of the major contractors at CEW (See Apps. C-18 and C-19).

PART B - TOWN OF OAK RIDGE

SECTION 4 - PLANNING AND DESIGN

4-1. Development.

a. General. - Plans for the development of Oak Ridge were initiated during the latter months of 1942 and evolved in three broad phases, instituted successively in the spring of 1943, the fall of 1943, and the spring of 1945. In addition, relatively minor programs of improvement and development were underway between and after the major programs. Initially it was planned to provide semi-permanent type of housing accommodations for operating personnel while portable trailers and temporary huts were provided to satisfy the needs as they developed for construction personnel. Throughout, plans were drawn on the basis of minimum necessary accommodations. As it later proved feasible to house part of the expanded numbers of operating personnel in the portable and temporary quarters, the second phase of the program included large numbers of this type. The initial house plans called for 100 percent on-site construction. Later modifications used prefabricated types to a large extent. The succeeding paragraphs of this section touch only slightly on the details of design which may be found in the sections discussing individual building types (See Sec. 7; also Apps. D-1 to D-27). Each of the three building programs, in addition to housing, included sufficient supplementary community facilities, e.g., schools, stores, public safety organizations, and utilities, to satisfy the minimum essentials of the community. The administrative units of the Manhattan District responsible for planning and design of the Central Facilities are described elsewhere (See Par. 3-6b).

b. First Phase. - The plans for the first phase resulted in the construction of 3,050 houses, three apartment buildings, 14 dormitories, and 980 hutments, and the acquisition, from the Federal Public Housing Authority, of 1,071 trailers. Although the program itself was not completely developed until the spring of 1943, preparation of plans for individual units was started in the fall of 1942. Other community facilities planned and constructed under the first building program included a high school of 500-student capacity (See Sec. 9), three grade schools of 500 students each, a medical service building, and a hospital of 50-bed capacity (See Sec. 10), as well as a central shopping center (See Sec. 8), three neighborhood shopping centers, two recreation halls, two cafeterias (See Sec. 8), two chapels (See Sec. 11), a telephone office (See Sec. 15), and fire and police headquarters (See Sec. 19).

c. Second Phase. - During the late summer of 1943, the needs for housing for operating personnel, based on personnel studies by the operating contractors for the industrial plants, as visualized at that time, far outstripped the facilities under construction. Consequently, studies looking to an expansion of the community to accommodate a total population of 42,000 were initiated. Planning and subsequent construction under the second program resulted in the addition of 4,793 family quarters of the semi-permanent type, 55 dormitories, 2,089 trailers, 391 hutments, a cantonment area of 84 hutments and 42 barracks and utility buildings, and the hutment apartments of 52 family units. Family-type housing consisted for the most part of individual houses, of which 2,823 units were prefabricated in sections at plants located away from

the project. An additional 375 houses, containing 1,000 units, consisted of panelized, duplex types which had been constructed as war housing at other war plants and were dismantled and shipped to the project for re-erection. Another 477 demountable buildings, of 970 units, varying between two-, four-, and twelve-family units, were erected on the site after acquisition elsewhere. Also under the second planning and construction program, the size of the high school was increased to accommodate 1,000 students (See Sec. 9), two additional primary schools were authorized, and certain of the existing schools were increased in size to provide elementary school facilities to accommodate about 7,000 students. The hospital facilities were increased to provide a total of 263 beds and separate outpatient and dental clinics (See Sec. 10). Additional shopping and recreational facilities were planned and constructed, and the fire, police, telephone, and other community services were expanded (See Secs. 8, 11, 15, and 19).

d. Third Phase. - Until late in 1944 it was expected that no additional community facilities would be required on the reservation, it being believed that by use of temporary expedients, such as overloading dormitories, schools, and hospitals, and very strict housing assignments, the peak of employment could be passed without additional construction. The pressure gradually increased as operators revised their estimates of personnel required to operate authorized plant facilities, and with the major increases in plant size in the winter of 1944, it became necessary again to plan further expansions. Efforts were directed towards procuring trailers for family accommodations, but the supply of trailers was limited. The approved program resulted in the construction

during 1945 of 1,300 family units, prefabricated on the reservation, and 20 additional dormitories; also, 744 additional trailers were acquired (See Par. 7-3a (4) for reference to housing authorized but not completed). The schools were increased to accommodate a total of 9,000 students, and a 50 bed addition for the hospital was constructed. Additional shopping and recreational facilities and other community services to maintain an adequate minimum were also constructed ~~(See Sec. 7)~~, and an extensive program of street improvement was undertaken (See Sec. 16).

e. Additional Work. - The most significant planning and construction activities in 1946 and after completion of the third phase consisted of the conversion of certain housing units (See Par. 7-2c), a major street and sidewalk improvement and construction program (See Sec. 16), and increments to the electric power system (See Sec. 12). Also, there was some minor construction in 1946 in connection with schools (See Sec. 9), the dental clinic (Sec. 10), and commercial and miscellaneous facilities (See Apps. C-5 and C-11). Beyond planning in connection with improvement of the physical facilities, studies aimed at developing improved methods and policies for the long term operation of Oak Ridge and the Central Facilities were initiated late in 1946.

4-2. Design Criteria.

a. Minimum Construction. - The purpose of the town of Oak Ridge has been to implement the successful operation of the industrial plants and to provide security for key personnel and the information they possessed. Consequently, the types and quantity of community facilities and services, as well as their manner of operation, have been based on the calculated best interest of the Government as reflected in facili-

tating the operation of CEW's industrial plants, instead of any endeavor to establish an ideal community in the social or aesthetic sense. It follows that, except for the essentials, the town was not provided with the number or quality of facilities available in normal American communities.

b. Statutory Limitations. - By public law, Federal construction of dwelling units was limited to a maximum cost of $7,500 per unit (App. A-7; see App. C-3 for unit costs of housing constructed).

c. Critical Materials. - All designs were directed toward minimum use of critical construction materials (App. A-8).

d. Labor. - Layout plans and building plans were designed to minimize use of on-site labor for construction, especially during the peak of the construction period (App. A-8).

4-3. Preliminary Work. - It was recognized at the outset that a certain amount of housing would be required, but it was not expected that a town of anything like the eventual size of Oak Ridge would be necessary. During a meeting in June 1942, when the preliminary organization of the work was being discussed, it was decided that Stone & Webster Engineering Corporation would work on the plans and site development as part of its general planning responsibility (Apps. A-9 and A-10). Stone & Webster was instructed to prepare plans for a self contained village based on the requirements of the plant operations. Considerable investigation was done, and the requirements were finally developed as a town with a population of approximately 13,000 and a trailer camp for about 1,000 trailers. Following the submission, on 26 October 1942, of an over-all plan showing the location of the basic roads and main buildings, approval was

given by the District for the construction of ten dormitories, a cafeteria, and a guest house; however, it was decided to relieve Stone & Webster of the added responsibility of the design of the town, (although it would but retaining managerial responsibility of construction and operation of utilities and roads), so that its maximum efforts could be concentrated on the design of the Electromagnetic Plant (App. A-12; also see Par. 3-6b). Subsequently, the Stone & Webster contract was modified to reflect this change (App. A-13).

4-4. Architect-Engineer Services.

a. John B. Pierce Foundation. - In order to obtain the best possible town design, it was decided to retain a specialist in low cost housing projects. The John B. Pierce Foundation, of New York, a non-profit organization doing work in the field, was selected because of its national reputation in research on low cost housing. A contract (App. A-14), effective 3 November 1943, with the Pierce Foundation to furnish advice and house plans for the town, was negotiated. The contract provided that the firm of Skidmore, Owings & Merrill, Architect-Engineer, would work with the Pierce Foundation as collateral architect in accordance with the usual Pierce arrangement (Apps. A-14 and A-15). The cost of the Pierce contract was $5,000.00 (App. A-325).

b. Skidmore, Owings & Merrill. - Since the Pierce Foundation was primarily a research organization, it was found desirable to negotiate a direct contract with Skidmore, Owings & Merrill for architect-engineer services for the town. Under this arrangement the Pierce Foundation became an adviser on design problems. The architect-engineer services of Skidmore, Owings & Merrill were continued through two subsequent contracts as the size of Oak Ridge expanded. The first contract

(App. A-16), dated 3 February 1943, was a lump-sum contract because the scope of the work could be well defined. The second contract (App. A-17), dated 6 September 1943, was of the cost-plus-a-fixed-fee type covering planning studies, field surveys, and plant inspection of prefabricated housing in addition to the direct town design. The third contract (App. A-18), dated 27 January 1945, was also a CPFF contract and covered the expansion program initiated in the spring of 1945. Design work under the first contract was performed at Skidmore, Owings & Merrill's home office, but a complete field office was required for the later contracts. Selection of Skidmore, Owings & Merrill for continuations of the original town was logical because of the firm's satisfactory performance and because it enabled full advantage to be taken of job experience (Apps. A-16 to A-18; also see Par. 3-6b). The cost of the Skidmore, Owings & Merrill lump-sum contract was $343,017; the costs of the second and third contracts, including the contractor's fees and Government and contractor-furnished items, were $1,668,246 and $349,797, respectively (App. A-325; see Par. 5-2 for Stone & Webster's fee).

4-5. Incidental Improvements. - During the periods in which a major building program was not in progress certain incidental structures became necessary, such as extensions to the steam distribution system and additions to the hospital. These and similar increments were designed by engineers of the Central Facilities and Facilities and Service Divisions and were, for the most part, constructed by Roane-Anderson Company (App. A-19).

4-6. Key Personnel. - The units of the planning organization for Central Facilities have been indicated previously (See Par. 3-6). In a

similar manner, the men responsible for the work were shifted from time to time as planning needs warranted. A list of key personnel, showing their respective responsibilities, is consolidated with a similar listing in the section on construction (Sec. 5), the activities usually being closely related, with construction frequently starting before planning was finished.

SECTION 5 - CONSTRUCTION

5-1. General. - Site preparation, preparatory to construction of the town of Oak Ridge, was begun in October 1942, after the first contingent of Stone & Webster Engineering Corporation construction personnel arrived at the site. Work was directed from temporary offices of Stone & Webster in Knoxville. The first major structure to take shape was the main administration building (App. D-32), which was started on 22 November 1942 and completed on 15 March 1943. Upon completion of the administration building, the Clinton Engineer Works offices of the Manhattan District and the CEW offices of Stone & Webster were moved to the site. The construction forces were increased rapidly but were never available in numbers sufficient to reach a schedule of construction which it was hoped to attain. In January 1943 the first group of dormitories (App. D-22) was started and other facilities, such as cafeterias and laundries (Apps. D-28g and D-31), followed in rapid succession. Construction of the first group of 1,000 housing units was begun in April; another group of 1,000 units was started in June, a group of 50 units was started in July, and still another group of 1,000 units was started in August (Apps. A-32 and A-33 to A-35; also see Apps. C-3a and D-1 to D-20). There was no slackening in town construction until April 1944, when the construction forces reached a peak of over 15,000, after which they gradually dropped off to nothing when the authorized work was completed in November 1944. The third phase, authorized in January 1945, and completed during the year, brought back over a thousand construction workers, but at that time they were easier to obtain because of reductions in plant construction forces (See Par. 4-1e for references to major work performed in

1946; also see Par. 3-6b; see Sec. 7 for details of housing construction).

5-2. Method of Construction.

a. General Policy. - It was the District policy to have town construction work performed, whenever feasible, by lump-sum or unit-price contracts let by competitive bidding. This policy was modified from time to time by other considerations. The watchword of the project was speed, and many cases arose where it was necessary to proceed with construction before completion of plans and specifications, in which cases the work was performed by Stone & Webster under its cost-plus-a-fixed-fee contract which provided for architect-engineer-management-construction services (App. A-82; see also App. A-193).

b. Managerial System. - To be able to meet any contingency, a flexible contract organization was developed whereby managerial responsibility for construction was placed with Stone & Webster under its general CPFF contract (Apps. A-82 and A-193). Stone & Webster prepared contracts, advertised work, evaluated bids, and recommended awards to the District Contracting Officer. Stone & Webster performed a major function in purchasing, expediting, and receiving materials in cooperation with the Manhattan District office. From the beginning of construction through 1944, construction work, performed directly by Stone & Webster, and that performed by other contractors under that firm, was supervised and inspected by Stone & Webster inspectors. The Stone & Webster fee earned in connection with planning, design, and construction of the Central Facilities was $636,278.00 (App. A-325). The Stone & Webster contract had been substantially completed when the additional construction was initiated in the spring of 1945. Under the 1945 construction program, all construction was

supervised directly by the Facilities and Service Division. Skidmore, Owings & Merrill, in that company's capacity as architect-engineer, inspected construction for the Government (Apps. A-8, A-30, and A-206).

5-3. Contractual Arrangements. - One of the methods used to overcome the extraordinary shortage of labor supply was to get as many separate contractors on the job as possible. In following this precept, about 150 separate prime contracts with the Government were let for construction or supply of materials during the Central Facilities construction period. Over 60 of these contracts were in connection with the town. During the same period Stone & Webster awarded approximately 37 subcontracts under the managerial contract. There were many additional subcontractors working for the prime contractors of major sections of the town; for example, O'Driscoll & Grove, Inc., awarded 16 subcontracts during its work on the first 1,000 houses, and Foster & Creighton Company awarded the same number in the construction of the Town Center buildings.

5-4. Operations.

a. Accomplishments. - Over $100,000,000 worth of housing, utilities, and other features constituting the Central Facilities were constructed.

b. Problems.

(1) Labor. - The shortage of labor was the largest single obstacle which had to be overcome in the construction of the town. The project was located in an area which contained no large labor pool from which to draw on, so recruiting efforts were spread over a wide area. Extraordinary labor priorities and recruiting methods were adopted to offset the disadvantage of location (For a discussion of the labor recruit-

ment program, see Book I, Volume 8).

(2) Supply. - Such items as lumber and millwork, which ordinarily presented no problem, were required in such large quantities that all the efforts of the Government and contractors were necessary to get them to the job when required.

(3) Speed. - The speed at which it was necessary to prosecute the construction work made it necessary for a large number of organizations and men to work on the job simultaneously and forced the adoption of certain measures and procedures which tended to increase the cost.

5-5. Construction Costs. - The construction and initial costs of the facilities and services administered, supervised, and operated by the Facilities and Service Division, together with the Division's own administration installations, are, perhaps, indicative of the extent and magnitude of CEW. The operation of these facilities and services was a major activity in itself, although the facilities function merely as auxiliaries to the industrial plants. Construction costs can be spread among the several facilities, services, and activities with reasonable satisfaction, if certain factors are kept in mind. In the war time rush and consequent emphasis on production, there were many instances in which several facilities, perhaps unrelated, were built under a single contract with the result that available cost and construction data for such a contract covered the entire cost of a group of buildings or other facilities. The spread of costs given in this paragraph is, therefore, only reasonably approximate, although the total cost much more nearly approaches accuracy. This is so because the cost of a fire station, for instance, may not be included in the cost of the security system, but is included in the

cost of commercial facilities, the station having been constructed as a relatively minor feature of a large group of store buildings. In addition, many buildings have been converted to uses other than that for which they were built or initially occupied; in such cases, the construction cost is assigned to initial use when known. With due consideration given these factors, the approximate spread of construction costs, which include estimated costs of $5,216,202.90, through 31 December 1946, is as follows (See individual sections for available operational costs and for qualifications of cost figures shown below. See App. A-6 for reference to estimates made prior to a more definite determination of construction costs):

Facility	Cost	Reference
Housing	$57,737,411.87	Apps. C-3 and C-3a Par. 7-3
Commercial Facilities	4,968,030.59	App. C-5; Par. 8-11
Schools	3,864,346.80	App. C-6; Sec. 9
Medical Facilities	1,829,640.01	App. C-6; Par. 10-5
Social and Welfare Services	1,060,966.94	Par. 11-11
Electrical System	2,000,000.00	Par. 12-18
Water Supply System	8,342,803.18	Par. 13-8
Sewerage System	6,013,976.77	Par. 14-15
Roads, Streets, Walks, and Bridges	8,680,749.35	Par. 16-8
Railroads	1,592,281.80	Par. 17-9
Passenger Transportation (Bus)	355,665.03	Sec. 18
Miscellaneous Facilities	5,119,890.26	Par. 19-9c; App. C-11
Security System	212,798.42	Pars. 19-3 and 19-4
Communications System	307,593.04	Par. 15-9

Facility (cont'd).	Cost (cont'd).	Reference (cont'd).
Site Preparation	$ 2,072,798.42	Par. 2-6
Architect-Engineer-Management Costs	3,002,338.00	Pars. 4-4 and 5-2
Total	$107,161,293.48	

5-6. Key Personnel. - Reference is made to Paragraph 4-6, on key personnel, and to the attached organization charts (Apps. C-17 to C-21). The following list indicates the men chiefly responsible for the planning and construction phases of Oak Ridge and the Central Facilities.

a. Colonel (then Lieutenant Colonel) Robert C. Blair was directly in charge of major planning throughout his period of service with CEW from August 1942 to July 1943, first as Executive Officer and then as Deputy District Engineer. As Deputy District Engineer, from May 1943 to July 1943, he was in charge of all construction at CEW.

b. Colonel (then Lieutenant Colonel) Thomas T. Crenshaw, who succeeded Colonel Blair in July 1943, served from July 1943 to May 1944 in various capacities, including the posts of Deputy District Engineer, Area Engineer, and Executive Officer and Chief of the Central Facilities Division, all connected directly with planning and construction.

c. Colonel John S. Hodgson succeeded Colonel Crenshaw and served as Executive Officer, CEW, and as Chief of the Central Facilities Division and Chief of the Facilities and Service Division from May 1944 until January 1946.

d. Lieutenant Colonel Warren George initiated preparation for construction of the Central Facilities in November 1942 as Area Engineer, Tennessee Area, and later, into the fall of 1943, served as Chief of the Construction Division.

e. Lieutenant Colonel (then Major) W. E. Kelley worked on preliminary planning of Central Facilities from September 1942 to April 1943 as Chief of the Engineering Division.

f. Major (then Captain) Edward J. Bloch was Executive Officer to the Deputy District Engineer in charge of CEW from January 1943 to November 1943. He was also connected with Central Facilities from November 1943 to December 1944 as Chief of the Construction Branch. He further served as Chief of the Operations Branch, Central Facilities Division, from December 1944 to March 1945, and as Assistant Chief, Facilities and Service Division, until July 1945.

g. Major Fred Belcher served as Area Engineer at Boston, from June 1943 to August 1944.

h. Major Benjamin Hough was Area Engineer at Boston from August 1942 to February 1943.

i. Major M. M. Pettijohn headed the Construction Branch, Central Facilities Division, from March 1945 until June 1945 and was responsible for town design during the expansion program of the spring of 1945.

j. Major T. J. Rentenbach was in charge of equipment and materials at CEW from November 1942 until May 1943 when he became assistant to Colonel George in charge of construction, serving thusly until November 1943. From November 1943 until March 1945, he served as Assistant to the Executive Officer and Assistant Chief of the Central Facilities Division under Lieutenant Colonel Crenshaw and Lieutenant Colonel Hodgson, in connection with Central Facilities planning and construction.

k. Major Paul F. Rossell, as Chief of the Engineering Division, CEW, and Chief of the Engineering Branch, Central Facilities Divi-

sion, from May 1943 to April 1944, reviewed and approved all sub-project plans, having previously served as assistant to Colonel George, on construction, from January 1943 until May 1943.

l. Major Melvin O. Swanson served as Area Engineer, Boston, from February 1943 to June 1943, and then as officer in charge of utilities planning and maintenance at CEW, from July 1943 to September 1945. He was also in charge of utilities construction from January 1945 to September 1945.

m. Major (then Captain) Walter C. Youngs, Jr., worked primarily on planning of utilities and roads from May 1943 to August 1945 as Assistant Chief of the Engineering Division, CEW, and he served as Assistant Chief of the Engineering Branch, Central Facilities Division, until April 1944; and until September 1945, he served as Assistant Chief of the Utilities and Maintenance Branch, Central Facilities Division, assisting in the supervision of construction and maintenance of utilities and the direction of road paving and maintenance.

n. Major (then Captain) Samuel Baxter was in charge of town planning from February 1943 to August 1944, except for a period as Town Manager in the summer of 1943.

o. Captain P. F. O'Meara served as assistant to Major Baxter, was responsible for town planning from June 1943 to October 1943, and served for a time as Town Manager.

p. Captain W. W. Lord was Area Engineer, Boston, from August 1944 until February 1946.

q. Captain R. L. Crawford supervised and coordinated utility construction and grading.

r. Captain B. F. Marx assisted in the supervision of grading, construction, and building maintenance.

s. Captain Van S. Reid supervised a part of building construction from March 1943 to July 1944.

t. Captain E. B. Calvin, of the Engineering Division, assisted Major Rossell as engineer in charge of bridge and railroad design, location, and construction from May 1943 to November 1943.

u. Mr. O. C. Aug coordinated building construction in the town from November 1942 to December 1944.

v. Mr. LeRoy Jackson supervised construction of sewer and water lines and grading work from February 1943 forward.

w. Mr. R. M. Thomas assisted Captain Crawford in supervision of utility construction from January 1943 to July 1944 and after July 1944 assisted Major Youngs in construction of additional water supply facilities.

SECTION 6 - OPERATIONS

6-1. General. - The operation of Oak Ridge began when the town facilities and utilities were placed in operation after the completion of the first buildings (See Pars. 1-8 and 1-9); the Town Management Division, Manhattan District, had been actively engaged for several months in lining up key employees and concessionaires and arranging for food and operational supplies (See Par. 3-6b). In the fall of 1943, after the increased size of the town led to the engagement of Roane-Anderson Company (See Par. 1-8), the company started assembling personnel. During the winter of 1943 and the spring of 1944 Roane-Anderson gradually assumed major, although limited, operation of the town. Roane-Anderson did not administer recreational facilities, and was given only limited responsibilities (See Par. 6-5b) in connection with the medical services (See Sec. 10), the schools (See Sec. 9) and the security system (See Sec. 19). Although the town was still growing, sufficient information was available by the end of 1944 to predict the ultimate growth of the project, and sufficient operating experience was collected to permit long term planning for the conduct of operations. In the latter part of 1944 studies which led to the negotiation of contracts with specialized operators were initiated (See Par. 1-8).

6-2. Controlling Policies. - Throughout the operation of the town there have been certain policies which controlled the operation. Some of the policies were evident in the beginning and have been followed throughout. Others have been formulated on the basis of experience.

a. Minimum Services. - The policy followed in planning facilities was continued in their operation. Thus, residents are furnished

adequate fare in the cafeterias, laundry and dry cleaning service which is limited to essential work, and store stocks which are chosen for day to day necessities instead of consisting of complete lines.

b. Subsidies. - Some operations do not make a profit. The policy of subsidized operation necessarily has been based on the best interest of the project in attracting and holding personnel for operation of the plants. Outstanding examples of this policy are the subsidized bus (See Sec. 18) and dormitory operations (See Sec. 7).

c. Security. - The necessity for strict security has precluded the granting of many concessions with privately-owned facilities which would have reduced the burden of services to be provided by the Government. It would have been simpler, for example, to allow the Federal Public Housing Agency to provide facilities and take charge of housing operations, as at many other locations, if it had not been necessary to refuse information required to plan such work.

6-3. Operation by Government Forces. - As indicated in Paragraphs 3-6b and 6-1, the Town Management Division began operations before any of the town was available for occupancy. Working with information made available from the planning groups, the Town Management Division laid out a plan to operate the town, negotiated with proposed concessionaires, computed rentals, and acquired the nucleus of key personnel to begin actual operations. Physical operation of the town facilities was begun by Government forces on 15 June 1943, with the opening of the first cafeteria (App. D-28g) and the first dormitories (Apps. D-22 and D-23). In July the laundry (App. D-31) was opened, and in August the first stores were opened for business. See Paragraph 3-6b for treatment of adminis-

trative organizations concerned during period of operation by Government forces.

6-4. Selection of Operating Contractor.

a. Organizations Considered. - It became apparent that it would be necessary to engage a central organization on a cost-plus-a-fixed-fee contract basis for the operation and maintenance of certain major revenue producing facilities (See Pars. 1-8 and 6-1), such as housing, dormitories, cafeterias, and non-revenue producing activities, such as road and street maintenance and warehousing, although certain commercial operations could be performed on a concession contract basis. Further, it was realized that the variety of operations and services required to be performed precluded the possibility of engaging any one organization experienced in all of the phases of work which would be involved. Because the various activities were so inter-related, operation by one overall organization was imperative. Construction activity was under way at the site on such a scale that it was recognized that, for a temporary period at least, the operating firm would have to be one familiar with construction conditions and experienced in property management and operation. Stone & Webster Engineering Corporation, then engaged in the construction of the Central Facilities as well as the Electromagnetic Plant, was first considered, but because of the enormous amount of construction work in which the corporation was currently involved, and because its supervisory personnel was already thinly spread on their current work, it was found that the organization did not have the personnel available to undertake another major operation. The J. A. Jones Construction Company, construction manager for the Diffusion Plant, was

also considered, but rejected for the same reason. Turner Construction Company was then considered on the basis of its reputation and past activities and was approached to determine its interest in the undertaking (Apps. A-23 and A-24a).

b. Negotiation of Contract. - A series of meetings was held with officials of Turner Construction Company during the month of September 1943 (App. A-23) to establish the qualifications of the contractor, the scope and nature of the work to be performed, the method of operation, and the compensation. Turner Construction Company proposed to organize Roane-Anderson Company as a Tennessee corporation, wholly-owned by Turner, and to staff it with key personnel from the parent organization. The negotiations culminated in an oral award on 20 September 1943 and a confirmation by letter of intent on 23 September 1943. The contract (App. A-24), embodying the decisions reached in the negotiations and the provisions of the letter contract, was awarded effective 15 September 1943.

6-5. Contractual Arrangements.

a. Costs and Contractor's Fee. - On the basis of a study of the operations involved, it was estimated that the expenditures would amount to approximately $2,780,728 per month or $33,368,740 per year (App. A-24a), and on the basis of a study of the personnel requirements involved, a fee of $25,000 a month was allowed (App. A-24). Because of a reduction in services eventually required of Roane-Anderson (See Par. 6-7), the fixed-fee was reduced to $14,000, effective 1 November 1945 (App. A-218).

b. Statement of Work. - Under the provisions of the statement of work, it is provided that Roane-Anderson act as agent for the

Government in operating and maintaining such of the Government-owned facilities, utilities, properties, and appurtenances within the CEW, but not including plants and appurtenances within restricted areas designated by the District Engineer, as the Contracting Officer, Central Facilities Division, might designate. The contract lists as illustrations the following: houses, hotels, cafeterias, auto pools, busses, roads and walks, and utilities; but sets forth specific limitations, as in the case of the hospital, which is operated by Roane-Anderson under the direction of the medical representative of the Contracting Officer and staffed by professional personnel from other sources, but paid by Roane-Anderson when so directed; the schools, which are operated separately by others, but with certain maintenance service furnished by Roane-Anderson; the fire, guard, and police forces which are paid by Roane-Anderson but directed by the Chief of the Department of Public Safety. Further illustrations listed are the entering into and supervision of concession agreements, residence agreements, distribution of fuel, location and purchase of materials, and assistance in procurement of labor.

c. Collections. - Subject to the direction of the Contracting Officer, Facilities and Service Division, the company is empowered to prescribe rates and fees to be paid by persons benefiting from use of the facilities, and to collect all revenue arising therefrom, using the revenue to reduce the net cost of the work performed.

d. Estimated Revenue. - While it was estimated that the cost involved in performance of the work under the contract would be $33,368,740 per annum (See Par. 6-5a), it was also estimated that the revenue to be collected by the contractor from operation of facilities

would be approximately $15,903,930 annually, reducing to the extent of revenue the net cost for which the company was to be reimbursed by the Government.

e. Construction Work. - The contract specifically requires the contractor, when directed, to perform construction work incidental or supplemental to existing facilities.

f. Payments. - A specific list of items is included, describing the items for which the contractor is to be reimbursed, including transportation expenses to and from the job of certain classes of employees. The fixed fee was to be paid in monthly installments up to 90 percent as it accrued, with 10 percent held back until expiration of the contract; this reserve feature was later modified to provide for full payment after one year of satisfactory performance.

g. Guarantee. - The performance of Roane-Anderson is formally guaranteed by Turner Construction Company.

h. Other Provisions. - The contract generally follows the standard form for CPFF operating contracts and contains other appropriate articles, including provisions relating to termination, renegotiation, wage rates, and discrimination.

6-6. Performance of Operating Contractor.

a. General. - Roane-Anderson set up its project office on 7 October 1943. The company initially was organized in five divisions: Supervisory, Utilities, Operations, Maintenance, and Accounts, under the direction of a Project Manager. Reference is made to the functional organizational charts in Appendices C-14 to C-16 which illustrate the evolutionary features of town management by Roane-Anderson.

b. Assumption of Operating Responsibility. - Roane-Anderson did not assume all operations at one time. Instead, the transition period extended from October 1943 through March 1944, during which the individual units were taken over from the Central Facilities Division as rapidly as the Roane-Anderson organization could be gathered and trained. The first feature, Laundry No. 1, was taken over on 17 October 1943. In rapid succession, followed the two operating cafeterias, the transportation system, general cleaning of public buildings, refuse collection, and coal distribution. The water and sewerage systems were transferred in November 1943 and the electric power and steam distribution systems in January 1944. Following the first of the year, many of the functions assumed by Roane-Anderson had not been operated before by others but were taken over upon completion (App. A-19).

c. Employment. - From the company's arrival on the job in October 1943, until February 1945, Roane-Anderson employment rolls grew to about 10,500 persons, including the company's direct employment and employment of concessionaires operating under subcontracts. In February there was a sharp drop when about 900 were released because of the transfer of the bus system to American Industrial Transit. Similar transfers were planned although it was then anticipated that the total personnel for direct town operation would hold at about 10,000 (App. A-19). On 31 December 1946, direct employment of Roane-Anderson was 2,905 and that of concessionaires and subcontractors was 3,663 (App. A-319).

d. Reimbursable Cash Costs. - Reimbursable cash costs incurred by Roane-Anderson through 31 December 1946 were as follows (App. A-296):

d. Reimbursable Cash Costs (cont'd).

(1) By Purpose.

Materials, Subsidies, Supplies	$ 24,657,644
Payrolls	42,673,955
Payroll Taxes	1,880,727
Workmens Compensation & Liability Insurance	544,009
Fee	827.667
Gross Reimbursable Costs	$ 70,584,002
Less: Revenue	25,930,974
Net Reimbursable Costs, including Construction	44,653,028

(2) Breakdown of Preceding Costs by Administrative Units.

	Gross Reimbursable Costs	Revenues	Net Reimbursable Costs
Division of Operations	$ 58,182,754	$ 18,751,704	$ 39,431,050
Division of Utilities	2,004,047	14,399	1,989,648
Concession Division	3,401,577	7,105,000	3,703,423 (cr)
Division of Administration	2,373,904	25,264	2,348,640
Division of Audit	305,735		305,735
Division of Accounts	2,060,907		2,060,907
Construction	1,576,789	34,607	1,542,182
Fee	827.667		827.667
SUB-TOTAL	$ 70,733,380	$ 25,930,974	$ 44,802,406

Less: Undistributed Credits, see next page.

	Gross Reimbursable Costs (cont'd).	Revenues (cont'd).	Net Reimbursable Costs (cont'd).
Less: Undistributed Credits (cont'd).			
(Returned Containers, Discounts, and Unclaimed Wages)	$ 149,378		$ 149,378
TOTAL	$ 70,584,002	$ 25,930,974	$ 44,653,028

6-7. Decentralization of Operations. - In the program of reduction of Roane-Anderson operations (See Par. 1-8), the first service to be transferred was the bus system which was taken over by AIT in February 1945, under the terms of an incentive-fee prime contract (See Sec. 18). The decentralization of housing management, beginning in the summer of 1945, is discussed in detail in Paragraph 7-4, and the decentralization of major commercial operations in Section 8.

SECTION 7 - HOUSING

7-1. General. - Housing is the largest single feature of the Central Facilities, its cost being more than all other features combined. Total cost of housing at Oak Ridge, through 31 December 1946, was $57,737,411.87, including $2,051,604.64 in estimated costs. As described in detail in Paragraph 4-1, housing at Oak Ridge, like other major features of the Central Facilities, developed in three major programs of planning and construction. General references to housing are contained in Appendices A-8, A-14, A-16 to A-18, A-31, A-193, and A-206. Complete cost data, showing types of housing, numbers of buildings and units, contract payments, Government and management costs, unit costs, costs of equipment and fixtures, and total direct and indirect costs of all types of housing, are shown in Appendix C-3. Complete contract data, showing contract numbers, names of contractors, types of housing, numbers of buildings and units, contract dates, building and equipment costs, and total contract payments, are shown in Appendix C-3a. Photographs and floor plans of major types of housing are shown in Appendices D-1 to D-27.

7-2. Planning and Design.

a. Family-Type Dwellings.

(1) Cemesto Type Houses. - The 2,600 houses, containing 3,050 units, constructed under the first program are all of the cemesto type, itself made up of nine types, known as Types "A" (App. D-2), "B" (App. D-3), "C" (App. D-4), "D" (App. D-5), "E" (App. D-6), "F" (App. D-7), "G" (App. D-8), "H" (App. D-9), and "D-D". Cemesto house designs were prepared by Skidmore, Owings & Merrill, Architect-Engineer, as adaptations of designs developed by the John B. Pierce Foundation (Apps. A-14, A-16,

and A-30; also see Par. 4-4). Each cemesto house is a single family unit, except type "E" which consists of four units. The design of cemesto houses is characterized by exterior walls of horizontal cemesto board panels supported by horizontal structural wood framing. Floors are of conventional type supported by wood joists and girders. The cello roofing consists of one-inch fiber insulation board covered with mineral surfaced roofing, factory applied; roofing is supported on wood trusses. The "G" and "H" types have no fireplaces and are heated by magazine-type coal stoves. Other cemesto houses are heated by central warm air coal furnaces, supplemented by fireplaces. Types "A", "B", and "G" have two bedrooms; Types "C", "D", "F", and "H" have three bedrooms; and Type "E" contains both one-and two-bedroom units (Apps. A-8 and A-30; also Pages 1083 to 1092 of App. A-193; see Apps. D-2 to D-9 for photographs and floor plans). One Type "E" house was converted into a welfare home in 1946 (See Sec. 11).

(2) Multi-Family Houses. - The multi-family type houses, developed in the second program, likewise were designed by Skidmore, Owings & Merrill. Types "K" (App. D-10), "L" (D-11), and "N" (App. D-12), consist of two story buildings having from two to 12 family units per building. Types "T" (App. D-13) and "U" (App. D-14) are built of asbestos siding and consist of two family units per building (App. A-8). Type "K" house has two two-bedroom units and two one-bedroom units; the "L" house, one three-bedroom unit and one two-bedroom unit; the "N" house, 12 one-bedroom units; the "T" house, one three-bedroom unit and one two-bedroom unit; and the "U" house, two two-bedroom units (Apps. A-8 and C-3; also Pages 1097 to 1101 of App. A-193). The 375 multi-family houses provide

a total of 1,000 family units (App. C-3).

(3) Prefabricated Houses.

(a) TVA and Related Types. - Because of the urgency of reducing on-site labor to a minimum and of obtaining large numbers of dwelling units in a very short time, the second phase of housing construction made extensive use of prefabricated type housing. The Tennessee Valley Authority made available drawings and specifications for three types of prefabricated houses, the A-6, B-1, and C-1, containing one, two, and three bedrooms, respectively. TVA designs were revised by Skidmore, Owings & Merrill as required because of the availability of materials, topography, and other conditions at the project. The revised designs provided for increased foundation bracings and for erection by crane. The A-6 type is a one-story, one-bedroom, one-family unit, with a floor area of 372 square feet. Type B-1 is a one-story, two-bedroom, one-family unit, with a floor area of 608 square feet, and Type C-1, a one-story, three bedroom, one-family unit, with a floor area of 768 square feet. All three types are set on wood posts. The superstructure of each is of prefabricated sections, walls, partitions, and floor and roof panels constructed of plywood glued to wooden frames. They have canvas roofs and plywood interior finish. Heating is by coal-fired space heaters. Prefabricated Type "V", while similar to TVA Type B-1, was developed by Skidmore, Owings & Merrill for fabrication at the project. Type "V" is a single-family house which consists of a living room, a kitchen, a bath, and two bedrooms; exterior walls are wood framed and surfaced on both sides with plywood (Apps. A-8 and B-16; also Page 1102 of App. A-193). Prefabricated Type "S", a one-

bedroom unit (App. D-17), was developed by Skidmore, Owings & Merrill for prefabrication at the project in the third building phase in 1945 (App. A-206). TVA Types A-6, B-1, and C-1 and Types "V" and "S" eventually numbered 3,373 (Apps. C-3 and C-3a).

(b) Hutment Apartments. - The so-called Hutment Apartments are prefabricated units consisting of 50 one-family units, one two-family unit, and four one-story utility buildings. One one-family unit consists of two 16 x 16 foot hutments joined together, and is partitioned so as to provide two bedrooms, a kitchen, and a living room. The exterior frame walls are surfaced with plywood and the interior walls with fibre-board. Community shower rooms are contained in adjacent utility buildings (Page 1162 of App. A-193).

(4) Demountable Units. - Demountable houses, known as Type TDU, and made up of one-, two-, and three-bedroom units, were transferred to the Clinton Engineer Works from projects of the Federal Public Housing Authority at LaPorte, Indiana, and Point Pleasant, West Virginia, during the second phase of building. Of the 970 units, contained in 477 houses, obtained from the FPHA, 140 have one bedroom, 680 have two bedrooms, and 150 have three bedrooms. Although the TDU houses vary greatly in materials, design, and number of units per building, all are one-story buildings constructed of prefabricated panels and can be disassembled and re-erected (Apps. A-8 and D-20).

(5) Victory Cottages. - The Victory Cottage, House Type VC-1 (App. D-18), was designed by Skidmore, Owings & Merrill for construction in the 1945 housing program (Apps. A-18 and A-206). The VC-1 was assembled at the project from prefabricated panels and parts,

constructed chiefly of plywood walls and roll roofing. The Victory Cottage has one story, and each cottage consists of two one-family units, each having one bedroom and a combination living room-kitchen.

b. Apartments. - Three cemesto-type apartment buildings were designed by Skidmore, Owings & Merrill for construction in the first building phase. Two of the apartments, Types 1A and 1B, are substantially identical in design; each is roughly rectangular in shape, is two stories, and has outside dimensions of 45 by 247 feet; each of the two buildings consists of 23 apartments, each containing a living room, a bedroom, and bath, and one apartment containing a living room, bath, and two bedrooms; in addition to apartment units, each building contains a lobby, lounge, office, laundry, boiler room, and miscellaneous utilities. The third apartment building, Type 2, a "U" shaped structure, has two stories and consists of 65 apartments, each containing a kitchen, a bath, and a combination living room-bedroom; in addition, the building contains the usual utility rooms. Construction of all three buildings consists of concrete block foundations, walls of cemesto boards on wood frame, floors of wood on wood joists and girders, wood frame built up roofing, and interior finish of gypsum board (Apps. A-30 and D-21; also Pages 997 to 1000 of App. A-193). The designs of apartments converted from dormitories are described in the succeeding subparagraph.

c. Dormitories. - Dormitories consist of two general types, 46 "H" shaped and 43 "S" shaped. Of the 89 dormitories, 18 "H" types were designed for men, 28 "H" types for women, 11 "S" types for men, 29 "S" types for women, and 3 "S" types for married couples. All dormitories

are two stories high, but there is considerable variation in the interior design. Each of seventeen of the men's "H" type buildings has 74 single and 38 double rooms; each of 27 women's "H" type dormitories has 70 single and 38 double rooms; one men's "H" type has 81 double rooms, plus 17 connecting baths, and one women's "H" type has 77 double rooms, plus 17 connecting baths. Of the "S" type dormitories, each of 11 for men has 67 single and 40 double rooms, each of 12 for women has 63 single and 40 double rooms, and each of 17 for women has 60 single and 40 double rooms. Each of the three married couples dormitories has 76 bedrooms, with a connecting bath for each two bedrooms. All dormitories have recreation rooms and community plumbing and showers. The women's dormitories have laundry rooms. Most of the dormitories are heated by boilers and furnaces built as parts of the structures, although a few buildings are heated from the central steam plant. Seven of the "H" type dormitories were designed by Stone & Webster Engineering Corporation, while the remaining "H" types and all "S" types were designed by Skidmore, Owings & Merrill (Apps. A-8, A-30, A-206, D-22, and D-23; also Pages 976 to 978, 1039, 1040, 1042, and 1094 of App. A-193). In addition to dormitories described ~~in the paragraph~~ herein above, a dormitory for nurses was designed and constructed as a part of the medical facilities (See Sec. 10). In 1946 a program of converting certain available dormitories into family-type apartment buildings was started. Under this program, four "H" type dormitories and one "S" type dormitory were converted. A converted "H" type dormitory has 20 apartments, made up of the following units; three apartments, each with one bedroom and a large living room, four apartments, each with one bedroom, a large living room, and a porch; six

apartments, each with one bedroom and a small living room; six apartments, each with two bedrooms and large living room; and one apartment with two bedrooms and a small living room. Each "H" type unit also has a bath and kitchenette. Together, the converted "H" type dormitories provide 80 apartments (Apps. A-260 and A-261). The converted "S" type dormitory has 42 apartments, each containing a kitchenette, bath, and a combination bedroom-living room (Apps. A-262 and A-263). Designs for conversion of dormitories into apartment buildings were drawn by the Department of Public Works of the Facilities and Service Division. Also in 1946, one and part of another of the "S" type dormitories designed for married couples and one of the standard "S" type dormitories were converted into hotels and operated as commercial facilities (See Par. 8-9c), but no design work was required for use of the standard "H" type as a hotel.

camps were designed and eventually developed in Oak Ridge. The original designs provided for a combined area of 285.5 acres and space for 2,265 single Government-owned and 539 double Government-owned trailers, and 116 privately-owned trailers, plus trailers and other structures designed for utility purposes. Trailer camp planning also provided for recreational areas and limited commercial facilities (App. A-206; also Pages 1138 to 1148 of App. A-193). Ultimate expansions of the camps gave them a capacity of nearly 4,000 Government-owned trailers and 269 privately-owned trailers. The Government-owned trailers were transferred to the project from other Government agencies (See Apps. D-24 and D-25 for photographs). In addition to trailer camps in Oak Ridge, operated as part of the Central Facilities, camps were developed in the Diffusion Plant Area for personnel employed in that area.

e. Hutments. - The factors of imported labor and lack of housing in nearby communities also led to the development of hutment areas. The original plans, made early in 1943, contemplated a camp of barracks as an auxiliary housing facility. However, barracks of the prefabricated type were not immediately available, but smaller prefabricated structures known as "Victory Huts" (See App. D-26 for photographs; "Victory Huts" are not to be confused with "Victory Cottages"), with a capacity of five men each, were not only available but had been used with outstanding success on other construction projects in the United States and abroad. Such a camp had additional advantages in that it permitted improved sanitary conditions and decreased friction among workers. Two hutment camps, one for white construction workers and the other for colored workers, were approved in which every group of 12 huts

had its own utility building and each camp had its own cafeteria, recreation building, barber shop, and other facilities. Such a group is termed a section. The camp for white workers was eventually expanded so as to consist of 699 single hutments and 67 utility buildings and the camp for colored workers so as to consist of 450 single hutments, four single family hutments, 10 double family hutments and 44 utility buildings. A small camp for supervisory workers consisted of 101 hutments and 11 utility buildings. In addition, a 750 man camp of 107 hutments and five other buildings was built by John A. Johnson Contracting Corporation for its own forces; this camp was subsequently purchased by the District. In addition to hutment camps in Oak Ridge, operated as a part of the Central Facilities, hutment areas were developed in the Diffusion Plant Area for personnel employed in that area. Single hutments are 16 feet by 16 feet, prefabricated, one-story structures with wood post foundations and lightweight wall and roof sections, surfaced on the outside with plywood; single family hutments have a kitchen wing; double family hutments consist of two single hutments connected by a wing containing two kitchens. The utility buildings are 16 feet wide and 32 feet long and are built on concrete slabs (Pages 1187 to 1205 of App. A-193).

f. Cantonment. - With housing provided by the hutments and trailer camps far from sufficient, it was decided that prefabricated barracks, originally purchased for a proposed military cantonment, ~~after barracks became available~~, could be used temporarily for construction workers. The original cantonment of 24 barracks and 14 other buildings, including offices, lavatories, recreation buildings, a mess hall, an infirmary, a

warehouse, and a canteen, was expanded by the transfer of 36 hutments and three other buildings from the white hutment area, and the later acquisition of four other prefabricated barracks and 48 additional hutments. The barracks were 20 feet by 100 feet prefabricated buildings, with exterior wall and roof sections of lightweight wood surfaced on the outside with plywood.

g. Farm Houses. - In addition to housing features planned and constructed, a number of existing farm houses were acquired incidentally with the reservation. Of these, approximately 165 were available for occupancy during the period of peak population (App. A-189), but by 31 December 1946, the number was reduced to slightly more than 100 (App. A-266).

7-3. Construction, Contract, and Cost Data (See Apps. C-3 and C-3a).

a. Houses.

(1) General. - Construction of houses was prosecuted under lump sum contracts let by competitive bidding and, during 1943 and 1944, managed by Stone & Webster, who also furnished engineering services. Construction accomplished during the 1945 program was supervised directly by engineers of the Central Facilities Division, with Skidmore, Owings & Merrill performing inspection services (App. A-206 and Page 31 of App. A-193). Work was let in groups as increments were authorized, and houses were completed for occupancy as rapidly as possible. The first contract was let in March 1943, and the first houses were ready for occupancy in July of the same year. By October over 400 houses were completed. The pace increased, and in January 1944, 710 units were completed, and during February, March, April, and May, more than 1,100 a month were completed.

During April, the peak month, 1,368 houses were completed ~~(App. A-10)~~. Construction of houses in the first two programs was completed in the summer of 1944 (App. C-3a).

(2) Cemesto Type. - The 3,050 cemesto-type units constructed under the first housing program, were built, under Stone & Webster supervision (Pages 1083 to 1091 of App. A-193), by O'Driscoll & Grove, Inc. (Apps. A-33 and A-35), Clinton Home Builders (App. A-34), and John A. Johnson Contracting Corporation (App. A-32). The total cost, including contract payments, Government furnished materials and equipment, and those furnished by Stone & Webster, and overhead, was $18,502,471.82 (Costs shown subsequently in this section include these same items, except as otherwise noted; see Apps. C-3 and C-3a for detailed contract, construction, and cost data).

(3) Multi-Family Type. - The 375 multi-family type houses, containing 1,000 units, were constructed as a part of the second housing program, under Stone & Webster supervision (Pages 1097 to 1101 of App. A-193), by Coupe Construction Company (App. A-36) and Foster & Creighton Company (App. A-37). Total cost was $4,628,483.28 (See Apps. C-3 and C-3a).

(4) Prefabricated Houses.

(a) TVA and Related Types. - The construction of the 2,823 prefabricated houses, Types A-6, B-1, C-1, and "V", in the second housing program, was under the supervision of Stone & Webster (Pages 1102 and 1151 to 1153 of App. A-193). These houses, plus the 550 "V" and "S" types constructed in 1945, were constructed by Schult Trailers, Inc. (Apps. A-38 and A-39), National Homes, Inc. (Apps. A-40

to A-42; also see App. A-43), Gunnison Housing Corporation (App. A-44), Alma Trailers, Inc. (App. A-44a), E. L. Bruce Company (App. A-45), and John A. Johnson Contracting Corporation (Apps. A-46 to A-46b, and A-265). Total cost was $13,446,370.06 (See Apps. C-3 and C-3a). John A. Johnson Contracting Corporation was awarded a contract in July 1945 for the construction of 225 "V" type houses and 225 "S" type houses, but immediately after the end of hostilities and before any houses had been completed to a point of use, the contract was terminated. Termination of the contract resulted in a net contract settlement of $125,794.80 (App. A-220; also see Apps. C-3 and C-3a).

(b) Hutment Apartments. - The Hutment Apartments were constructed by Stone & Webster forces. Their cost was $155,785.09 (Page 1162 of App. A-193; also see Apps. C-3 and C-3a).

(5) Demountable Units. - The 477 demountable houses, containing 970 units, were dismantled, moved to CEW, and erected on new foundations, under Stone & Webster supervision (Pages 1154 to 1160 of App. A-193), by John A. Johnson Contracting Corporation (Apps. A-47 and A-49) and Foster & Creighton Company (App. A-48). The total cost was $2,660,662.57 (See Apps. C-3 and C-3a).

(6) Victory Cottages. - The 375 Victory Cottages, Type VC-1, containing 750 units, were assembled and erected in 1945 by John A. Johnson Contracting Corporation (Apps. A-49a and A-54). Total cost was $954,582.92 (App. A-265; also see Apps. C-3 and C-3a).

b. Apartments. - The three apartment buildings were erected as a part of the original housing program by Foster & Creighton (App. A-51), under Stone & Webster supervision (Pages 997 to 1000 of App. A-193).

Total cost was $703,612.17 (Apps. C-3 and C-3a).

c. Dormitories. - Ten "H" type dormitories were constructed by Stone & Webster field forces and four were constructed jointly by Stone & Webster and Foster & Creighton. The other 32 were constructed by A. Farnell Blair, under Stone & Webster supervision (Pages 976 to 978 and 1042 of App. A-193; also Apps. A-53 and A-55 to A-57). The total cost of "H" type dormitories was $6,784,459.14 (Apps. C-3 and C-3a). Twenty-three "S" type dormitories were constructed in 1944 by Clinton Home Builders, under Stone & Webster supervision (Pages 1039, 1040, and 1094 of App. A-193; also App. A-58), and 20 were constructed in 1945 by John A. Johnson Contracting Corporation, under direct Government supervision (Apps. A-79 and A-81). Total cost of all "S" type dormitories was $3,934,330.91 (Apps. C-3 and C-3a). The conversion of five dormitories into apartment buildings was performed in the summer of 1946 by John A. Johnson Contracting Corporation. Cost of conversion, not including some minor Government-furnished items, was approximately $271,148.20 (Apps. A-260, A-262, and A-264). With the exception of the conversion of one dormitory into an office building, a major commercial facility (See App. C-5), the conversion of other dormitories for other uses required no capital expenditures.

d. Trailer Camps. - The seven trailer camps in Oak Ridge, as part of the Central Facilities, were built by Stone & Webster. Cost of the camps, not including trailers themselves, which were transferred from other Government agencies, was $1,303,696.14 (Pages 1138 to 1148 of App. A-193; also see Apps. C-3 and C-3a).

e. Hutments. - The supervisory, white, and colored hutment

areas, including hutments and supplementary buildings, were constructed by Stone & Webster at a cost of $1,862,760.27. Cost of the hutment camp purchased from John A. Johnson Contracting Corporation was $21,152.28 (Pages 1187 to 1206 of App. A-193; also Apps. A-31a, C-3 and C-3a).

f. Cantonment. - The original cantonment facilities of 24 barracks and 14 other buildings were constructed by Stone & Webster. Cost of construction, plus the cost of moving only of the 36 hutments and three other buildings from the white hutment area, was $472,673.09 (Pages 263, 265 to 272, and 280 of App. A-193). The remaining 48 hutments and four additional barracks were erected by Roane-Anderson Company. The 48 hutments were purchased for $16,033.92 (App. A-184) and the four additional barracks for $22,640.00 ~~(App. A-264)~~; the cost of erection was $28,355.11 for the hutments and $61,943.66 for the barracks, including, in the case of the barracks only, outside water and sewer work (App. A-267). The total cost of the cantonment area was $601,645.78 (See Apps. C-3 and C-3a).

g. Farm Houses. - The value of existing farm houses was included in the price of site acquisition at CEW, and a separate cost figure for these houses is not available.

h. Furniture. - Furniture and other items were purchased by Stone & Webster and Roane-Anderson for the initial furnishing of housing units at an estimated cost of $1,780,456.44 (Pages 1072 to 1083 of App. A-193; also App. A-270).

7-4. Operation and Maintenance.

a. General. - During the period of town operation directly by the Government, housing assignments, administration, rentals, and ser-

vices were handled by the Central Facilities Operating Division and, after September 1943, by the Central Facilities Division, except for the trailer and hutment camps for construction workers, which were operated by Stone & Webster. On 11 December 1943, Roane-Anderson took over the housing operation, exclusive of trailers and hutments, under the general supervision of the Central Facilities Division. Operation of trailers and hutments was taken over by Roane-Anderson in May 1944 (App. A-19). As described in detail elsewhere in this paragraph, certain of the housing operations subsequently were subcontracted. Administration of housing operations and management always has been closely controlled by the Manhattan District because of the close relation between equitable housing policies and employee morale and efficiency. The housing management companies are supervised by the Housing Section of the Administrative Department of the Facilities and Service Division and by Roane-Anderson Company. The manner of compensation to the housing management companies and the disposition of rents collected vary considerably between the different types of housing; the details thereof are related in the succeeding subparagraphs.

b. Houses. - Under Roane-Anderson management, an application for a housing unit was made by the individual to his employer, who determined that the applicant was eligible for a house under the assignment policies. The application was then forwarded to the Roane-Anderson housing office for determination of availability of quarters. If the quarters were available, the house was assigned. Exceptions to the standard policies were required to have approval of the District Office before the assignment could be made. The usual procedure was for rental to be

deducted from the employee's pay, although this procedure required the approval of the District Engineer (App. A-189). On 1 May 1946 the system of payroll deductions was abandoned in favor of cash collections (App. A-269). House maintenance service was provided by Roane-Anderson at no charge for normal wear and tear, but at the occupant's expense if damage was due to neglect or willful misuse. Since income derived from house rentals did not cover the cost of operation when amortization of capital expenditures was considered, studies were made to determine the advisability of raising rents (App. A-59). It was decided that rents should not be increased, but that it would be to the best interests of the Government to place the management of family dwelling units in the hands of specialized operators. As a result, Roane-Anderson entered into a subcontract, effective 29 July 1945, with Tri-States Homes, Inc., for operation of all types of housing except dormitories, trailers, hutments, hutment apartments, and barracks (App. A-189). The subcontract with Tri-States Homes was terminated, effective 30 September 1946, and a subcontract for operation of houses, effective 1 October 1946, and the continued operation of converted dormitory-type apartments, was entered into with the Oak Ridge Housing Company (App. A-200; also see App. A-268). In the matter of Victory Cottages, 79 houses containing 158 units, were made available for colored occupancy on 28 January 1946, and their management was assumed by Ridenour Management Company; the number of units was increased to 220 on 7 March 1946 (App. A-259); the remaining Victory Cottages remained under the same management as other houses (Apps. A-189 and A-200). The subcontract with the Oak Ridge Housing Company provided that all rents accrue to the Government and the company be paid a manage-

ment fee of $8.41 per month for each housing unit, whether house, apartment, or Victory Cottage, under the company's management (App. A-200). In the case of Victory Cottages operated by the Ridenour Management Company, the fee to the company was fixed at $10.13 per month for each unit, with rents accruing to the Government (App. A-259).

c. Dormitories. - The operation of the dormitories was assumed by Roane-Anderson in December 1943. At that time there were 3,500 dormitory spaces available. As an emergency measure, it became necessary, in October 1944, to assign all unoccupied rooms on the basis of two occupants for single rooms and three for double rooms. All vacated rooms were added to this category and current occupants were invited to volunteer for doubled up accommodations to carry over a peak occupancy expected during the winter of 1944. The number of dormitories was gradually increased by new construction until in March 1945 the company operated 69 dormitories with space for approximately 10,500 persons. It finally became necessary in 1945 to construct 20 additional dormitories (App. A-52). Enliated personnel of the WAC Detachment assigned to CEW were quartered in a wing of one women's dormitory. As dormitory operations stabilized, it became feasible to negotiate with specialized operators as subcontractors under Roane-Anderson. In July 1945 the partnership of Leatherman and Alley was awarded a subcontract to operate 12 of the dormitories (App. A-190), and in August 1945 ~~(App. A-190)~~ Galbreath-Moore Company entered into a subcontract to operate the remaining occupied dormitories, including the "S" types for married couples (App. A-191). The subcontract with Galbreath-Moore was subsequently renewed, effective 16 September 1946 (App. A-201), and the contract with Leatherman and Alley

was terminated, effective 30 September 1946. The five apartment buildings converted from dormitories were operated after 1 August 1946, when they were released for occupancy, by the Oak Ridge Housing Company (App. A-268). Following the end of the war with Japan, dormitory occupancy declined sharply, until at the end of 1946 only 32 dormitories, occupied by 4,299 persons, were being used to house unmarried persons (App. A-301). Of the others, six and part of another, consisting of the five converted buildings and two of the married couples dormitories, were being used as apartment buildings; one and part of another as hotels, two as military barracks, three as warehouses, and one as an office building (See App. C-3b). Under the subcontract with Galbreath-Moore Company in force at the end of 1946, the company received all rents and, in addition, a monthly fee for the operation of each dormitory, the fee varying between types of buildings, the seasons, and the services required of the operator. The lowest amount was $450.12 per month for the operation of half of one dormitory building and the greatest amount was $1,339.32 for each dormitory used as military barracks from which no rent accrued (App. A-201). In the matter of converted dormitory apartments, the subcontract with Oak Ridge Housing Company provided that the company be reimbursed on the same basis as for houses (App. A-268).

d. Apartments. - The operation and management of the three original apartment buildings have paralleled that of houses, involving Government forces, Roane-Anderson, Tri-States Homes, Inc., and Oak Ridge Housing Company (Apps. A-19, A-189, and A-200). Under the subcontract in force at the end of 1946, the management company was allowed a fee of $8.41 per month for each unit, with rents being paid to the Government (App. A-200).

e. Trailers. - When the first trailer camp was ready for operation in June 1943, Stone & Webster was designated the operator thereof (App. A-60). As suggested by the FPHA, on 21 June 1943 (App. A-61), rental rates of $7.00 and $8.00 per week for single and double trailers, respectively, were put into effect immediately (App. A-328); rent included normal utility services. Effective 30 January 1944, rents were reduced and fixed at $5.00 and $6.00 per week, respectively (Apps. A-329 to A-331). Management of trailer camps in Oak Ridge was transferred to Roane-Anderson on 29 May 1944 (Apps. A-350 and A-351). On 1 September 1944, rates were reduced further and fixed at $15.00 and $20.00 per month for single and double trailers, respectively; however an occupant was not charged rent for the month following each six months of occupancy (Apps. A-332 and A-333). Beginning in October 1944, collection was changed to a weekly basis ($3.45 and $4.00, respectively), and no rent was assessed for each four weeks after each 26 weeks of occupancy (Apps. A-334 and A-335). In June 1945 negotiations with Gibson Service Management Company for operation of trailer camps in Oak Ridge were concluded; rental rates were again fixed at $15.00 and $20.00 per month, and the provision for no charge for each seventh month was continued (App. A-148). Effective on 1 June 1946, the free rent feature was eliminated as it concerned new occupants, but tenants occupying trailers prior to 31 May 1946 were allowed occupancy credits through their current seven months occupancy period (Apps. A-352 and A-353). Operation of the trailer camps in Oak Ridge was continued by Gibson under another agreement, effective 1 July 1946; rates were fixed at $15.00 and $20.00 per month (App. A-257); Gibson also managed a camp in the Diffusion Plant Area for a short period early in 1946 (App. A-258). The subcontract with Gibson

in force at the end of the year provided that the subcontractor retain all rents collected for occupancy of trailers and hutment apartments, but that the subcontractor, in turn, pay to the Government, through Roane-Anderson Company, a monthly fee of between $1.00 and $1,100.00, depending on the percentage of occupancy (App. A-257). Trailer availability is shown on an attached chart (App. C-4).

f. Hutment Apartments. - The operation of the hutment apartments has paralelled that of the trailers, with provision for their operation being contained in the subcontracts with Gibson Service Management Company (Apps. A-148 and A-257; See Par. 7-4e for details of compensation to the management company).

g. Hutments. - The hutment camps were operated by Stone & Webster with the same organization which managed the trailer camps and were transferred to Roane-Anderson operation along with the trailers (App. A-19). As the need for construction personnel began to decrease at CEW, portions of the hutment camps were closed. At the end of 1946, the Colored Hutment Camp was still in operation, it having been operated since 28 January 1946 by the Ridenour Management Company (App. A-259). The other camps had been inactivated and the huts made available for transfer to other Government installations, including the Diffusion Plant Area where hutments were operated by the J. A. Jones Construction Company. Initially, rental rates for standard hutments with five occupants ~~was~~ were set at $0.30 per man per day with provision that all lump sum contractors pay the estimated additional cost to the Government of $0.40 per man per day to share the expense of housing as a subsidy for their employees (App. A-146). On 30 March 1944, the rental rate was reduced from $0.30

to $0.20. The rental for supervisors' hutments was set at $0.75 and $0.50 per man per day for three and four occupants, respectively; the contractors' share was $0.60 per man day. Single and double family hutments rented for $7.00 and $8.00 per week, respectively, plus a sum of $3.00 per week paid by the contractor (App. A-147). The rates were subsequently reduced, as shown in the attached schedule (App. C-8). The subcontract with Ridenour Management Company provided for reimbursement to the company by all rents collected for hutment occupancy, plus a weekly fee of $125.65 per week for the operation of each hutment section (App. A-259).

h. Cantonment. - After the cantonment was vacated by civilian construction forces, quarters for the enlisted men of the CEW Special Engineer Detachment and for the CEW Military Police Detachment were provided by the barracks in that area. In January 1946, the military was moved to dormitories in West Village, and the cantonment was closed and, with exception of four barracks, dismantled.

i. Farm Houses. - Farm house occupancy and rentals were managed by Roane-Anderson until the execution of the contract with Tri-States Homes, Inc., which assumed management of these houses (A-189). Management of farm houses later passed to the Oak Ridge Housing Company. The subcontract with the company provided for a fee of $1.00 per month per house, with rents being retained by the Government (App. A-200).

7-5. Assignments. - The demand for houses has always exceeded the number available. Therefore, it was necessary to establish a policy of allocation of units equitably between the operating organizations at CEW (App. A-62). On this basis, blocked assignments of houses were made and

adjusted as the needs of the project varied. The policies also provided for assignment of certain types of houses to certain classifications of operating personnel and prohibited the assignment of permanent and semi-permanent housing to employees not considered essential to the operation of CEW. Because a maximum of about one-fourth of the employees could be housed on the area in family-type housing and not all employees could be housed even in substandard family units, no arbitrary distribution methods could be devised which would satisfy all of the employees at CEW. Accordingly, constant attention was applied to the housing problem by the Central Facilities Advisory Committee (See Par. 3-6d). Under the relatively high turnover of personnel which existed throughout the construction and operations period, it was impossible to occupy all of the houses because a pool of vacancies was created by virtue of the time involved in the process of occupancy. This pool was kept at a minimum except during that period of readjustment when changes in operations or policy occurred. Before the stabilization of operations, the number of houses in the pool sometimes reached as much as eight percent of the total, but after stabilization units in the pool averaged two percent. At the end of 1946, the pool for cemesto, multi-family, prefabricated, and demountable houses was only 0.63 percent of the total available; with Victory Cottages, the pool was only 1.18 percent of the total. A chart showing availability and occupancy of housing at the end of December 1946 is attached (App. C-3b). With the exception of trailers and Victory Cottages, and, also, a few hutments in the Diffusion Plant Area, all vacancies of family-type quarters were very temporary and were due solely to the short time involved in effecting vacation and occupancy. With

the exception of these marginal types and dormitories, there was no surplus of housing units. The differences between units and buildings constructed and the number available at the end of 1946 are due to several factors, including loss by fire, demolition, dismantling, movement of units elsewhere, and conversion to other uses.

7-6. Rentals. - In order to permit the maximum use of housing, special authority was granted by the Secretary of War to suspend the provisions of Army Regulations 35-3240 and to establish uniform rates based on the value of housing rather than the income of the individual renters, thus permitting, in the cases of civilians, assignments based on minimum housing needs. In general, rates for houses have been based on fair charges for water, electricity, coal, sewage disposal, trash collection, and building maintenance and charges of approximately four to five-tenths of one percent for amortization of the capital expenditure. Combined charges for amortization and services averaged slightly less than one percent of building costs. Charges for amortization and maintenance were less than the OPA ceiling of eight-tenths of one percent of appraisals equivalent to those of 1942 (App. A-64). Rental rates for dormitories, trailers, and hutments, have been based not only on charges for the services furnished, but, also, on the best interest of the project in retaining certain types of personnel. A schedule of rental rates for housing, as of 31 December 1946, is attached (App. C-8).

SECTION 8 - COMMERCIAL FACILITIES

8-1. Scope. - The commercial facilities of Oak Ridge include all establishments needed to furnish the day to day necessities of the resident population, but they are fewer in number and handle fewer luxury items than are found in a normal community. They include complete central shopping centers, supplemented by integrated neighborhood shopping centers strategically located to serve the population. Recreation facilities are not considered commercial activities because at Oak Ridge they function as social services (See Sec. 11). The location and extent of the shopping centers are shown in Appendices B-4 and B-5 (Also see Apps. C-5 and C-13).

8-2. Initial Planning. - Original studies for the Oak Ridge commercial facilities were begun by Stone & Webster Engineering Corporation in 1942 and culminated in a proposed facilities schedule submitted on 5 January 1943 to the District Engineer (App. A-21). This schedule was revised by Skidmore, Owings & Merrill, Architect-Engineer, who became responsible for the town planning and design (App. A-30), but certain features of the preliminary Stone & Webster design were used, such as the laundry (App. D-31), the Guest House, and the first cafeteria (App. D-28g). The plans for the original town of 13,000 population, as finally approved for construction, provided for commercial facilities as follows:

a. A town center, called Jackson Square (See Apps. B-5 and D-28 to D-28g; the terms "Town Center" and "Jackson Square" are interchangeable, although the latter, as an official designation, came into use laterand is sometimes used to designate only a part of the Town

Center), of six buildings containing two drug stores, a soda fountain, a tailor shop, a shoe repair shop, a bank, a post office, a telegraph office, two super markets, a department store, a jewelry store, a variety store, a florist shop, gift shops, a restaurant, a barber shop, and a beauty shop (Apps. D-28 to D-28e; also see Apps. A-8, A-30, C-5, and C-13).

b. Three neighborhood stores, each containing a super market, a barber shop, a drug store, a shoe repair shop, and two boiler rooms (See Apps. D-29 and D-30).

c. A laundry, located near the Town Center (App. D-31).

d. Two cafeterias, one in Town Center (App. D-28g), and one in East Village.

e. A filling station and auto repair shop.

8-3. Secondary Planning. - When the housing was increased to accommodate approximately 42,000, a corresponding expansion of commercial facilities added the following (See Apps. A-8 and A-30):

a. Grove Center (Apps. B-5 and D-29), containing two food markets, five shops, a bank, a post office, and a restaurant.

b. Two additional neighborhood shopping centers containing facilities similar to those previously described (Apps. B-5 and D-30).

c. Three additional cafeterias in the western part of Oak Ridge (App. B-5).

d. A second laundry and a dry cleaning plant (Apps. B-5 and D-31a).

e. Two filling stations and a complete auto repair shop.

8-4. Additional Planning. - In addition to the facilities described, designed to serve the permanent houses and dormitories, additional shop-

ping facilities were provided in conjunction with the trailer and hutment camps. The largest of these is Middletown Center (See App. B-5), supplemented by a small commercial area, a farm market area, and other scattered facilities. The plans for expansion to a town of 66,000 population included additional facilities comparable in type and service to the existing ones (App. A-65). The facilities were first designed on the basis of national averages; later additions were controlled by actual job experience. Details of the planning and design, which harmonize with adjacent housing, are contained in completion reports prepared by Skidmore, Owings & Merrill (Apps. A-8 and A-30). Photographs of typical structures are appended (Apps. D-28 to D-31a).

8-5. Construction. - Some of the commercial buildings were constructed ~~partially~~ by Stone & Webster forces (App. A-193), but the majority was constructed by lump sum contractors under Stone & Webster management. Commercial construction was handled in a manner similar to the housing construction and proceeded at the same time so that occupied homes were served by shopping facilities. The first commercial buildings started were the Central Cafeteria (App.D-28g), the Guest House, and Laundry No. 1 (Apps. A-31, B-5, and D-31). Beginning in March 1943, construction proceeded as shown by the tabulation of facilities and contracts (App. C-5), until the summer of 1944 when the facilities for the town of 42,000 residents were completed (App. A-50). Construction of additional facilities in 1945 was under direct supervision of the Central Facilities Division and that in 1946 under the supervision of the Facilities and Service Division. Construction data through December 1946 are attached (App. C-5).

8-6. Operating Policies. - The basic policy for operation of the commercial facilities, as formulated during the initial stages, called for operation by separate concessionaires whenever possible and whenever good service could be obtained with reasonable prices (App. A-66). When a concession agreement reflecting the best interest of the Government could not be effected, the facility involved was operated by hired labor either directly by the Government or by a fixed-fee contractor.

8-7. Selection of Concessionaires. - The original concession plans were worked out by Stone & Webster and the Town Management Division of the District (App. A-21) during December 1942 and January 1943. Numerous consultations were held with possible concessionaires and with recognized authorities on town planning and business administration. As the business district plans were worked out, rental rates for facilities were established by studies of other installations and by consultation with such authorities as Dun & Bradstreet. Individual concessions were let on a competitive basis for each type of service required. Proposals were evaluated by the District on the basis of business reputation, gross percentage of receipts offered as rental to the Government, and other factors indicating relative desirability to the community.

8-8. Concession Operations.

a. General. - Concessions were originally operated by direct agreement between the Government and concessionaires under the supervision of the Town Manager. Later, as Roane-Anderson assumed operation of the town (See Sec. 6), the operating company was instructed to become responsible for operation of the concessions or for the supervision of their operation. Existing agreements were cancelled, and new

ones were executed with Roane-Anderson as agent for the Government (App. A-67). In the vast majority of commercial enterprises, e.g., shops and stores, monthly revenue consisting of a fixed percentage of gross receipts, is paid to the Government, through Roane-Anderson, as rent for use of Government-owned property. Other individuals and enterprises, including doctors, dentists, attorneys, insurance offices, and various agencies, pay a flat monthly space rental.

b. Receipts and Revenue. - In the instance of enterprises being operated on the basis of payment to the Government of a percentage of total sales, gross receipts were reported, for example, as $1,571,770.83 in March 1945, $1,908,856.30 in December 1945, $1,528,534.96 in April 1946, and $1,542,940.14 in December 1946; total gross receipts of these commercial facilities through 31 December 1946 were $50,115,781.01. The largest single type of business, in terms of gross receipts, was grocery stores, with cumulative total receipts, through 31 December 1946, of $15,563,550.65. Receipts to the Government, in the form of percentages of gross receipts and flat space rentals, were $93,322.76 in December 1946; the cumulative total through that month was $2,434,164.65 (Apps. A-68b, A-315, and C-13). Revenue to the Government for rental of equipment was $9,530.95 in December 1946; the total cumulative revenue from this source through 31 December 1946 was $171,002.47 (App. C-13a).

c. Types and Numbers of Concessions and Other Activities. - Concession privileges and other types of activities being operated under agreement, license, or lease include automotive garages and service stations, barber and beauty shops, miscellaneous establishments in the commercial areas, department and ready-to-wear stores, farmers' markets,

grocery stores, super markets, insurance agencies, miscellaneous businesses throughout the reservation, restaurants and lunchrooms, shoe repair shops, drug stores, dentists', physicians', and surgeons' offices; fraternal orders, and labor unions. There was a considerable increase in the number of individual concessionaires and licensees after V-J Day, a development made possible by the relaxation of certain security measures following the end of hostilities. It then became possible to offer the residents something more than the minimum essentials of civilized life and to encourage competition, thereby resulting in better service, greater availability of commodities, and savings to the consumers. A list of concessionaires and other individuals and activities licensed to operate at Oak Ridge, as of 31 December 1946, is attached (App. C-13).

8-9. Hired Labor Operations. - Certain of the major commercial facilities, intended for concession operation, were operated by Roane-Anderson until it became possible to make satisfactory concession agreements (See Pars. 1-8 and 6-7). These facilities included all but one of the cafeterias, both of the laundries, and the Guest House.

a. Cafeterias.

(1) Initial Period. - When cafeteria operation was first being considered by the Town Management Division, several possible operators were approached as possible concessionaires. However, in each case the prospective operator demanded a guaranteed weekly income which was considered excessive. Therefore, operation was started by the Government, beginning 15 June 1943, when the Central Cafeteria was opened under the direction of a cafeteria officer. Prices charged were Knoxville cafeteria prices less 10 percent, a device useful in making for

non-profit operations (Cafeteria construction costs are shown in App. C-5).

(2) Roane-Anderson Operations. - Roane-Anderson began operation of the cafeterias on 1 November 1943 and by March 1945 was operating 17 establishments, which included cafeterias, snack bars, and dining rooms. They were serving more than 36,000 meals a day with gross sales of more than $11,000. The operation of the Adams Cafeteria, in the West Village Dormitory Area (App. B-5), was assumed by Tennessee Sportservice, Inc., on 4 May 1945, and continued until 31 January 1946 (App. A-175) when many of the dormitories served by this cafeteria were closed. Canteen Food Service, by concession agreement from Roane-Anderson, assumed management of the Central, Jefferson, and Louisiana Cafeterias on 20 August 1945 (App. A-177); the Louisiana Cafeteria was closed on 2 August 1946 (App. A-273). Canteen Food Service also operated the White Hutment Area Cafeteria from 30 July 1945 to 14 November 1945, the Wheat Cafeteria from 8 September 1945 to 14 November 1945, the Cantonment Area Cafeteria from 5 September 1945 to 17 December 1945, and the Colored Hutment Area Cafeteria from 15 August 1945 to 30 June 1946. The White Hutment, Wheat, and Cantonment Cafeterias were closed after Canteen Food Service was relieved of their operation; in the case of the Colored Hutment Area Cafeteria (App. A-176), the management was assumed by J. Saunders Thompson and Robert H. Watkins (App. A-22). The Arkansas Cafeteria was operated by Anthony Cappiello and Tommy and H. G. Tucker from 27 August 1945 until 20 January 1946 (App. A-180), when the cafeteria was closed. On 31 December 1946, only the Central, Jefferson, and Colored Hutment Area Cafeterias were being operated (See App. C-13).

b. Laundries. - The first laundry service operated by the project was handled in temporary facilities available at Clinton, Tennessee. Laundry No. 1, including a dry cleaning plant, near the Town Center (App. D-31), was opened in June 1943 by the Town Management Division and was so operated until October 1943, at which time Roane-Anderson assumed responsibility, taking over the management and most of the personnel. Operation of the second laundry in the west part of Oak Ridge (App. D-31a) was begun in March 1944. Laundry prices were based on Knoxville prices less profit, with a discount allowance of 20 percent for cash and carry (App. A-68). By March 1945 the two laundries were handling about 20,000 orders a month (App. A-19). A specialized operator for the laundries and dry cleaning plant was obtained with the execution of a subcontract, effective 1 October 1945, with Mr. Eugene L. Dellegh (App. A-89). The subcontract was superseded on 30 September 1946 by a concessions agreement with the Area Laundry & Dry Cleaning Company (Apps. A-186 and A-207); Laundry No. 2 was closed a short time later. Construction costs of laundries are shown in Appendix C-5.

c. Guest House and Hotels. - The Guest House, near Jackson Square (See App. D-28), was opened under Government management on 5 August 1943 and was taken over by Roane-Anderson in December 1943. A specialized operator for the Guest House was obtained with the granting of a concessions agreement, effective 16 January 1946, to Alexander Hotels, Inc. (App. A-271). The Guest House is operated as a transient hotel. There are two beds in each room. A room may be assigned to persons not acquainted with each other. Thus, although there are only 52 rooms, the daily occupancy averages more than 100 persons (App. A-69). The rates

are low, but because of the high occupancy rate, the Guest House operates at a profit. Construction cost of Guest House was $205,415.51 (Pages 979 and 980 of App. A-193). Other hotel accommodations have been available through the use of dormitories as hotels under the management of Galbreath-Moore Company and Leatherman & Alley (See Par. 7-2c; also App. A-272).

8-10. Special Operating Arrangements.

a. Banking Facility. - Banking service is provided by the Oak Ridge Facility of the Hamilton National Bank, Knoxville, Tennessee. The facility was established in the summer of 1943 under provisions of emergency legislation which permitted the establishment of such facilities on certain military establishments (Apps. A-70b and A-70c). Cost of the bank building is included in total cost of Building No. 1831-T (See App. C-5). Additional facilities were later established at Middletown and Grove Center; the Grove Center office eventually absorbed the Middletown office (App. A-70c).

b. Telegraph Service. - Public telegraph service for Oak Ridge was originally provided by contract between Roane-Anderson and the Western Union Telegraph Company, whereby Roane-Anderson installed and operated the equipment. Roane-Anderson paid all receipts to Western Union, less 25 percent of the tolls on prepaid messages sent, 25 percent of the tolls on collect messages received, 10 cents for each cablegram or radiogram, and 25 percent of the tolls on money orders accepted (App. A-69a). This arrangement was superseded by a license agreement between Roane-Anderson and Western Union, whereby, beginning 1 November 1944, the Government was to receive $20 per month in rental to be col-

lected by Roane-Anderson, and all utilities to be provided by the Government. Western Union was to furnish adequate telegraph service, under the inspection of the District Engineer (Apps. A-69a and A-70a). Cost of the building used by Western Union is included in cost of Building No. 1832-T (See App. C-5; also Par. 15-10, for other information regarding Western Union).

8-11. Construction Costs. - The cost of construction of commercial facilities through 31 December 1946 was $4,968,030.59, including $860,417.66 in estimated or approximate costs (Apps. A-183, A-193, A-225, A-306, and A-314). Cost, contract, and construction data of commercial facilities are tabulated in Appendix C-5. Many individual shops are grouped under such group buildings as those in the Town Center (as shown in App. C-5), and costs of individual shops are therefore not available in these instances.

SECTION 9 - SCHOOL SYSTEM

9-1. Basic Features.

a. Policy. - The educational system at Oak Ridge is based on the fixed policy that the school population must be provided with an accredited school system of the highest order. Such, in fact, was demanded by the host of technicians and professional persons who, with their families, descended on the Clinton Engineer Works. There has been no deviation from this policy.

b. Operation. - OSW being entirely within Anderson and Roane Counties, and the population being almost entirely within Anderson County, the District, as recommended by the National Advisory Commission on Education, sought to integrate the new school system with that of Anderson County. Negotiations resulted in an agreement whereby Anderson County would operate the schools, with Roane County contributing proportionally to the expense involved. However, because it was considered essential to raise the level of education above that of the surrounding countryside, it was recognized that for all useful purposes the Oak Ridge system would have to operate independently. On the other hand, the District left to the county the matter of procuring financial aid from Federal sources, but supported the county's petitions. Since Oak Ridge was not an incorporated municipality, it could not appeal for Federal aid under the Lanham Act (App. A-75). In theory, then, the school system has been operated as a part of the Anderson County School System, a matter of policy recommended to the District and for the additional reason of obtaining Federal aid. Thus, all buildings and permanent equipment are furnished by Manhattan District, whereas the teaching staff and all expendable sup-

plies are furnished by Anderson County, the latter using Federal Works Agency funds, supplemented by Manhattan District funds (App. A-299). In practice, the Oak Ridge School System is a separate installation directed by a superintendent selected by the District. The superintendent has been, technically, an Anderson County official, but has been allowed a free hand in selecting teachers. For reasons of security, attendance has always been limited to residents of the reservation, compelling the Attorney-General of Tennessee to rule that the State could give the schools no aid beyond advice and consultation, the schools, it was held, being non-public in character (App. A-74).

a. Standards of Education. - The Oak Ridge schools are fully accredited and it is believed that they compare favorably with national standards.

9-2. Development.

a. Initial Period. - Of the present 12 schools - one high school, one junior high school, and 10 elementary schools (Apps. A-185 and B-4) - at Oak Ridge, three, Jefferson Junior High (formerly Robertsville Elementary), Scarboro Elementary, and Wheat Elementary, have their origins in buildings acquired with the CEW reservation (Wheat was soon replaced by a new building, the old one being used as an administration building in the Diffusion Plant Area). Robertsville soon grew to be what was believed to be the largest elementary school in the country, and although an ambitious building program, aimed at meeting the needs of the thousands of children who were to come to Oak Ridge, was launched in 1943, there was much congestion, particularly during the period in which the construction forces had not departed and the students were attending

school. For a time, a shift system was necessary, but the acceleration of the building program and the continuing departure of the construction forces soon relieved crowding and congestion.

b. School Buildings. - The design of the new elementary school buildings was consistent with the designs of adjacent housing; their locations were determined by the density of centers of population, but because of the temporary nature of the western part of the town only one school was built there and extensive additions were made to the existing Robertsville School. The sizes of the elementary buildings were first based on the national average of .5 pupils per dwelling unit; this factor was later modified to .45 in the light of actual school attendance. The high school building was enlarged after initial construction, because it was seen that a separate high school building in West Village would not be economically justified. Robertsville School underwent many alterations and expansions; the last was in connection with its conversion into a junior high school in August 1945 (See Apps. D-34 and D-35 for photographs of schools).

9-3. Description of School Buildings (See App. C-6 for contract data).

a. Elementary Schools. - The elementary schools contain the following facilities and rooms, in addition to light, water, plumbing, and heating services (Some of the schools are known also by numbers, as shown after the names):

Cedar Hill (School No. 3)	Fairview
1 kindergarten room	2 kindergarten rooms
13 class rooms	18 class rooms

Cedar Hill (School No. 3) (cont'd).

1 music room

1 art room

1 library

1 gymnasium - auditorium

Elm Grove (School No. 1)

1 kindergarten room

14 class rooms

3 portable rooms

1 music room

1 library

1 art room

1 gymnasium - auditorium

Glenwood (School No. 4)

2 kindergarten rooms

18 class rooms

1 art room

1 library

1 music room

1 gymnasium

Highland View (School No. 5)

2 kindergarten rooms

23 class rooms

1 art room

1 music room

1 gymnasium

Fairview (cont'd).

1 library

1 art room

1 music room

1 gymnasium

1 cafeteria

Gamble Valley

1 kindergarten room

12 class rooms

1 art and music room

1 library

1 gymnasium

1 cafeteria

Linden (School No. 6)

2 kindergarten rooms

23 class rooms

1 art room

1 music room

1 gymnasium

1 cafeteria

1 library

Pine Valley (School No. 2)

1 kindergarten room

13 class rooms

1 music room

1 art room

Highland View (cont'd).

1 cafeteria

1 library

Scarboro

9 class rooms

1 library

1 art and music room

1 gymnasium

1 cafeteria

Pine Valley (cont'd).

1 library

1 gymnasium - auditorium

Wheat

1 kindergarten room

19 class rooms

1 library

1 music room

1 art room

1 physical education room

b. Junior High School. - The Jefferson Junior High School, now housed in the former Robertsville Elementary building, has, in addition to utilities, 54 class rooms, four home economics rooms, four shops, one library, three art rooms, three music rooms, two gymnasiums, and two converted science rooms.

c. High School. - The Oak Ridge High School has, in addition to utilities, 30 class rooms, one art room, two economics rooms, two shops, one mechanical drawing room, one gymnasium, one music room, one auditorium, one library, and science laboratories.

9-4. School Population.

a. Enrollment, as of 31 December 1946 (App. A-298):

School	Number
Cedar Hill	506
Elm Grove	614
Fairview	794
Gamble Valley	403

School (cont'd).	Number (cont'd).
Glenwood	716
Highland View	801
Linden	864
Pine Valley	523
Scarboro	54
Wheat	91
Jefferson Junior	1,216
High School	746
Total	7,328

b. Teachers Employed, 31 December 1946 (App. A-297):

(1)	Elementary Schools	182
(2)	Junior High School	66
(3)	High School	37
	Total	285

c. Other Personnel. - Other school personnel on 31 December 1946 consisted of: the superintendent and his assistant; a curriculum assistant; a physician; 13 principals; 14 librarians; 12 guidance counselors, specialists and visiting teachers; 30 secretaries and clerks; 13 persons working in the nursery schools and 31 in the adult education program; 116 building supervisors, custodians, and aids; and 34 building maintenance employees (App. A-297).

d. Comparisons. - The enrollment figures given herein may be compared with the first registration in October 1943 in which 228 elementary pupils, 112 high school students, and 58 teachers were enrolled (App. A-76). During the entire school year ending 30 June 1946

and during the period from September through December 1946, the total number of school children enrolled were 11,007 and 8,316, respectively, but the number enrolled at any particular time of course was less than the total number enrolled during the entire year or period.

9-5. Physical Description of Schools (See Apps. A-8, A-30, and A-206; also Pages 1054 to 1065 and 1125 to 1136 of App. A-193).

a. Dimensions. - Because of the number of additions made to several schools, the temporary nature of a few facilities, and the architectural nature of some of the schools, it is impossible to arrive at exact and reconcilable figures regarding dimensions and square footage in the instance of each school. The square feet figures given herein are approximate only.

School	Square Feet
Cedar Hill	32,220
Elm Grove	32,200
Fairview	32,300
Gamble Valley	26,200
Glenwood	34,190
Highland View	52,170
Linden	50,700
High School	89,810
Addition to High School	27,580
Pine Valley	32,220

School (Cont'd).	Square Feet (cont'd)
Scarboro	35,350
Jefferson Junior High	135,350
Wheat	33,705

b. Further Construction Features. - Additional construction features are brought out to reconcile partially the figures immediately above and indicate further features, architectural and otherwise, of some of the schools:

(1) Pine Valley, Elm Grove, and Cedar Hill Schools are one-story "H" shaped buildings and have concrete block foundations and cemesto board walls. Additions consist of a one-story prefabricated class room adjacent to each building.

(2) Glenwood and Highland View Schools are one-story wooden buildings.

(3) The High School was first built to accommodate 500 students. It was originally a combination one and two-story building with a concrete block foundation, gymnasium and auditorium of brick, and the class rooms sections of cemesto board walls on wooden frames. The addition added several class rooms and other facilities.

(4) Jefferson Junior High School came into being 1 September 1945, replacing the old Robertsville Elementary School to which many additions, some of them two stories high, had been made. The establishment of the junior high school required the addition, in most cases by conversion of class rooms, of a guidance office, gymnasium, four shops, new music and art rooms, science laboratory, and new blackboards

and furniture.

(5) The Fairview and Gamble Valley Schools are outgrowths of temporary class rooms at Middletown and Gamble Valley, respectively. Extensive work in connection with cafeterias and boiler houses was done at these schools in the fall of 1946 (Apps. A-306 and A-308).

(6) Exact cost data for Wheat School are not yet available because the school was built by the J. A. Jones Construction Company under its general contract. It has a front and rear wing connected by a 65 foot corridor. Its cost, which will be shown in J. A. Jones' Completion Report, is now estimated to be between $150,000 and $250,000.

9-6. Construction Costs. - Through 31 December 1946, the cost of construction of school facilities was $3,864,346.80, including $200,000 assigned as the estimated cost of Wheat School. Construction cost and other data are appended (App. C-6). Because of the frequency in which several buildings were built under a single contract, it has not always been possible to determine the cost and contract features of each building. In such cases the totals of the contracts are given. The dates shown are useful only in connection with studies of engineering features, as they represent the beginning and the close of contract accounts, not the actual dates of construction.

SECTION 10 - MEDICAL FACILITIES AND SERVICES

10-1. General. - A complete record of the medical program of the Manhattan District is contained in Book I, Volume 7. Consideration is given in this section only to medical facilities as have concerned the Facilities and Service Division. In April 1943, the University of Rochester was requested to organize and temporarily conduct a non-profit medical program at the CEW. Previously the Stone & Webster Engineering Corporation Field Hospital provided first aid and emergency treatment to employees and residents; the critically ill were transferred to Knoxville and Harriman hospitals. The Medical Service Building, completed during the summer of 1943, was the first of the medical facilities to be built (this building is now used as the District Communications Building); in November 1943 a 50-bed hospital was completed. After the appearance of Roane-Anderson Company, the operation of the physical facilities of the rapidly expanding medical and dental services were transferred to Roane-Anderson. Dentists, administrative personnel, nurses, and technicians were placed on the Roane-Anderson payroll. The medical staff was commissioned into the Army Medical Corps in order to assure retention of their outstanding professional abilities and to safeguard the security of the project. As the project progressed and expanded, the work of the medical program increased; a Dental Clinic, Public Health Center, dispensaries, and other facilities conducive to the health of the community were added.

10-2. Medical Facilities.

a. Need. - In the spring of 1943 the project's demand for labor increased the number of employees so rapidly that it became evident

that the originally planned medical facilities would be insufficient to serve satisfactorily the growing community. A survey at that time also revealed that the existing hospital facilities in the surrounding territories were already overtaxed and could not support the additional burden of so large a population. It was, therefore, necessary to provide complete medical care and hospitalization for residents and employees on the area. For reasons of security and convenience it was expedient to locate the hospital on the reservation. The construction of the 50-bed hospital in Oak Ridge to serve the then estimated total of 12,000 to 15,000 residents was not completed before work on the additions started. The three subsequent additions and an increase in the original hospital's capacity gradually increased the number of beds to 313. An out-patient wing to treat an estimated 6,000 patients per month was also provided to serve a population which in June 1945 reached approximately 75,000 persons, including Happy Valley (App. C-1). Photographs of the hospital area are attached (Apps. D-36 and D-37).

b. Construction.

(1) Fifty-Bed Hospital. - The original 50-bed hospital is a one-story cemesto type building located west of the Town Center on West Tennessee Avenue near New York Avenue. It was, by a rearrangement of beds, soon converted into a 63-bed hospital; the dimensions are 186 feet by 364 feet and provide a floor area of 33,250 square feet, plus extensive sun porches. Facilities are a public lobby, 21 two-bed wards, five four-bed wards, one one-bed room, an operating suite, doctors' offices, out-patient treatment rooms, X-ray rooms, laboratories, first aid rooms, a kitchen, a staff dining room, an autopsy room, and a morgue. A

storage and boiler room are in the basement. The sun porches brought the total floor space close to 68,000 square feet (App. A-30).

(2) Hospital Addition No. 1. - The first addition is a 100-bed extension at the west end of the original hospital. It is a two-story concrete block structure, 90 feet 10 inches by 129 feet 6 inches, built on a "T" plan and provides an additional 23,061 square feet of floor space. This addition houses the isolation, obstetrics, and pediatrics sections (App. A-8).

(3) Hospital Addition No. 2. - The second addition was added to the group of medical facilities to increase the number of beds by 100 and to provide additional storage facilities, laboratories, toilets, and a utility room. This 50 ~~feet~~ feet by 200 feet concrete block building, extending north and south, is south of the original building; it is, in part, a two-story building (App. A-8; also see Pages 1008 to 1019 of App. A-193 for this and two preceding subparagraphs).

(4) Hospital Addition No. 3. - The third addition is a concrete block building, 152 feet by 52 feet, extending in an east and west direction and located west of No. 2 addition. Its approximately 7,600 square feet provide an additional 50 beds, a diet kitchen, two toilets, two utility rooms, and two nurses' stations.

(5) The Out-Patient Wing. - The Out-Patient Wing, for the treatment of persons not requiring hospitalization, was designed to accommodate approximately 6,000 persons per month. The building is south and east of the original hospital building and is connected to it by a communicating passage. It is a 67 feet by 260 feet frame building with a mineral surfaced siding and a concrete block foundation. Its 21,000

square feet provide space for a general public waiting room, five secondary waiting rooms, 27 doctors' offices, 47 examination and consultation rooms, X-ray rooms, a general pharmacy for the hospital group, laboratories, office and record rooms, toilets, and locker rooms (App. A-8; also Pages 1001 to 1004 of App. A-193).

(6) Dispensaries and First Aid Stations. - In addition to permanent facilities, temporary dispensaries were set up by the Central Facilities Division during construction periods in the Diffusion Plant Area and Gamble Valley; both are now closed. In April 1946 five first aid stations were established, three in the warehouse areas and one each in the Main Administration Building and the main office of Roane-Anderson; all of the five stations were being operated at the end of 1946 (App. A-274; also see App. A-275).

(7) The Nurses' Home and Dormitory. - A two-story cemesto type building 29 feet by 126 feet, with a floor area of 7,410 square feet was constructed to the east of the original hospital as the Nurses' Home. Facilities include a lobby, a parlor, 29 bedrooms, 15 baths, the supervisor's suite, a kitchen, and a laundry. Upon expansion of the hospital, an "3" type dormitory was built adjacent to the original home to provide additional housing for the nurses (Pages 1019 and 1041 of App. A-193; also Apps. A-8 and A-30). Later a group of cottages was erected near the Dental Clinic for use of additional nurses.

c. Operation. - The operation of the medical service program was unique in that the business management was the responsibility of Roane-Anderson, while the professional aspects of the services rendered were the responsibility of, and were supervised by, the Manhattan District

medical officers. The fees charged for medical service were based on the prevailing rates of the surrounding communities. Medical service was furnished military personnel in accordance with Army Regulations. After 1 March 1946 the operation of the medical service was changed to conform more nearly to that in a normal civilian community. The medical officers were gradually replaced by civilian doctors, and the Out-Patient Wing was renamed the Medical Arts Building, in which doctors rented office space from Roane-Anderson. A Board of Governors for the Oak Ridge Hospital was formed to advise the District Engineer. On 31 December 1946 the hospital medical staff consisted of 26 active members, 11 consulting members, and four military members (App. A-274; also see App. A-277).

d. Oak Ridge Health Association. - To further the health and medical program at Oak Ridge, the District Engineer, in October 1944, issued a grant of authority for the establishment of the Oak Ridge Health Association, a non-profit group insurance and hospitalization program (App. A-188). On 28 April 1944, a contract, effective 1 December 1944, for hospitalization, was executed by the Association with Roane-Anderson, the hospital business manager (App. A-192). This contract was terminated 30 April 1946 (App. A-197), leaving group members to deal directly with the hospital and with the Association until 1 August 1946, when the Association was incorporated under the laws of Tennessee and the Provident Life and Accident Insurance Company of Chattanooga agreed to underwrite the insurance plan for one year (App. A-274).

10-3. Dental Clinic.

a. Need. - A dental program at CEW was established in close association with the medical program. When it became apparent that the

dental facilities of the surrounding area were inadequate and would so continue in spite of planned expansion of private facilities, a completely equipped dental clinic was provided for the residents of Oak Ridge.

b. Construction. - The Dental Clinic is a two-story frame building, 28 feet 4 inches by 130 feet 4 inches, having a floor space of approximately 7,654 square feet. Constructed at a cost of $96,053.18, the clinic contains two waiting rooms, 21 operating rooms, one large laboratory, five small laboratories, three X-ray rooms, offices, record room, doctors' lounge, nurses' lounge, toilets, and locker rooms (App. C-6). The building is southeast of the hospital group on East Vance Road, near the center of Oak Ridge (App. A-8; also Pages 1005 to 1007 of App. A-193). In 1946, the building was altered, at a cost of $11,147.69, to provide facilities for private practitioners; also, a Victory Cottage was altered, at a cost of $1,398.33, to provide office space for a colored dentist (Apps. A-306 and A-307).

c. Operation. - In addition to the newly constructed Dental Clinic Building, a part of the Medical Service Building was used to provide the children of school age with complete dental facilities. The plan of operation permitted the patients to choose their dentists within the limits of their availability. Operations of a general practice were not standardized even though dentists first worked on a salary basis; each dentist was permitted to conduct his practice according to his training, ability, and judgement. During April 1946 the status of the dentists was changed to that of private practitioners. The fees charged civilians were those prevailing in Knoxville and surrounding areas. Military personnel are treated by Army dental officers. On 31 December 1946 there were

13 dentists practicing in the Dental Clinic Building and one dentist practicing elsewhere on the area (App. A-274).

10-4. Other Medical Services.

a. Oak Ridge Department of Public Health.

(1) The Oak Ridge Public Health Department was organized in January 1944, in the Medical Service Building. Because of its expanding activities the Public Health Department was moved to the Stone & Webster Field Hospital which had been remodeled for new use, 15 May 1945. The Public Health Department concerns itself with the usual functions of a municipal public health department, including area sanitation, purity of milk and water, inspections of food concessionaires and food handlers, the control of venereal disease, vermin and insect control, and all matters concerning the health of the community as a whole.

(2) The Division of Nursing of the Department of Public Health conducts physical examinations of school children and supervises student immunization and dental care. It provides visiting nurse service, advises parents on medical problems, particularly infant care, and the screening of children for tuberculosis and other communicable diseases.

(3) The Public Health Department is now staffed by civilian sanitary engineers and by nurses. Although considered to be an important and integral part of the Oak Ridge medical services and facilities and of the municipal administration, the Health Officer was responsible to the Director of the Oak Ridge Hospital until 24 October 1946, when the Department became a separate organization under the Department of Public Welfare of the Facilities and Service Division; however, close

administrative liaison between the Hospital and the Department was continued (App. A-274).

b. Department of Psychiatry and Medical Social Service. - This department and service are in the twilight zone between medical facilities and service on one hand and community social service on the other. Although this program is, to a degree, handled medically, its problems are rooted, for the most part, in social problems of individuals and the community and non-medical problems of hospital patients. The Department of Psychiatry was established in March 1944 and the Medical Social Service in December 1944. Since then the work of the two agencies has been closely coordinated and they are considered to be a part of the community medical services. The Department of Psychiatry provides professional psychiatric treatment to persons referred by the medical staff, the Review Board (See Sec. 19), and others. The work of the Department was disrupted by the departure, on 31 December 1946, of the only remaining psychiatrist, but efforts to obtain a successor were being made (App. A-274). The Medical Social Service arranges for private treatment of convalescents in dormitories, for the care of children whose parents are ill, the medical care and finances of indigents, the transportation from the reservation of persons with protracted illnesses, and the transfer, when indicated, of veterans to Veterans Administration hospitals.

c. Veterinary Service. - The Veterinary Service in charge of an Army veterinary officer was established in August 1943 for the care of government-owned livestock and for assistance in milk and meat inspections. On 21 August 1946 the Veterinary Service became a part of the Department of Public Health (App. A-274). Rabies inoculation of all dogs

brought into the reservation is compulsory. The Veterinary Building is on Emory Valley Road.

d. Emergency Disaster Program. - A Medical Emergency Disaster program has been established for operation in case of major disasters, emergencies or catastrophes which require medical participation. Field units are equipped for definite emergency assignments.

e. Collaboration with Industrial Medical Groups. - Because of the special industrial hazards existing at CEW, the operating contractors have employed specially trained physicians to conduct a pre-employment examination and to safeguard the health of their personnel. To maintain close liaison, these doctors were sometimes appointed as consultants on the staff at the Oak Ridge Hospital. On 31 December 1946, there were 14 doctors employed by the operating companies; two of these doctors were consultants at the Hospital (App. A-274).

10-5. Contract Data and Construction Costs. - Contract data for construction of medical facilities are attached (App. C-6). The following is a list of medical facilities constructed at Oak Ridge and a few extensions outside the town area, with the cost of each facility, except various first aid stations of a temporary nature (See Apps. A-193, A-276; A-306, and A-307):

BLDG. NO.	BUILDING	COST
1706	Medical Service Building (Now used as District Communications Building)	$ 168,771.33
1808-T	Out-Patient Wing (Medical Arts Building)	185,769.41
1810-T	Hospital	
1810-T-1	Hospital Addition No. 1 (Equipped)	993,634.01
1810-T-2	Hospital Addition No. 2	

BLDG. NO. (cont'd).	BUILDING (cont'd).	COST (cont'd).
1809-T	Dental Clinic	$ 96,053.18
1811-T	Nurses' Home	69,431.58
1823-T	Nurses' Dormitory	102,974.64
1839-T	Storage Building (Inflammable Gases)	1,358.61
1910-T-1	Public Health Center (Old Field Hospital)	50,617.00
1810-T-1b	Hospital Addition No. 3	80,680.39
1810-T-1a	Alteration, Psychiatric Ward	15,362.69
1809-T	Alteration, Dental Clinic	4,272.48
	Dental Facilities Added, 1946	12,546.02
1810-T	Emergency Entrance, Hospital	20,332.90
1810-T	Addition to Kitchen	17,784.16
	Veterinary Building	5,051.99
	Total Actual Cost	$ 1,824,640.01
	Gamble Valley Dispensary (Closed)	2,500.00 Est.
	K-25 Dispensary (Closed)	2,500.00 Est.
	Total Estimated Cost	$ 5,000.00
	Total Costs	$ 1,829,640.01

SECTION 11 - SOCIAL AND WELFARE FACILITIES AND SERVICES

11-1. General. - In addition to providing shelter and material necessities for the residents of Oak Ridge, the District recognized that the community would require facilities for recreation, religious worship, and other social services; hence, from the beginning, each group of housing was provided with necessary social facilities.

11-2. Development. - As the community developed, various organizations to provide certain social needs made their appearances. Many of these activities are dealt with in connection with other matters in other sections of this volume. For example, the hospital and medical services are discussed elsewhere (Sec. 10), as are the Public Health Department (Par. 10-4a (1)), the hospital social services (Sec. 10), the Division of Nursing of the Public Health Department (Par. 10-4a (2)), and the Department of Psychiatry (Par. 10-4b). Important social services remaining are the Public Library, the American Red Cross, the Public School Social Service, religious facilities, and, also, a myriad of social and welfare agencies of relative degrees of activity and significance.

11-3. Controlling Policies. - The District has encouraged beneficial social organizations, but interfered as little as possible in their organization and operation. Because of the limited facilities, coordination of their use was necessary through a Special Services Officer and later through the Chief of the Department of Public Welfare, Facilities and Service Division, and the chiefs of various sections, e.g., Public Relations, Community Relations, Public Welfare, medical facilities, and the Oak Ridge Schools. Of these, some, e.g., the medical facilities (Sec. 10) and school operations (Sec. 9), are discussed at length else-

where (See Par. 11-10 for listing of other agencies).

11-4. Oak Ridge Recreation & Welfare Association.

a. Purpose. - It was recognized early that, particularly in view of the town's lack of many normal community features, the residents of Oak Ridge should be provided with a measure of recreational and welfare facilities. It was to guide the resident's leisure time activities into desirable channels and, at the same time, to offer opportunities for self expression and general community relations that the Recreation & Welfare Association was brought into being.

b. Development and Organization.

(1) Activation. - The Association was activated on 21 July 1943 at an open meeting. There was adopted a code of by-laws which stated the Association's objects, to wit, to operate, for the use of the residents of Oak Ridge, all recreational and welfare buildings made available by the District and to establish and operate any additional facilities approved by the Association's Executive Committee. Membership in the Association was open to residents and employees over 18 years of age (App. A-25). An Executive Committee, composed as prescribed by the by-laws, of the Town Manager and one member from each major operating organization at the Clinton Engineer Works, was chosen. The Executive Committee was empowered to procure the services of a business manager and fix his compensation and duties, to incur indebtedness, and to have complete management control of the Association, subject to limitations of policies of the District. The office of Business Manager was established as a paid full time position, responsible to the Executive Committee for the operation of all facilities. It was provided that there be an annual

meeting of the Association and, further, that, in event of dissolution of the Association, surplus funds would be remitted to the District. On 17 August 1943, the Executive Committee, at its first meeting, elected a President and a Secretary-Treasurer from its membership.

(2) First Grant of Authority. - In January 1944, the Association was given a formal grant of authority by the District Engineer. The grant established the basic principles of operations and embodied certain changes in organization designed to overcome weaknesses of control which had become apparent during the period of initial operation; these changes were primarily in connection with the composition of the governing body and the regulation of the Association's financial affairs. The grant fixed the membership of the Council as two members to be elected by the personnel of each major organization or group, which were defined as Manhattan District civilian personnel, Roane-Anderson Company, Clinton Laboratories, Carbide and Carbon Chemicals Corporation, Tennessee Eastman Corporation, and Manhattan District military personnel; later, representatives of Ford, Bacon, and Davis, Inc., and Percleve Corporation were added. The grant required the Council to elect, from its membership, a President, a Vice-President, a Secretary, A Treasurer, an Assistant Treasurer, and Executive, Budget, and Audit Committees. The operating organization was to be headed by a paid, full time Business Manager employed by the Council. The surplus which the Association could accumulate was limited to $75,000. The grant committed the District to making certain buildings and equipment available to the Association (Apps. A-25 and A-26).

(3) Second Grant of Authority and Reorganization. - A

second grant of authority, superseding the first, became effective on 1 June 1945. In general, the organization and policies established by the first grant were continued, although the office of Managing Director, created in place of that of Business Manager, was given wider discretionary powers than those vested in the Business Manager, and the Council was relieved of some of its responsibilities. The second grant of authority was still in force at the end of 1946 (Apps. A-27 and A-282). On 31 December 1946, the Association's normal personnel strength for operations was 230 full time employees and 40 part time and seasonal employees (Apps. A-280 and A-281).

c. Operations.

(1) Facilities, Services, and Costs. - Immediately following the activation of the Association, the District Engineer made available to the Association certain buildings, rent free, to be used to provide recreational and educational facilities to the residents of Oak Ridge. The Association was made responsible for the maintenance, up to the point of structural changes of buildings made available, regardless of whether such buildings were used directly by the Association or by concessionaires licensed by the Association. The first facilities available were a bowling alley, a recreation hall, a restaurant, a theater, and a tavern, all located in the Town Center. These and other revenue producing facilities, e.g., motion picture theaters, are operated as commercial facilities, and revenues derived from their operation are used to pay for the sponsorship and operation of facilities and activities which are not self supporting. The scope of the activities were rapidly expanded as additional facilities became available, until in 1945 the

Association handled businesses having revenues well over a million dollars a year (App. A-28). The activities and major facilities of the Association consist of:

(a) Six Motion Picture Theaters:

(1) Grove (Bldg. No. RA 1873-T-1), in Grove Center. Cost: $ 162,967.27 (equipped).

(2) Middletown (Bldg. No. 1873-T-3, in Middletown, now operated by a concessionaire (Cost tabulated on Page 2, App. C-5).

(3) Jefferson (Bldg. No. 1873-T-2). Cost: $ 66,431.59 (equipped).

(4) Center. Cost is included in cost of Bldg. No. 1 of Townsite Bldg. 1831-T (See App. C-5).

(5) Ridge. Cost is included in cost of Bldg. 6 of Townsite Bldg. No. 1838-T (See App. C-5).

(6) Drive-In (between Gamble Valley and Scarboro Road, now operated by a concessionaire). Cost: $ 21,224.28.

(7) Total of separate costs shown above: $ 250,623.14 (Page 972 of App. A-193).

(b) Other Major Recreation Facilities.

(1) Recreation Building, Grove Center. Cost: $ 127,929.67.

(2) Recreation Building, Middletown (Bldg. No. RA 1875-T-3; now occupied by concession-

(b) Other Major Recreation Facilities. (cont'd).

aire under name of Midtown Sports Center). Cost: $ 82,872.62.

(3) Recreation Building, Jefferson Circle (Bldg. No. 1870-T-2). Cost: $ 75,789.94.

(4) Townsite Play Grounds (Bldg. No. 1885-T). Cost: $ 132,515.97.

(5) Townsite Recreation Shelters (Bldg. No. 1885-T). Cost: $ 22,774.00.

(6) Recreation Building, Townsite (Cost is included in cost of Bldg. No. 1 of Bldg. No. 1832-T; See App. C-5).

(7) Ridge Recreation Building and Public Library, Townsite (Bldg. No. 1819-T). Cost: $ 170,691.29.

(8) Middletown Community Building (sometimes known as New Middletown Recreation Building), Oak Ridge Turnpike and Robertsville Road (See succeeding subparagraph for cost).

(9) Gamble Valley Community Building: Combined costs of Middletown and Gamble Valley Community Buildings: $69,050.81 (App. A-196).

(10) Main Office, Recreation and Welfare Association (Bldg. No. 1708; formerly used as Employment Office. See App. C-11 for cost).

(b) Other Major Recreation Facilities. (cont'd).

(11) Swimming Pool. Constructed by the Association at no cost to the Government.

(12) Total of separate costs shown above: $ 681,624.30 (Pages 970 to 973 of App. A-193).

(c) Services. - Services provided through the above facilities, plus other activities provided or sponsored by the Association, include movies, soda fountains, snack bars, taverns, "teen-age" centers, athletic fields and equipment, a swimming pool, outdoor dances, library services, athletic direction, game officiation, and clubs embracing or concerned with music, art, drama, photography, handicraft, folk dancing, chess and checkers, horseshoe pitching, boxing, riding, shuffle board, and building of model airplanes (Apps. A-280 and A-281).

(2) The Oak Ridge Journal. - The Oak Ridge Journal, a weekly newspaper, is published under the sponsorship of the Association. Encouraged by the Special Services Officer and with the approval of the Deputy District Engineer, and after meeting the objections of security, the first copy of the Journal, consisting of four 7 x 8½ inch mimeographed pages, was published on 4 September 1943. The editor was Sergeant Murray Levine, assisted by Private D. M. Wendland, WAC. Since then the Journal has grown to a 12 page, tabloid-size sheet. The Journal is made up of approximately 60 percent news and 40 percent advertising. The paper is partly self supporting, with the Association meeting any deficits. The Journal is distributed free throughout the community and is registered at the Oak Ridge Post Office under the free postal statutes.

On 31 December 1946, its staff included an editor, a managing editor, an assistant editor, reporters, and an advertising manager. Both the news and the advertising columns consist of unclassified material. Its news columns are limited to local news and events. Editorial policy, in any controversial issue, is determined by the Manhattan District in the interest of the public welfare and of the security and efficiency of the project.

(3) Budget. - In order to be self-sustaining, the Association has maintained a very careful balance between revenue-producing activities and those recreational diversions furnished at no expense to the public. Long-range planning programs are followed and new enterprises entered into only when studies prove their value and show ways in which increased obligations can be met (App. A-29).

(4) Audit. - Periodic audits are conducted by the Council and by the District Engineer.

11-5. Religious Facilities and Services. - Facilities for religious worship are provided in two modified Army type chapels, one constructed in the Town Center, known as the Chapel-on-the-Hill, and the other called East Chapel, located in East Village. In the western part of the town an existing church was remodeled. Supplementary facilities for the 17 denominations at Oak Ridge are provided by making schools, theaters, and recreation halls available. Problems of the churches requiring official assistance are handled and coordinated by the Chief of the Department of Public Welfare, Facilities and Service Division, except that routine matters not requiring major administrative action, are handled by the Chief of the Community Relations Section, who in turn, is

responsible to the Chief of the Department of Public Welfare. Cost of the two chapels was $128,719.50 (Page 1022 of App. A-193).

11-6. American Red Cross. - A branch of the Anderson County Chapter of the American Red Cross was organized at Oak Ridge in December 1943. The group performs the usual Red Cross functions of training, first-aid and medical assistance, preparation of medical material and personal supplies for the Armed Forces, and liaison between service men and their families. It assists the hospital staff and provides sewing service for enlisted service personnel at Oak Ridge. The staff consists of professional Red Cross employees and volunteer social workers. The Red Cross unit is directly responsible to the Chief of the Department of Public Welfare.

11-7. The Oak Ridge Public Schools Social Service. - The Public Schools Social Service investigates students' social problems, such as truancy, and furnishes advice to parents on child welfare. The staff consists of teachers and counsellors under supervision of the School Superintendent.

11-8. Nurseries.

a. The Oak Ridge nurseries have undergone an unusual history and their operation has, at various times, involved the Federal Works Agency, Roane-Anderson, J. A. Jones Construction Company, the Recreation and Welfare Association, the school system, and various other community forces, such as the Red Cross, the Police Department, the Review Board, the Family Service Bureau, the Department of Psychiatry, and the Social Service Department.

b. The nurseries, now operated by the school system, in

the past have been characterized by a certain lack of continuity, movement from one location to another, discontinuance of service, and changes in names, management, and responsibility. Of the five nurseries once operated, two were being operated at the end of 1946.

c. The nurseries were originally subsidized by the FWA, but when the FWA nursing program was terminated, management was taken over by various operating companies and other agencies. The nurseries taken over by the school system with dates of acquisition of control are as follows:

(1) Two from Roane-Anderson (Middletown, October 1945; and Wheat, 20 August 1945).

(2) One from J. A. Jones Construction Company (Happy Valley, 25 July 1945).

(3) Two from the Recreation & Welfare Association (Nesper Road, 21 March 1945; and Tennessee Avenue, 29 October 1945).

d. Thereafter numerous consolidations and changes of names were effected, until, at the present, only Grove and Tennyson are operated. The former is open from 0700 to 1800 hours, with two meals served, and Tennyson from 0800 to 1600, to which the children, if they stay all day, bring their own lunches.

e. Children may be enrolled for full terms, in which cases the charges are approximately $7.00 a week per child. Children are also taken by daily or hourly rates. The nurseries are now self-sustaining.

f. Construction costs are available for only Tennyson, Grove, and Gamble Valley; the total for the three is $96,735.54. These

costs are included in the costs of schools and, with contract data, are shown in Appendix C-6.

11-9. Oak Ridge Welfare Service. - The Oak Ridge Welfare Service was brought into being after the issuance, on 1 July 1945, of a grant of authority by the District Engineer. The Welfare Service was created with the object and purpose of providing professional social case work in assisting Oak Ridge employees and residents in their adjustments to local conditions and to coordinate the work of community welfare organizations. The grant of authority was amended in July 1946 so as to allow the Welfare Service to establish and operate Nesper House, a home through which temporary and emergency care is given children under 18 years of age needing such care. During 1946 the Welfare Service rendered service on an average of approximately 46 family problems per month and coordinated cases on an average of approximately 134 per month. Nesper House cared for approximately 17 children per month (Apps. A-280, A-283, and A-284). Nesper House is a Type "B" house (See Sec. 7).

11-10. Organization.

a. General. - The Government is represented in social and welfare services by the Welfare, Community Relations, and Public Relations Sections of the Department of Public Welfare of the Facilities and Service Division (See Pars. 11-2 and 11-3 for references to agencies described elsewhere in this volume or previously in this section). Some agencies listed below are described in detail elsewhere, but are included in this subsection to illustrate their places in the general scheme of things.

b. Detail.

b. Detail. (cont'd).

(1) Welfare Section.

(a) Oak Ridge Welfare Service.

(1) Family Service Bureau.

(2) Social Service Exchange.

(3) Nesper House.

(b) Juvenile Department.

(c) Advisory Relationships.

(1) Council of Social Agencies.

(a) Red Cross.

(b) Medical Social Service.

(c) Psychiatric Clinic.

(d) Public Health.

(e) School Guidance Departments.

(f) Family Service Bureau.

(g) Juvenile Department.

(h) Churches.

(i) Nurseries.

(2) Advisory Board to Council of Social Agencies.

(a) District Engineer's Representative.

(b) Hospital.

(c) Civic Organizations.

(d) Veterans Organizations.

(e) Operating companies.

(f) Recreation & Welfare Association.

b. Detail. (cont'd).

(g) Police.

(h) Churches.

(i) Schools.

(2) Community Relations Section.

(a) Community Relations.

(b) Service Subsection and Information Bureau Subsection.

(c) Liaison and Recreation and Welfare Association Subsection.

(3) Public Relations Section.

11-11. Construction Cost Summary. - Construction costs shown in this section and not tabulated elsewhere in this volume are as follows (Pages 970 to 973 and 1022 of App. A-193; also App. A-196):

Theaters	$ 250,623.14
Major Recreation Facilities	681,624.30
Chapels	128,719.50
TOTAL	$ 1,060,966.94

PART C - AREA FACILITIES

SECTION 12 - ELECTRICAL SYSTEM

12-1. General Considerations.

a. Interrelation of System. - Because of the physical lay-out of the electric power system at the Clinton Engineer Works and the administrative features of construction, distribution, and operations generally, it is not feasible to consider the system solely as it relates to the town of Oak Ridge or as a part of the facilities and service organization. For example, the greater part of contractual arrangements were made with the Tennessee Valley Authority either directly by the Manhattan District or by the engineer-management contractor, Stone & Webster Engineering Corporation, for CEW as a whole. TVA bills CEW for all power furnished, regardless of ultimate use; the CEW Electric Power Division acts as both the administrative clearing house and as distributor of power entering the reservation, even though some TVA lines connect directly with the operating plants. As far as TVA is concerned, CEW is a single consumer of power and the CEW electrical system is necessarily considered in a similar manner in this volume (See Pars. 12-16 and 12-17). Further considerations of electric power features of each of the manufacturing plants at CEW may be found in the completion reports of construction contractors and in the books relating to the operating plants (See Apps. B-6 and B-6a for schematic designs of CEW electric power system; also see Par. 12-18, for discussion of available construction costs).

b. Requirements. - The basic requirements of CEW depend primarily on an abundant and continuous source or sources of electric power; more than any other, it was this consideration that led to the

building of CEW in the TVA area. This problem of utilization was successfully solved by extending the existing TVA power system into the CEW area and integrating it with the scheme of the project's needs. The process loads constantly increased from the beginning, from an initial load of 4,000 kw at the Electromagnetic (Y-12) Plant alone in 1943 to a maximum of 298,000 kw in August 1945 for the entire CEW, with a corresponding power consumption that month of 200,000,000 kilowatt hours for CEW. Estimates prepared in April 1945, before the end of hostilities, contemplated a maximum of 455,000 kw in January 1946 (See App. C-7 for quantities actually required).

c. Elza Substation No. 1. - Pending the completion of the first 154 kv transmission line from the TVA system into the reservation, temporary power for the town, the pumping station, and miscellaneous construction was obtained in limited quantities from existing low voltage power distribution lines on the reservation. This service was partially replaced in June 1943 with the completion of the connection to the Norris Dam-Watts Bar transmission line, and entirely replaced in July 1943, with the completion of Elza No. 1 substation and the second connection to the TVA system, with exception of small amounts of power required for lighting at several of the area gates. The TVA high voltage transmission lines from Norris Dam to Watts Bar generating stations lie partly within and also along the northern boundary of the project and had sufficient capacity and power reserve to supply initial process loads. Arrangements were made with TVA to build this extension in the form of a loop to a point nearest the center of load (Elza No. 1 substation). By proper arrangement of switching equipment, a two-way source was thus obtained, namely, from

Norris and/or Watts Bar. This loop provided three phase, 60 cycle, 154 kv service over a three-wire circuit of 400 MCM copper and one 636 MCM aluminum cable, steel reinforced, on wood pole structures; it is approximately 3.5 miles long, one way. These incoming feeders were individually protected by oil circuit breakers and terminated at a common bus bar. From this bus, two circuits of the same voltage extend through oil circuit breakers into the restricted area of Y-12 and terminate at the transformer busses of the various process buildings.

d. Elza Substation No. 2. - To meet the increasing demands for power due to expansion of the Electromagnetic Plant Area it became necessary to provide additional facilities; therefore, another supply from the TVA system was tapped at Fort Loudoun Dam switchyard located approximately 14 miles south of the project. This, in turn, necessitated an additional terminal center. Elza No. 2 substation was constructed for that purpose in the southwest part of the Electromagnetic Plant Extension Area. The Fort Loudoun feeder is also a three phase, 60 cycle, 154 kv circuit, the conductors of which are 636 MCM aluminum cable, steel reinforced, supported by wood structures, that terminate through oil circuit breakers at this station's main bus. From the bus, three 154 kv feeders, individually protected by circuit breakers, were constructed to extend to the transformer busses in the process area. Further expansion in the Y-12 Extension Area in the fall of 1945 required the construction of a fourth 154 kv feeder to serve the Beta Process buildings. To insure continuous supply of power at this substation, a tie line, approximately one and one-half miles long, of design similar to the main circuits, but using copper conductors of 500 MCM, was constructed between

these substations. This tie line affords an exchange of power when necessary and serves as a means of providing a third source of power to Elza No. 1 substation from the TVA system at Fort Loudoun.

e. Town Power Supply. - The main bus at Elsa No. 1 substation serves as a medium of power for the town of Oak Ridge. The rapid growth of the community soon exceeded the originally provided facility and it became necessary to increase the capacity to twice the original capacity of 15,000 kva. The town was served by two 15,000 kva, three phase, 60 cycle, 154/13.8 kv transformers and eight three phase, four wire distribution feeders interconnected by means of sectionalizing switches. It became evident in early 1945 that further growth in the townsite would require additional facilities; therefore, the installation of an additional 15,000 kva transformer, four additional distribution circuits, (one of which is being used temporarily to supply power to the X-10 Area) and necessary switching equipment was authorized. The construction of these additional features was completed in February 1946 (App. A-320). The distribution system is of the overhead type construction, three phase for industrial and large power loads and predominantly a single phase, grounded neutral in the town proper. The secondary distribution is usually three wire 120/240 volts. Street lighting is provided from regular distribution system transformers and is a multiple system controlled by pilot wires and relays.

f. Diffusion Plant Area. - A new problem in the project's power distribution system came with the development of the Diffusion Plant (K-25) Area and the construction of an associated steam generating station capable of producing variable frequency power to meet special

process requirements (App. A-94). It became evident that an electrical connection would have to be established between the western (Gas and Thermal Diffusion Plant Areas and the Clinton Laboratories Area) and the eastern (Electromagnetic Plant and Townsite Areas) end of the project, in order to make full use of the facilities, to provide interchange, and/or supplements of power, and to coordinate the system for maximum dependability and efficiency. This was accomplished by constructing a tie line between Elza No. 1 substation main buss and the switchyard buss at the Diffusion Plant (K-25) power plant station (App. A-95); and initially this line was connected to a transformer bank temporarily installed to furnish power for construction and testing operations at K-25 until such time as the permanent K-25 substation was completed and ready for service (App. A-320). This is a three phase, 154 kv line on H-frame wood pole structures, 300 MCM, 30 percent conductivity copperweld conductors, approximately 11.3 miles long. Another power supply from the TVA system at Fort Loudoun ties into the switchyard buss in the K-25 Area, thus affording four independent power sources to the project. From the K-25 Area switchyard, a 13.8 kv, 60 cycle, three phase line, wood pole supported, of 1/0 aluminum cable, steel reinforced, ~~feeder~~ serves the Clinton Laboratories (X-10) Area. This line is approximately six miles long. The four sources of power and the primary substation facilities mentioned above provided the project with facilities having a capacity of approximately 310,000 kw to serve loads estimated as follows in the various areas: 200,000 kw to the Electromagnetic Plant Area and its extensions, 23,000 kw to the town, 80,000 kw to the Gas Diffusion Plant Area, 6,000 kw to the Thermal Diffusion Plant Area, and 1,000 kw to the Clinton Lab-

oratories Area. These process loads were scheduled to reach these values in December 1945.

g. Diffusion Plant Extension Area. - With the addition of the Diffusion Plant Area Extension (K-27), extensions to the Electromagnetic Plant Area, and further extensions to the Diffusion Plant Area, it became necessary to provide additional facilities to meet a total anticipated demand of 455,000 kw scheduled for January 1946. To accomplish this, the Watts Bar-Norris Dam 154 kv line has been looped into the K-27 Area primary substation and a 154 kv tie line has been constructed between K-27 and K-25 substations. These additional facilities provide three independent outside sources of power to K-25 and K-27 substations. Additional measures required to strengthen the system on the area included the termination of the existing Elza No. 1 - K-25 tie line at Elza No. 2 substation instead of Elza No. 1 substation, as formerly; the installation of one 25,000 kva synchronous condenser at the K-25 steam plant switch house; two 25,000 kva synchronous condensers at the K-27 substation switch house, and 50,000 kva in static condensers on the process 13.8 kv feeders in the Y-12 and Y-12 Extension Areas, although 45,000 kva in static condenser capacity in Y-12 and Y-12 Extension later were removed. The synchronous and static condenser installations are required to maintain satisfactory power factor conditions in the various areas.

12-2. Sources of Power. - The additional facilities mentioned above provided four independent sources of 154 kv power to CEW high voltage power distribution system and three sources of 154 kv power to each of the principal primary substations, together capable of meeting a de-

mand of 455,000 kw. In 1946 TVA undertook to strengthen its system by constructing a 154 kv line from Cherokee Dam to Norris Dam installing transformers and switching equipment to interconnect its 110 and 154 kv transmission systems at Fort Loudoun switchyard, increasing the 154 kv bus capacity at the switchyard, and rearranging switching equipment there to utilize existing equipment fully. These improvements, when completed (See Par. 12-9a), incidentally will affect CEW by providing a more assured supply of power to consumers.

12-3. Operation.

a. General.- All of the incoming 154 kv power to the various primary substations within the reservation are operated and maintained by the TVA up to the inclosures around each substation. Stone & Webster Engineering Corporation, under authority of the War Department and under the supervision of the United States Engineers, built, operated and maintained the Elza No. 1 and Elza No. 2 substations, 154 kv process feeders, and interconnecting tie lines until the completed units were turned over to Roane-Anderson Company as the operating agency. The operation and maintenance of these facilities remained under the supervision of the operating agent until these responsibilities were assumed by the CEW Electric Power Division of the Manhattan District in November 1945. To provide a centralized control and authority for all matters relative to the distribution of all high and low voltage to the various consuming agencies at CEW, a power dispatching unit, under the supervision of the Electric Power Division, was organized on 27 May 1946 (App. A-320).

b. Oak Ridge. - The Roane-Anderson Company, as operating agent, operates and maintains all electrical facilities in the town and

the unrestricted area around the Electromagnetic Plant.

c. Diffusion Plant Area. - The Carbide and Carbon Chemicals Corporation, as operating contractor for the K-25 area, supervises the operation and maintenance of the K-25 and K-27 primary substations, the K-25 steam generating station, and all process and local power distribution circuits in the restricted K-25 Area, including all plant equipment.

d. Clinton Laboratories Area. - The Monsanto Chemical Corporation, operating contractor in the X-10 Area, operates and maintains all power distribution facilities and plant equipment within the restricted area. The patrol and maintenance of the 13.8 kv incoming power lines from K-25 switch house and the 12.0 kv stand-by line from Lenoir City is performed by the Maintenance Section of the Electric Power Division.

e. Electromagnetic Plant Area. - The Tennessee Eastman Corporation, as operating contractor in the Y-12 and Y-12 Extension Areas, operates and maintains all power distribution facilities and plant equipment within these restricted plant areas.

12-4. Authorized Expansion.

a. General. - It became evident early in 1945 that the existing power facilities provided at CEW to a predetermined load of 317,000 kw in December 1944 (App. A-78) were inadequate to meet the demands of an additional 145,000 kw resulting from proposed increases in the town and Beta Process loads in the Y-12 plant and the K-27 plant load scheduled to reach its peak in February 1946. At a conference held in the TVA offices in Knoxville, 26 April 1945, in which representatives of

Manhattan District, CEW operating contractors' engineers, and TVA participated, it was agreed that steps should be taken to provide additional facilities at CEW and strengthen portions of the TVA system to meet anticipated power requirements. At subsequent conferences it was determined that certain changes and extensions should be made.

12.5. Contractual Arrangements with the TVA.

a. General. - In its relationship with TVA at CEW, the War Department has run the gamut of power agreements and has dealt with nearly every branch of the TVA. Of the several contracts concerned with electric power, the smallest provided light for one farm house at a total cost of $35.80, while another contract accrued in the month of August 1945 alone, a bill of $623,267.16. Generally the contracts fall into three classes, those for temporary power service, those for construction of facilities, and those for permanent power service.

b. Temporary Power Service.

(1) A Stone & Webster subcontract with TVA, dated 3 February 1943, and terminated on 19 June 1943 (App. A-80), provided temporary construction power for the initial work on the project until a better source was available. Power was delivered and metered to Stone & Webster over existing TVA lines from a tie at Solway Bridge. Rates charged were standard TVA rates for industrial service. A unique provision of this contract provided for a continuance of power service by the TVA to unevacuated residents on the reservation. It further provided for the maintenance of all lines by Stone & Webster and for the TVA to read all meters, render bills direct to the residents, and make nec-

essary reductions in power charges to Stone & Webster. The total cost amounted to $6,134.49.

(2) Another Stone & Webster subcontract, entered into with TVA on 1 May 1943 (App. A-83), replaced the subcontract (App. A-80) mentioned above and provided that the TVA would furnish temporary construction power not to exceed 3,000 kw over the first of the two tap lines from Watts Bar - Norris Dam. The agreement provided for construction of a temporary substation and metering equipment at the Elza No. 1 terminal and for subsequent removal of the equipment when permanent facilities were completed. Rates were in accordance with established TVA rates for heavy industrial service; the monthly billing rendered for power furnished under this subcontract extended through and including March 1944. Inasmuch as the rates charged for power under the new contract (App. A-85) negotiated between the War Department and the TVA for power service at CEW were lower than under the 1 May 1943 subcontract, refund of $69,297.53 was obtained on the basis of the differential between the rates of the two contracts. Total cost under this subcontract was $310,905.03.

(3) A subcontract, dated 1 February 1943 (App. A-209), under E. I. duPont de Nemours & Company's prime contract (App. A-210), provided for temporary power for the construction of Clinton Laboratories. Power was to be delivered over TVA constructed facilities at standard rates for industrial power. Because of the temporary character of the service taken under this contract, terms of the contract provided for the payment of $5,000 to reimburse the TVA for the cost of furnishing, constructing, and installing such facilities. This sum covered the TVA

cost of constructing the facilities including labor and materials, and the cost of removing all salvageable materials, less the value of salvageable materials. Another prime contract with TVA, dated 24 June 1944 (App. A-84) and terminating on 26 October 1944, was a utility service contract for temporary lighting service to a farm house used from June to September 1944 during construction of housing. The total cost was $35.80.

c. Construction Contracts. - There were ten contracts pertaining to construction of facilities. Discussions of the individual contracts will be found in succeeding paragraphs in the discussion of facilities to which they pertain. The points which should be considered are that the actual construction contracts were cost-plus-fixed-fee contracts; that they contained provisions for including the cost of moving men and equipment from other TVA work; and that rights-of-way off the reservation were obtained by the TVA and made available to the War Department by easement.

d. Permanent Power Service.

(1) The main power supply contract between the TVA and the War Department, executed on 25 April 1944, effective as of 1 October 1943, reflects the results of long negotiations to determine an equitable instrument for defining the relationship and mutual benefit between the agreeing parties (App. A-85). The contract makes available the standard wholesale power rate which is available to the large cities in the TVA system but does not allow resale of power to commercial users. The second supplement to the above contract, dated 1 July 1945, contained provisions which permitted the Government to resell power in limited quantities to concessionaires within the reservation. The agreement re-

cognizes and provides for the fact that on occasion the K-25 Power House will have surplus energy to deliver to the TVA system which may be accepted by the TVA and credited at the actual generating cost against the power bill. A provision was included to make the contract retroactive to 1 October 1943 and thus permit a refund of the amount paid by Stone & Webster on the commercial rate that was over and above the amount due computed at the wholesale rate. The special provisions of the contract occur in the definition of the methods used for determining Firm Demand and Firm Energy, in the provision for TVA maintenance of all 154 kv lines outside of restricted plant areas, and the provision that all facility construction plans up to and including the substations are subject to TVA review and approval (See Pars. 12-16 and 12-17). The total cost through 31 December 1946 was ~~$14,094,054.12~~ $14,086,753.40 (App. A-320).

(2) A contract between the War Department and TVA, entered into on 1 October 1944 (App. A-86), provided for lighting service to the Edgemoor Gate. Rates were standard TVA large lighting rates. Total cost to 15 January 1946 was $834.54. On 15 January 1946, the TVA contract was cancelled, and a contract, which replaced the TVA contract, was entered into on 16 January 1946 with the Clinton Power Commission, Clinton, Tennessee (App. A-321). The cost under this latter contract through 31 December 1946 was $420.67 (App. A-320).

(3) A contract between the War Department and TVA, entered into on 31 January 1944 (App. A-87), provided for furnishing emergency power to the Clinton Laboratories at such times as power is not available from the normal source. Facilities used were the circuits from the TVA system at Lenoir City over which temporary construction

power was furnished under subcontract (App. A-209). Rates charged were a minimum rate of $330.25 per month and a standard commercial rate. Total cost to 15 January 1946, was $7,159.76 (App. A-320). On 16 January 1946, a contract which replaced the contract with TVA was entered into with the Lenoir City Water and Light Department, Lenoir City, Tennessee (App. A-322). Cost through 31 December 1946 under this contract was $3,747.13 (App. A-320).

(4) A contract between the War Department and the Harriman Power Department, Harriman, Tennessee (App. A-323), entered into on 1 August 1946, provides for lighting service at Blair (Poplar Creek) Gate. Total cost under this contract through 31 December 1946 was $93.18 (App. A-320).

(5) A contract between the War Department and the Fort Loudoun Electric Cooperative, Madisonville, Tennessee (App. A-324), entered into on 10 April 1945, provides for lighting service to White Wing Bridge; the total cost through 31 December 1946 under this contract was $713.69 (App. A-320).

(6) The total cost of power under the main power supply contract with TVA (App. A-85) was ~~$14,095,799.14~~ $14,086,753.40 through 31 December 1946 (App. A-320).

12-6. Norris-Watts Bar Connection.

a. Planning. - Using the power requirements developed in conference in September 1942 as a basis, Stone & Webster developed a plan to supply the load, which included cutting the existing Norris-Watts Bar 154 kv transmission line (Apps. A-77 and A-211). The plan was to cut the existing line and build two 154 kv tap lines from the two ends of the cut

and to loop them through a switching station adjacent to the Electromagnetic Plant.

b. Design. - A Stone & Webster subcontract, dated 6 February 1943 (App. A-88), under Stone & Webster's prime contract (App. A-82) provided that the TVA would design the transmission lines.

c. Construction. - The same CPFF subcontract provided that for a fixed-fee of one dollar and an estimated cost of $82,000 TVA would construct two 154 kv tap lines 3.6 miles long from a tap-off structure to be provided by TVA to a substation to be constructed by Stone & Webster. The contract further provided for installation and removal by TVA of temporary equipment and to permit the first line to be used for temporary service. Construction was started on 7 February 1943 and was completed on 15 June 1943. Total actual cost of features described in this paragraph was $151,064.79 (Page 218 of App. A-193).

12-7. Fort Loudoun to Elza Substation No. 2 Connection and Elza No. 1 to Elza No. 2 154 KV Tie Line.

a. Planning. - With the authorization of the extension to the Electromagnetic Plant, the power requirements for the Y-12 Area and the town exceeded the capacity of the original facilities. Following the recommendation of the TVA, Stone & Webster submitted a plan on 11 December 1943, to bring additional power from Fort Loudoun and provide a tie line for interchange of power between Elza No. 1 substation and Elza No. 2 substation. This plan was approved on 10 January 1944.

b. Design. - A War Department contract, dated 20 January 1944 (App. A-90), provided for design of the transmission line by the TVA. (All studies and design data are the property of the TVA and are

located in their files. Copies of the specifications, bills of material, location and profile plans required for the construction of this line are in the Manhattan District files at CEW).

c. Construction. - Under the same contract (App. A-90), construction of 14 miles of 154 kv transmission line supported on H-type wood pole structures from the Fort Loudoun Dam switchyard to Elza No. 2 substation and a 154 kv tie line approximately 1.3 miles in length between Elza No. 1 and Elza No. 2 substations was accomplished. Work was started 20 January 1944 and was completed 1 July 1944, at a total cost of $195,357.43. This was performed by the TVA.

12-8. Fort Loudoun to K-25 Connection.

a. Planning. - In the summer of 1944 a new manufacturing plant was authorized for construction at CEW. Because this plant, for the Thermal Diffusion Process (S-50 Area), required large amounts of high pressure steam, available only at the K-25 Power House, the plant was located nearby (See Book VI, Thermal Diffusion Project). Because of the effect of the diversion of energy for the new process on overall power capacities, it was decided to construct a new line to bring power into the K-25 Plant. TVA's proposal to construct a line from Fort Loudoun to the K-25 switchyard was accepted on the basis of greatest dependability (App. A-91. See Par. 12-14 for discussion of integration of this line with other power sources in the Diffusion Plant Area).

b. Design. - A War Department contract, dated 22 August 1944 (App. A-92), was entered into with the TVA for design of the transmission line. (All studies and design data are the property of the TVA

and are located in their files. Copies of the specifications, bill of material, location and profile plans for the construction of this line are in the Manhattan District Office files at CEW).

c. Construction. - The same CPFF contract provided for construction of the 154 kv transmission line by TVA. Additional provisions in this contract, not found in the others, required the War Department to provide certain construction equipment and assistance in procuring critical classes of labor in order to complete the work in the unusually short construction period. Construction was started in August 1944 and was completed in the following December, at a cost of $256,829.08 (App. A-92).

12-9. Watts Bar-Norris to K-27 Connection.

a. Planning. - As the power requirements of the newly authorized K-27 Process Area exceeded the capacity of existing facilities in the K-25 Area, it became necessary to give consideration to provision of additional sources of power and terminal facilities in the K-27 Area. As a result of several conferences held during April and May 1945, the TVA made studies and investigations to determine the most economical methods of providing additional facilities. These studies were reviewed at a conference held in New York, 14 June 1945, and it was decided that steps should be taken to meet power requirements for K-25 and additional requirements of other process areas, to loop the Watts Bar-Norris 154 kv line through a primary substation at K-27, to provide an additional source of power for K-27 Area consisting of a 154 kv tie line between K-25 and K-27 substations, and to reconnect the Elza No. 1 terminal of the 154 kv tie line to K-25 from Elza No. 1 substation to Elza

No. 2 substation. In addition to the proposed extensions to the existing facilities at CEW, it was deemed necessary to firm up the TVA power supply by constructing additional extensions to that system. To accomplish this, TVA proposed to construct a 154 kv transmission line from Cherokee Dam to Norris Dam, to loop the Watts Bar-Alcoa 154 kv line through Fort Loudoun Dam switchyard, to install transformers at Fort Loudoun switchyard to provide an interconnection between the 110 and 154 kv systems, and to provide additional switching equipment and relocate existing switching equipment at Fort Loudoun switchyard. It was estimated that an expenditure of approximately $2,000,000 by TVA would be required to provide the additional extensions and additions to the TVA system. Of this amount, it was agreed that CEW would absorb approximately $600,000. However, at a conference held at the Manhattan District Office at CEW, 19 September 1945, consideration was given to the reduction in total CEW power requirements brought about by the cutbacks in production following V-J Day. Because of the reductions, it was decided that the TVA would abandon the construction of the facilities as originally planned and construct only those necessary to provide a firm power supply to K-27. Under this plan, the construction of the Cherokee Dam-Norris Dam 154 kv line and the looping of the Watts Bar-Alcoa 154 kv line through the Fort Loudoun switchyard were abandoned. Early in 1946, the TVA found it necessary to strengthen its system because of abnormal growth by constructing a 154 kv transmission line between Norris and Cherokee Dams. This line, which was constructed at no cost to the Manhattan District or the War Department, was placed in service in April 1946 (App. A-320).

b. Design. - The engineering design and construction of the Watts Bar-Norris loop into K-27 was performed by TVA (Apps. A-212 and A-213). The design for the connection between the Watts Bar-Norris line consisted of opening the 154 kv line between towers adjacent to the substation, and extending line connections between new dead-end structures in the line and dead-end structures in the switchyard. Wood pole construction was used for supporting the line taps to the substation. TVA also performed the engineering and design and prepared the specifications for the materials to be furnished by the Government for the construction of approximately one mile of 154 kv line of steel tower construction, to be used as a tie line between K-25 and K-27 substations. The contracts also covered the purchase of rights-of-way, engineering, design, inspection, and construction of additional electrical facilities and extensions to existing facilities at the Fort Loudoun Dam switching station, and the purchase of rights-of-way and engineering and design of other facilities which were originally proposed but not constructed.

c. Construction. - The construction of the Watts Bar-Norris loop into K-27, completed in December 1945, was performed by the TVA (App. A-212), at a cost of $15,913.12. The K-25 and K-27 154 kv tie line was constructed by the A. S. Schulman Electrical Company under contract dated 25 September 1945 (App. A-213). Work was started 13 September 1945, and the line was completed and placed in service 26 January 1946. Construction cost by Schulman was $37,946.24. The design cost by TVA was $1,674.28 which placed the total at $39,620.52 (App. A-226).

12-10. Clinton Laboratories 13.8 KV Feeder (From K-25)

a. Planning. - The 12.0 kv power line from Lenoir City

which served Clinton Laboratories during the construction period was inadequate to carry the entire X-10 load after the various units in this area were activated. In view of the anticipated process loads it became necessary to provide a source having greater capacity. After some study the TVA proposed the construction of a 13.8 kv power line approximately six miles in length to extend from the switch house at K-25 steam plant to Clinton Laboratories. This line consisted of single pole construction having 1/0 A.C.S.R. conductors and one ground wire and terminated at an outdoor switching station immediately north of X-10 Process Area.

b. Design and Construction. - Under contract dated 26 July 1943 (App. A-96), TVA engineered, designed, and constructed the line from K-25 to X-10 and furnished all materials and equipment necessary to place the line in service. Construction of this line was started 26 July 1943 and was completed 26 September 1943. A contract modification provided for the rental of necessary transformers and switching equipment at the X-10 terminal of the line. The total cost was $44,548.09 (App. A-320).

12-11. Thermal Diffusion Area Temporary and Permanent Power Supply. - Power for testing purposes in the S-50 Area was initially supplied from temporary construction circuits installed near the K-25 steam plant. The temporary service was replaced 3 July 1945, with a permanent 13.8 kv underground service connected to the 13.8 kv bus in the K-25 switch house through the No. 6 auxiliary transformer. The cost of this work is included in the cost of installing the 13.8 kv feeder cables to the various process units.

12-12. Elza Substation No. 1.

12-12. Elsa Substation No. 1 (cont'd).

a. Planning. - In solving the problem of receiving and distributing power to the various parts of the project, a switching station was necessary as a terminal for the high voltage transmission lines with controls and stepdown transformers to effect proper distribution. The original switching station, known as Elsa No. 1 substation, was recommended by Stone & Webster, 21 October 1942 (App. A-93). It became necessary in the spring of 1945 to consider plans for additional facilities, estimated to cost $101,879.63, at this station to meet anticipated power requirements expected in January and February 1946. However, because of cutbacks starting in September 1945, after the end of the war, and a shortage of materials, a revision of requirement estimates was made. It was decided to proceed with construction, but estimated completion dates were indefinitely deferred.

b. Design. - Design of the substation and subsequent changes and additions were performed by Stone & Webster electrical engineers in their Boston office (Apps. A-82 and A-215). The original design included six 154 kv circuit breakers with necessary protective and control equipment, two 15,000 kva three-phase transformers to supply townsite and pumping plants, oil circuit breakers for the 154 kv feeders, Y-12 process, structures for outdoor switch gear, a substation building to house the 13.8 kv cubicle-type circuit breakers for townsite power distribution feeders and electrical equipment, and relays and instruments controlling incoming 154 kv power lines, substation tie lines and 13.8 kv power distribution feeders. Changes and additions required in 1945 to meet anticipated 1946 power requirements (App. A-215) included relocation of ter-

minal connections at Elsa No. 1 substation buss, for the Watts Bar line and Elsa No. 2 154 kv tie line, the relocation of the 154 kv circuit breaker vacated by the removal of Elsa No. 1 terminal of the tie to K-25, to Elsa No. 2 substation for future use as tie line breaker between the Watts Bar and Norris Dam 154 kv incoming power lines, the installation of a third 15,000 kva three phase transformer and necessary switching equipment and structures to meet additional townsite power requirements, an extension to the existing substation building, and the installation of parts necessary to increase the interrupting capacity of all circuit breakers in the Elsa terminals of all incoming power and substation tie lines.

c. Construction. - The original substation was constructed by Stone & Webster (App. A-82). Work was begun 7 February 1943 and was completed 15 June 1943 at a cost of $928,342.72 - $685,728.85 for the substation and $242,613.87 for the control house (Pages 220 to 225 of App. A-193). Stone & Webster performed all construction for the changes and additions made to this station between 8 May 1945 and 1 March 1946 (App. A-215). Responsibility for work remaining uncompleted when Stone & Webster was relieved, plus certain additional items, were assumed in March 1946 by Watson-Flagg Engineering Company (See App. A-213a; also see App. A-214). The Watson-Flagg contract was terminated on 1 July 1946, although, because of material shortages, the work remained unfinished. At the end of 1946, it was planned that no additional contracts be awarded except for technical services, as it was planned that the uncompleted items be completed by Government forces when materials became available. It was estimated that materials would become available in time for the

work to be completed by 1 July 1947 (App. A-320).

12-13. Elza Substation No. 2.

a. Planning. - Plans for bringing power over the Fort Loudoun 154 kv line to meet requirements in the Y-12 Extension included a substation, known as Elza No. 2 substation, to be located at the west end of Y-12 Extension Area. This substation provided a terminal for the transmission line and a means of serving this area with 154 kv feeder circuits. Anticipating a further increase in the load in this area in early 1946, steps were taken in the spring of 1945 to provide additional facilities, at an estimated cost of $168,104.00, to meet new load requirements.

b. Design. - The original installation was designed by Stone & Webster (App. A-82). It consisted of an outdoor switching structure, a control house, two 154 kv breakers for the Fort Loudoun transmission line, Elza No. 1 substation tie line, three 154 kv breakers for circuits serving Y-12 Extension, and necessary control equipment. Stone & Webster designed the changes and additions required in 1945, consisting of an additional 154 kv circuit to Y-12 Extension, extensions to existing switchyard structures, relocation of the Fort Loudoun line terminus, provisions for reconnecting the Y-12 terminus of the Elza No. 1 and K-25 tie to Elza No. 2 substation, and the installation of conversion parts in the breakers in all incoming lines and tie lines to increase capacity of breakers (App. A-215).

c. Construction. - The original construction likewise was performed by Stone & Webster (App. A-82). Work was started on 7 February 1944 and was completed in July 1944 at a cost of $514,940.71, including cost of the control house. The additional work planned for 1945 and 1946

at Elza No. 2 substation followed the exact pattern of 1945 and 1946 work at Elza No. 1 substation (See Par. 12-12c).

12-14. Diffusion Plant Area (K-25).

a. K-25 Substation. - Power facilities in the K-25 Area consist of a steam generating station with a total installed capacity of 238,000 kw, capable of generating constant (60 cycle) and variable frequency power to meet special process requirements and a high-voltage substation having a capacity of 120,000 kva, known as K-25 substation, and which is served by 154 kv lines connected to the TVA system. With exception of limited amounts of high frequency power, all constant and variable frequency power generated by the steam plant is delivered to a complex system of 13.8 kv busses in the steam plant switch house from which it is distributed to the various units in K-25 Process and X-10 Area. It was also distributed to the S-50 Area until that process plant was placed in stand-by. Constant frequency power is available from the TVA system through a primary substation known as the K-25 substation. This substation is served by one 154 kv transmission line from Fort Loudoun Dam, a 154 kv tie line from Elza No. 2 substation and a third source of power consisting of a 154 kv tie line between K-25 and K-27 substations which provides a connection to the TVA's Watts Bar-Norris line. Through suitable switching arrangements and stepdown transformers in the K-25 substation switch yard, power from the TVA system is delivered to the 13.8 kv busses at the steam plant switch house and provides a means of supplementing the constant frequency power generated by the steam generating station and, also, a means of delivering surplus generation from the steam plant to the TVA system.

b. Planning. - The initial installation of electrical

facilities in K-25 Area consisted of a 154 kv transmission line extending from Elza substation No. 1 to a point near the present site of K-25 primary substation, to which this line was connected temporarily through suitable switching equipment to a step-down transformer. This connection afforded a source of power for miscellaneous construction operations and for testing and trial runs in the power plant and process areas prior to the time power became available from the steam generating station. Original plans contemplated that the large quantities of process steam required by Thermal Diffusion process would be available from the steam generating station boilers. In the early part of 1944 it was recognized that Thermal Diffusion process steam demands would reduce steam plant power generation and that another source of power from the TVA system into K-25 Area was necessary to supplement steam plant power generation. As a result, plans were adopted which provided for a 154 kv transmission line to extend from TVA's Fort Loudoun Dam substation to a permanent primary substation, known as the K-25 154 kv substation, and which afforded a terminal for the new Fort Loudoun 154 kv line and the 154 kv tie line from Elza substation No. 1, and a means of serving K-25 process loads and, ultimately, the Thermal Diffusion and Clinton Laboratories process loads, through the 13.8 kv busses located in K-25 steam generating station switch house. Anticipated additional loads in K-25 and K-27 Areas in 1945 and early 1946, resulting from expansion in operations in these areas, required that additional facilities be provided. Plans adopted at a conference held with TVA representatives in Chattanooga in April 1945 provided for a third source of power in the K-25 Area from the TVA system. This consisted of a 154 kv tie line between the K-25 and K-27 substations

where the K-27 substation connects to the Watts Bar-Norris Dam 154 kv transmission lines. Measures to increase the dependability of the power supply to the two substations included the installation of suitable relay protection equipment and the installation of parts necessary to increase the capacity of all circuit breakers in the lines serving the substations. Calculating board studies made by the TVA indicated the need for additional reactive to supply the deficiency created by the additions of large blocks of lower power factor load in the K-25 and K-27 Process Areas. To supply this deficiency, the Kellex Corporation performed the engineering and design which provided for the installation of two outdoor type 25,000 kva synchronous condensers in the 154 kv switchyard at K-27 and two 25,000 kva condensers to be installed in a lean-to constructed adjacent to K-25 steam plant switch house. Only one of these units was installed at K-25 due to the cutback in process load following V-J Day.

c. Design. - The temporary and permanent substations were designed by the Kellex Corporation (App. A-216). The designs included studies and plans for transferring the construction and process loads from the temporary substation to the permanent substation. Kellex also designed the extensions and additions required to serve anticipated K-25 process loads scheduled for January 1946.

d. Construction. - A. S. Schulman Electrical Company, under prime contract (App. A-213), constructed the temporary and permanent substations and performed all construction work incidental to providing the additions and extensions to the station necessary to meet increased loads. The 154 kv tie line extending from Elza No. 1 substation to the temporary substation at K-25 was constructed by TVA at a cost of $75,467.75.

This work was started in August 1943 and was completed in October 1943 (Apps. A-95 and A-320). Work was started on the temporary substation in July 1943 and was completed on 8 October 1943. The original installation, as planned for the permanent substation, included switching facilities for two incoming 154 kv power lines and three 40,000 kva three phase 154/13.8 kv power transformers. This phase of work was started October 1943 and completed December 1943. Under the same contract the Schulman Company constructed additions and extensions to the substation which provided for an additional incoming 154 kv tie line from K-27 and other extensions required to increase the capacity of installed equipment, and, also, undertook to perform additional work designed to increase capacities. Schulman's additional work was started in September 1945 and, although the revised estimated completion date was late in 1946, Schulman's contract was terminated effective 30 June 1946 (App. A-217a), after material and equipment shortages forced a suspension of work. Plans at the end of 1946 called for completion of this work by Carbide and Carbon Chemicals Corporation, the operator of the Diffusion Plant, by 1 July 1947 (App. A-320). The estimated cost of all work provided for by the Schulman prime contract was $5,662,534.00, including the cost of the K-27 substation and related work (See Par. 12-15) and that of other construction accounted for separately in this section, e.g., the K-25 and K-27 154 kv tie line (See Par. 12-9c). References to construction of incoming power lines to K-25 substation are appended (Apps. A-92, A-213, and A-217). Cost of the TVA Fort Loudoun K-25 - 154 line is shown in Paragraph 12-8c.

12-15. K-27 Substation. - In order to meet an estimated normal load of approximately 120,000 kw in the K-27 Process Area, scheduled to

begin operations in October 1945 and scheduled to reach a peak in January 1946, it was necessary to provide another permanent substation, known as K-27 substation, in the K-25 Area adjacent to the K-27 Process Area. This station consists of an outdoor 154 kv switchyard in which were located high voltage busses and switching facilities for five three-phase 40,000 kva 154/13.8 kv transformers and three incoming 154 kv power lines. A 13.8 kv switching station adjacent to the outdoor switchyard and process building provided a means of distributing power at 13.8 kv to the various units in the process areas. The power lines consist of a loop from the Watts Bar-Norris 154 kv line, which provided two independent sources of power from the TVA system and a 154 kv tie line from K-25 substation which provided a third source of power from the TVA system via the Fort Loudoun hydro generating station. Because of the heavy induction motor load and associated low power factor, it was found necessary to install two 25,000 kva outdoor type synchronous condensers in the 154 kv yard to provide a means of improving the power factor and controlling the high voltage level at CEW. Design was by Kellex (App. A-216) and construction by Schulman (App. A-213; for construction data on K-27 substation incoming lines see Apps. A-212 and A-213).

12-16. Generating, Reception, and Distribution Data (App. A-227).

a. December 1946 - Total KWH.

(1)	Received and generated, CEW	159,495,000
(2)	Meter inaccuracies and unaccounted for losses	2,230,000
(3)	Distributed to entire CEW	157,265,000
(4)	That part of 157,265,000 kwh dis-	

12-16. Generating, Reception, and Distribution Data (cont'd).

a. December 1946 - Total KWH (cont'd).

tributed to town	13,498,000

b. Cumulative, October 1943 - December 1946 - Total KWH.

(1)	Received and generated, CEW	4,722,664,000
(2)	Meter inaccuracies and unaccounted for losses	122,731,000
(3)	Distributed to entire CEW	4,599,933,000
(4)	That part of 4,599,933,000 kwh distributed to town	315,833,000

12-17. Power Costs, Received and Generated (App. A-227).

a.	December 1946	$ 522,586.98
b.	Cumulative, October 1943 - December 1946	$ 18,349,729.22
c.	TVA power charges to CEW:	
(1)	December 1946	$ 480,190.50
(2)	Cumulative, October 1943 - December 1946:	$ 14,086,753.40

12-18. Construction Cost Data.

a. General Considerations. - For reasons previously indicated (Par. 12-1a), it is not feasible to attempt to spread total electrical construction costs among the major facilities at CEW, and, particularly, to attempt to assign an accurate construction cost figure to that part of the system serving the Central Facilities.

b. Summary of Available Construction Costs, CEW. - Available cost data for CEW electrical construction, although incomplete be-

cause many features are included in the cost of the process plants (e.g., the steam generating plant in the Diffusion Plant Area, probably the largest single electrical feature at CEW), and consisting of Manhattan District disbursements only, are as follows:

Contract No. & Reference	Contractor	Feature	Cost
(W-7412-eng-23	du Pont	Temporary Facili-	
(XPG 1057	TVA	ties, X-10	$ 5,000.00
(W-7401-eng-13	Stone &	Norris-Watts Bar	
(47-C-6232	Webster (Planning)	connection, two	
(Page 218 of	TVA (Construction)	154 kv lines through	
(App. A-193		substations Elza Nos.	
		1 and 2	151,064.79
(W-7415-eng-69	TVA	Fourteen miles, 154	
		kv line to Elza Nos. 2	
		and a 1.3 mile tie-	
		line to Elza No. 1,	
		serving Y-12 Area and	
		Y-12 Extension inter-	
		changes and wood pole	
		H-frame supporting	
		lines).	195,357.43
(W-7418-eng-163	TVA	Transmission line,	
		154 Kv, from Ft.	
		Loudoun into K-25	
		switchyard	256,829.08

12-18. Construction Cost Data (cont'd)

b. Summary of Available Construction Costs. CEW (cont'd).

Contract No. & Reference	Contractor	Feature	Cost
W-44-153-eng-39	TVA	K-25 & K-27 tie line (Design);	$ 1,674.28
		Watts Bar-Morris loop into K-27 (Design and Construction);	15,913.12
		Unrecoverable costs (Design and Construction) Watts Bar-Alcoa Loop into Ft. Loudoun switchyard	193,480.28
W-7418-eng-5	TVA	K-25 - K-10 line	44,548.09
W-7401-eng-13 pages 220 and 226 of App. A-193	Stone & Webster	Elza No. 1 substation	685,728.85
		Elza No. 1 substation control house	242,613.87
		Elza No. 1 substation, addition	101,879.63*
	Stone & Webster	Elza No. 2 substation	440,337.91
		Elza No. 2 substation control house	74,602.80
		Elza No. 2 substation, addition	168,104.00*
W-7405-eng-101	Schulman	K-25 and K-27 substations, plant additions, K-25 and K-27 - 154 kv tie line, and general work in Diffusion Plant Area	5,662,534.00**

12-18 Construction Cost Data (cont'd).

b. Summary of Available Construction Costs. CEW (cont'd).

Contract No. & Reference	Contractor	Feature	Cost
(W-7418-eng-6	TVA	Elza No. 1 line to K-25 - 154 kv line	$ 75,467.75
	TVA	K-25 steam plant; connection to K-25, K-10 and S-50;	(Not
	Jones	and related work	Available)
(Pages 230 and	Stone &	Overhead electrical	
(231 of App.	Webster	distribution system,	
(A-193		Oak Ridge	$1,612,460.81
		TOTAL	$9,927,569.69

*Estimated

**Estimated contract total only

c. Central Facilities Construction Costs. - Of the total available cost given in the subparagraph immediately above, only the Oak Ridge distribution cost of $1,612,460 is clearly assignable to the Central Facilities. Since the major facilities, e.g., TVA lines, substations, and interchange lines within the reservation, are primarily for use of the process plants, the total construction costs assignable to the Central Facilities probably would not exceed $2,000,000.

SECTION 13 - WATER SUPPLY SYSTEM

13-1. General Description. - The central Water Supply System consists of complete facilities to supply the town of Oak Ridge and the Electromagnetic Plant (App. B-9; for general discussion of water system, see Pages 38 to 41 of App. A-193). A pumping plant (App. D-38) with a normal capacity of 24 million gallons per day and a maximum capacity of 28 mgd is located on the Clinch River west of Solway Gate (App. B-2). The filtration plant (App. D-39) is capable of supplying 17.5 mgd of filtered water. The filtration plant is located two and one-half miles north of the pumphouse. The pumphouse and filter plant are connected by two 24-inch cast iron force mains. Adjacent to the filtration plant is one 4.0 mg concrete reservoir and one 3.0 mg concrete reservoir; both reservoirs are interconnected. Cast iron pipe lines, with aid of booster pumping stations, supply two supplementary reservoirs, and three elevated storage tanks. The two supplementary reservoirs and three elevated storage tanks, with a combined capacity of 3.4 mg, are located on the top of the ridge above the town to provide gravity feed and control for the town distribution system. The Electromagnetic Plant Area is supplied with filtered water by feed lines from the 4.0 mg reservoir and with raw water, through a 16-inch feed line from the 24-inch force mains. Maps of the water supply system are attached (Apps. B-7 to B-9). The system does not supply the Diffusion Plant Area and the Clinton Laboratories, each of which is supplied by an independent system (See Books II and IV, respectively).

13-2. Preliminary Planning. - As a part of the original planning studies made to provide an adequate water system for the Clinton Engi-

neer Works, consideration was given to obtaining the required amount of water from wells, but because of the nature and extent of sub-surface limestone formations both the quantity and quality of water were uncertain. Data from the Tennessee Valley Authority, together with chemical and bacteriological investigations, indicated that the Clinch River was the only dependable and adequate source of raw water available (App. A-97). However, since raw water from the Clinch River was not satisfactory for domestic consumption without treatment, it was necessary to design and construct a plant to treat and filter water prior to use, although a single system to provide water for the whole reservation was not considered economically feasible because of the large amounts necessary and the great distances involved (App. A-98).

13-3. Development. - The water system developed as the demands increased. The broad phases of development, as discussed in this paragraph, began in November of 1942 when the initial drinking water supply was trucked to the reservation from Clinton (Page 38 of App. A-193) and that used in construction was taken from wells. During this period, which extended until March of 1943, a temporary system to serve until the permanent system could be constructed, was built in the vicinity of major construction. The permanent system, which was started in March of 1943, was built to supply the large quantities of water needed by the Electromagnetic Plant for process water and by the town for domestic usage. In the fall of 1943, the construction of extensions to the Electromagnetic Plant and an estimated increase in the population of Oak Ridge to 42,000 necessitated the expansion of the water facilities. A new raw water supply line was provided for the cooling towers at the

Electromagnetic Plant, in addition to new distribution mains for filtered water. The west section of Oak Ridge was provided with new facilities to supply the large number of housing units constructed there. In the spring of 1945, it again became apparent that the system required further expansion to supply adequately an equivalent population, making proper allowance for transient workers, of 68,000 persons. The raw water demands of the Electromagnetic Plant had also increased. Consequently, plans were developed and work was completed during 1945.

13-4. Temporary System. - To provide an adequate supply of water for the construction forces, a temporary water supply system, consisting of a small pumphouse, force mains, treatment plant, storage facilities, and distribution lines, was constructed (App. A-99; also see Pages 38 and 39 of App. A-193). The pumphouse, with a capacity of 200 gpm was located on the Clinch River near Elza Gate (App. B-4) as this location provided the shortest lines to the points of major construction. An 8-inch force main was laid, generally above ground, to the temporary treatment plant south of the present central heating plant and east of the Administration Building; the capacity of the treatment plant, comprised of pressure filters, was 100 gpm. A 150,000 gallon elevated tank was erected in the townsite to provide storage and to equalize pressure for consumption and fire protection. This system was designed and constructed by Stone & Webster Engineering Corporation. The approximate net cost was $90,000. A part of the distribution features only of the temporary system was eventually incorporated into the permanent system (Page 39 of App. A-193).

13-5. Permanent System.

a. Planning. - In order to provide for minimum construction and operating costs, plans were developed to construct the permanent water system in the vicinity of major demand. The filtration plant and largest reservoir were, therefore, built on a ridge immediately northeast of the Electromagnetic Plant to supply conveniently both the plant and the town. The pumphouse was built on the Clinch River about two miles west of Solway Gate, as this location provided for the shortest force mains. The storage facilities for the town were placed on the ridge northwest of the town to provide a gravity feed and control for the distribution system. The initial permanent system, designed as shown schematically on sketch in Appendix B-7, had roughly about one-half the capacity of the present system, described previously. Its scope included a river pumphouse, having a maximum capacity of 12 mgd, connected to the filtration plant by a single 24-inch cast iron force main. The filtration plant was designed for a capacity of 9.0 mgd and was of the conventional type, having mechanical mixers for floc formation, settling tanks for clarification, rapid sand filters for filtration, chemical feeding equipment of the gravimetric type for proportioning of alum and hydrated lime and soda ash, as well as equipment for both pre-chlorination and post-chlorination of the water. The 4.0 mgd, double compartment reservoir was located adjacent to the filtration plant, from which two 16-inch feed lines served the Electromagnetic Plant Area and a 12-inch line served the town of Oak Ridge. A booster pumping station, with a capacity of 4.0 mgd, was placed in the 12-inch townsite feed line to pump water to the 1.2 mg reservoir located on Pilot Knob above the townsite. Water was fed by gravity to the town distribution lines. Two

additional booster pumping stations and three elevated storage tanks were constructed to provide water distribution to those portions of the town which could not be provided with water from the two reservoirs. Authority to proceed with the design and construction of the Water Supply System was given Stone & Webster by the District on 21 January 1943 (App. A-278; also see Pages 39 to 41 of App. A-193).

b. Construction. - Construction of the distribution lines was started 13 May 1943 by labor supplied by sewer and water contractors, supervised by Stone & Webster. These contractors were: D. W. Winkelman Company (Apps. A-100, A-101, and A-167); Sullivan, Long & Hagerty (Apps. A-106, A-107, and A-110); Christopher & Company (Apps. A-130 and A-137); Drainage Contractors, Inc. (Apps. A-138 and A-174); and Birmingham Construction Company (App. A-170). The pumphouse, started on 22 March 1943 by Stone & Webster forces, was completed 25 August 1943. The 4.0 mg reservoir and the filtration plant, likewise constructed by Stone & Webster, were started 29 March 1943 and were completed 6 August 1943 and 31 October 1943, respectively. The system was placed in operation on 25 November 1943. As subsequent distribution lines were completed, they were included in the system.

13-6. First Expansion. (November 1943)

a. Planning. - Because of extensions to the Electromagnetic Plant and the subsequent increase in the size of Oak Ridge (See Par. 13-3; also see map of water system of Oak Ridge and the Electromagnetic Plant Area in Appendix B-8), it was necessary to expand the original water supply facilities. An addition to the filtration plant and more extensive distribution facilities were necessary to provide for the

additional housing units in the western part of Oak Ridge. The additions to the system increased the capacity and extent of the facilities to that shown in the appended diagram (App. B-8). The maximum capacity of the pumphouse was increased from 12 to 20 mgd by addition of two 2,800 gpm electric-driven pumps. An additional 24-inch cast iron force main, which paralleled the existing one from the pumphouse to the Electromagnetic Plant Area, was added, as were a 16-inch feed line to furnish raw water for the cooling towers and a 24-inch filtered-water feed for the plant. Two filters were added to the treatment plant to increase its maximum capacity to 12.5 mgd. A 16-inch and 14-inch supply line with booster station led to a new west town reservoir, with a capacity of 2.0 mg, from which the west section of Oak Ridge was serviced by gravity feed. The 14-inch supply main to West Town reservoir and the 12-inch supply main to the East Town reservoir are connected at Oak Ridge Turnpike. The two reservoirs are connected by mains along Outer Drive. All additions to the distribution system west of Pennsylvania Avenue were designed by Skidmore, Owings & Merrill, Architect-Engineer, prior to construction by Government contractors under Stone & Webster supervision (Apps. A-8 and A-278). The 16-inch and 14-inch supply main, booster pumping station, and the 2.0 mg reservoir were designed by Stone & Webster (See Pages 38 to 41 of App. A-193).

b. Construction. - The portion of the 24-inch force main from the River Pumphouse to the connection with the 16-inch raw-water line serving the Electromagnetic Plant Area was constructed by labor supplied by D. W. Winkelman Company, under Stone & Webster supervision (App. A-169 and Page 202 of App. A-193). The 16-inch filtered water

line from the 4.0 mg reservoir to the West Town booster pumping station, the 14-inch force main from the West Town booster pumping station to the connection with the 14-inch line along Outer Drive and the 14-inch connecting line along Oak Ridge Turnpike from the connection with the 12-inch main at Scarboro Road to the connection with the 16-inch main at Gamble Valley Road were constructed by the Birmingham Construction Company, under Stone & Webster supervision (App. A-170 and Page 211 of App. A-193). The section of the 14-inch force main along Outer Drive to the 2.0 mg West Town reservoir was constructed by D. W. Winkelman Company (App. A-167). Labor only for the 2.0 mg concrete West Town reservoir was furnished by A. Parnell Blair (App. A-168 and Page 210 of App. A-193). With the exception of the contracts noted above, all construction was performed by Stone & Webster.

13-7. Second Expansion. - Additional expansion of the Electromagnetic Plant and the town of Oak Ridge necessitated a second expansion to the water system. In order to furnish the required amounts of raw and filtered water and to safeguard the supply with a high degree of certainty, several additions were made, planned, designed, let to contract, and completed in the fall of 1945 (See App. B-9 for map of system). The pumping station was expanded to a normal capacity of 24 mgd and a maximum capacity of 28 mgd, and the maximum capacity of the treatment plant was increased to 17.5 mgd by the addition of one settling tank and four filters. Construction of these facilities was performed by the John A. Johnson Contracting Corporation (App. A-171) at a cost of $302,262.38 (App. A-63). A 3.0 mg capacity filtered-water reservoir adjacent to the 4.0 mg reservoir, to provide additional protection to the water sup-

ply, was completed by the L. C. Powers Construction Company (App. A-172), after site excavation was performed by Harrison Construction Company (App. A-248). Cost of the 3.0 mg reservoir was $190,729.44, including $40,358.03 for site excavation (App. A-63). An extension from the terminus at the Electromagnetic Plant to the Filtration Plant of the 24-inch cast iron force main, which had previously been deferred for reasons of economy, since it was believed that the danger of major breaks was negligible, was reconsidered and approved when a series of breaks in the main line threatened the water supply. The construction (App. A-173), performed by Christopher and Company, ~~Inc.~~, was completed in the summer of 1945 at a cost of $77,567.65 (App. A-63). Additional increments to the system consisted of water distribution lines to new housing areas, installed by Drainage Contractors, Inc., at a cost of $19,008.53 (Apps. A-63 and A-249); John F. Humphrey Company, at a cost of $112,495.75 (Apps. A-63 and A-250 to A-252); Christopher & Company, at a cost of $53,074.70 (Apps. A-63 and A-179); and B. R. Hinson Construction Company, at a cost of $40,024.05 (Apps. A-63 and A-178); a water control tank (Bldg. No. 1410-2), as an addition to the filtration plant, constructed by Roane-Anderson Company, at a cost of $17,861.02 (Apps. A-63 and A-247); a 24-inch raw water main from the control tank to the existing filtration plant, installed by Christopher & Company, at a cost of $8,248.10 (Apps. A-63 and A-253); distribution lines to miscellaneous buildings, installed by Sullivan, Long & Hagerty, at a cost of $51,353.83 (Apps. A-63 and A-254); and miscellaneous distribution facilities in the trailer camps and Farmers' Market and other areas, installed by Harrison Construction Company, at an estimated cost of

$12,503.08 (Apps. A-63, A-247, and A-255).

13-8. **Construction Cost Summary.**

Building Number	Description	Cost
(1402-1	Reservoir No. 1 (4.0 mg)	
(1402-2	Reservoir No. 2 (1.2 mg)	
(1402-3	Reservoir No. 3 (2.0 mg)	
	Elevated Tanks	
	Wood (100,000 gallons)	$ 698,428.49
	Steel (75,000 gallons)	
	Wood (60,000 gallons)	
	Wood (13,000 gallons), dismantled	
	Wood (13,000 gallons), dismantled	
	Wood (13,000 gallons), dismantled	
1402-5	Reservoir (3.0 mg)	190,729.44
(1404-1	River Pumping Station	406,901.34
(1404-2	Extension (first)	
1412-1-4	Booster Pumphouses	148,501.41
(1405	Filtration Head House	
(1406	Filter House	
(1407-1	Settling Tank	1,348,817.83
(1407-2	Extension	
(1410	Filtration Control Tanks	
(1404 (Ex.)	River Pumping Station (East extension)	
(1406 (Ex.)	Filters	302,262.38
(1407 (Ex.)	Settling Tank	
1410-2	Control Tank	17,861.02

Building Number (cont'd).	Description (cont'd).	Cost (cont'd).
1413-1 & 2	Raw Water Supply Lines (Stone & Webster construction and supervision)	$ 559,776.08
(1503-T, 1506-T, (1503-1 & 2, 1506, (2503, 2506	Filtered Water and Fire Protection Lines (Stone & Webster construction and supervision)	4,295,249.50
	Force Main, 24-inch (1945)	77,567.65
	Raw Water, 24-inch Main (1945)	8,248.10
	Filtered Water Distribution Lines (1945)	282,459.94*
TOTAL		$ 8,342,803.18

*Includes $12,503.08 in estimated costs.

13-9. Operation. - The water system was operated by Stone & Webster until 29 November 1943, when it was taken over for operation by Roane-Anderson Company under its service contract. As additional facilities were completed, they were included in the provisions of this contract (App. A-24). To provide an experienced operating force, many of Stone & Webster's employees continued to work for Roane-Anderson.

13-10. Purity of Water. - Chemical and bacteriological tests made in the filter plant laboratory show that the filtered water supplied by the system meets the requirements for drinking and culinary water supplied by common sources in interstate commerce as specified in "U. S. Public Health Service Drinking Water Standards and Manual of Recommended

Water Sanitation Practice", adopted by the U. S. Public Health Service, 25 September 1942 (App. A-102).

13-11. Operational Costs. - A chart showing quantities and unit costs in the Water Supply System for 1944, 1945, and 1946 is attached (App. C-8b). Minor variations in monthly unit costs of pumping and treatment of water over the period between January 1944 through December 1946 were largely due to the variation in water consumption. However, in instances of large monthly variations in unit costs, the variations were chiefly due to maintenance cost accounting methods by which accumulated maintenance costs were charged against the operation in one particular month, thus effecting substantial increases over the preceding months.

13-12. Work in 1946. - Work done on the system during 1946 was almost completely in the nature of maintenance, and the capacity of the system was not affected.

SECTION 14 - SEWERAGE SYSTEM

14-1. General Description. - The sewerage system for Oak Ridge and the Electromagnetic Plant Area consists of two treatment plants having a combined rated capacity of 5.5 million gallons per day, pumping facilities, and an extensive collection system of 130 miles of mains with almost 8,000 service connections (Apps. A-247 and B-14; also Pages 189 to 200 of App. A-193). Complete treatment by an activated-sludge plant, with a capacity of 2.0 mgd, is provided for the sewage collected by gravity in the Clinch River watershed because the effluent is discharged into the Clinch River nine miles above the water supply intake. The West Treatment Plant, which serves the western part of Oak Ridge and the Electromagnetic Plant Area, was constructed when the town expanded into the Poplar Creek watershed. This plant, with a rated capacity of 3.5 mgd, provides only primary treatment to the sewage collected by gravity from this area. The effluent is discharged into East Fork of Poplar Creek which provides further dilution before discharging into the Clinch River below the Diffusion Plant Area water intake. The system west of Pennsylvania Avenue was designed by Skidmore, Owings & Merrill, Architect-Engineer, and the remainder by Stone & Webster Engineering Corporation, who also, in 1943 and 1944, either performed construction or supervised other contractors; 1945 construction was supervised by the Facilities and Service Division (Apps. A-8 and A-279; also Pages 189 to 200 of App. A-193). A map of the system is attached (App. B-14).

14-2. Design and Development.

a. First Phase. - The original system was designed to serve a population of 13,000 persons in Oak Ridge, plus the Electromag-

netic Plant Area (App. A-103). Because of the distances involved, separate sewerage systems for the other active process plants at the Clinton Engineer Works - the Diffusion Plant and Clinton Laboratories - were constructed (See Books II and IV, respectively). The design of the collection system which served Oak Ridge was based on an approximate allowance of 150 gallons per capita per day, with sewers running one-half full in the residential areas, and 300 gallons per capita per day, running 0.7 full, for main and outfall sewers (App. A-103). As the original town of Oak Ridge lay almost wholly in the Clinch River watershed, the system was designed to permit flow by gravity to the treatment plant, except from the Electromagnetic Plant Area and the western part of Oak Ridge; these areas were in the Poplar Creek watershed where sewage flowed by gravity to separate pumping stations and was pumped through force mains into the townsite outfall so that all sewage could be treated in a single plant. An 18-inch trunk sewer carried the sewage from the Electromagnetic Plant Area to the pumping station. The sewage treatment plant was designed to obtain maximum efficiency in the removal of oxygen-demanding organisms and other harmful bacteria constituting a menace to public health. It was considered more economical to construct complete treatment facilities on the Clinch River near Elza Gate than to provide the long force mains and additional pumping equipment necessary to discharge below the water supply intake (App. A-104).

b. Second Phase. - In the fall of 1943 the extensive expansion of sewer services, due to the increased construction of the project, required the design of additional treatment facilities. The addition of the new treatment plant in the western portion of the town made

possible a new collection system designed to serve the Electromagnetic Plant Area and that portion of the town in the Poplar Creek watershed, thereby eliminating the pumping of sewage over the ridge into the Clinch River system and permitting the sewage from this section to flow by gravity through an intercepter sewer to the new treatment plant (App. A-105). In the interest of reducing construction costs and because the discharge from the plant was to be into Poplar Creek and from there into the Clinch River below other project facilities (App. A-105), this plant was constructed at the extreme west end of Oak Ridge on the East Fork of Poplar Creek.

14-3. Construction.

a. East System. - The original sewerage system, which consists of the East Treatment Plant, pumping station, and mains, was constructed by Stone & Webster's own forces (Pages 189 to 195 and 199 and 200 of App. A-193), because it was necessary that these be started prior to completion of plans and that they be put into partial operation to serve occupied buildings before the construction was completed. Most of the collection lines were constructed by other contractors under Stone & Webster supervision (See Par. 14-3b). The treatment plant was started in April 1943 and was completed at a cost of $588,567.38 on 15 September 1943. Beneficial use of the plant for partial treatment processes was obtained 15 July 1943. The plant consists of a pre-aeration building, a mechanical control building, a pre-aeration tank, two primary settling tanks, two secondary settling tanks, an aeration tank, a chlorine contact tank, a primary sludge tank, a secondary sludge tank, and eight sludge drying beds. The pumping station was constructed at a cost

of $37,859.72 (Pages 192 to 195 and 199 and 200 of App. A-193).

b. West System. - Construction of the West Treatment Plant and interceptor sewer was also performed by Stone & Webster. This plant was started on 15 February 1944 and was completed at a cost of $388,600.30 on 1 July 1944. Beneficial use of the plant was obtained 30 May 1944. The West Treatment Plant consists of the same features as the East Treatment Plant, less aeration, secondary settling, and secondary sludge tanks (Pages 196 to 198 of App. A-193). Most of the collection lines leading to the mains of the East and West systems were constructed by other contractors under Stone & Webster supervision (Pages 189 to 191 of App. A-193). Contractors supervised by Stone & Webster were D. W. Winkelman Company (Apps. A-100, A-101, and A-167), Sullivan, Long & Hagerty (Apps. A-106, A-107, and A-110); Christopher & Company (Apps. A-130 and A-137), and Drainage Contractors, Inc. (Apps. A-138 and A-174). Sewer lines constructed by Stone & Webster and under their supervision cost $4,664,515.12 (Page 191 of App. A-193).

c. Expansion. - Increments added by prime contractors in 1945, after the Stone & Webster construction period, consisted of lines to serve additional housing areas, constructed by Drainage Contractors, Inc., at a cost of $19,911.70 (Apps. A-63 and A-249); John F. Humphrey Company, at a cost of $171,413.45 (Apps. A-63 and A-250 to A-252); Christopher & Company, at a cost of $32,526.94 (Apps. A-63 and A-179); and B. R. Hinson Construction Company, at a cost of $38,719.69 (Apps. A-63 and A-178); lines from miscellaneous buildings, constructed by Sullivan, Long & Hagerty, at a cost of $57,184.95 (Apps. A-63 and A-254); and miscellaneous lines from the trailer camps and the Farmers' Market and other

areas, constructed by Harrison Construction Company, at an estimated cost of $14,677.52 (Apps. A-63, A-247, and A-255).

d. Storm Sewers and Drainage. - Storm sewers form a relatively insignificant feature of the system, as most drainage is surface. See Paragraph 2-6 for reference to drainage work done as a part of general site preparation.

14-4. Operation. - The operation and maintenance of the sewerage system and disposal works, excluding the part of the collection system in the Electromagnetic Plant Area, were performed by Stone & Webster until 29 November 1943, at which time Roane-Anderson Company assumed responsibility for such work. As subsequent expansions to the system were completed they were turned over to Roane-Anderson for operation and maintenance. Maintenance of the sewage collection system has decreased to that normal for a city of comparable size since the cessation of overall construction activities and the stabilization of earth backfill over the pipes. The East Sewage Treatment Plant operated at overload capacities ranging from 110 percent to 150 percent of design capacity between December 1943 and July 1944, but since that time has operated at capacity or below. The effectiveness of the activated sludge treatment process of the East Sewage Plant has been very satisfactory, with efficiencies in the reduction of biochemical oxygen demand and reduction in suspended solids ranging above 80 percent and as high as 95 percent. Generally, the effluent from this plant has been of better quality than the water of the Clinch River into which the plant empties. The West Sewage Treatment Plant has continuously operated under overload conditions ranging up to 150 percent of the design capacity, but

because of the reduction in the number of trailers and hutments and the curtailment of operations in the Electromagnetic Plant Area, the sewage influent, at the end of 1946, was approximately 120 percent of the design capacity of the West Sewage Plant (App. A-279). This plant, which receives domestic sewage from Oak Ridge and sewage and industrial wastes from the Electromagnetic Plant, operates at efficiencies ranging from 40 to 55 percent in the reduction of biochemical oxygen demand and the reduction of suspended solids. These efficiencies are within the ranges expected from a plant providing primary treatment.

14-5. Costs. - A chart showing quantities and unit costs for 1944, 1945, and 1946 for the system, is attached (See App. C-8a). Construction costs of the system are as follows (Pages 188 to 200 of App. A-193):

DESCRIPTION		COST
Plants:		
East Treatment (Bldg. No. 1608)		
Buildings (Tanks)	$ 298,008.33	
Equipment	290,559.05	
Total		$ 588,567.38
West Treatment (Bldg. No. 1608-2)		
Buildings (Tanks)	$ 168,812.68	
Equipment	219,787.62	
Total		$ 388,600.30
Pumping Station (Bldg. No. 1611)		
Building	$ 15,802.40	
Equipment	22,057.32	
Total		$ 37,859.72

DESCRIPTION (Cont'd).		COST (Cont'd).
Collection:		
Lines and manholes, Stone & Webster construction and supervision	$ 4,664,515.12	
Additional lines and collection features (1945)	$ 334,434.25*	
Total		$ 4,998,949.37*
TOTAL		$ 6,013,976.77*

*Includes $14,677.52 in estimated costs.

14-6. Work in 1946. - The construction of sewer laterals in 1946 was confined to a few new service lines, and no major construction work was performed (App. A-279).

SECTION 15 - COMMUNICATIONS

15-1. Organization. - From the beginning of construction of communications facilities at the Clinton Engineer Works until April 1943, advisory service in all matters of communications was given the Area Engineer Office by a Signal Corps officer from the Fourth Service Command. In April a communications unit was organized as a part of the Area Office. This unit developed into the Communications Section of the Services Branch after the organization of the Central Facilities Division in the fall of 1943 (See Par. 3-6b and App. C-18), and, later, into the Division's Communications Branch (App. C-19), and, finally, into the Communications Department of the Facilities and Service Division (App. C-20). The organization and personnel of the Department, as of October 1946, are shown in Appendix C-23; the organization and personnel were approximately the same on 31 December 1946. Also, at that time the Southern Bell Telephone and Telegraph Company had 37 persons assigned at CEW for maintenance, repair, and installation work under the supervision of the Chief of the Communications Department.

15-2. Development of Main Area System. - A six mile section of the Clinton-Harriman toll line ran through part of the CEW Area as acquired. A few farms had the only telephones in the entire reservation. The first telephone for CEW was installed in December 1942 in a farmhouse on Oak Ridge Turnpike, about a mile west of the present Elza Gate. The first switchboard position was installed in January 1943 on the second floor of the Blue Moon Cafe, on Oak Ridge Turnpike, where the steam plant now stands. Shortly thereafter, work was started on the administration and other buildings, and it was evident that a considerable increase in

telephone requirements could be expected. Accordingly, it was decided to construct a telephone building to house a three-position switchboard, which was installed and put into service on 28 March 1943. Between March 1943 and the fall of 1943, 10 more switchboard positions were added. This telephone building was constructed by Stone & Webster Engineering Corporation at a cost of $94,816.25 (Page 1280 of App. A-193). Until the fall of 1944 all service in the main area was manual. During the fall of 1943, it became evident that the town of Oak Ridge would grow to a point which would require abandonment of the manual system. As a result of conferences with officers of the Fourth Service Command and Southern Bell engineers, it was decided to install a dial system to serve the town area. A new, larger, permanent building to house the dial equipment, constructed by Stone & Webster at a cost of $97,349.46, was completed. The main area was cut over to dial service on 9 September 1944, after installation of the dial switchboard. This system grew to include approximately 4,100 telephones in July 1945 (App. A-199). Manual switchboards were installed at the local hospital to serve approximately 130 telephones; a switchboard, serving approximately 35 lines, was installed in the Dental Clinic and a special fire reporting switchboard was installed as the nerve center for 250 emergency telephones located strategically throughout the residential and administrative areas. The greater part of other construction in the town area was performed by Stone & Webster, whose additional construction consisted of the Telephone Construction Building, costing $15,127.17 (Page 1280 of App. A-193), and the installation, by Stone & Webster forces, of railroad dispatchers' lines, police telephone lines and radio poles, and poles for general over-

head service, and the installation, by Wright and Lopez, under Stone & Webster supervision, of an underground conduit system, all at a cost of $100,300.16. Guys, cross arms, wires, cables, and other accessories were furnished and installed by Southern Bell (Page 235 of App. A-193; also App. A-109).

15-3. Development of Industrial Areas. - A typical example of development of a telephone plant in an industrial area can be taken from that of the Diffusion Plant Area. The first request for telephone service was for a single guard line, made in the spring of 1943. To provide this one station, it was necessary to build a new pole line from the town area to a farm house in the Diffusion Plant Area, a distance of approximately 14 miles. A month later four more telephones were requested. It soon became known that a power plant was to be constructed near the Diffusion Plant, and as a result approximately 300 miles of open wire were strung between the town and the plant area, providing 14 circuits. During the summer of 1943, a period of considerable construction in the Diffusion Plant Area, a two-position manual switchboard was installed to serve Ford, Bacon and Davis, Inc., construction contractors, and another in the Wheat School to serve that community. In the meantime, the main Plant Administration Building was being constructed, and a 200 line dial exchange was installed in it in the fall of 1943. Three hundred more lines were added to the dial equipment in March 1944. Other additions were 300 lines in September 1944, 400 more in March 1945, and 400 in June 1945, making a total of 1,600 lines. The entire central office was replaced in a new fireproof building and cut into service on 16 February 1946. This large exchange was necessitated by the overlapping of tele-

phone requirements by both construction and operating companies. To keep pace with the growth of the telephone system it was frequently necessary to duplicate cable installations. Also, almost continuous rearrangement of the cable distribution plant was necessary. Development of telephone facilities in the other major industrial areas was similar to that of the Diffusion Plant Area.

15-4. Residential and Business Service. - In the spring of 1943 authorization was received from Headquarters Fourth Service Command to construct facilities to provide residential telephone service for a limited number of housing units then under construction. Residential telephone service was considered essential only when it was necessary that various contracting firms be able to reach key employees during other than working hours. The number of telephones considered essential was held at a minimum. In general, restrictions called for the installation of residence telephones only for those employees who had to be called during other than working hours and then only when equipment was available. Although the demand for residence telephone service has been great, it has not been possible to install telephones without restriction. Approximately 3,500 commercial stations were in service on 31 December 1946.

15-5. Pay Stations. - There are approximately 150 pay stations or public telephones on the area. They are located in places of convenience to the public, such as dormitories, bus terminals, drug stores, cafeterias, the hospital, recreation halls, administration buildings, community centers, and hutment areas. There are also several outdoor stations in booths, which are available to the public 24 hours a day. The pay stations are manually operated by the operators at the central switchboard.

Prior to 1 November 1946, the operation of pay stations was under the direct jurisdiction of District forces; when the Southern Bell Telephone and Telegraph Company assumed operations of the commercial portion of the telephone system (See Par. 15-11), pay stations were included in the transfer. The Government, through Roane-Anderson Company, entered into an agreement with Southern Bell guaranteeing a return on certain pay stations, chiefly in dormitories; in return, Roane-Anderson was named the agent to receive the usual commission based on the revenue from these stations. Further negotiations in connection with pay stations were scheduled for 1947 (App. A-317).

15-6. Telegraph Facilities. - The Communications Department is the liaison office between CEW and the Western Union Telegraph Company which furnishes all telegraph facilities used on the area. The first telegraph service provided at Oak Ridge was at Williams Drug Store, on Jackson Square (See App. D-28a), in the spring of 1943. As the number of workers increased on the area, it was seen that a more extensive service would be required. Accordingly, Western Union opened a branch office of its own on Jackson Square (See App. D-28d). The first contract with Western Union provided that the Manhattan District would furnish the office space, operating personnel, and delivery facilities for incoming telegrams, with Western Union providing the equipment and leasing the required circuits to the main office. The contract was originally made with Roane-Anderson Company as a representative of the District (App. A-71; see Par. 8-10b for contract detail). Another office, under a similar arrangement with the J. A. Jones Construction Company, was put into operation in Happy Valley, in the Diffusion Plant Area, in the spring of 1944. The contract

arrangements did not prove particularly beneficial, and Western Union terminated its contracts with Roane-Anderson and J. A. Jones and assumed primary operation of the two offices (App. A-70a). Accordingly, in July 1944, the Western Union took over the operation of the Jackson Square office and two months later assumed similar obligations at Happy Valley. The Happy Valley office was closed in March 1946 after activity in that area diminished. The cost of the main office on Jackson Square is included in a group building cost (See App. C-5, Bldg. No. 1832-T). On 24 December 1946, Western Union requested the District to approve a reduction of operating hours at Jackson Square. In view of decreased use of the office, approval of the company's request was recommended by the Communications Department (App. A-317).

15-7. Teletype-Teletypewriter Service. - At the end of 1946, the District had one Army Command Administrative Network printer, one Commercial TWX printer (Bell System), and one duplex Western Union printer in the Administration Building. Also, there was one Bell System Teletypewriter Exchange printer in the Clinton Laboratories Area. The equipment in the Administration Building was operated by a WAC detachment until the fall of 1946 when it was taken over by civilian personnel. The Western Union printer in the Administration Building was scheduled to be removed in January 1947, other equipment having proved sufficient (App. A-317).

15-8. Equipment and Facilities. - A 4,400 line switchboard serves the Oak Ridge town area. The switchboards in the Clinton Laboratories, the Electromagnetic Plant, and the Diffusion Plant Areas have capacities of 450, 1,400 and 1,600 lines, respectively. The distribution plant needed to serve the various stations from the several switchboards con-

sists of over 200 miles of cable and over 1,400 miles of open-wire circuits or conductor pairs. Over 500 miles of Army field wire have been placed and removed on temporary jobs which later became permanent. Most of the cable and open-wire is aerial. Because of the distances involved on the area, much of the cable has been equipped with loading coils in order to maintain voice transmission at prescribed levels, and vacuum tube repeators have been installed on circuits used for long distance toll calls. All equipment is leased or rented from Southern Bell which is responsible for installation and maintenance work. Recent changes in the telephone system serving CEW (See Pars. 15-11 and 15-12), included the addition of a 1,050 line dial exchange in the town area from which nearly all official stations in the Administration Area are served. Seven switchboard positions at this installation provide control facilities over official telephones throughout CEW.

15-9. Construction Costs. - In lieu of mileage charges for circuits within the reservation, the Government has paid 75 percent of all outside plant construction costs for permanent facilities, and 100 percent of all costs incurred in placing temporary plant, replacing and relocating all types of plant and repairing damaged plant. Also included under the 100 percent costs to the Government are the supporting structures in all areas, including extensive underground duct and manhole installations and the costs of all telephone buildings. The total costs under 75 percent billing has amounted to approximately $600,000. As this cost has been incurred in lieu of operational and service charges, only in a qualified respect has it been properly a construction cost. A summary of costs incurred on a 100 percent basis in the town and Central

Facilities Area follows (App. A-109 and Pages 235 and 1280 of App. A-193):

Telephone Construction Headquarters (Bldg. No. 1742)	$ 15,127.17
Manual Switchboard Building (Bldg. No. 1702-1)	94,816.25
Dial Equipment Building (Bldg. No. 1702-2)	97,349.46
Government-owned poles, conduits, and lines	100,300.16
Total	$ 307,593.04

Other 100 percent construction, as distinguished from construction performed in lieu of mileage charges, was performed elsewhere in the CEW reservation by other contractors. The Communications Building (Bldg. No. 1706) was formerly the Medical Service Building, and its construction cost is charged to medical facilities (See Sec. 10; see App. C-11, Bldg. No. 2714, for note as to cost of installation of switchboard position for Administration Building exchange in 1946).

15-10. Operating Costs. - Prior to 1 November 1946, the Government was the only subscriber to telephone service on the reservation and, as such, was responsible for all costs incurred, subrenting a large portion of this service to residential and business users. As an example, in February 1946 the Government paid to Southern Bell approximately $43,800 for equipment rentals and trunk mileage charges. Salaries for personnel amounted to approximately $11,000 and long distance tolls to approximately $27,500; carrying charges were $5,100. Revenue derived from furnishing telephone service to non-official users, such as business houses, pay station users, and residential subscribers, netted approximately $27,800. Hence, the monthly telephone cost approximated $59,600 (App. A-198). Operating costs for December 1946, after execution of the contract with Southern Bell (See Par. 15-11), included approximately $31,100 for equip-

ment rental and mileage, $10,700 for salaries, and $10,500 for long distance tolls (Apps. A-317 and A-318).

15-11. Transfer of Commercial Accounts. - In order that more business houses and residential subscribers in the town area might be furnished telephone service, a condition previously not possible because of the unavailability of funds for additional non-military construction work, and, further, to effect a savings to the Government, the District proposed to Southern Bell that the company assume the operation of a portion of the system as a commercial enterprise. The desirability of effecting the change was emphasized by the fact that non-official telephone service required approximately 80 percent of the foreign exchange trunks, 100 percent of the telephone accounts section personnel, and 70 percent of the switchboard operating staff, and comprised 50 percent of the work load of the records section. Conversion to operations by Southern Bell was accomplished 2 November 1946. The contract with Southern Bell provides: that the company furnish general commercial service throughout the CEW; that the company make a one-time payment of $95,883.34 to the Government as a retroactive feature consisting of the difference in cost to the Government if the system had been operated on a mileage basis rather than a construction cost in lieu of mileage basis as it had been; that the company pay the Government space rentals of $2,572.50 per month and rentals of 15 cents per foot per annum for use of Government-owned conduits and a charge of two dollars per pole per year as rental of Government-owned supporting structures; that all rates, including those for service furnished the Government, be subject to regulation by the Tennessee Railroad and Public Utilities Commission; and that the contract be subject to can-

cellation on 30 days notice after 31 October 1947 (App. A-182).

15-12. The Present System. - Upon execution of the Southern Bell contract, operation of the telephone systems serving the plant areas was modified to include dial access to direct trunks to Knoxville, but not otherwise changed. Official telephones in the town area are now served from a dial exchange in the Administrative Area where seven manual positions exercise control over the official traffic and provide access to toll trunks to several adjacent cities, as well as to a full period circuit to the War Department switchboard in Washington, D. C. Free service between official telephones and commercial subscribers is provided under the present system, the Government switchboard being a PABX off the Oak Ridge Exchange. As of 31 December 1946, operating costs had been reduced by approximately $7,300 per month (App. A-317). It was expected that the contract with Southern Bell would permit further savings through additional force reductions early in 1947. At the end of 1946, extensive rearrangement and additions to the outside distribution plant at the Clinton Laboratories were underway, and plans called for increasing the dial exchange in that area from 450 lines to approximately 1,200 lines within two years.

SECTION 16 - ROADS, STREETS, WALKS, AND BRIDGES

16-1. General. - Reference is made to six maps appended, one (App. B-2) map illustrating the road system in a radius of 30 to 50 miles of Oak Ridge; a second (App. B-10), showing access roads in the immediate vicinity of the Clinton Engineer Works; and four maps showing the road system within the CEW area as of 31 March 1945 (App. B-3), 29 May 1945 (App. B-13), 1 April 1946 (App. B-13a), and 31 December 1946 (App. B-13b), respectively. One of the primary factors in site selection for CEW, namely, the necessity of isolation, resulted in the selection of an area itself almost bereft of roads and, on the other hand, practically isolated from the outside world as far as access roads were concerned. Within the area, east-west roads, such as they were, followed the three main valleys, namely, Bethel, Bear Creek, and East Fork Valleys (See App. B-3). The only north-south roads were Scarboro and White Wing Bridge Roads. There were, also, a considerable number of trails and secondary roads, but with the exception of a portion of Tennessee State Highway 61 which passed through a corner of the reservation from Elza Gate through Oliver Springs Gate, none of the roads was paved with an all-weather dust and mud-free surface. The access roads were even less satisfactory (See Par. 16-5a).

16-2. Development and Improvement of Existing Area Roads.

a. General. - The fact that three large manufacturing areas and the town of Oak Ridge, each widely separated from the others, were to be built on the reservation, adequate roads and streets - "adequate" meaning no more than "usable" - were a matter of prime necessity. Ultimate development brought about the construction or improvement to a

point of use of approximately 300 miles of roads and streets at the CEW, approximately 87 miles of which were in Oak Ridge.

b. Scarboro Road. - Because Scarboro Road was the more important of the two north-south roads on the area (See App. B-3), it was one of the first roads improved and further developed. At the time of acquisition of the reservation, Scarboro was a narrow road with a light macadam surface; eventually, it became a four lane highway and, at the peak of construction, carried in excess of 10,000 vehicles per day.

c. Bear Creek Road. - Of almost equal importance was the development of Bear Creek Road from Scarboro Road west to the Diffusion Plant (K-25) Area, so that it could carry the extensive truck traffic moving sand and gravel from the river barges at the K-25 Area to concrete plants in the Electromagnetic Plant (Y-12) Area (See App. B-3).

d. Bethel Valley Road. - Similarly, it was essential to improve Bethel Valley Road from the Clinton Laboratories (X-10) Area to Solway Bridge and Edgemoor Bridge so as to accommodate truck and automobile traffic between Knoxville, Oak Ridge, and the X-10 Area.

16-3. Construction of Area Roads, Streets, and Walks.

a. General Area. - Because of the thousands of vehicles entering and leaving the reservation each day, traffic congestion within and without the area became so severe that it threatened to interfere seriously with efficient plant and town construction and operation. To alleviate these conditions within the area, further construction and improvement programs were undertaken. A new road - to be called River Road - was built within the eastern boundary of the reservation from Elza Gate to Edgemoor Bridge (See App. B-3), thus affording another north-south

connection with the existing east-west roads. This road was particularly beneficial to construction forces working in the town then being built in the northern corner of the reservation and, also, to the forces at Middletown and the X-12 Area, all of which had previously been compelled to use a narrow, winding trail to reach either Solway or Edgemoor Bridges. The building of this road, because of heavy rock cuts and extensive fills, involved unusual engineering difficulties. The increasing development of the K-25 and related plant areas necessitated the improvement, in part, and all new construction, in part, of the original route known as East Fork Valley Road so as to connect the K-25 Area with Elza Gate by a direct route running the entire length of the reservation within the northern boundary. This road - known originally and variously, dependent on the particular stretches involved, as Highway No. 61, East Fork Valley Road, and Wheat Road (because it served the village of Wheat) - is now Oak Ridge Turnpike and, partly because it runs through the town of Oak Ridge, is the reservation's main east-west highway. Further, it provides connections with two area gates - Elza and Gallaher (See App. B-13a). Further work included construction and improvement of roads in the western part of the reservation leading from Oak Ridge Turnpike to the Clinch River at White Wing Road Ferry, thereby affording adequate roads to and from the K-25 and X-10 Areas and White Wing Gate.

b. Oak Ridge. - In addition to improving existing area roads and building new ones, it was necessary to proceed with the construction of streets in Oak Ridge simultaneously with the construction of the town.

c. Road and Street Construction Data, 1943 and 1944. -

[redacted]

Most of the roads and streets built in 1943 and 1944 were constructed by Stone & Webster Engineering Corporation under the corporation's general AEC contract and by Harrison Construction Company under its grading contract (App. A-221) and under Stone & Webster supervision. For the most part, stone for the roads came from two quarries on Bethel Valley Road, operated by Ralph Rogers Company (Apps. A-108 and A-295). The costs incurred by Stone & Webster, Harrison Construction Company, and Ralph Rogers Company in connection with clearing, grubbing, grading, and placing of crushed stone on 152.63 miles of roads and streets totaled $3,670,124.82 (Page 180 of App. A-193). During initial work on Oak Ridge Turnpike, which consisted of clearing, grubbing, and grading of the road bed, the excavation, backfill, and installation of pipe culverts and bridges on 13.35 miles of road, and the placing of crushed rock surfacing 44 feet in width on 10.21 miles of roadbed, was performed by Stone & Webster and Harrison Construction Company at a cost of $423,315.08 (Page 185 of App. A-193). Because of the amount of heavy construction traffic and the heavy equipment on the roads and streets, it was not considered feasible to surface the various crushed stone roads and streets with a bituminous wearing course during the main part of the construction program. In the summer of 1944, however, it was found feasible to place a bituminous surface on Oak Ridge Turnpike from Elza Gate to Scarboro Road and on various town streets, including those around the main business section of Jackson Square. This paving was done by Dave L. Brown, contractor, and R. B. Tyler Company, Inc. (App. A-294) under subcontracts from Stone & Webster, at a cost of $99,726.29 (Page 181 of App. A-193).

d. Walks, Curbs, and Gutters. Initial Work. - Walk, curb,

[redacted]

and gutter work prior to 1945 was performed by Stone & Webster, who constructed 163.04 miles of wood and 65.87 miles of crushed stone walks, and, also, 0.44 miles of concrete curbs and gutters in the town, ~~together~~ all at a cost of $1,195,794.88 (Page 186 of App. A-193).

e. Parking Areas. - Parking areas totaling 105 acres were constructed by Stone & Webster and Harrison Construction Company, using crushed rock supplied by Ralph Rogers Company, at a combined cost of $174,919.92 (Apps. A-108, A-221, and A-295; also Page 187 of App. A-193).

f. Culverts. - In addition to bridges and culverts built and installed in connection with Oak Ridge Turnpike, three small bridges were constructed by Stone & Webster and 61,976 feet of pipe culverts were installed by Stone & Webster and Harrison Construction Company, in connection with roads and streets, all at a cost of $763,613.63 (App. A-221; also Pages 182 and 183 of App. A-193).

g. Paving Program, 1945. - During the spring and summer of 1945, after completion of the bulk of CEW construction, it became feasible to institute a large-scale paving program justified on overall savings which could be effected in road and street maintenance and other costs incidental to the use of non-surfaced roads in a 12 months period of use. All of the important area roads and Oak Ridge streets were surfaced with either hot-laid asphaltic concrete paving or with an asphalt surface treatment, depending on such factors as traffic conditions and relative importance of certain roads and streets. Prepaving work was performed by Roane-Anderson Company's Roads and Streets Department and the actual paving surfaces were placed by Wilson and Rogers Company under two contracts (App. A-219).

h. Road and Street Expansion Program, 1945. - Simultaneously with the paving and prepaving programs, it was found necessary to construct additional town streets and construction camp roads to accommodate new housing and other added features generally. This work was performed by Harrison Construction Company (App. A-221) and Roane-Anderson Company's Roads and Streets Department. Work consisted chiefly of grading, stoning, and drainage of Oak Ridge streets and a few roads in the western part of the town, the trailer camps, and the Victory Cottage area (App. A-225). The 1945 prepaving, paving, and expansion programs together cost $430,979.94 (Apps. A-219, A-224, and A-225).

i. Major Street, Walk, Curb, and Gutter Work, 1946. - In order to reduce the cost of maintenance of town streets, side ditches, fills, and culverts, it was decided, (1) ~~one~~, to add concrete curbs and gutters and to place bituminous concrete over the existing pavement, and, (2) ~~two~~, to replace existing walks with six to nine foot concrete sidewalks in the town commercial area and four foot bituminous concrete sidewalks on one side of the other improved streets. Based on the volume of traffic, the distances from gutter to gutter were established as 28, 30, or 33 feet. In most instances, the widths provided an additional two to four feet of wearing surface and permitted parallel parking on at least one side of the street. The program for the summer of 1946 included the main arterial roads in the area bounded by West Outer Drive and Outer Drive on the north, Oak Ridge Turnpike on the south, California Avenue on the east, and Illinois Avenue on the west. Field survey parties were organized on 1 February 1946, and the design and layout of the curb and gutter work and paving were completed on 20 September 1946. The pro-

blem of adjusting the alignment and grade of the improvements to the existing ~~payments~~ pavements, poles, fire hydrants, and other utilities required detailed field study and drafting room design. Drainage of the steeper streets presented a problem. A flat steel grating and collar to be installed in the grade of the curb and gutter were designed by the District and fabricated at a local foundry. A model consisting of a 25 foot section and a six-foot width of street, from which weir measurements were made of the flow intercepted by one and two gratings, varying the slope of the model up to 12 percent, was constructed by the District. From these hydraulic tests, the spacing of the gutter inlets and the requirements for double inlets were determined (App. A-286). Prepaving work, including rough grading and stabilization of base, was accomplished by Roane-Anderson's Roads and Streets Department at a cost of $256,404.69 (Apps. A-287 and A-303). Approximately 38.6 miles of curbs and gutters and 1.37 miles of concrete sidewalks were placed by E. J. and W. L. Cobb, Inc. (App. A-288). Work under the contract was initiated on 18 June 1946 and was completed on 1 November 1946, at a cost of $267,738.08 (Apps. A-289 and A-303). In addition, the cost of Government-furnished materials was $15,971.23 (Apps. A-290 and A-303). Approximately 19.4 miles of bituminous concrete pavement and 18.2 miles of bituminous concrete sidewalks were placed by H. K. Williams Company (App. A-285); work under this contract was initiated on 19 August 1946 and was completed on 13 December 1946, at a cost of $182,767.46 (Apps. A-286 and A-303). In addition, the cost of Government-furnished materials was $56,915.15 (App. A-303). The improvements to loading lanes and adjacent areas at the Central Bus Terminal are discussed in Section 18. The cost

of engineering, supervision, inspection, and testing in connection with work described in this subparagraph, plus that in connection with work on Bethel Valley Road and the Clinton Laboratories Area, described in the succeeding subparagraph; paving at the Central Bus Terminal, described in Section 18; and erosion control work, described in Paragraph 2-6b, was $95,052.26 (App. A-303).

j. Surface Treatment, 1946. - In addition to the 1946 work described immediately above, during 1946 over 472,000 square yards of secondary streets were reshaped, stabilized, and given a single surface treatment in the area between California and Illinois Avenues (App. A-286). This work was accomplished by Roane-Anderson's Roads and Streets Department between March and October 1946. The town streets west of Illinois Avenue and east of California Avenue, consisting of 322,000 square yards, were given an asphaltic resurfacing treatment; this work was performed by Roane-Anderson's Roads and Streets Department between October and December 1946. Cost of this 1946 street work was $63,956.03 (Apps. A-291 and A-303). Further, approximately 71,587 square yards of parking areas were given a single surface treatment by Roane-Anderson forces; the cost was $6,850.88 (Apps. A-286, A-291, and A-303). Also, the increased traffic resulting from additional construction at the Clinton Laboratories required that a more durable surface course be placed on a portion of Bethel Valley Road; accordingly, a bituminous concrete surfacing was applied by H. K. Williams Company, at a cost, including $8,640.25 for Government-furnished materials, of $40,338.03 (Apps. A-285, A-286, and A-303).

k. Improvement of Oak Ridge Turnpike, 1946. - The con-

struction of Oak Ridge Turnpike between Wheat School and White Wing Bridge road had included narrow shoulders and minimum road-side drainage, but, beginning in the summer of 1946, an improvement job whereby culverts were to be lengthened and side slopes extended to provide for the placing of a 10 foot crushed stone shoulder on each side of the pavement was started; at the end of 1946, this work was still under way, and the cost of work performed in 1946 had not been determined (App. A-286).

16-4. Maintenance. - Maintenance of area roads and town streets, walks, and related features was performed by Stone & Webster until this function was assumed by Roane-Anderson during the latter part of 1943. Because of the extremely large volume of traffic, the cost of maintenance of open-surface (unpaved) crushed stone roads and streets was relatively high prior to the placing of bituminous surface courses in 1944 and 1945.

16-5. Access Road Program.

a. General. - With CEW located in an area practically devoid of anything approaching adequate access roads, it was remarkable that as many construction workers were able - or willing - to make the daily effort to reach and leave the project as did. No single road touching or approaching the area may fairly be said to have approached adequacy in relation to the traffic volume and weight. Only the Solway and Edgemoor Roads (See App. B-10) approached the reservation from Knoxville and they were quite inadequate. Moreover, for various reasons, it was impossible to improve the access road situation until late 1943 when approximately 20,000 cars per day already were entering and leaving the reservation. It was early 1944 before any improvements were apparent,

and by that time employment was over 50,000. During the construction period and much of the early operational period, access to the area was dependent on existing roads (Shown in App. B-10 ~~as the black lines without red borders~~). Conditions affected private automobiles as well as busses and other carriers.

b. Negotiations and Development. - It was essential that access roads to surrounding and nearby areas and towns, as a means of obtaining personnel and receiving materials, be developed, and that external communications be established with Clinton, Harriman, Knoxville, and Oliver Springs, to mention some. To this end, an overall access road program was worked out on 3 November 1943 at a meeting attended by representatives of the State of Tennessee, Manhattan District, the Public Roads Administration, the two counties particularly involved, i.e., Roane and Anderson Counties, and the principal contractors at CEW (App. A-111). It was decided at this meeting that improvements and construction would be undertaken in order of urgency, i.e., by assignment of priorities (See App. B-10). Priority No. 1, although it failed to serve the project directly, was the conversion of U. S. Highway 25W from Knoxville to Clinton into a four lane highway with necessary realignment of the right-of-way. Priority No. 2, an entirely new road from Gallaher Bridge to U. S. Highway 70, and Priority No. 3, a new road from K-25 Area to State Highway 61 at Blair, were considered by the District to be of great urgency because both were to furnish access to the Diffusion Plant Area. Priority No. 4, a new road from Solway Bridge to Knoxville, was likewise considered essential to provide a short route to Knoxville to the exclusion of a network of narrow, winding, and otherwise unsatis-

factory county roads on which the bulk of construction forces relied. Priority No. 5, the repaving and realignment of State Highway 61 from Elza to Clinton, was useful to the degree that it would provide a first class road from Elza to Clinton. Priority No. 6, the relocation of State Highway 61 outside the reservation along the northern part of Black Oak Ridge, was useful to local interests as it provided a route outside the closed reservation between Clinton, Oliver Springs, and Harriman. The State agreed to prepare applications immediately for Federal assistance and planning for priorities 2 to 5, inclusive, and to begin preliminary planning, for the Knoxville-Clinton Road. Although State and local officials appeared to do their best to plan and proceed with construction, in the end much was done by project forces, chiefly because there was not time to await action by the PRA and delay construction until the time proposed by PRA, or to build the urgently needed roads, particularly those leading to the Diffusion Plant Area, in accordance with the peace-time specifications of that agency. Not being able to proceed along the lines of long term planning, the District was compelled to devote its major efforts to access roads considered to be the most urgently needed (App. A-112).

c. Gallaher Bridge Road and Blair Road. - The project statements for the Gallaher Bridge and Blair Roads (See App. B-10) were submitted to PRA in November 1943 for approval and allotment of funds. It developed, however, that because of procedures of PRA and the Tennessee Department of Highways and Public Works, with respect to such matters as preparations of plans, acquisition of rights-of-way, and advertisement for bids, construction could not begin until April 1944, whereupon

the District decided to proceed on its own, using project funds. The plans were taken over from the State and slightly modified to reduce construction costs and time involved. The rights-of-way were acquired through the Real Estate Branch of the Ohio River Division of the Corps of Engineers. The contract for the Gallaher Bridge Road was awarded to R. E. Martin Company (App. A-304), and work was started 18 January 1944. The contract for the Blair Road was awarded to Oman-Creighton Construction Company (App. A-305), and work was started 7 February 1944. Construction was prosecuted vigorously through the winter, and both roads were opened to traffic in May 1944. The cost of the Gallaher Bridge Road was $189,169.95 and that of Blair Road was $153,800.18. Both of these roads were maintained by project forces with War Department funds, after it was determined that the State would not perform maintenance, and county forces were unable to do so, because of lack of labor and equipment.

d. Solway - Knoxville Road. - In the view of the District, the Knoxville-Solway Road was next in importance after the two roads connecting with the K-25 Area, as it would afford a direct route to the large population center of Knoxville and would, when completed, be the most important approach to CEW. It began at an excellent bridge - Solway Bridge - across the Clinch River. The project statement for this road, too, was submitted to PRA in November 1943, but as the need was less urgent, it was decided to allow the normal procedure to unfold with a minimum of action by the District. The contracts were let in June 1944, with the completion date set as 1 December 1944. Because of considerable obstacles in the form of deep slides and wet weather, it ap-

peared that work would be suspended until the following spring. However, at the insistence of the District, work proceeded and the road was opened 25 January 1945. Surfacing was delayed until spring. The matter of maintenance of secondary roads during the construction period was finally solved by convincing PRA that these roads were properly detours. The District, using PRA funds, and Knox County provided some limited maintenance. In September 1945, a pavement ~~an application~~ of 100 pounds of bituminous concrete per square yard was applied to the 2.14 miles beginning at the CCW end of the road. At a meeting, in June 1946, between representatives of the PRA, the Tennessee State Highway Department, and the District, it was agreed that a bituminous concrete surface should be placed on the remaining 11.23 miles at the southern end of the road. Thus, beginning on 9 August 1946, an application of 100 pounds of bituminous concrete per square yard was placed under contract let by the State Highway Department, using funds advanced by PRA. This project was completed on 28 September 1946, thus providing a bituminous concrete surface for the entire road (App. A-286).

e. White Wing Bridge Road. - Access to the area from the vicinity of Loudon and Lenoir City, south of the reservation, was gained by construction of a pontoon bridge across the Clinch River at the site of the old White Wing Ferry and improvement of 4.8 miles of a road connecting with U. S. Highway 70 near Eaton Cross Roads. The temporary bridge was constructed by CCW, and the road improvement was accomplished by the State Highway Department using its own forces and equipment and with CCW providing crushed rock for surfacing. Again, maintenance was performed by Loudon County, assisted by CCW.

f. U. S. Highway 25W. - The State carried the responsibility for the proposed widening of U. S. Highway 25W from Knoxville to Clinton into a four lane highway. This road was useful as a CWS access road and was, also, a link in the national strategic network as defined by the Transportation Command and for which Federal aid funds had been allotted. The first phase of improvement covered the road from Knoxville to the Knox County-Anderson County line. The State Highway Department, having rejected the bids on the section from the county line to Clinton as excessive, was prevailed upon to construct 3.05 miles of the highway into Anderson County so as to connect with Edgemoor Road at a point just north of Claxton School. This work was performed by Ballinger Construction Company. Work was started on 12 July 1945; paving was finally completed on 27 April 1946, and the job accepted on 6 August 1946.

g. Elza-Clinton Road. - Although the project statement for the Elza-Clinton Road had been submitted and approved concurrently with the proposals for the K-25 Area access roads and the Bolway-Knoxville Road, construction of the Elza-Clinton Road was deferred at the request of the Manhattan District until other roads were opened to traffic so that so many entrances to the reservation would not be blocked at the same time. As soon as the other entrances were opened, the State was requested to start construction, but bids were not solicited until 27 February 1945. When bids were received, the lowest bid was much higher than the amount of money which had been made available for this project by FHA. The State Highway Department consequently rejected all bids. The Department agreed to readvertise for bids, but only for 1.4 miles of the road leading from Clinton. Work was started on this contract on

12 July 1945 and was completed about 1 August the following year. At the request of the War Department, $70,700 were allotted to the District by PRA for improvement of the remaining section of this road - approximately 4.5 miles - connecting with CEW at Elza Gate. This improvement, which consisted of topping the road with a plant mix bituminous surface course, clearing ditches, patching, and reconsolidation of the base where necessary, was completed by 30 August 1945.

h. Edgemoor Road. - The section of the Anderson County road from Edgemoor Bridge to U. S. Highway 25W at Claxton School (See App. B-10), known as Edgemoor Road, has always carried a considerable amount of traffic to and from CEW, although the maximum load across Edgemoor Bridge is limited to eight tons for reason of safety. While the road was adequate for light county traffic, it was entirely inadequate for the volume of access road traffic and deteriorated rapidly. Because Anderson County was unable to furnish necessary maintenance, it was necessary for maintenance to be performed by project forces in order to keep the road open for traffic. In 1945, funds in the amount of $75,400 were authorized by PRA in order to relocate an approximate 0.5 miles east from Edgemoor Bridge and to improve and resurface the entire 3.8 miles from the bridge to Claxton. In addition to relocation, improvements included clearing the ditches and reconsolidating the base of the remaining distance to Claxton. The main portion of the resurfacing was completed in September 1945; the grading and base course for the relocated portion were completed in December 1945. At the end of 1946, plans called for the placing of a hot mix surface on the relocated section of the road some time during 1947 (App. A-286).

1. State Highway 61 Relocation. - Because the reservation, as finally established, included several miles of Tennessee State Highway 61 (See App. B-10; also see Par. 16-5b), it was necessary for reasons of security to close the road to through traffic, thus requiring a relocation of a section of the road so as to have it pass around and outside the northeast corner of the reservation. This proposed by-pass was not of great importance to CEW as an access road, but it was of some value as such, and as the District had closed the road, the State was supported in seeking Federal approval for construction of a relocation of the road and for a grade separation at Dossett, which would eliminate an unusually hazardous grade crossing. Project labor and funds were not involved. The relocated highway and underpass were completed for beneficial use early in 1946. Paving was completed in the summer of 1946.

16-6. General Maintenance of Access Roads. - Because of the unusually heavy traffic loads, with resultant rapid deterioration of road beds and surfacing, a very active maintenance program was necessary to keep the network of access roads in a state of adequate repair. Roads of the State highway system were maintained by the State of Tennessee; the only action required of CEW was to notify State authorities of poor conditions as they developed. Although the counties concerned were responsible for maintenance of roads under their jurisdiction, they lacked funds, labor, and equipment. It was thus necessary for CEW to establish a maintenance program using project forces and equipment and expending funds allotted by PRA. In this matter, the guiding principle was to establish and maintain standards which would provide reasonably satisfactory conditions and involving the barest minimum of time, labor, and

equipment. Written agreements with the counties granted the District authority to perform such work but relieved it of all responsibility for continuance of maintenance when roads became unnecessary for efficient project operations.

16-7. Bridges.

a. General. - As the CEW reservation is bounded on three sides by the Clinch River, bridges form an important feature of the access routes at the reservation boundaries. Two county bridges existed when CEW was established and two temporary structures were erected by the project (See App. B-10 for locations).

b. Solway Bridge. - Solway Bridge is a concrete arch structure owned by Knox County. The bridge was closed to general use in February 1943, and guards were posted by CEW to restrict passage to authorized vehicles and persons. As this bridge had been built under a special bond issue, the county demanded reimbursement from the Government, backing up its demand with a threat to close the bridge and important access roads leading to it. Negotiations resulted in a contract whereby CEW was to have exclusive use of the bridge for one year beginning in February 1943. The county was to maintain the structure and, in return, to receive $25,000 for cost of maintenance of the bridge and for use in retirement of the bonds. This departure from settled War Department real estate policy was approved by the Comptroller General before final contract action. The original contract was followed the next year by a new contract which would expire at the end of the emergency. The new contract called for payment to the county of $15,000 per year (App. A-113).

c. Edgemoor Bridge. - Edgemoor Bridge, which spans the river a few miles above Solway, is a steel truss, wooden deck structure owned by Anderson County. It was closed to general use by CEW, concurrently with the closing of Solway Bridge. It was not in good condition, requiring extensive deck repairs. The county would not repair it and following the lead of Knox County, served notice of intention to close the bridge to all traffic. Negotiations revealed that the county was unable to repair the bridge, thus making it necessary for repairs to be made by use of CEW forces and funds. A contract with the county provided for exclusive use of the bridge by CEW and payment to the county of $4,000 the first year and $2,400 each year thereafter until the end of emergency (App. A-113).

d. Gallaher Bridge. - Immediate access from the west and south is provided by a temporary bridge of the through-plate girder type. This bridge - known as Gallaher Bridge - is 1.3 miles upstream from the old Gallaher Ferry and furnishes a connection between Oak Ridge Turnpike and Gallaher Bridge Road (See Par. 16-5c) and indirectly with U. S. Highway 70 (See App. B-10, Priority Road No. 2). The bridge was completed by project forces (J. A. Jones Construction Company) in December 1943. Temporary permits for construction and operation of the bridge were obtained from the War Department and the Tennessee Valley Authority; a request for a permit extension was made to the War Department on 7 November 1946, and it was planned to seek a similar extension from TVA in 1947 (App. A-303).

e. White Wing Bridge. - White Wing Bridge affords a crossing of the river at the southwest corner of the reservation (See App.

B-10). It is formed by two large oil barges connected with each other and the river banks by girders and anchored in place by cable ties. The bridge has two 12 foot wide planked decked lanes, which, in the full depth section between the barges, cover steel beams connecting the barges to each other. The oil barges, which have a very shallow draft, were part of the large fleet designed and constructed to carry petroleum from Gulf Coast ports to Atlantic Coast refineries during the period when German submarines were inflicting heavy losses on coast-wise oil tankers. The two barges, which had never been used as petroleum carriers, were procured from the Defense Plant Corporation and towed to the site from New Orleans via the Mississippi, Ohio, Tennessee, and Clinch Rivers. Temporary permits for construction and operation of the bridge were obtained from the War Department and the TVA; a request for a permit extension was made to the War Department on 7 November 1946, and it was planned to seek a similar extension from the TVA in 1947 (App. A-303). This ingenious floating bridge was conceived and designed by Captain E. B. Calvin of the Manhattan District Engineering Division after he located, inspected, and arranged for procurement of the barges. Construction was by project forces, namely, J. A. Jones Construction Company.

16-8. Construction Cost Summary (Manhattan District Funds Only).

a. Oak Ridge and CEW Area.

(1) Stone & Webster construction and supervision (Pages 179 to 187 of App. A-193).

(a)	Service roads	$ 3,670,124.82
(b)	Road surfacing	99,726.29
(c)	Culverts and bridges	763,613.63

16-8. Construction Cost Summary (cont'd).

a. Oak Ridge and CEW Area (cont'd).

(1) Stone & Webster (cont'd).

(d) Oak Ridge Turnpike	$ 423,315.08	
(e) Walks, curbs, and gutters	1,195,794.88	
(f) Parking areas	174,919.92	
Total, Stone & Webster		$6,327,494.62

(2) 1945 Street Construction. - Grading and crushed stone (by Harrison Construction Company, App. A-225) 317,739.00

(3) Roane-Anderson prepaving (App. A-224) for 1945 CEW prepaving program.

(a) Reconstruction work	$ 80,837.73	
(b) Base preparation	31,911.36	
(c) Bituminous surfacing (prime)	90.772.76	
Total, Roane-Anderson, 1945		203,521.85

(4) Wilson & Rogers Company, 1945 CEW paving program (App. A-219) 430,979.94

(5) 1946 Construction (Apps. A-285 to A-289, A-291, and A-303).

(a) Prepaving (Roane-Anderson Company)	$ 256,404.69	

16-8. Construction Cost Summary (cont'd).

a. Oak Ridge and CEW Area (cont'd).

(5) 1946 Construction (cont'd).

(b) Curbs, gutters, and sidewalks (E. J. & W. L. Cobb, Inc.)	$283,709.31	
(c) Pavement and sidewalks (H. K. Williams Company)	239,682.61	
(d) Surface treatment		
(1) Streets	63,956.03	
(2) Parking areas	6,850.88	
(3) Bethel Valley Road	40,388.03	
(e) Engineering costs	95,052.26	
Total, 1946 work		$ 986,043.81
TOTAL AREA		$8,265,779.22

b. Access Roads (Apps. A-304 and A-305).

(1) Gallaher Bridge Road	$189,169.95	
(2) Blair Road	153,800.18	
Total		342,970.13

c. Bridges (Apps. A-222 and A-223).

(1) Gallaher Bridge	$ 32,000.00 (est.)	
(2) White Wing Bridge	40,000.00 (est.)	
Total		72,000.00
GRAND TOTAL		$ 8,680,749.35

SECTION 17 - RAILROAD SYSTEM

17-1. General Description. - The Clinton Engineer Works railroad system consists of two units - the so-called Central System, serving Oak Ridge and the Electromagnetic Plant (Y-12) Area, and the K-25 System, serving the Diffusion Plant (K-25) Area. The K-25 System was originally operated by the J. A. Jones Construction Company, but operation was taken over by the Southern Railway System on 1 October 1946 (App. A-293). The K-25 System, which connects with a line of the Southern Railway System and does not connect with the other area system, is considered elsewhere. On the other hand, it is not possible to separate consideration of the system embracing Oak Ridge and the Electromagnetic Plant Area, which is operated as a single establishment. The Central System consists of approximately 37 miles of trackage connecting with the Louisville & Nashville Railroad main line near the northeast corner of the reservation (See App. B-4). The Central System's major operating equipment is listed in Paragraphs 17-5 and 17-6. The engagement of the Louisville & Nashville Railroad Company as a prime contractor in connection with the Central System after 30 June 1946 was expected to result in substantially improved operating efficiencies.

17-2. Existing Conditions. - At the start of construction at CEW, no railroad track existed within the project boundaries. The Louisville & Nashville line between Knoxville and Cincinnati closely paralleled the northeastern boundary (See Map, App. B-2), and a short spur for immediate use was constructed parallel to the Louisville & Nashville tracks at Elza. Grading work for the Elza spur was performed by Walter & Prater, contractors, and the tracks were placed by Stone & Webster Engineering Corporation

(App. A-293). Main line tracks of the Southern Railway System between Cincinnati and Chattanooga approached the southwest corner of the reservation, while a secondary line between Knoxville and Harriman paralleled the northwestern boundary (App. B-2).

17-3. Planning. - At the inception of CEW, the problem of receiving and handling the large volume of material and equipment to be used was studied in detail on the basis of information available at that time. After giving consideration to construction of a project railroad and the alternative of transporting materials by truck fleets from Clinton, Knoxville, and other points, it was concluded that rail facilities should be constructed, and since the connection at Elza appeared most economical, plans were drawn accordingly. Because of the uncertain scope of the project in the early stages, plans for the railroad were made in small increments. Thus the growth of the railroad reflected the expansion of the project as a whole. An attached map (App. B-11) shows the numerous classification yards and spurs which were found necessary. The procedure of adding small increments was made possible by designs which made provisions for further necessary expansion. A plan was laid out to extend the Louisville & Nashville connection to the Diffusion Plant Area, but was discarded in favor of a connection from that area to the Southern Railway at Blair which, as indicated, was shorter and afforded a connection with a second main line railroad. The connection between the Central System and the Diffusion Plant Area was again considered in 1945 for passenger service but was rejected as not economically justified.

17-4. Construction of the Central System. - A contract for grading was let on 2 November 1942, one day before the first cars arrived at Elza.

Grading for the Elza extension was completed on 12 December 1942 (App. A-31). Construction of the project main line connection was started on 7 December 1942 and was completed in April 1943, although parts of the track were used before completion. Construction of additional capital facilities, such as classification yards, extension lines, storage warehouses, and pit yards, continued at a rapid rate. All authorized trackage was completed 30 June 1944. In general, grading was done under Stone & Webster supervision by the Harrison Construction Company, grading contractors, and track construction was performed by Stone & Webster's own forces (Apps. A-31 and A-221). Part of the crushed stone ballast was supplied from crushers operated at CEW by Ralph Rogers Company (Apps. A-108 and A-295). Pipe culverts required in the construction of the railroad were installed by Harrison Construction Company under Stone & Webster supervision (~~App. A-294; also~~ See Pages 173 to 178 of App. A-193).

17-5. Acquisition of Equipment. - The greater part of the original operating equipment was obtained by transfer of accountability and possession from various Corps of Engineers establishments and later from the Chief of Transportation; much of the original equipment was transferred from CEW or declared surplus prior to 1 July 1946 (Apps. A-19b and A-293). Major items of equipment used in the operation of the Central System by the Louisville & Nashville are listed in Paragraph 17-6. Major pieces of accountable equipment transferred to CEW, with values shown, were as follows (App. A-19b):

EQUIPMENT	UNIT COST	TOTAL COST
3 steam locomotives	$ 20,000	$ 60,000
1 diesel locomotive	40,000	40,000

EQUIPMENT (cont'd).	UNIT COST (cont'd).	TOTAL COST (cont'd).
1 diesel locomotive	$ 25,000	$ 25,000
3 steam locomotive cranes	15,000	45,000
1 gas locomotive crane	15,000	15,000
1 rail loader	9,000	9,000
10 flat cars	2,000	20,000
8 hopper cars	3,000	24,000
2 maintenance cars	500	1,000
Total		$ 239,000

17-6. Operation. - Cars were received from the Louisville & Nashville tracks at the interchange track near Elza Gate and then classified for delivery to the proper sidings in Oak Ridge and the Electromagnetic Plant Area. The railroad was operated by Stone & Webster from the beginning of construction until 29 October 1944, when operation and maintenance were transferred to Roane-Anderson Company (App. A-19), which, in turn, was relieved of this responsibility with the engagement of the Louisville & Nashville. The "Cost of Operation and Maintenance" contract with the Louisville & Nashville was entered into on 27 May 1946 and became effective on 1 July 1946. Under this contract, which was to expire 30 June 1947, the carrier agreed to handle all train operations and maintenance of way and to service and repair all equipment furnished by the Government. The Government was to furnish all materials required in maintenance of way. In general, the company was to be reimbursed on a basis of expenditures made and rental for its equipment, without fee or profit (App. A-32a). Major items of equipment furnished to the carrier by the Government for operation and maintenance of way were: two 131-ton

diesel electric locomotives, one 80-ton diesel electric locomotive, one five-ton burro crane, one 25-ton steam locomotive crane, three 35-ton flat cars, and two railroad motor cars (App. A-293).

17-7. Passenger Service. - Passenger service to the reservation terminates normally at Knoxville, except for a conditional stop at Edgemoor for first class ticket holders traveling on the Louisville & Nashville between Oak Ridge and points north. Railway passenger service between Oak Ridge and Knoxville during the construction period at CEW is described in Section 18.

17-8. Operating Data. - The heaviest freight traffic period occurred during the year from May 1943 to May 1944 when over 400 cars per week were received. During the highest single week, that of 5 December 1943, 699 cars, 126 of them in one day, were handled. This traffic was handled by an average of 100 to 125 operating employees. During the period of operation by Stone & Webster, 38,568 freight cars were received from the Louisville & Nashville (App. A-31). Under Roane-Anderson operation, the Central System handled 17,761 cars "received" and 2,450 cars "out" or a total of 20,211 cars handled from 1 November 1944 to 30 June 1946 (App. A-31c). During the period 1 July 1946 to 31 December 1946, under the Louisville & Nashville contract, the Central System handled 3,265 cars "received" and 755 cars "out" (App. A-293).

17-9. Costs.

a. Stone & Webster. - Because of the urgency of all construction and operations which confronted Stone & Webster, it was usually impossible for that corporation to separate railroad operation and maintenance costs from other costs in its widespread activities. Construction

costs under Stone & Webster were as follows (Pages 173 to 178 and 1175 of App. A-193):

DESCRIPTION	COST
Clearing and grading	$ 304,123.65
Ballast	449,094.92
Rails, ties, and special work	673,411.14
Culverts	117,139.94
Locomotive house	8,819.52
Coal trestles	39,692.63
Total	1,592,281.80

b. Roane-Anderson. - When Roane-Anderson took over operation and maintenance in October 1944, the situation was stabilised sufficiently for that agent to maintain cost records. Following is a summary of railroad costs by Roane-Anderson from 29 October 1944 to 30 June 1946 (App. A-196):

Maintenance of way (direct)		$ 242,410.44
Train operations (direct)		482,276.54
Train operations	$ 228,496.15	
Inspection of equipment	8,064.72	
Service company equipment	52,109.02	
Service other equipment	5,225.92	
Repair company equipment	95,908.10	
Repair other equipment	3,638.94	
Crossing watchmen	43,124.15	
Yardmaster Department	45,709.54	
Less: Total cash revenue		3,298.40 (Cr.)

17-9. Costs (cont'd).

b. Roane-Anderson (cont'd).

Less: Total additional revenue		$ 188,960.30(Cr.)
Administration & general office overhead		80,181.16
Maintenance of way (33 percent):	$ 26,459.78	
Train operation (67 percent):	53,721.38	
Maintenance of way		268,870.22
Train operations		343,739.22
Total (Net)		$ 612,609.44

c. Louisville & Nashville. - At the end of 1946, exact figures for the cost of operations for the period 1 July 1946 to 31 December 1946 were not immediately available, but carefully determined estimates were as follows (App. A-293):

Shop maintenance and materials furnished by the Government	$ 42,680.26
Services of company for train operations and maintenance of way	87,960.65
Total	$ 130,640.91

SECTION 18 - PASSENGER TRANSPORTATION SERVICE

18-1. General.

a. Initial Development. - Transportation facilities were meager when work at the Clinton Engineer Works was begun in the fall of 1942. The sole public transportation facility was a bus line whose route from Knoxville to Rockwood via Harriman passed through the area. From the outset, the construction companies experienced difficulty in procuring and retaining personnel in the absence of mass transportation facilities. To supplement private cars, Government sedans and construction vehicles assigned to CEW were used to move workers from neighboring communities daily. Even after bus service was established the transportation problem was aggravated by the condition of the roads in and near the area, conditions which made private car commutation unsatisfactory and expensive (See Sec. 16 for description of road and traffic conditions).

b. Bus Operations by Contractors. - Recognising the effect of the situation on labor turnover and absenteeism, major contractors at CEW, beginning in March 1943, entered into contracts with bus companies to provide employee commutation service to CEW, and by June 1943, 25 privately-owned busses were operating to and from CEW daily. During the summer and fall of 1943 some busses, along with other vehicles, were acquired from various Government installations, but these were sufficient to satisfy only a fraction of the rapidly increasing demand. The distance from clock alleys to work areas created a local transportation problem, and Government busses were assigned to construction companies; also, the companies made extensive use of stake trucks. Labor recruiters

frequently developed the off-area transportation network, because, as employees were hired in communities, it was necessary to arrange for transporting them to and from the project daily. Occasionally local school bus contractors were available, and arrangements were made with them to transport employees on a subsidy basis, but in most communities there was no existing or potential bus service, and it was necessary to send busses and trucks to these locations. In November 1943, the area bus service was inaugurated with one line in operation. The scarcity of busses was the main deterrent to the development of service throughout 1943, and in the fall of that year the aid of the Fourth Zone Transportation Officer, Transportation Corps, Atlanta, Georgia, was enlisted, and a substantial number of busses were assigned to the project.

c. Consolidation and Expansion. - Early in 1944 all bus services were consolidated under the management of Roane-Anderson Company. A division of this company, the OCW Bus Authority, was established to operate the bus lines within OCW and to manage the off-area system on a subcontract arrangement with local carriers. The transfer, to this central system of the local and off-area bus services conducted by each contractor, was effected during the spring of 1944. New lines were established within the reservation as housing areas were completed; similarly, the service to work areas was expanded to accommodate the Diffusion Plant Area which was started at this time as well as to provide for additional traffic to the Electromagnetic Plant Area. In February and March 1944, OCW Bus Authority arranged with several bus companies to provide commutation service for those employees living outside the reservation. Regular routes were established to replace the lines over

which contractors' vehicles had operated. Service was established on a mileage contract basis, and each company on the area agreed to provide transportation for its employees for $1.50 per week per person irrespective of the distance, as compared with the earlier fare of $1.80 established early in 1943. In most instances, this service replaced free transportation. The new off-area service was successful from its inception, and soon after the service was instituted all lines were reporting over-loads. In June 1944 a survey measured the use of existing services as a step in developing maximum utilization (App. A-115). Following this, an active share-the-ride program was inaugurated and the fare structure was extended to all bus services. Both area and off-area bus services continued to expand throughout the latter half of 1944 and early 1945. In September 1945, after V-J Day, the volume of area and off-area bus operations began to decrease.

18-2. Authorizations.

a. General. - An act of Congress provides that whenever, during World War II, the Secretary of War determines that assured and adequate transportation is necessary for the effective conduct of the war, he is authorized, in the absence of adequate private or other means, to provide transportation to and from places of employment for personnel engaged in the manufacture of war materials (App. A-181).

b. Railroads. - The first assistance from the Office of Defense Transportation was in ordering the Louisville & Nashville Railroad to operate rail shuttle service between Knoxville and the project (See Par. 18-9a).

c. Bus Operations. - Orders, supplements, and modifica-

tions issued by the ODT in 1944 authorized the use of over 600 Government-owned vehicles for the transportation of employees and residents to, from, and within CEW (Apps. A-117 to A-119). Each off-area contract carrier obtained operating authority, in the form of a Contract Hauler's Permit, from the Tennessee Railroad and Public Utilities Commission (App. A-149). The lease of busses to off-area commercial operators was authorized by the Chief of Transportation on 11 October 1946 (App. A-300; also see Par. 18-7d).

18-3. Organization and Management.

a. Manhattan District. - Personnel transportation matters and transportation contractors have been supervised by the Facilities and Service Division and its predecessor organizations (See Par. 3-6b), first through an equipment unit, the principal problem being one of procurement; later, beginning in June 1943, by a branch formed to supervise all forms of transportation within and adjacent to project; still later, by the Automotive Transportation and Bus Transportation Sections, both in the Services Branch of the Division (See Apps. C-18 and C-19); and, finally, by the Bus Transportation Section of the Division's Department of Public Works (See App. C-20).

b. CEW Transportation Board. - The CEW Transportation Board, composed of representatives of major contractors, was organized in December 1943 as an advisory group to the District in developing a coordinated transportation system. The activities of the Board were in connection with rationing, ride-sharing, bus and rail passenger transportation, traffic regulation, licenses and regulatory activities, and Government-owned passenger vehicles. This group formulated the plans

by which the contractors' bus operations were consolidated into the central system operated by the CEW Bus Authority, developed the policies governing bus service, and initiated the ride-sharing program. In the spring of 1945 the activities of the Board were assumed by District officers.

c. Fourth Zone Transportation Office. - Throughout the development of passenger transportation services, close liaison was maintained with the Chief of Transportation, Fourth Zone Transportation Office, through whom virtually all Government busses at CEW were obtained.

d. CEW Bus Authority. - Immediately after the creation of the Transportation Board, the CEW Bus Authority was organized as a division of Roane-Anderson Company, to consolidate and operate all bus services within the reservation and to supervise the contract bus lines entering CEW. The Bus Authority managed and operated the bus transportation services at CEW until February 1945.

e. Management. - Roane-Anderson made heroic but not altogether successful efforts to procure experienced and competent bus personnel, and it was necessary to assign personnel from other activities to supervise the bus services. Continued efforts were made by the District and Roane-Anderson to effect economies, but unit costs continued higher than normally expected under experienced management, and it was recognized that bus operations had grown to a magnitude requiring specialized management. Negotiations undertaken (App. A-121) with several organizations culminated in a contract with American Industrial Transit, effective on 1 February 1945 (App. A-120), to operate all bus

services within CEW and to supervise the off-area bus lines through subcontracts. The AIT management, composed chiefly of officials from Southeastern Greyhound Lines, brought with it certain managerial talent. Under the contract, AIT was required to furnish, on a non-reimbursable basis, five supervisory persons with wide experience in motor transportation. Also, a group of consultants was made available for advisory services and several experienced supervisors were procured (See Par. 18-8a for other features of the AIT contract).

18-4. Procurement of Bus Equipment. - The first busses received at CEW were made available from other installations in the spring of 1943, but the number did not approach that sufficient to satisfy requirements. The need for passenger-carrying facilities developed so rapidly that consideration was given to the construction of a railroad between the town and the Diffusion Plant Area (See Par. 18-9b). The Transportation Corps directed a flow of busses to CEW in lots of 50 and 100, lasting through the spring of 1944. After the survey made in June 1944, busses were obtained in lots commensurate with the need, and, as the traffic demand warranted, the fleet was supplemented by the Transportation Corps with replacements and vehicles for additional service. In general, the following types of equipment were made available by the Transportation Corps: (1) war-worker coach, a 15-passenger unit which consists of a sedan with extended chassis to accommodate three additional cross rows of seats; (2) body-on-chassis bus, a 29-passenger or 37-passenger unit, consisting of a standard one or one and one-half ton truck chassis with a school bus body; and (3) tractor-trailer, consisting of a one and one-half or two and one-half ton truck-tractor with a

wooden frame trailer built to accommodate 45 passengers seated. In addition to these vehicles, 30 city transit busses, each accommodating 27 seated passengers, were purchased in June 1944 for use in the residential area. From the standpoint of utility and appearance, these vehicles represented the only designed transit equipment used within CEW to transport personnel, but, because of the steep terrain of the residential areas, the city transit busses and the war worker coaches proved to be unserviceable and they, with the obsolete tractor-trailer busses, were removed from service and replaced by 29-and 37-passenger International busses. Government-owned busses have been used throughout in area bus operations and also have constituted much of the off-area fleet. The number of Government- and privately-owned busses used each month is shown in Appendices C-9 and C-10.

18-5. Area Bus System.

a. General. - The first services within CEW consisted mainly of truck and bus hauls between clock alleys and work sites; no fares were collected. As housing developed, contractor-operated bus services were extended into the residential area. The town bus service was inaugurated late in 1943. Since the residential area expanded away from the central shopping district more rapidly than neighborhood shopping facilities could be opened, it was necessary to provide bus service on main streets as houses were ready for occupancy, not only to facilitate home to work travel, but also to furnish access to stores and schools. Area bus service grew at a swift rate throughout 1944 and the spring of 1945, the peak being reached in the summer of 1945. The number of busses in use, miles traveled, and passengers hauled each month

from February 1944 through December 1946 are shown in Appendix C-9.

b. Operations.

(1) Terminal System. - A terminal system, to facilitate the interchange of traffic, was established in February 1944. The first terminal - Central Terminal - was opened near the Town Center that month. Jefferson Terminal, in West Village, was opened in May 1944 and provided a similar service for the western part of the residential area. Terminal facilities also were provided at the Diffusion Plant Area to permit interchange of CSW and internal plant traffic.

(2) Residential Service. - By March 1944 (App. A-19) five residential routes in the town were in operation; during that month approximately 215,000 passengers were carried and cash fares totaled slightly less than $10,000. By March 1945 (App. A-122) the service had expanded to 21 residential routes with a total of approximately 1,335,000 passengers, and total revenue rose to more than $59,000. The frequency of service on residential routes varied from two to 30 minutes, and in conformity with ODT requirements schedules were designed so that approximately a full seated load would be carried on each trip. "Owl" and express services were instituted in the spring of 1945. In December 1946, approximately 915,000 residential passengers were transported; this service produced a revenue of approximately $37,000 in December 1946 (App. A-122b).

(3) School Service. - School bus operations were begun in the fall of 1943. During the initial period of the school system, this service was performed by the residential area busses. In March 1944, in addition to the children who used the town service, 500

school children were transported daily in busses assigned especially for that purpose. In order to conserve facilities, limitations were placed upon school bus operations; passes were issued to school children limiting the hours during which they could ride, and restricting school children to residential busses where desirable (App. A-123). In contrast to other bus operations, the school bus service has steadily increased, reaching approximately 7,700 passengers during December 1946.

(4) Work Area Service.

(a) General. - The survey conducted in June 1944 revealed that 41 percent of area residents traveled to and from work by bus (App. A-115).

(b) Electromagnetic Plant Area. - Bus service from the residential area to the main gates of the Electromagnetic Plant was begun in the fall of 1943. The initial system was operated by Tennessee Eastman Corporation, the plant operator, and was absorbed by the central system in February 1944. In March 1944, this service made approximately 4,300 round trips and carried approximately 151,000 passengers between the residential area and the plant. This service reached its peak in August 1945 when approximately 445,000 passengers were moved. During December 1946, passengers totaled approximately 131,000; 40 busses were required to make approximately 5,500 round trips. A shuttle service within the plant area was operated by the plant operator.

(c) Diffusion Plant Area. - Service from the town to the Diffusion Plant Area was started by the CEW Bus Authority on 4 March 1944. During March there were approximately 7,500 passengers. This service was augmented by additional tractor-trailer busses in the

work area. In May 1945, transportation to this area reached its highest figure, totaling 530,209 passengers. During December 1946, passengers totaled approximately 154,000; 80 busses were required to make between 5,000 to 6,000 round trips. Shuttle services in this area and the Thermal Diffusion Plant Area were operated by plant operators and contractors.

(d) Clinton Laboratories. - Work bus service to the Clinton Laboratories was inaugurated in the fall of 1943. It was managed by the plant operator until April 1945, when the system was consolidated with other bus operations. This service constituted a relatively small operation, requiring not more than 25 busses at shift changes. During December 1946, passengers totaled approximately 36,000; 23 busses were required to make approximately 1,500 round trips.

(e) Miscellaneous Service. - In addition to the various routes within CEW, the area bus system has provided emergency service over off-area routes when breakdowns and overloads occurred and, also, transportation for contractors, including personnel shuttle service between nearby cities and CEW for newly-hired personnel.

c. Fare Structure.

(1) General. - The law which permits the Secretary of War to establish transportation facilities (See Par. 18-2a) provides that reasonable rates of fare be established for transportation provided. However, because of the nature of the services performed by the bus system during the initial operation, it was not feasible to charge a fare. Busses and trucks used by companies for transporting workers were run in an informal manner, without special regard for schedules and routes, and a portion of the service transported workers between job sites while

on duty, for which reimbursement to the men would have been necessary if a fare were established. Under these circumstances, it was not feasible to establish fares on the area busses until after the town service was instituted.

(2) Town Fare. - A five cents fare was charged on town busses beginning on 1 February 1944. Cost data to determine whether the system would be self-sustaining at this rate were not available at that time, and the fare was set at five cents to conform with general practices in communities of equivalent size. School bus service was initiated on a fare-free basis.

(3) General Area Fare. - Service from terminals to work areas was continued on a fare-free basis during the first half of 1944. Meanwhile, cost studies, conducted to develop an equitable rate structure, revealed that current operations involved an expense of approximately 20 cents per passenger trip, but that certain costs were due to local conditions, such as long distances between homes and work sites, unpaved roads, steep hills, and high peak movements at shift changes. Since passengers were not responsible for these circumstances, it was felt that the bus system could not reasonably be made self-sustaining. In July 1944 (App. A-124) it was decided that a fare of 10 cents per trip or the sale of 3 tokens for 25 cents was equitable, and this fare, effective 8 August 1944, was established. (App. A-327) This fare structure was soon modified by the sale of five tokens for 30 cents; the 10 cent fare remained in effect for passengers paying cash. Transfers between connecting lines were authorized, and children under 12 rode free if accompanied by parents. The new rates were effective on 20 August

1944 (App. A-125) and were still in effect on 31 December 1946.

18-6. Off-Area Contract Bus Service.

a. Development and Operations.

(1) Initial Operations. - The existing bus service of the Tennessee Coach Company through CEW was utilized by Stone & Webster Engineering Corporation and the company in their contract for the first employee commutation bus service between Knoxville and CEW. Tickets were sold to Stone & Webster personnel for $1.80 per week which was one-half of the established $3.60 weekly rate from Knoxville, and Stone & Webster reimbursed the carrier for the full amount. The operators of the Clinton Laboratories and the Electromagnetic Plant arranged with Local Bus Lines for service between Knoxville and CEW on a similar basis. Gradually, as Government busses became available, they were placed in service to haul workers from surrounding communities to the job. Meanwhile, arrangements were made by other area contractors with bus companies to furnish commutation for employees on a basis similar to that developed by Stone & Webster.

(2) Consolidation of Services. - By the fall of 1943 the Knoxville shuttle train (See Par. 18-9a) was accommodating about 1,000 commuters, approximately 2,800 employees were traveling via private bus lines daily from neighboring points, the contractor-operated busses were carrying some 1,800 employees, at least 1,000 were commuting to the area daily in stake trucks, and an average of about 10,000 private cars were entering and leaving CEW daily. It was thus apparent that coordination of off-area transportation was necessary. One of the first decisions of the CEW Transportation Board was that all off-area

bus services should be placed in the hands of public carriers as soon as practicable, and the Bus Authority was directed to arrange with private lines for the service (App. A-127). Subsequently, additional busses for lease to these carriers were obtained. Off-area bus operations expanded rapidly, particularly during the first half of 1944.

b. Bus Subcontracts.

(1) Negotiations and Development. - With the consolidation of off-area bus operations and the decision to place off-area service on a uniform subsidy contract basis, consideration was given to the contract form to be used. The prospective operators were reluctant to furnish service without some assurance of a reasonable return. Payment on a passenger-mile basis was considered but was discarded in favor of a unit-mileage price contract whereby each operator would be paid a given rate per mile. Because of lack of experience among bus operators, an arrangement was devised whereby each operator would be paid an arbitrary rate for the first six months. At the end of this time rates were to be revised retroactively in the light of actual costs during the trial period. Although it provided economical off-area service, this form of contract required a study of each operation to determine equitable rates. In one instance, it led to alleged attempted bribery and termination of one contract (App. A-128). Thereafter contracts were revised to provide a fixed-rate per mile when the operations stabilized sufficiently to permit determination of equitable rates. Generally two contracts were executed with each carrier (App. A-129), one for the use of privately-owned busses, the other for operations with Government-owned busses. The carrier paid from 2.5 cents to 3.5 cents per mile

for the use of each Government vehicle. With these exceptions, contracts were patterned after the War Department Standard contract form (App. A-150). By June 1945, approximately 50 contract bus routes, some of which extended as far as 90 miles (e.g., to Cumberland Gap and Jamestown) from CEW, had been established. The number of busses in use in off-area contract service, miles traveled, and passengers hauled each month from February 1944 through December 1946 are shown in Appendix C-10. A list of carriers who operated under contracts with Roane-Anderson Company, AIT, or both, together with the communities served by each, is attached (App. C-10a), as are maps showing the maximum extent of routes of each carrier (Apps. B-12 and B-12a).

(2) Mileage Rates. - Fourteen of the carriers to whom subcontracts were awarded early in 1944 received trail rates of 25 cents per mile, three received a trial rate of 29 cents per mile, and one subcontract was negotiated for 35 cents per mile; the subcontract with Knoxville Transit Lines provided for a trial rate of 45 cents per mile, with a credit of 6.11 cents for each passenger carried. Studies and conferences late in 1944 had the following results: (a) the rate with the 14 companies with the 25 cent per mile rate was revised to an average of 23.1 cents per mile; (b) the rate for the three companies with 29 cent trial rates was revised to an average of 26.7 cents per mile; (c) the rate with Tennessee Coach Company, originally fixed at 35 cents, was revised to an average of 33.3 cents per mile; (d) the Knoxville Transit Lines agreed to a 5 cent reduction to 40 cents per mile; (e) two mileage rates were negotiated with each carrier, one for the operation of leased Government-owned equipment, the other for the car-

rier's own busses; (f) the rates allowed for service with private equipment were slightly higher, so as to encourage operators to purchase and make the fullest use of their own vehicles.

c. Fares. - As housing facilities were limited at CEW, and the competitive labor situation being what it was, concession was necessary to induce personnel to work at CEW. Important headway was made in the general adoption of the plan developed by Stone & Webster and Tennessee Eastman (App. A-131). In March 1944, the CEW Transportation Board determined that a schedule of cash fares on busses from outlying points to CEW was necessary to accommodate new personnel, salesmen, and other authorized visitors, as well as persons living within the area who desired to visit the surrounding towns. The Bus Authority, working with the Tennessee Railroad and Public Utilities Commission, prepared a schedule of tariffs which was approved by the State authorities and placed in effect on 1 May 1944. It was recognized that the $1.50 weekly commutation rate would return only a fraction of the cost of off-area bus operation, but with the need for additional employees, the chief concern was merely to establish a reasonable fare.

d. Curtailment of Service and Discontinuance of Subsidies. - Throughout the period of contract bus service, there was a more or less continual adjustment and modification of contracts, extending or curtailing the service required of the contractors; as the need for service disappeared from a community, that community was removed from the points to be served under contract. Eventually, entire contracts were cancelled as the diminution of need warranted. The first contract was cancelled in June 1944, and by 1 September 1946, all subsidy contracts

had been terminated, leaving all off-area service on a commercial basis (See Par. 18-7). A chart showing termination dates of the various subsidy contracts is attached (App. C-10a).

18-7. Off-Area Commercial Bus Service.

a. Development. - In addition to the off-area contract bus service, discussed in the preceding paragraph, an extensive off-area service, operated by carriers in the orthodox commercial manner, was developed. The first commercial service, Tennessee Coach Company's route between Knoxville and Rockwood, via the site of Oak Ridge, existing when the reservation was acquired, was supplemented by the company in March 1943 by a local service between CEW and Knoxville; in January 1945 Tennessee Coach routed four Knoxville - Nashville busses through CEW. Local Bus Lines and Smoky Mountain Stages, Inc., instituted an additional service between CEW and Knoxville early in 1944. Additional service to Knoxville was established by Local Transit Lines in 1946. Service between CEW and Chattanooga, via Decatur and Kingston, was established by Cherokee Motor Coach Company in February 1943; in the summer of 1945, Cherokee instituted another route to Chattanooga via Dayton, Harriman, Rockwood, and Spring City, and, in November 1945, by purchase of the CEW - Knoxville certificate of Local Bus Lines, extended its lines into Knoxville, thus providing through service between Knoxville and Chattanooga via CEW.

b. Expansion After Termination of Subsidy Contracts. - The termination of the subsidy contracts, while not actually increasing the off-area service, resulted in a substantial increase in commercial operations. Service was continued by the Smith Bus Line to Maryville,

by Medlin Bus Lines to Athens and Decatur, by Wilhite Bus Line to Loudon, Sweetwater, and Madisonville; by Lenoir City - Alcoa Bus Line to Lenoir City and Madisonville, by Cherokee Motor Coach Lines to all points previously served, by Fox Bus Line to Lake City, by Tennessee Coach to points previously served, and by Local Transit Lines to Knoxville. In addition, the contract service of LaFollette Coach Lines to LaFollette and Jacksboro was continued on a commercial basis by the newly organized Baker Bus Line, the service of Morgan Bus Line to Crossville and Spring City by Tennessee Coach and Cherokee, the service of Owen Bus Line to Clinton and Norris by the newly organized Norris Motor Coach Company, the service of Oliver Springs Bus Lines to various points in Morgan County by Southeastern Greyhound Lines, and the Knoxville service of Smoky Mountain Stages by the newly organized Central Bus Lines, Inc.

c. Mileage. - During December 1946, mileage to nearest major terminals or junction points by commercial carriers totaled approximately 440,000 miles.

d. Lease of Equipment to Commercial Carriers. - With the discontinuance of the off-area contract service, it was necessary, in the interest of continuing this service on a commercial basis, to lease over 90 Government-owned busses, which had been in contract service, to commercial operators to supplement the operators' own fleets. Busses were accordingly leased, in the fall of 1946, to Wilhite Bus Line, Tennessee Coach Company, R. M. Clark doing business as Lenoir City - Alcoa Bus Line, Norris Motor Coach Company, Local Transit Lines, Fox Bus Line, Baker Bus Line, and Smith Bus Line (App. A-300).

18-8. Operational Costs, Contract Bus Service.

a. AIT Contract. - Because cost analyses of area bus operations during 1944 revealed that the unit cost was approximately 60 cents per bus mile, which was much higher than operations of comparable magnitude elsewhere, the negotiations with prospective contractors, during the latter part of 1944 for the management of bus services, emphasized economy, and avenues to develop an incentive for its attainment were explored. When finally a contract was awarded to AIT on 1 February 1945, provisions were included whereby the contractor would receive, in addition to a fixed-fee of $10,000 per month, a monthly incentive fee, based on the unit-cost of operations per mile per month. The fixed-fee was reduced to $9,000 per month, effective 1 December 1946, and was to be reduced to $8,000 per month, effective 1 January 1947. No incentive fee was to be paid in a given month if the unit-cost increased by four or more cents above that of the previous month. To insure dependable service, the contract provided that the incentive fee would be modified upward or downward by a service factor predicated upon adherence to schedules, proper collection of fares, and other features in connection with service rendered. During the first three months under AIT management, the unit-cost was reduced from 57.14 cents per mile in February 1945 to 48.01 cents per mile in April (App. A-126), yet no incentive fee was earned because the cost reduction had not reached the 45.00 cents per mile warranting an incentive fee. AIT first earned an incentive fee, of $1,500, in July 1945.

b. Cost Summary. - For the month of April 1945, for example, the gross operating cost of area bus operations was in excess of

$409,000; revenue was approximately $91,000. During the spring of 1945, for example, the subsidy for area bus operations ranged between $281,789.28 and $397,091.70 monthly. In December 1946, the area gross cost was $200,337.80, and revenue was $61,816.26 (App. A-325). Under AIT management, from 5 February 1945 through 31 December 1946, the area and off-area bus systems together called for total cash disbursements, exclusive of non-reimbursable items, of $9,857,027.99; during the same period, cash receipts totaled $3,513,530.74, leaving the net (cash) cost to the Government as $6,343,497.25 (App. A-20). The total net operating cost, including cash cost to the Government, of the area and off-area systems from the beginning of AIT operations through 31 December 1946, was $7,853,221 (App. A-194). A detailed breakdown of this cost is attached (App. C-10b). A substantial portion of the operating loss was eliminated with the termination of the off-area subsidy contracts.

c. Off-Area Contract Operations. - From February to June 1945, inclusive (less the first four days of February), the cost to the Government for the off-area system averaged $256,669.76 monthly. The gross monthly cost averaged $418,603.58, less a monthly average revenue from commutation tickets and rentals from leased equipment of $161,933.82 (less, in all figures cited, the first four days of February). The monthly subsidy for the last half of 1945 averaged $199,624.09; the off-area gross cost of operations averaged $326,265.65 each month, less an average monthly revenue of $126,641.56. The gross cost of operations and the amount of the subsidy in May 1945, the peak month, were $446,432.14 and $289,357.63, respectively. Revenue reached its peak, $184,694.30, in June (App. A-326).

18-9. Rail Transportation (Also see Sec. 17).

a. Knoxville Shuttle Train. - Because rail facilities between Knoxville and Elza were already established when the project started, early consideration was given to the development of rail service for employee commutation. In March 1943 Stone & Webster asked the Louisville & Nashville to establish daily service between Knoxville and CEW for the former's personnel. The railroad refused, asserting that such service would require motive power, coaches, and crews which it could not furnish (App. A-114). An appeal was made to ODT, and after ODT obtained coaches from other lines, the railroad was ordered to operate the service between Knoxville and CEW (App. A-116). A contract was then executed between Stone & Webster and the Louisville & Nashville. It provided for the operation of a 15-coach passenger train on a maximum of three round trips daily for a contract price of $1,440 per day, or $1,340 on each day that only two round trips were made. Stone & Webster was required to handle all fare collections and to assume all liabilities resulting from accidents (App. A-132). Because the commutation fare on busses between Knoxville and CEW had been set originally at $1.80 per week, Stone & Webster charged its employees the same amount for rail service. The passenger train served a real need at a time when transportation facilities were critical, but the service failed to attract consistently the expected volume of traffic. After the schedules were revised and the line extended into the Electromagnetic Plant Area the traffic increased, but after the reorganization of the off-area bus service in February 1944, the train traffic declined sharply, and in July 1944 the shuttle train was discontinued (App. A-133).

b. Proposed Area Railroad. - Studies were made in the summer of 1943 for rail service between the town and the Diffusion Plant Area by extending the Louisville & Nashville connection to that area, it being felt that a connection would be advantageous by providing a link between the Louisville & Nashville and the Southern Railway. Because of the limited labor supply and the urgency of other construction work, the proposal was soon dropped. In January 1945, the proposal was revived (App. A-134). It was estimated that eight miles of rail construction would be required, together with terminals, involving a cost of approximately $520,000. After a review of the services involved in contrast with estimated cost, it was decided to forego further consideration of the connection.

18-10. Automobile Transportation.

a. Development.

(1) Private Transportation and Traffic Volume. - Despite restrictions on the sale of vehicles, tires, and gasoline, workers made extensive use of privately-owned automobiles in traveling to and from work sites. In March 1943, an average of 1,500 cars passed through the gates daily. Six months later, the volume of traffic had increased to approximately 10,000 cars in each direction (App. A-135). It was to handle this traffic that the extensive road and street construction and improvement program was undertaken (See Sec. 16). At the beginning of 1944, the daily traffic through the gates neared 25,000 vehicles. Most of the access routes and main roads within CEW were patrolled to alleviate traffic tie-ups. Shift hours were staggered among the contractors, and one-way traffic was instituted at certain entrance gates, with in-

bound flow in the morning and outbound at night. In June 1944 it was revealed that 48 percent of all employees traveled to and from work by private automobiles ~~(App. A-136)~~, and a major portion of this figure was of persons living outside the area. Approximately 10,300 private vehicles were being driven regularly, transporting an estimated 25,000 employees from off-area points, this figure representing about 63 percent of the non-resident personnel. Eighty-eight percent of the cars owned by off-area residents were being used for home to work travel. (App. A-115) Traffic volume through the gates declined to approximately 20,000 vehicles daily by the fall of 1944.

(2) Ration Board. - A subpanel of the Knoxville War Price and Ration Board for handling gasoline and tire applications was established by Stone & Webster in January 1943 for the corporation's employees. This group was reorganized a few months later as the CEW Panel Board, with subpanels among each of the major contractors at CEW. In February 1944, a separate War Price and Ration Board was established at Oak Ridge.

b. Share-the-Ridge Program. - During 1943 some group riding was developed among employees through individual arrangements, advertisements in local newspapers, and the OPA requirement and that each applicant have three riders to be eligible for occupation gasoline rations. This activity was further encouraged by an arrangement made with Tennessee Eastman Corporation whereby its employees purchased, for $2.00 per week, tickets valid for home to work transportation in their own or other employees' automobiles. The major campaign for car-sharing was begun in June 1944, when car-sharing exchanges were established by each of the

major contractors at CEW. The exchanges, affiliated with the gasoline ration subpanel, furnished the names of prospective riders to each gasoline applicant and insisted that each car be filled to capacity before certification for a complete allotment was made. Publicity material was ddistributed, and campaigns were conducted among employees to encourage share-the-ride transportation. Assistance was also given to gasoline applicants in completing forms for supplemental rations. The effect of the share-the-ride program was evidenced by the fact that by October 1944 the average car occupancy had increased to 3.35 persons per vehicle ~~(App. A-136)~~. During that same interval the number of cars passing through the entrance gates decreased 19 percent. (App. A-336 to A-349) After V-J Day group riding was continued only on an individual basis.

c. Government Automobiles. - Government passenger vehicles were procured from other War Department installations and assigned to the contractors in proportion to their needs. These vehicles generally were operated in pools and were chauffeur-driven; in effect, the service was conducted in a manner similar to taxi operations. The provisions of Army Regulations 850-15 were policy requirements with respect to safety precautions, drivers' permits, and maintenance. During the first 18 months of the project, a limited number of cars assigned to key personnel were permitted to be used for home to work travel in order to enable these individuals to reach job sites during emergencies, but controls were used to insure that these vehicles were used for only authorized travel. Following the enactment of appropriate legislation in June 1944 (App. A-151), the use of Government automobiles was limited so as to exclude all travel between homes and places of employment, ex-

cept in actual emergencies. Several months later, all Government-owned vehicles were returned to the company pools to permit maximum utilization. By these and other restrictions, the number of Government automobiles at CBT was reduced from 1,275 vehicles in June 1944 to slightly less than 1,000 in June 1945. The last six months of 1945 showed a further decrease of approximately 50 percent in company personnel transportation by Government cars. The use of Government automobiles for off-area company personnel service was discontinued after the completion of major construction contracts.

18-11. Construction. - The Central Bus Terminal and smaller adjacent buildings were converted from their initial uses as clock alleys and examination buildings. The initial construction cost - $84,881.75 - is tabulated in Appendix C-11 (Bldg. Nos. 1701, A-B) in the costs of miscellaneous buildings. The Jefferson Bus Terminal (Bldg. No. 1856) was constructed by Roane-Anderson Company at a cost of $66,246.83 (App. A-196). The Bus Repair Shop and Maintenance Building (Bldg. No. 1758-2) was constructed by Stone & Webster at a cost of $278,184.02 (Page 1281 of App. A-193). By the summer of 1946, the paving in the Central Bus Terminal Area had worn to an extent that maintenance cost had become excessive, and in October a nine-inch concrete slab was laid in the two bus lanes and the surrounding parking and pedestrian areas were graded and surfaced with a single asphalt treatment. The pavement was placed by E. J. and W. L. Cobb, Inc. (App. A-288); drainage, prepaving, and single surface treatment work were performed by Roane-Anderson. Total cost of these improvements was $11,234.18 (Apps. A-286, A-288, A-292, and A-303). Railroad construction costs are shown in Section 17.

SECTION 19 - SECURITY SYSTEM

19-1. General. - Because of the extreme importance of the project in the prosecution of the war, it was essential that there be established an extensive security system at the Clinton Engineer Works to protect the plants, their auxiliaries, and the resident population from enemy activity, internal disorder, and natural hazards. The security system of the Facilities and Service Division is organized as a part of the Department of Public Safety. The system embraces the functions, outside the restricted plant areas, relating to a guard service and general fire and police protection (See App. C-24).

19-2. Authorizations.

a. Statutory. - The President is authorized by law to provide, through appropriate Government agencies, "...for the procurement and training of civilian personnel necessary in connection with the protection of critical and essential items of equipment and the use or operation thereof." (App. A-203).

b. Executive Order. - The Secretary of War is authorized by an Executive Order "...to establish and maintain military guards and patrols, and to take other appropriate measures to protect from injury and destruction..." certain premises, materials, and utilities (App. A-204).

c. Directive of The Adjutant General. - The activation of the Auxiliary Military Police was ordered by a directive of The Adjutant General, dated 2 July 1942.

d. Public Proclamations. - A Public Proclamation, issued over the signature of the Commanding General, Southern Defense Command,

dated 25 March 1943, designated and established the CEW reservation as Total Exclusion Area No. 1 of the State of Tennessee and provided that the presence of any person on the reservation be by permission of the District Engineer and in accordance with conditions prescribed by him (App. A-205). The provisions of this proclamation were continued in force by subsequent proclamations issued by Headquarters Eastern Defense Command and Headquarters Seventh Army after responsibility for the overall defense of the region successively passed to these commands (App. A-195).

19-3. Guard and Police.

a. Development. - The guard and police forces at CEW date from 1 February 1943 when a unit, consisting of two persons, was established. The force, which soon came to be known as the CEW Guard Force, grew rapidly and by the end of the summer of 1943 reached a strength of 1000 men. During the summer the Guard Force was reorganized into five lettered Divisions, A to E, among them a unit also known as the Townsite Guard Department. Operating under control of an officer known first as the Plant Guard Officer (App. A-229), and later as the Chief Guard Officer (App. A-230), the Guard Force was responsible for guarding the industrial plants while they were under construction, handling vehicular traffic, and performing general police duty throughout the area. In September 1943, members of the Guard Force became members of the Auxiliary Military Police. The protective effectiveness of the Force was greatly increased by the acquisition of radio and other equipment and, in November 1943, by the organization of the Detective Bureau, the forerunner of the present Criminal Investigation Section. In April 1944 the Guard Force was reorganized into three Divisions, known as the Roane, Oak Ridge,

and Anderson Divisions, each responsible, as the designations indicated, to the Guard Officer for guard and police functions in prescribed geographical areas (App. A-152). The Guard Force, under this plan of organization, was also known as the Auxiliary Military Police, the Roane-Anderson Guard Force, and the Roane-Anderson Auxiliary Military Police (Apps. A-152, A-231 and A-232), a result of the fact that the guards were paid through Roane-Anderson Company. The Guard Force was a part of the general overall District intelligence and security organization, and this fact was formally recognized in the summer of 1944 (Apps. A-233 and A-234). A Military Police Detachment was acquired in July 1944 and was assigned to guard duty around prohibited zones (App. A-154) until June 1945, when the Detachment was assigned to perimeter protection of the area and the control of entrances to the reservation (App. A-155). The organization of the Guard Force on a three Division basis continued until 15 March 1945, when the Guard Force, then described officially as the Roane-Anderson Guard Department, was reorganized into an organization termed the CEW Security Force. The Security Force was formed into two "subdivisions", the CEW Police Department, and the CEW Protective Unit. The Police Department consisted of a Headquarters, an Oak Ridge Branch, a Wheat Branch, and a Traffic Division. The Protective Unit consisted of (1) the CEW Guard Department, itself divided into a Gate Section and an Installation Protection Section, and (2) the Military Police Detachment (App. A-153). In the spring of 1945, the police, guard, and Military Police forces were removed from the District Intelligence and Security Division and formed into the Security Branch of the District Facilities and Service Division (Apps. A-235 and A-236). The Security

Branch, in turn, was divided into Police, Fire, and Preventive Security Sections and the Review Board (App. A-236; also see Par. 19-5). The administrative organization was clarified on 11 July 1945 when the "CEW Security Force", as a part of the Security Branch, was reorganized into (1) the Guard Department, made up of (a) the Military Police Detachment, (b) the Auxiliary Military Police Detachment, and (c) Pass Control; (2) the Police Department, made up of (a) the Patrol Division, (b) the Traffic Division, and (c) the Criminal Investigation Section, the new name of the Detective Bureau; (3) a Service Section; (4) a Communications Section; (5) a Training Section; and (6) Plant Liaison (App. A-156). An Identification and Investigation unit was added as a major unit of the Security Branch in the fall of 1945; it was discontinued in the spring of 1946 (Apps. A-237 to A-241). In November 1945, the Military Police Detachment was separated from the Guard Department and, with the Guard and Police Departments, became one of the major security units at CEW. The Security Branch was further reorganized in December 1945 so as to combine police and guard administration in a Police and Guards Section (App. A-240). In February 1946 the Security Branch was renamed the Public Security Branch, and separate Police and Guard Sections were reestablished, along with the Military Police (App. A-241). In March 1946 the Public Security Branch was superseded by the Department of Public Safety, and the Police Department, the Guard Department, and the Military Police were reestablished as separate forces (App. A-242). In May 1946, a further reorganization established the Military Police Detachment and the Guard Detachment as separate units under a CEW Security Force; the Police Department remained outside the Security Force (App. A-243). In

July, a Pass and Identification Bureau was added as a third unit of the Security Force (App. A-244). On 12 June 1946, the function of providing watchman service for warehouses of Roane-Anderson Company containing Government-owned property was transferred from the company to the supervision of the Department of Public Safety. These watchmen, although not Auxiliary Military Policemen because their work did not involve project security, were made a part of the Guard Detachment (App. A-316).

b. Present Operation.

(1) Organization. - After 1 October 1946 and as of 31 December 1946, the CEW Security Force and the Police Department constituted two of the four major units of the Department of Public Safety; the other two were the Fire Department and the Safety Section. The CEW Security Force consists of (1) the Military Police Detachment, responsible for perimeter defense and special security details; (2) the Guard Detachment, which provides guard protection for vital installations and Government property outside the plant areas and operates an area visitor control system; and (3) a Pass and Identification Section, responsible for the issuance of passes and badges. The Police Department consists of (1) a Patrol Section, which provides police coverage of Oak Ridge; (2) a Traffic Section, which directs and controls traffic in Oak Ridge and on roads leading to plant areas, and investigates accidents; (3) the Criminal Investigation Section, which investigates violations of the law and area regulations; and (4) a Records and Service Section, which is concerned with records, communications, supply, and maintenance (App. C-24).

(2) Personnel, as of 31 December 1946 (App. A-316):

(a) CEW Security Force

(2) Personnel, as of 31 December 1946 (cont'd).

(a) CEW Security Force (cont'd).

(1)	Administration	2	
(2)	Military Police Detachment	217	
(3)	Guard Detachment (including Watchmen)	243	
(4)	Pass and Identification Section	4	
(b)	Police Department		153
(1)	Administration	2	
(2)	Patrol Section	52	
(3)	Criminal Investigation Section	13	
(4)	Traffic Section	42	
(5)	Records and Service Section	44	
	Total		619

(3) Facilities of Security Force and Police Department.

(a) Buildings.

(1) Police Headquarters (formerly Guard Headquarters, Bldg. No. 1705), Oak Ridge Turnpike and Bus Terminal Road (For cost, see Par. 19-3b (6)).

(2) Guard Headquarters, Robertsville and Raleigh Roads (For cost, see Par. 19-4e (7) (h)).

(3) Facilities of Security Force and Police Department (cont'd).

(a) Buildings (cont'd).

(3) Military Police Headquarters and Barracks, West Village (Cost included in dormitory construction cost; see Sec. 7).

(b) Automotive Equipment (App. A-316).

(1) 23 sedans, radio equipped.

(2) 11 sedans.

(3) Nine carry-alls.

(4) 10 trucks, pick-up.

(5) Four armored cars.

(6) Two weapons carriers.

(7) Eight command cars.

(8) Two wreckers.

(9) Two busses.

(10) Three 2½ ton trucks.

(11) Two station wagons.

(12) One panel truck.

(13) Two trailers.

(c) Radio Apparatus. - The Police Department maintains a central radio sending station and 15 substations.

(d) Weapons. - Weapons of the two forces consist of: pump action shotguns, 12 gauge, 53; Thompson .45 calibre submachine guns, 23; 37 mm tear gas guns, 14; revolvers, .38 calibre, 313; automatic pistols, .45 calibre, 10; revolvers, .45 calibre, 74; Reising .45

calibre submachine guns, 21; Harrington and Richardson Sportsman .22 calibre revolvers, eight; one machine gun, .30 calibre; machine guns, .50 calibre, six; U. S. Rifles, .30 calibre, M-1, 109; U. S. Rifles, .30 calibre, M1903, 12; and carbines, .32 calibre, 40 (App. A-316).

(4) Enforcement of Security Regulations. - The Security Force enforces the requirements as to persons entering, leaving, or remaining on the CWW Area. Briefly, the requirements are that no person over 12 years of age, whether employee, resident, or visitor, is permitted to enter, leave, or remain on the area without a pass, badge, or tag issued by authority of the District Engineer. A child of 12 years or less is the responsibility of an adult who possesses the requisite authority. All cars and persons entering and leaving the area are subject to search for contraband articles, which include firearms, other weapons, implements of war, explosives, and radio transmitters. When found, such articles are confiscated and are returned only by authorization granted by the Chief of the Department of Public Safety. Persons found possessing explosives and radio transmitters are held for investigation (App. A-158). However, most contraband articles may be brought into the area and retained if there is prior clearance and compliance with certain conditions (App. A-316).

(5) Relationship with Other Agencies. - In its relations with nearby civil enforcement officers, the Department of Public Safety follows a policy of friendly cooperation (See Par. 19-5). Also, close liaison is maintained with plant security forces.

(6) Construction Costs. - Construction costs, initially assignable to the guard and police system, are: the Guard Garage

(Bldg. No. 1707), $14,052.00 (Page 1280 of App. A-193); Gate Houses Nos. 1 and 2 (Bldgs. Nos. 1703-1 and 1703-2), $22,325.47 and $1,381.74, respectively (Page 1280 of App. A-193); Guard Headquarters, Middletown (Bldg. No. 1905-T-1), $6,700.79 (Page 1163 of App. A-193); the Pistol Range (Bldg. No. 1912-T-1), $7,723.24 (Page 1165 of App. A-193); Police Headquarters (Bldg. No. 1705), $69,757.20 (Page 1280 of App. A-193); and the new Police Radio Control Room, added in 1946, $9,094.00 (Apps. A-246 and A-306), a total of $131,034.44.

(7) Operational Costs. - Practically all guard and police personnel, except military, are paid through Roane-Anderson Company, whose estimated annual expenditures for salary payments, plus certain items of supply, are, for the Guard Detachment, including watchmen, $473,818.00, and, for the Police Department, $350,000.00 (App. A-245).

19-4. Fire Protection System.

a. General. - The fire protection system always has been operated as a major activity of the security system, comparable to the Guard Force, the Auxiliary Military Police, the Police Department, and the Guard Department, and has developed under the same overall administrative control as have the various police and guard units, as shown in Paragraph 19-3a. The fire protection service has, generally, been known as the Fire Department, although it, also, has been operated under other administrative titles, including "Fire Section" during two periods of time (See Apps. A-236 and A-240).

b. Initial Development. - The Fire Department was organized on 1 February 1943, under the direction of Chief H. H. Maples. Firemen were drawn from Government forces and those of Stone & Webster Engin-

eering Corporation. Headquarters was set up in a barn near Elza Gate. Organization of the first company, consisting of four men, a 500 gallons per minute pumper, and 1,500 feet of hose, was completed on 11 February. The first alarm was answered on 17 February (App. A-159). The first months of operation were occupied largely by training of personnel, planning for expansion, and recruiting of firemen. In May 1943, the Fire Department, which had grown to consist of two engine companies, was inspected by Mr. C. M. Johnson, Director of the Firefighting Service of the Office of Civilian Defense, who reported the training program to be so far advanced that the firemen were recommended to be passed to a status of regular Civil Service firemen upon completion of their basic training (App. A-160). Also in May, Fire Headquarters was moved from Elza Gate to Terminal Road, where it remained until September 1943 when it was moved to its present location in the Town Center.

c. Expansion. - The Fire Department expanded with CEW, providing protection for the town and the plant areas under construction. In the face of such conditions as a shortage of fire fighters, roads whose state of repair hampered the movement of apparatus, construction which expanded more rapidly than mains and hydrants could be installed, and the usual hazards attendant on construction, the Department succeeded in preventing the development of single major fire during the construction period. Fire stations were established in the industrial areas as follows: Clinton Laboratories Area, 12 March 1943; the Electromagnetic Plant Area, 13 March 1943; and the Diffusion Plant Area, 29 July 1943. The personnel of the Fire Department was transferred to Roane-Anderson in December 1943, although direction was retained by the Dis-

trict security officers. The growth of the residential areas in 1943 and 1944, particularly trailer camps and hutments, required the activation of additional residential fire companies, each consisting of one engine manned, at that time, by five to eight men, the exact number contingent upon the type of equipment and the area of responsibility assigned a company. The Fire Prevention Bureau was established in May 1944, and fire prevention rules and regulations were adopted as a guide to good fire prevention practices (App. A-157).

d. Decentralization. - As the industrial plant areas developed to a point at which they could assume fire protection service within their own areas, the industrial areas were detached from the jurisdiction of the Oak Ridge Fire Department. Fire protection was assumed by the plant operators in the Clinton Laboratories Area and the Electromagnetic Plant Area in November 1943 and in the Diffusion Plant Area in August 1944. The detachment of these areas brought about mutual-aid agreements whereby each firefighting service at CEW is required to reinforce another service if required. The Oak Ridge Fire Department is the principal reinforcement for the industrial areas.

e. Present Operation.

(1) Organization. - The Oak Ridge Fire Department, under the immediate direction of the Fire Commissioner and the general direction of the Chief of the Department of Public Safety, is organized into (1) the Fire Prevention Section, which conducts inspections and services fire extinguishers; (2) the Service and Records Section, responsible for supply, maintenance, and records keeping; and (3) the Fire Protection Section, which is responsible for actual firefighting. The

Fire Protection Section consists of two battalions, (1) the Oak Ridge Unit, consisting of 10 companies, and (2) the West Oak Ridge Unit, consisting of two companies. Each company has two platoons. The 10 fire companies in Oak Ridge are strategically placed in relation to commercial and thickly populated residential areas. The fire stations (See App. D-30; also see Par. 19-4e (7)), some of them housing two companies, are so located that no part of the town is more than a mile and a quarter from a fire company. The company is the basic unit of the Fire Department. Companies are now manned, dependent upon type of apparatus, as follows: seven men on a 750 gpm pumper in the strategic area, five men on a 500 gpm pumper, and three men on a brush truck, as recommended for municipalities by the National Board of Fire Underwriters.

(2) Operational Procedures. - Two companies respond to a call from the residential section and at least three companies respond to a call from a highly congested area. To date, the most serious fire was brought under control by five fire companies, allowing the remaining companies to be in readiness for other alarms. From reservoirs high on Black Oak Ridge (App. B-9) water is distributed at adequate pressure to all sections of the town. Hydrants are so located that there are at least two within a short distance of every residential building and three or more available to every major building. Hydrants and water pressure are checked regularly. An emergency telephone alarm system extending throughout the area facilitates the prompt reporting of fires. There are two hundred and twenty telephones in weather-proof boxes throughout the town, and are so distributed that no building is farther than 500 feet from a means of communication with the Fire Department. Telephones are directly

connected with the Fire Department dispatcher.

(3) Fire Prevention Practices. - Emphasis is placed on fire prevention. The light construction and all-wood buildings make the control of fire difficult, once headway is gained. An intensive fire protection program is considered essential in preventing major fire losses. The Fire Prevention Section's inspectors make weekly inspections of all mercantile establishments, warehouses, office buildings, dormitories, shops, and places of public assembly, in fact all buildings, exclusive of dwellings, huts, and trailers. In addition to the discovery and correction of fire hazards, the Fire Prevention Section provides and maintains fire extinguishers in all buildings subject to inspection. A fire prevention code similar to that in force in large cities throughout the country has been adopted for Oak Ridge. It sets forth a general policy for good fire prevention practices and is closely followed by the merchants, contractors, and residents of Oak Ridge.

(4) Operational Data. - There is an average of less than two fires every 24 hours, but generally fires have been discovered early and extinguished quickly with little or no loss, although there have been a few major fires (App. A-316). On the night of 11 October 1944, a fire of undetermined origin broke out in the basement of a grocery store in Jackson Square (App. A-161). Five engine companies used over 200,000 gallons of water in three hours to prevent the fire from spreading and then to bring it under control. The total loss exceeded $50,000. A spectacular fire, believed to have been caused by a discarded cigarette, occurred on the night of 21 January 1945 (App. A-162) and destroyed an entire wing of a large dormitory on North Jefferson Circle,

with a loss of approximately $60,000. Relatively few fires have occurred in residences, and losses in this group have been small. For the first full reporting year of 1944, 909 fire alarms were answered (App. A-163). The total estimated loss sustained was $171,147.60 or a loss per fire of $188.28, an unusually low figure. There were 12.7 alarms per 1,000 residents per annum, an unusually high figure, indicating that Oak Ridge had a large number of fires per capita per annum but sustained a low loss per fire. The per capita loss was estimated to be $2.37, compared with the per capita losses in the older cities of Chattanooga, $2.22; Memphis, $4.11; and Nashville, $3.00. In 1945, 1,075 alarms were answered with a total estimated loss of $176,669, although $116,167 of this loss occurred during January and February, and a loss per fire of $164.34 (App. A-164). There were 16.17 fire alarms per 1,000 inhabitants and a per capita loss of $2.66 (App. A-165). The per capita loss of $2.66 in 1945 may be compared with four and five year averages in other cities in Tennessee: Chattanooga, $2.14; Jackson, $3.21; Johnson City, $2.01; Memphis, $2.29; and Nashville, $3.16 (App. A-166). During 1946, there were 632 runs made; of these, 520 involved actual fires. The per capita fire loss was $0.58. The Tennessee Inspection Bureau inspected the fire protection facilities at Oak Ridge in November 1944 and graded the town 4th Class. As a result of this grade, fire insurance rates were reduced approximately 15 percent, and the contents of dwellings in Oak Ridge now are insured at the same fire insurance rates as the contents of similar dwellings in Chattanooga, Knoxville, and Nashville. The contents of mercantile establishments in Oak Ridge are insured at slightly higher rates than in the other cities mentioned. Considering the fact that the mercantile

sections of these cities consist primarily of fire resistant buildings of brick, steel, and concrete construction, Oak Ridge may be said to compare favorably. Although the dwellings and other buildings in Oak Ridge, being Government-owned, are not insured against fire, it appears that, if they were insured, the rates would follow the pattern of the rates established for their contents. An inspection was made in October 1946 by the National Board of Fire Underwriters. The results of this inspection were to be used in 1947 as a basis for further improvements in the fire protection and prevention systems (App. A-316).

(5) Operational Costs. - The bulk of the Fire Department personnel is paid through Roane-Anderson Company. The estimated annual cost for salaries, plus some items of supply, is $510,000 (App. A-245).

(6) Personnel, as of 31 December 1946 (App. A-316).

(a)	Headquarters		1
(b)	Fire Prevention Inspection Section		14
(c)	Service and Records Section		11
(d)	Fire Protection Service		146
	(1) Headquarters	2	
	(2) Oak Ridge Unit	124	
	(3) West Oak Ridge Unit	20	
	Total		172

(7) Fire Station Locations and Costs.

(a) Town Center, including Fire Headquarters and Companies No. 1 and No. 2; part of Building No. 1850-T (Cost is shown in App. G-11).

(7) Fire Station Locations and Costs (cont'd).

(b) New York and Utah Avenues, Fire Company No. 11. Cost is included in total cost of New York Stores (See App. C-5, Bldg. No. 1826-T).

(c) East Village, Fire Company No. 4, Anna and Atlanta Streets. Cost is included in total cost of Arkansas Stores (See App. C-5, Bldg. No. 1829-T).

(d) Ogden Lane and Outer Drive, Fire Company No. 12. Cost is included in that of Ogden Stores (See App. C-5, Bldg. No. 1827-T).

(e) Gamble Valley, Fire Company No. 9. Cost: $10,422.30 (Page 1140 of App. A-193).

(f) Trailer Camp No. 1, Building No. 1872-T-3, now closed. Cost: $5,103.91 (Page 1111 of App. A-193).

(g) Elm Grove, Tennessee Avenue and Tacoma Road (now closed). Cost is included in that of Elm Grove Stores (See App. C-5, Bldg. No. 1828-T).

(h) Grove Center, Fire Company No. 10, Building No. RA-1872-T-1. Cost: $38,338.37, including that of Grove Center Police Station and Guard Headquarters (Page 1110 of App. A-193).

(i) Jefferson Circle, Fire Companies 5 and 6. Cost is included in total cost of Jefferson Store Group (See App. C-5, Bldg. No. 1870-T).

(j) Firemen's Training School, in the town area, Building No. 1710, formerly Fire Department Headquarters. Cost: $27,899.40 (Page 1280 of App. A-193).

(7) Fire Station Locations and Costs (cont'd).

(k) West Oak Ridge.

(1) Wheat Village (now closed).

(2) Power House, Fire Companies No. 7 and No. 8.

(3) Both fire stations in the Diffusion Plant Area, while under the jurisdiction of the Oak Ridge Fire Department, were built by J. A. Jones Construction Company under its general contract. Costs are not available.

(l) Total Costs. - Total available cost of fire stations built as separate features was $81,763.98 (See Apps. C-5 and C-11 for costs of buildings of which fire stations are incidental features).

19-5. Review Board and the Punishment of Crime.

a. General. - As the population of Oak Ridge increased, it became impracticable for the Guard Force and Detective Bureau to process, and refer to the civil authorities, all offenses against the law and to dispose of all violations of regulations peculiar to the area. Consequently, a Review Board, consisting of commissioned military personnel, was established under the supervision of the Security and Intelligence Division, on 24 July 1944, to dispose of alleged violations of area regulations. Also, the Review Board became the intermediary, between the District security forces and civil authorities, with respect to persons committing offenses against the law on the area, and, by agreement and

consent of the civil authorities of Roane and Anderson Counties, the agency which screened the charges of such violations and referred cases to appropriate civil authorities concerned if charges appeared justified.

b. Development. - When first set up, the Review Board consisted of two lieutenants who maintained regular office hours and, further, were on call at all times. These two officers were assisted by two civilian stenographers. The Review Board offices at that time consisted merely of a railed inclosure on the second floor of Town Hall, but as the number of cases handled by the Review Board increased, it expanded both as to its personnel and physical facilities. In August 1944, a third officer, another lieutenant, was added to the staff. Later, because of the large percentage of cases involving juvenile delinquencies, it became necessary to add a Juvenile Department under the supervision of yet another lieutenant whose civilian experience and training especially suited him for that type of work; this was done on 1 January 1945. In September 1945, the Review Board was moved to Police Headquarters. In April 1946, it was decided to modify the organization of the Review Board, as the principal purpose for which the Board was originally organized had disappeared. This purpose was to relieve the regular guard personnel of the responsibility of disposing of cases in accordance with legal and project considerations. With the rapid progress of the Oak Ridge Police Department, which had been organized in March 1945, it was found feasible to permit ranking police officials to review cases before disposition was made, and thereby permitting the reduction of the membership of the Board to one individual, a civilian, with the title of Law Advisor. The Law Advisor was made responsible for the establishment of policies and for

seeing to the proper administration of such policies by police officials. In some types of cases, the Law Advisor was authorized to continue to administer dispositions directly. The election of justices of the peace, in August 1946, further relieved police officials and the Law Advisor of other duties in connection with the disposition of police cases. The Law Advisor's office continued to be the principal liaison with the State's District Attorney-General and the justices of the peace (App. A-316). During December 1946, the police officials and the Law Advisor reviewed 292 traffic cases and 160 cases of other types (See App. C-12 for number of cases reviewed each month between April 1945 and December 1946).

c. Courses of Action. - In hearing charges, the Review Board has not, either before or after the reorganization of April 1946, undertaken to act as a judicial body passing on the merits of cases, but merely as an agent of the District Engineer in clearing, from the restricted military area to the proper civilian authorities, persons violating the law within the limits of CEW. The Board has no power to impose fines, but effective courses are open. In an individual case the Board may: (1) refer the case to the proper civil authorities for appropriate action; (2) refer the case to proper area authorities for administrative action, including termination, if desirable; (3) revoke the accused's right to drive on the reservation for an appropriate period, in case of a traffic violation; (4) release the accused with a reprimand when only a technical and minor violation is involved; or (5) dismiss the charge when no probability of a violation is established.

d. Present System.

(1) Procedure. - Under the system established by the

reorganization of April 1946, the Law Advisor establishes broad rules for the guidance of the Reviewing Officers who, under the system, are ranking police officers. The rules of procedure adopted provide that when an arrested person is brought to Police Headquarters, the police lieutenant in charge of the shift acquaints himself with the facts in the case. If the lieutenant, after consulting with the arresting officer, feels that the offense is minor in nature, or possibly not in violation of State law, or that the case of the arresting officer is weak, he may order the arrested person released. If, however, the lieutenant feels that the case should be referred to the civil authorities, the arrested person is taken before the senior criminal investigator on duty by the arresting officer. There, in an informal hearing, the arresting officer presents his case, the accused person is allowed to make any statements he wishes, and any witnesses are heard. If the senior criminal investigator, who is also a county deputy sheriff, feels there has been an offense and that the evidence reasonably points to the accused as the offender, he orders the case referred to the proper civil authorities of the county in which the offense occurred (App. A-316), these authorities being, in the instance of Anderson County, either of the justices of the peace sitting at Oak Ridge.

(2) Purpose. - The system is designed to minimize the possibility of referring to the civil authorities any case not supportable on the evidence, as the reference of a police case to the county authorities requires the concurrence of two responsible police officials; dissent by either prevents an arrested person from being turned over to the county authorities. Should an arrested person be released erroneous-

ly, he may be rearrested after the issuance of a warrant. All cases are reviewed daily by the Law Advisor to determine adherence to policy and legality of actions taken. Traffic citations are handled by the office of the Law Advisor and under his immediate supervision (App. A-316).

(3) Juvenile Department. - On 1 July 1946, the Juvenile Department, theretofore, a unit of the Review Board, was transferred to the Department of Public Welfare of the Facilities and Service Division, but its connection with the Police Department remained generally the same. Juvenile cases (cases involving principals under the age of 17) originating with a police arrest are referred to the Juvenile Department for investigation, disposition, and, in the Juvenile Department's discretion, prosecution (App. A-316).

(4) Justices of the Peace. - On 1 September 1946, the two justices of the peace, elected in August by the voters of the civil districts of Anderson County in which Oak Ridge is located, took office. The filling of these offices made little material difference in the operation of the Review Board, and cases continued to be heard and disposed of as described above, except that after 1 September cases requiring prosecution and arising in Anderson County were referred to the justices by the Review Board instead of turning the accused in such cases over to the sheriff. If the justice of the peace hearing a case possesses jurisdiction to dispose of the case, he does so, without jailing the accused, unless the accused pleads "not guilty" or cannot pay his fine, if any. In a case beyond the jurisdiction of the justices of the peace, or one in which the accused pleads "not guilty", the accused is bound to the Circuit Court by the justice so that bond can be made or

the accused retained in jail (App. A-316).

(5) Relationship with Other Agencies. - The Law Advisor is in frequent communication with the sheriffs and judicial officers of the two counties - Roane and Anderson - in whose boundaries CEW is included. Liaison with the Federal Bureau of Investigation, the United States District Attorney, and other Federal law-enforcement agencies and officers is maintained through the Chief of the Department of Public Safety.

19-6. Other Safety and Protective Activities.

a. Organization. - Prior to March 1946, the CEW Safety Branch performed certain fire prevention activities, traffic engineering, and the licensing of Government-owned vehicles, functions which were closely allied to police and fire-protective activities, but which were carried on separately and apart from other fire and police activities. When the Department of Public Safety was created in March 1946 (See Par. 19-3a), it absorbed not only the functions of the Public Security Branch, but also those of the old CEW Safety Branch. These functions were lodged in the Department's Safety Section. The units of the Safety Section are indicative of the Section's responsibilities. They are: the Accident Investigation Subsection, the Community Safety Subsection, the Occupational Safety Subsection, the Traffic Engineering Subsection, the Driver Training and Testing and Subsection, and the Fire Engineering and Education Subsection (Apps. A-242, A-243, A-316, and C-24).

b. Development. - The functions of the CEW Safety Branch, which were taken over almost intact by the Safety Section, were continued without major change until the addition of the Fire Engineering and Edu-

cation Subsection in October 1946. Also, public safety lane inspection by the Community Safety Subsection was added in December 1946. At the end of 1946, the Safety Section's personnel consisted of six safety engineers, 10 safety inspectors, seven clerks, and one investigator (App. A-316).

c. Present Operations. - The Safety Section provides the principal technical advice to the Chief of the Department of Public Safety, organizes safety programs, and performs inspections of facilities to determine that the safety programs are carried to a successful conclusion. School safety programs are carried forward in the schools. Accidents in occupations, homes, streets, and elsewhere are investigated and analyzed with a view to minimizing repetition. Long range fire prevention plans are made and public education in fire prevention and other safety practices are carried out (App. A-316). The success of the safety programs is most dramatically illustrated by the fact that there was not one traffic fatality during 1946 in Oak Ridge, and none in the entire CEW area after 3 April.

MANHATTAN DISTRICT HISTORY

BOOK I - GENERAL

VOLUME 12 - CLINTON ENGINEER WORKS, CENTRAL FACILITIES

INDEX

INDEX

Abbreviations

App. = Appendix
Co. = Company
Corp. = Corporation
U. S. = United States