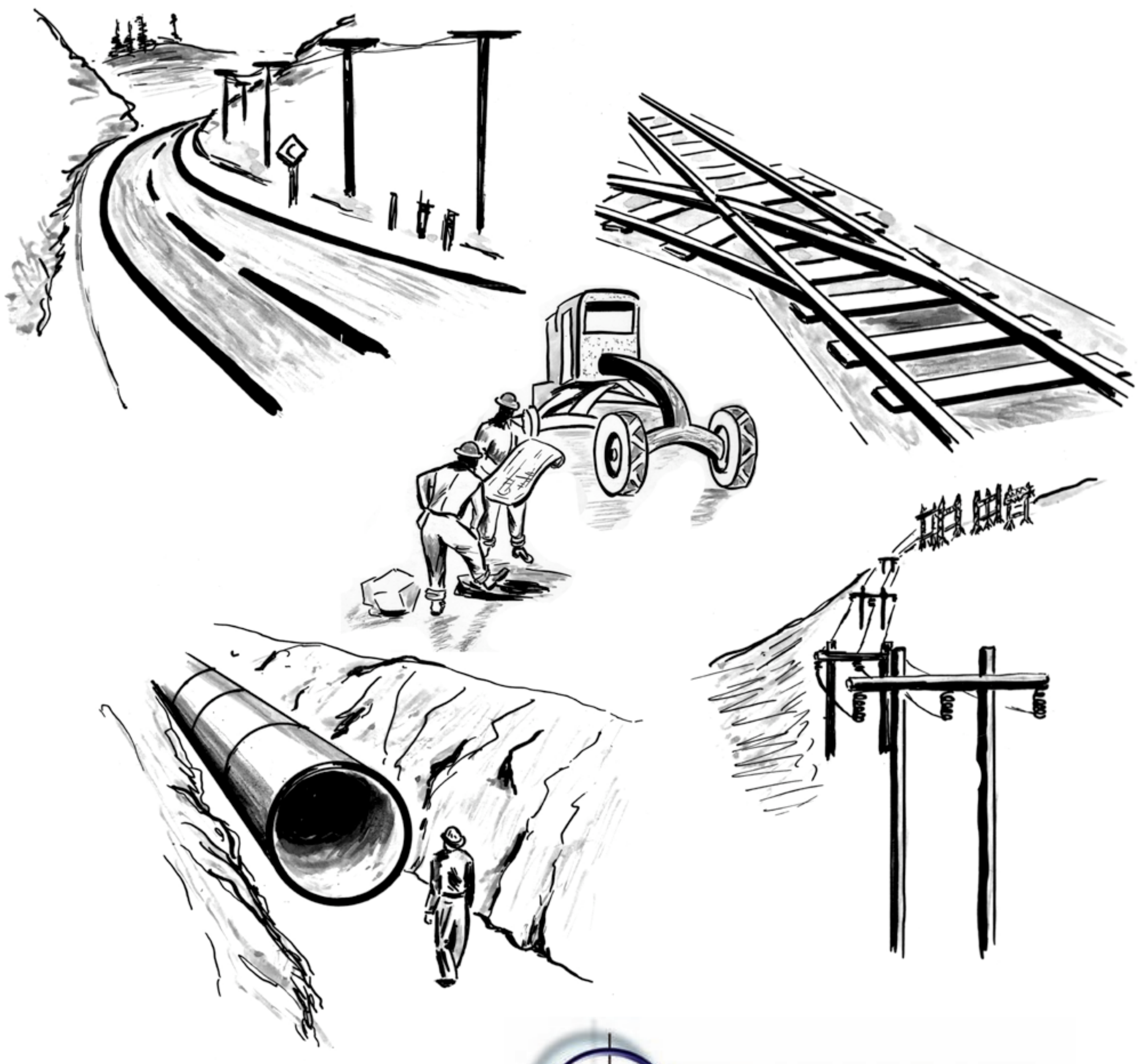
You Can't Run a Reactor If You Can't Get To It:

A Study of Savannah River Site's Infrastructure

Aiken, Barnwell and Allendale Counties, South Carolina



NEW SOUTH ASSOCIATES
PROVIDING PERSPECTIVES ON THE PAST

SAVANNAH RIVER SITE COLD WAR HISTORIC PROPERTY DOCUMENTATION

NARRATIVE AND PHOTOGRAPHY

YOU CAN'T RUN A REACTOR IF YOU CAN'T GET TO IT:

A STUDY OF SAVANNAH RIVER SITE'S INFRASTRUCTURE

Aiken, Barnwell and Allendale Counties, South Carolina

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September 30, 2010 • Final Report

New South Associates Technical Report 1793

ABSTRACT

This documentation was prepared following the Consolidated Memorandum of Agreement (MOA) signed by the Department of Energy-Savannah River (DOE-SR) and the South Carolina State Historic Preservation Office (SHPO) in August 2004 in response to the proposed deactivation and decommissioning (D&D) of infrastructure-related historic properties. While the Consolidated MOA ws the catalyst for the study, a Cultural Resource Management Plan (CRMP) was later developed in 2004 that more fully defined how documentation studies were to be completed at the Site. Since 2004, other infrastructure-related historic properties have undergone D&D with SHPO concurrence. These actions precipitated the development of an infrastructure thematic study using a systems approach to describe and document the related property types that are considered eligible for listing in the National Register of Historic Places (NRHP). This documentation is based on field analysis, oral history, primary documentation, and research. New South Associates completed the research, prepared the narrative, and compiled the documentation, while Savannah River Nuclear Solutions (SRNS) completed the photographic documentation.

ACKNOWLEDGMENTS

Just as infrastructure covers a wide range of activities within the Savannah River Site, there are a wide range of people who need to be thanked for their contribution to this project. First and foremost would have to be the various people who work at Savannah River Site and whose knowledge of the Site and its history helped make it possible. Paul Sauerborn of SRNS Public Affairs, our technical contact at the site, has helped coordinate our work there from the beginning of the project. This project and report would not have been possible without his input. Denny Vanover of Document Control provided access to the engineering drawings and maps pertinent to the project. Scott Youell and Bill Cherry of Site Development Control provided maps and other information on the military sites constructed in the 1950s, most of which are now abandoned. A tour of the former military site Number 92, currently used by the Forest Service, was arranged by Robert Moon. The SRS Archives were made available by Carmen Hall and Maxine White, who are always willing to look for materials that no one has called up in years.

A number of SRS employees provided insights to the problems of infrastructure during our tours of the facilities. George Bell, an E and I Mechanic, was helpful at 681-3G, while Ken Blankenship, a construction engineer, provided considerable assistance in deciphering the electrical transmission system used at Savannah River Site. Mark Collins was our guide and companion during the tour of the various site powerhouses, where we discovered a pleasing array of home-made barbecue grills. There was not a single powerhouse without an outdoor grill of some kind hidden away behind the boilers.

Absolutely essential to the success of this project was the contribution made by SRS Photography. This effort was coordinated by Tom Kotti, with Steve Ashe and Byron Williams serving in the field as our photographers. All of the field photography work was processed by both Steve Ashe and Byron Williams. SRS Photography is also the archives for most of the early SRS photographs. We were allowed to go through these photographs to make selections that were then used in this report. These negatives were scanned and processed by Bruce Boulineau and Steve Ashe.

At the office of New South Associates, a number of people have to be thanked for their contributions. Mary Beth Reed coordinated and directed the project, and it would never have come together without her assistance. Caroline Bradford, the New South artifact curator at SRS, provided valuable information and a number of rare reports. Everyone in Graphics and Production, particularly Lis Cap and Jennifer Wilson, need to be acknowledged for their part in making this report presentable. Terri Gillett helped to assemble the documentation appendix.

The 12 people interviewed for this project provided valuable information on the early development of the SRS infrastructure, whether it was initial surveys, roads, power, or water facilities. These 12 individuals were: Dan T. Bates, Raymond R. Black, Patrick B. Harris, Bud Hartwell, William D. Hinson, Charles

Hober, John T. Kephart, Henry R. Main, Joe C. Pendleton, George R. Shealy, Robert R. Smith, and Marvin W. Tarpley. Mr. Shepherd Archie, head of Traffic and Transportation, was interviewed earlier for the Site's anniversary history; this rich narrative is also included here. It remains one of the best oral histories we have collected at SRS. Each of these individuals enriched the program in ways that were not always expected. They participated in one of the largest construction programs of the Cold War, and for many, their story has never before been told. All were justly proud of their contribution to the Savannah River project and to their role in our nation's defense.

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APPENDIX B: PLANS, DRAWINGS, AND DOCUMENTATION PHOTOGRAPHY

ACRONYM LIST

ACHP	ADVISORY COUNCIL ON HISTORIC PRESERVATION
ACL	ATLANTIC COAST LINE RAILROAD
ACSR	ALUMINUM CABLE, STEEL-REINFORCED
AMCP	ASSISTANT MANAGER FOR CLOSURE PROJECTS
AM&F	AMERICAN MACHINE AND FOUNDRY
AEC	ATOMIC ENERGY COMMISSION
AEC SROO	ATOMIC ENERGY COMMISSION SAVANNAH RIVER OPERATIONS OFFICE
AED	ATOMIC ENERGY DIVISION – DU PONT COMPANY
AOE	ASSESSMENT OF EFFECT
CAB	SAVANNAH RIVER SITE CITIZEN'S ADVISORY BOARD
CERCLA	COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT
CFR	CODE OF FEDERAL REGULATIONS
CNTA	CITIZENS FOR NUCLEAR TECHNOLOGY AWARENESS
COE	U. S. ARMY CORPS OF ENGINEERS
CRM	CULTURAL RESOURCE MANAGEMENT
CRMP	CULTURAL RESOURCE MANAGEMENT PLAN
CSRA	CENTRAL SAVANNAH RIVER AREA
C&WC	CHARLESTON AND WESTERN CAROLINA RAILROAD
DECP	DECOMMISSIONING PROJECT (DOE-SR)
D&D	DEACTIVATION AND DECOMMISSIONING
DOD	DEPARTMENT OF DEFENSE
DOE	U. S. DEPARTMENT OF ENERGY
DOE	DETERMINATION OF ELIGIBILITY
DOE FPO	U. S. DEPARTMENT OF ENERGY FEDERAL PRESERVATION OFFICER
DOE-SR	U. S. DEPARTMENT OF ENERGY SAVANNAH RIVER
DWPF	DEFENSE WASTE PROCESSING FACILITY
ECS	EMERGENCY COOLING SYSTEMS
EM	ENVIRONMENTAL MANAGEMENT
EOC	EMERGENCY OPERATIONS CENTER – SRS
EPA	U. S. ENVIRONMENTAL PROTECTION AGENCY
ERDA	ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
FFA	FEDERAL FACILITIES AGREEMENT
FRA	FEDERAL RECORDS ACT
GPM	GALLONS PER MINUTE
GS	GIRDLER SYSTEM
HABS	HISTORIC AMERICAN BUILDINGS SURVEY
HAER	HISTORIC AMERICAN ENGINEERING RECORD
HWCTR	HEAVY WATER COMPONENTS TEST REACTOR
INL	IDAHO NATIONAL LABORATORY
IRM	INFORMATION RESOURCE MANAGEMENT DEPARTMENT - SRS
JCAE	JOINT COMMITTEE ON ATOMIC ENERGY
KV	KILOVOLT
KVA	KILOVOLT AMPERE
KW	KILOWATT
LANL	LOS ALAMOS NATIONAL LABORATORY
LTBT	LIMITED TEST BAN TREATY
LTR	LATTICE TEST REACTOR

MCM	THOUSAND CIRCULAR MILS (CABLE SIZE)
MED	MANHATTAN ENGINEERING DISTRICT
MOA	MEMORANDUM OF AGREEMENT
MPPF	MULTI-PURPOSE PROCESSING FACILITY
MVA	MEGAVOLT AMPERE
NARA	NATIONAL ARCHIVES RECORDS ADMINISTRATION
NASA	NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
NEPA	NATIONAL ENVIRONMENTAL POLICY ACT
NHL	NATIONAL HISTORIC LANDMARK
NHPA	NATIONAL HISTORIC PRESERVATION ACT
NNSA	U. S. DEPARTMENT OF ENERGY NATIONAL NUCLEAR SECURITY ADMINISTRATION
NPS	NATIONAL PARK SERVICE
NPT	NON-PROLIFERATION TREATY
NRC	NUCLEAR REGULATORY COMMISSION
NRHP	NATIONAL REGISTER OF HISTORIC PLACES
NTG	NEUTRON TEST GAGE
NURE	NATIONAL URANIUM RESOURCES EVALUATION
NYX	NEW YORK SHIPBUILDING COMPANY
ORA	OPERATIONS RECREATION ASSOCIATION
ORNL	OAK RIDGE NATIONAL LABORATORY
PA	PROGRAMMATIC AGREEMENT
PDP	PROCESS DEVELOPMENT PILE
PSE	PRESSURIZED SUB-CRITICAL EXPERIMENT
PSIG	POUNDS PER SQUARE INCH GAUGE
RBOF	RECEIVING BASIN FOR OFFSITE FUEL
RTR	RESONANCE TEST REACTOR
SALT	STRATEGIC ARMS LIMITATION TREATY
SCDAH	SOUTH CAROLINA DEPARTMENT OF ARCHIVES AND HISTORY
SCDHEC	SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL
SCE&G	SOUTH CAROLINA ELECTRIC AND GAS
SCIAA	SOUTH CAROLINA INSTITUTE OF ARCHAEOLOGY AND ANTHROPOLOGY
SDI	STRATEGIC DEFENSE INITIATIVE
SE	SUB-CRITICAL EXPERIMENT (EXPONENTIAL TANK)
SHPO	STATE HISTORIC PRESERVATION OFFICE/OFFICER
SHRINE	SAVANNAH RIVER INFORMATION NETWORK ENVIRONMENT
SP	STANDARD PILE
SRARP	SAVANNAH RIVER ARCHAEOLOGICAL RESEARCH PROGRAM
SRI	SAVANNAH RIVER NATURAL RESOURCE MANAGEMENT AND RESEARCH INSTITUTE
SRL	SAVANNAH RIVER LABORATORY
SREL	SAVANNAH RIVER ECOLOGY LABORATORY
SRNL	SAVANNAH RIVER NATIONAL LABORATORY
SROO	SAVANNAH RIVER OPERATIONS OFFICE
SRP	SAVANNAH RIVER PLANT
SRNS	SAVANNAH RIVER NUCLEAR SOLUTIONS
SRS	SAVANNAH RIVER SITE
SRSO	U. S. DEPARTMENT OF ENERGY-SAVANNAH RIVER SITE OFFICE
SRSOC	SAVANNAH RIVER SITE OPERATIONS CENTER
SRTC	SAVANNAH RIVER TECHNOLOGY CENTER
STI	SCIENTIFIC AND TECHNOLOGICAL INFORMATION
TC	TEMPORARY CONSTRUCTION
TCAP	THERMAL CYCLING ABSORPTION PROCESS
TRAC	TRACKING ATMOSPHERIC RADIOACTIVE CONTAMINANTS
T&T	TRAFFIC AND TRANSPORTATION
TTBT	THRESHOLD TEST BAN TREATY
UCNI	UNCLASSIFIED CONTROLLED NUCLEAR INFORMATION
UGA	UNIVERSITY OF GEORGIA
USC	UNIVERSITY OF SOUTH CAROLINA
USFS	U. S. FOREST SERVICE

USGS	UNITED STATES GEOLOGICAL SURVEY
USH	UNIVERSAL SLEEVE HOUSING
V	VOLT
VWF&S	VOORHEES, WALKER, FOLEY AND SMITH
W	WATT
WIND	WEATHER INFORMATION AND DISPLAY SYSTEM
WSRC	WESTINGHOUSE SAVANNAH RIVER COMPANY

I. INTRODUCTION

Between 1950 and 1955, a rural agricultural landscape along the Savannah River was transformed into a Cold War industrial complex that produced plutonium and tritium for the nation's nuclear arsenal. Savannah River Site (SRS), known as the Savannah River Plant (SRP) prior to 1989, produced plutonium and tritium for use in the manufacture of nuclear and thermonuclear weapons from its inception throughout the course of the Cold War. Du Pont, functioning as prime contractor for the Atomic Energy Commission (AEC), constructed the facilities that would carry out this production mission.

Many of the individuals engaged in this transformation had strong experience in large-scale construction projects, having participated previously in the Civilian Conservation Corps, the U.S. Corps of Engineers, and the Manhattan Project. They brought this experience to the Savannah River Project, designing a plant-wide infrastructure within the 312-square mile South Carolina site that could be likened to a city in its scale and scope. A testament to functional utilitarian design, the plant's many networks – transportation, energy, water, waste - were established to facilitate the plant's successful production of nuclear materials for our nation's defense during the Cold War. While these facilities and structures typically are cast in a supporting role, they underpinned the success of the entire plant's operation. Former Transportation Department Supervisor Shepherd Archie summed up the importance of the plant's roads and utilities, succinctly noting in an oral history interview: "you can't run a reactor if you can't get to it."

For this reason, infrastructure-related properties are considered to be historically significant for the role they played at the Cold War plant. Given their significance, the Department of Energy Savannah River (DOE-SR) conducted a site-wide thematic study of infrastructure-associated properties using a network organizational framework, i.e., transportation-related properties, power-related properties, communication-related facilities, etc. This approach grouped the disparate resource types functionally and allowed a more useful systemic approach. While there are relatively few building types (less than 10), they are located site-wide and are part of the Site's support systems. Thus, the study treats companion and connecting structures/features such as roads, bridges, rail beds, rolling stock, fencing, outdoor lighting, steam piping, the burial ground, and other facilities, as part of the historic Cold War built environment of the Site. The functional character of the Site's infrastructure contributes greatly to the site's overall appearance. This study looks at this distinctive industrial landscape and discusses how these facilities and their connecting roads, rails and utilities unified the site.

This documentation was prepared following the Consolidated Memorandum of Agreement (MOA) signed by the Department of Energy-Savannah River (DOE-SR) and the South Carolina Historic Preservation Office (SHPO) in August 2004 in response to the proposed deactivation and decommissioning (D&D) of infrastructure-related historic properties. While the Consolidated MOA was the catalyst for the study, *Savannah River Site's Cold War Built Environment Cultural Resource Management Plan* (CRMP) was developed later, and signed by the Department of Energy-Savannah River (DOE-SR), the South Carolina State Historic Preservation Office (SHPO), as well as other consulting parties. The CRMP more fully defined how documentation studies were to be completed at the Site, stipulating that thematic studies be undertaken as a thorough yet cost effective manner of documenting a complex number of processes and topics involved in the history of SRP. As noted, the impetus for these thematic studies was the imminent deactivation and decommissioning (D & D) of the majority of those historic properties found to be eligible for the National Register of Historic Places (NRHP) as contributing resources to a Cold War Historic District. In addition, some of the infrastructure-related facilities that were considered eligible have undergone D&D with SHPO concurrence since 2004. These actions precipitated the development of an infrastructure thematic study to describe and document the related historic properties that are considered eligible for listing in the NRHP. The resulting narrative is based on oral history, primary documentation and research. New South Associates prepared the narrative and Savannah River Nuclear Solutions (SRNS) completed the photographic documentation.

SRS COLD WAR HISTORIC DISTRICT AND ITS SIGNIFICANCE

SRS is located on 198,344 acres in Aiken, Barnwell, and Allendale counties of South Carolina. The Savannah River is its western border. The rural site comprises roughly one percent of the state of South Carolina and contains approximately 310 square miles within the upper coastal plain of the state. Historically, the area that became the site was mostly agricultural and its current physical setting remains fairly rural. The county seat of Aiken County, the city of Aiken, lies 12 miles to the north; the Augusta, Georgia metropolitan area lies 15 miles to the northwest. The cities of Jackson and New Ellenton are located on the site's northern perimeter. SRS is considered part of the 18-county Central Savannah River Area (CSRA), adjoining the Savannah River in both South Carolina and Georgia.

SRS is an exceptionally important historic resource containing information about our nation's twentieth-century Cold War history. It contains a well-preserved group of buildings and structures placed within a carefully defined site plan that is historically linked, sharing a common design and aesthetic. The Site layout, predicated on environmental safety best practice in 1950 and a functional industrial approach, is intact. The site, its buildings, structures, and its layout, constitute a unique cultural landscape that possesses historical significance on a national, state and local level in the areas of engineering, military, industry, and social history. The Site is directly associated with the Cold War, a defining national historical event of the twentieth century that lasted over four decades. This association satisfies National Register Criteria A, or the association of a property with events that have made a significant contribution to the broad patterns of our history. The site's process and research facilities were also used to further research in pursuit of peaceful uses of atomic energy. The transplutonium programs, the discovery of the free neutrino, the production of plutonium-238 for heat sources, and the production of heavy water for research were all notable achievements. The Cold War and the development of atomic energy for weapons and for peaceful purposes have received considerable scholarly attention as definitive forces in twentieth-century American history.

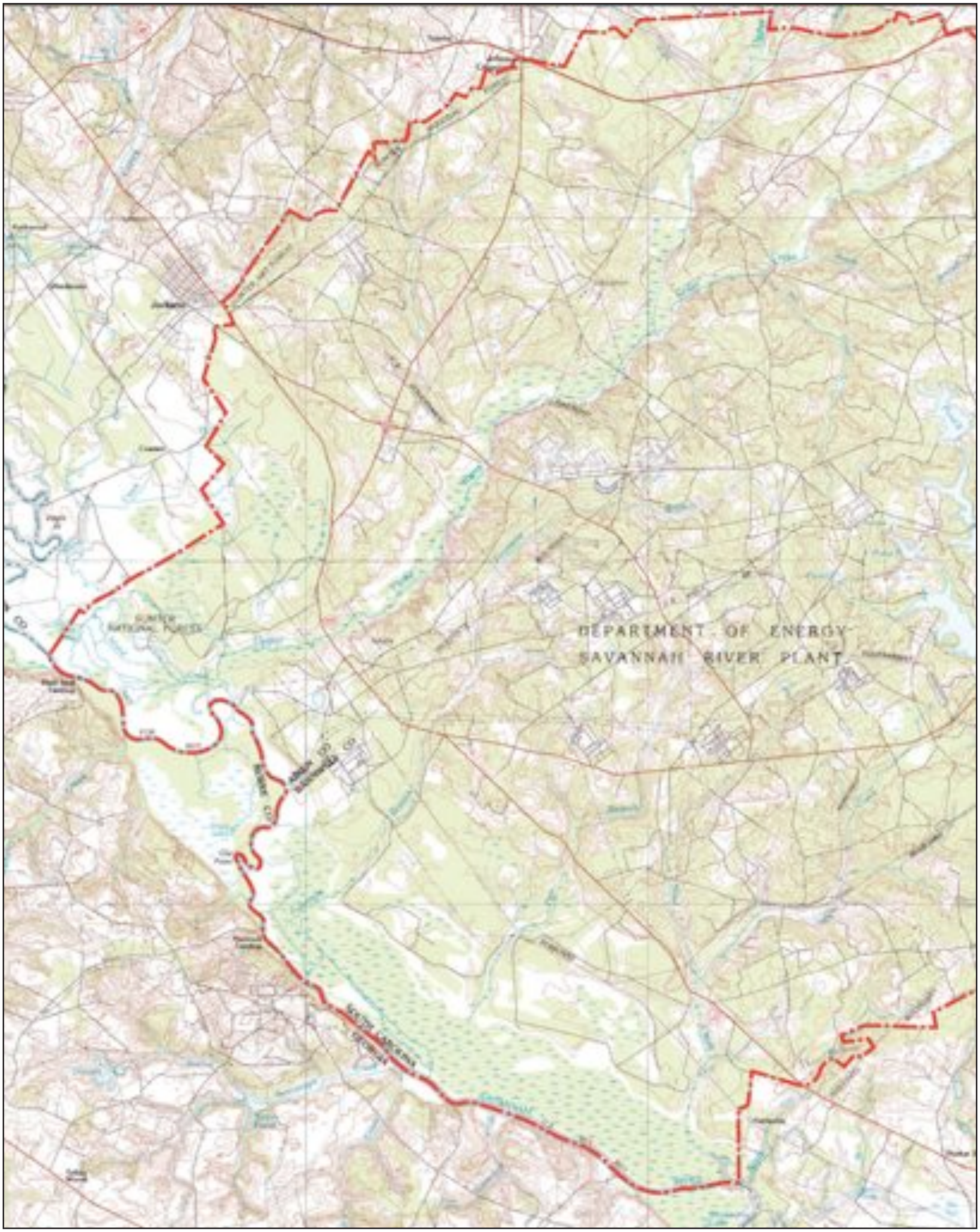
The proposed Cold War district also satisfies National Register Criteria C as it embodies best practice principles of nuclear design and safety at the time of construction. It represents the work of a master. Du Pont was the designer of the unique and unprecedented complex, which required the simultaneous construction of five nuclear production reactors, two separation plants, an industrial size heavy water plant, and a fuel and target manufacturing plant. Du Pont was considered the single American firm with the capability to handle the enormous job entailed in the construction and operation of SRS. While this facet of Criteria C is usually applied to an architect or architectural firm, it is appropriate here. Du Pont brought its corporate culture, management skills, adherence to flexible design and its deep atomic energy experience to the job. A letter from President Truman requesting that Du Pont take the project underscores that company's unique qualification to build and operate SRS.

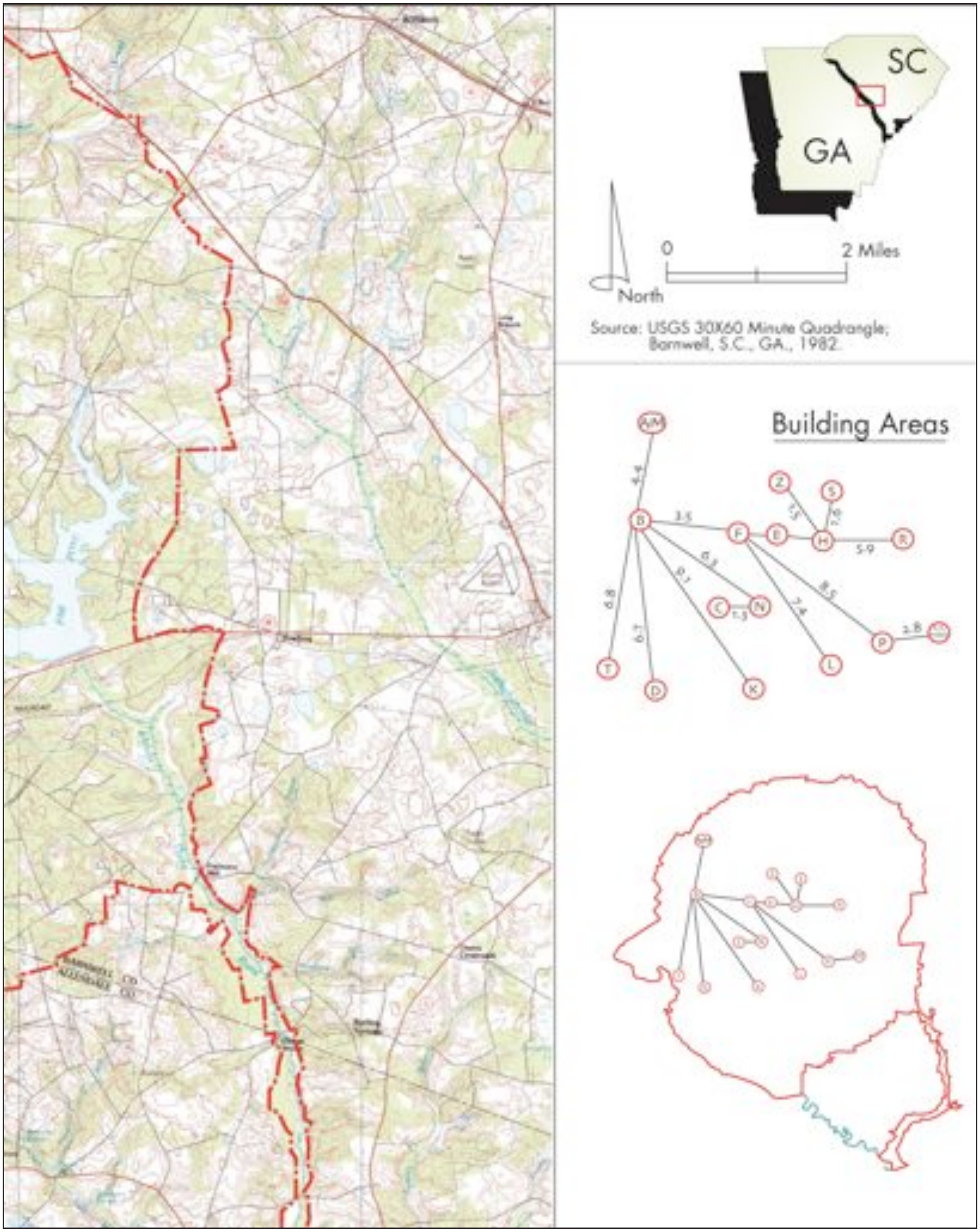
The historic district is also considered eligible under Criteria C for the methods of construction used. These involved flexible design, an innovative approach that was characteristic of Du Pont and its management style, and that directly contributed to SRS's success. The proposed district's buildings and structures reflect unique architectural and engineering attributes that were consonant with their mission. These include construction materials, functional design, and special design criteria for radiological shielding, personnel safety, and the ability to sustain a military attack. The engineering required to bring the nine Savannah River plants online was innovative and was successfully completed under rigorous schedules unparalleled in our nation's twentieth-century history. For all the above reasons, the proposed Cold War District amply satisfies National Register Criteria C.

SRS's historic district may also fulfill National Register Criteria D, the potential to yield information in history. While this criterion is usually reserved for archaeological resources it is applicable here. Much of the historical data that elucidates SRS's full Cold War history is held as classified information. When these records are declassified and open to the American public, new information disclosed might yield important information about SRS's Cold War past that is unknown or imprudent to release publicly at this time.

While its national importance to the Cold War is evident, SRS also gains National Register standing for its impact on South Carolina as a whole and on the CSRA as a region. It transformed an agricultural landscape into an industrial site, recasting a mostly agricultural workforce into technical jobholders. Since SRS, there has developed an industrial corridor that spans along the Savannah River from Clark Hill Dam to Georgia Power's nuclear Plant Vogtle near Waynesboro. The selection of the site along the Savannah River for the construction of what would be known as SRS shifted the image of South Carolina from that of a rural agrarian state to one that was more progressive and industrialized. Prior to SRS, the main state industry was textile milling. The training and inclusion of locals within the SRS workforce demonstrated the ability of Southerners to work within modern industrial facilities. Du Pont's management of this labor force, and the harmonious relations between races at SRS, diminished Northern concerns about establishing factories in the South. The existence of SRS, and the efforts of local politicians, would result in additional nuclear facilities coming to the region. Local interstate and regional pacts on nuclear topics would become models for interstate cooperation. The presence of SRS would begin to shift state university curricula from a solely agricultural focus to a new emphasis on engineering, raised the hopes and self esteem of its citizens, and placed the state at the forefront of the march to a New Age. No other single construction, site, or event would so affect South Carolina's history in the Cold War era, and SRS derives National Register standing at the state level from this influence as well.

SRS Location Map




SC
GA
0
2 Miles
North
Source: USGS 30X60 Minute Quadrangle; Barnwell, S.C., GA., 1982.
Building Areas
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F
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H
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3.5
5.9
7.4
2.8

No other undertaking would so dramatically alter a region. By its very construction, SRS rewrote the history of the CSRA. Communities, like Ellenton and Dunbarton, vanished in its wake, as did the rural areas that surrounded them. Other communities, like Aiken, changed almost overnight. As the first "open" nuclear site, SRS brought an influx of scientists and engineers the likes of which few regions in the nation would ever experience, changed the housing stock and appearance of the towns these atomic immigrants would move to, changed the make-up of their schools, political parties, and other social organizations, and rewrote local history. It is difficult to imagine anyone within the CSRA, if asked about the history of their region, not mentioning SRS in their first words. SRS is extremely significant regionally as well as nationally and at the state level.

INFRASTRUCTURE-ASSOCIATED PROPERTIES

Although once spread out over the site, infrastructure properties are dwindling as they reach the end of their operational life, become obsolescent, or are part of a planned area closure. A number of infrastructure buildings were decommissioned prior to the start of Cold War preservation activities at the site or as part of area closures following Section 106 compliance for Cold War properties. For example, all the reactor area powerhouses, with the exception of K Area's powerhouse, are no longer extant; some reactor area substations also have been lost. The military gun sites are no longer intact.

The largest powerhouse on site, located in D Area, was targeted for deactivation and decommissioning activities (D&D) in 2003 as part of D Area closure. In consultation with the State Historic Preservation Office, DOE-SR developed a Memorandum of Agreement (MOA) for the treatment of D Area historic properties in 2003. A later agreement, the 2004 Consolidated MOA, allowed D&D activities to proceed in D Area after mitigation was complete, but solely for the heavy water production properties. Eight D-Area properties, including the powerhouse, were under lease to South Carolina Electric and Gas Company and were in operation at that time. Stipulation 8 in the Consolidated MOA required that this group of D-Area infrastructure-related properties, namely, 451-D, 484-D, and 485-D, would be documented in the same manner as the other D Area properties when their operational life was completed. This lease has ended and the facilities are now proposed for D&D, completing the D-Area decommissioning process started in 2003. Some properties discussed in the narrative in this report were fully documented in earlier thematic studies. Communication buildings, 703-A and 702-A, were treated in the Administration thematic study.

Still other infrastructure properties remain intact and are in current use. Table 1 contains a list of the varied resource types that will be treated in this thematic study organized by systems, namely transportation, power and water, communications, waste, and military.

Table 1. Infrastructure Properties Treated in Thematic Study

Area	Facility No.	Survey No	Name	Theme/System
A	607-1A	R/03/2306	Sewage Treatment Plant	Waste
	607-2A	R/03/2303	Sewage Lift Station	Waste
	607-3A	R/03/2307	Comminutor	Waste
	702-A*	R/03/2315	Telephone Building	Communications
	751-A	R/03/2424	Control House and Primary Substation	Power
	751-2A	R/03/2415	Diesel House	Power
	784-A	R/03/2444	Steam Generation Plant	Power
	785-A	R/03/2445	Cooling Tower	Power
	905-A***		Chlorine Building	Power
B			Concrete Pad with Military Era Logo	Military
C	151-1C	R/11/0206	Primary Substation	Power
	151-2C	R/11/0207	Primary Substation	Power
D	451-D	R/11/0171	Primary Substation	Power
	483-3D*	R/11/0176	Electrical Control Building	Power
	484-D	R/11/0183	Powerhouse	Power
	484-4D**	R/11/0180	Power Maintenance Facility	Power
	484-9D**	R/11/0182	Valve House	Power
	485-D	R/11/0184	Cooling Tower	Power
	488-D***		Ash Disposal Basin	Power
F	251-F	R/03/2638	Primary Substation	Power
	252-F		Secondary Substation	Power
	282-F	R/03/2651	Reservoir and Pump House	Power
	284-F***	R/03/2654	Powerhouse	Power
	285-F***	R/03/2655	Cooling Tower	Power
	288-F***		Ash Disposal Basin	Power
G	504-1G		Switching Station	Power
	504-2G		Switching Station	Power
	504-3G		Switching Station	Power
	603-G		Cloverleaf	Transportation
	608-G	R/11/0383	Track Scale House	Transportation
	616-G	R/03/2463	Truck Scale House	Transportation
	618-G	R/11/0388	Locomotive Shops	Transportation
	619-G		Diesel Oil Storage Tanks	Transportation
	623-1G		Patrol Radio Station	Communication
	627-G		Fire Observation Tower	Communication
	643-G		Burial Ground	Waste
	662-G		River Loading Dock	Transportation
	681-1G	R/03/2467	River Water Pump House	Power
	681-3G	R/11/0390	River Water Pump House	Power
	681-4G***		River Water Pump House	Power
	681-5G	R/11/0391	River Water Pump House	Power
	681-6G	R/11/0392	Par Pond Pump House	Power
	715-G***		Gas Station	Transportation

Area	Facility No.	Survey No	Name	Theme/System
H	251-H	R/03/2545	Primary Substation	Power
	252-H***		Secondary Substation	Power
	282-H	R/11/0424	Reservoir and Pump House	Power
	284-H	R/11/0425	Powerhouse	Power
	285-H***	R/03/2567	Cooling Tower	Power
K	151-1K	R/11/0240	Primary Substation	Power
	151-2K	R/11/0241	Primary Substation	Power
	152-K		Secondary Substation	Power
	184-K	R/11/0245	Powerhouse	Power
	185-K***	R/11/0247	Cooling Tower	Power
	188-K***		Ash Disposal Basin	Power
L	151-1L	R/11/0267	Primary Substation	Power
	151-2L	R/11/0268	Primary Substation	Power
	152-L***		Secondary Substation	Power
	184-L***		Powerhouse	Power
	185-L***		Cooling Tower	Power
	188-L***		Ash Disposal Basin	Power
P	151-1P***	R/11/0294	Primary Substation	Power
	151-2P***	R/11/0295	Primary Substation	Power
	152-1P***	R/11/0296	Secondary Substation	Power
	184-P***		Powerhouse	Power
	185-P***	R/11/0302	Cooling Tower	Power
	188-P***		Ash Disposal Basin	Power
	715-P***		Gas Station	Transportation
R	151-1R***	R/11/0319	Primary Substation	Power
	151-2R***	R/11/0320	Primary Substation	Power
	152-1R***	R/11/0321	Secondary Substation	Power
	184-R***		Powerhouse	Power
	185-R***		Cooling Tower	Power
	188-R***		Ash Disposal Basin	Power
All Areas	501		Fence and Road Lighting	Transportation
	503		Transmission and Distribution Lines	Power
	505		Fire Alarm System	Communication
	506		Telephone Cable and Instruments	Communication
	507		Safety Alarm System	Communication
	601		Standard Gauge Railroad Track	Transportation
	602		Standard Gauge Railroad Rolling Stock	Transportation
	604, 613		Walkways, Parking Areas	Transportation
	801, 802, 901		Pipe Supports, Overhead Steam Lines, Underground Water Pipes	Power
	903, 904, 907		Sanitary, Process, and Storm Sewers	Waste
	905		Wells and Pumps	Power
			Rain Shelters	Transportation

Area	Facility No.	Survey No	Name	Theme/System
Military Sites***			Barracks Site No. 12***	Military
			Barracks Site No. 51***	Military
			Barracks Site No. 72***	Military
			Barracks Site No. 92***	Military
			Barracks Site No. 95***	Military
			Gun Site 120***	Military
			Gun Site 510***	Military
			Gun Site 720***	Military
			Gun Site 920***	Military
			Gun Site 91R***	Military
			Gun Site 812***	Military
			Gun Site 816***	Military
			Gun Site 606***	Military
			Gun Site near 701-2G***	Military
			Gun Site 404***	Military
			Gun Site 314***	Military
			Gun Site 317***	Military
			Gun Site 305***	Military
			Gun Site near 701-3G***	Military
			Gun Site 209***	Military
			Gun Site 115***	Military
			Gun Site 113***	Military
			Gun Site 103***	Military
			Gun Site 102***	Military
			Gun Site 008***	Military

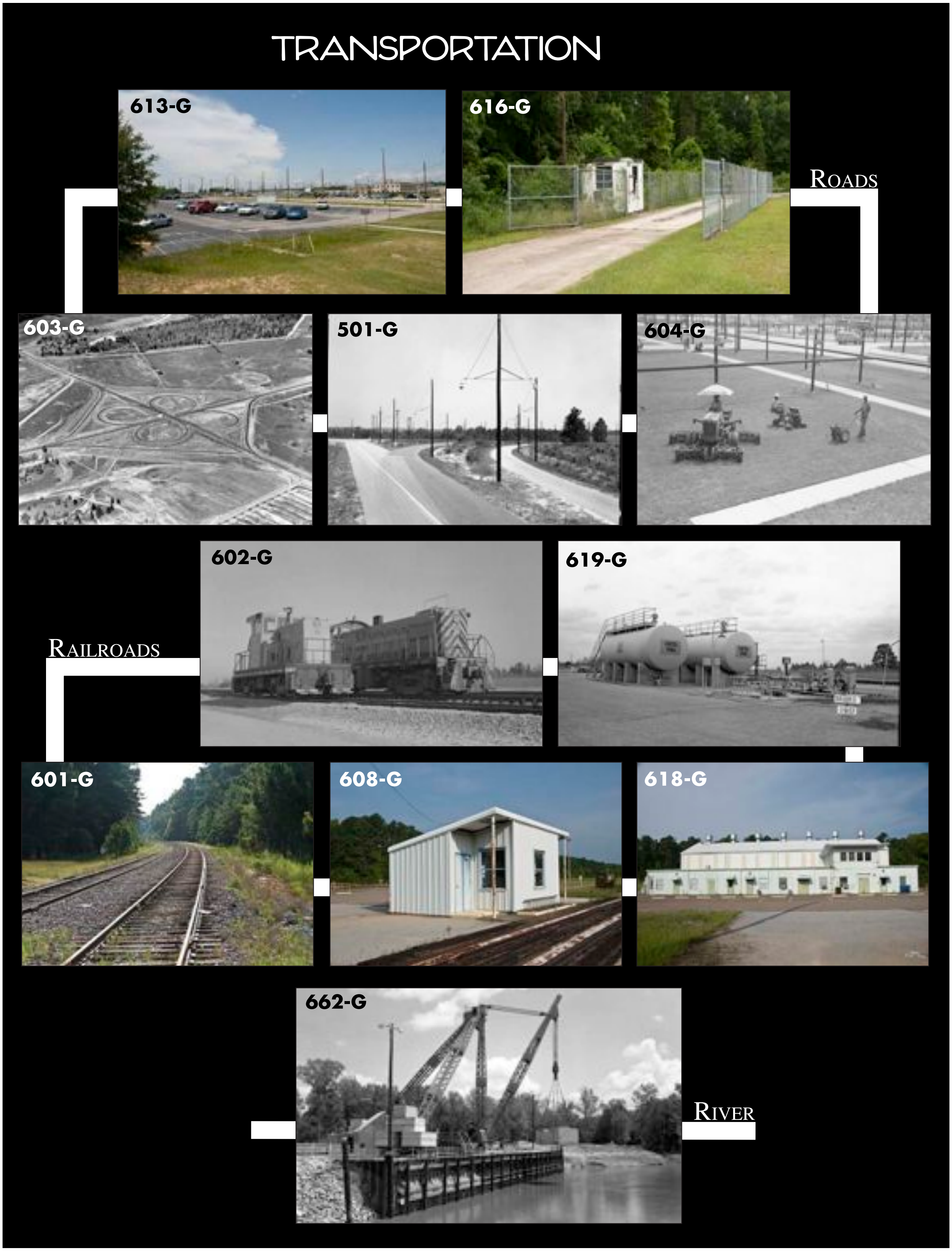
* Treated in the D Area Thematic Study
** Associated with Powerhouse
*** No Longer Extant

DOCUMENT ORGANIZATION

This narrative provides a history of Savannah River's infrastructure using a systemic approach: categorizing the resources by function, including transportation, power and water, etc., and linking resource types to the associated system. While the major thrust of the storyline lies in the creation of the site when the site's infrastructure was designed and built, it also deals with how the infrastructure evolved and continued to sustain SRS operations. Both current and historic views are used to tell this story.

This document is a volume within a developing portfolio of similar studies that address the historic mission of SRS during the Cold War and its role within the Atoms for Peace Program. After this introduction, there are 10 chapters. Chapter 2 presents a Cold War context while the remaining chapters are SRS-specific, highlighting site layout and design, the facilities constructed and the various infrastructure networks under study. An operational history follows in Chapter 10 and excerpts from the oral history interviews are provided in the final chapter.

Several appendices follow. Appendix A contains oral history transcripts. Appendix B contains mitigation documentation, including plans, drawings, and documentation photography.


TRANSPORTATION
613-G
616-G
ROADS
603-G
501-G
604-G
602-G
619-G
RAILROADS
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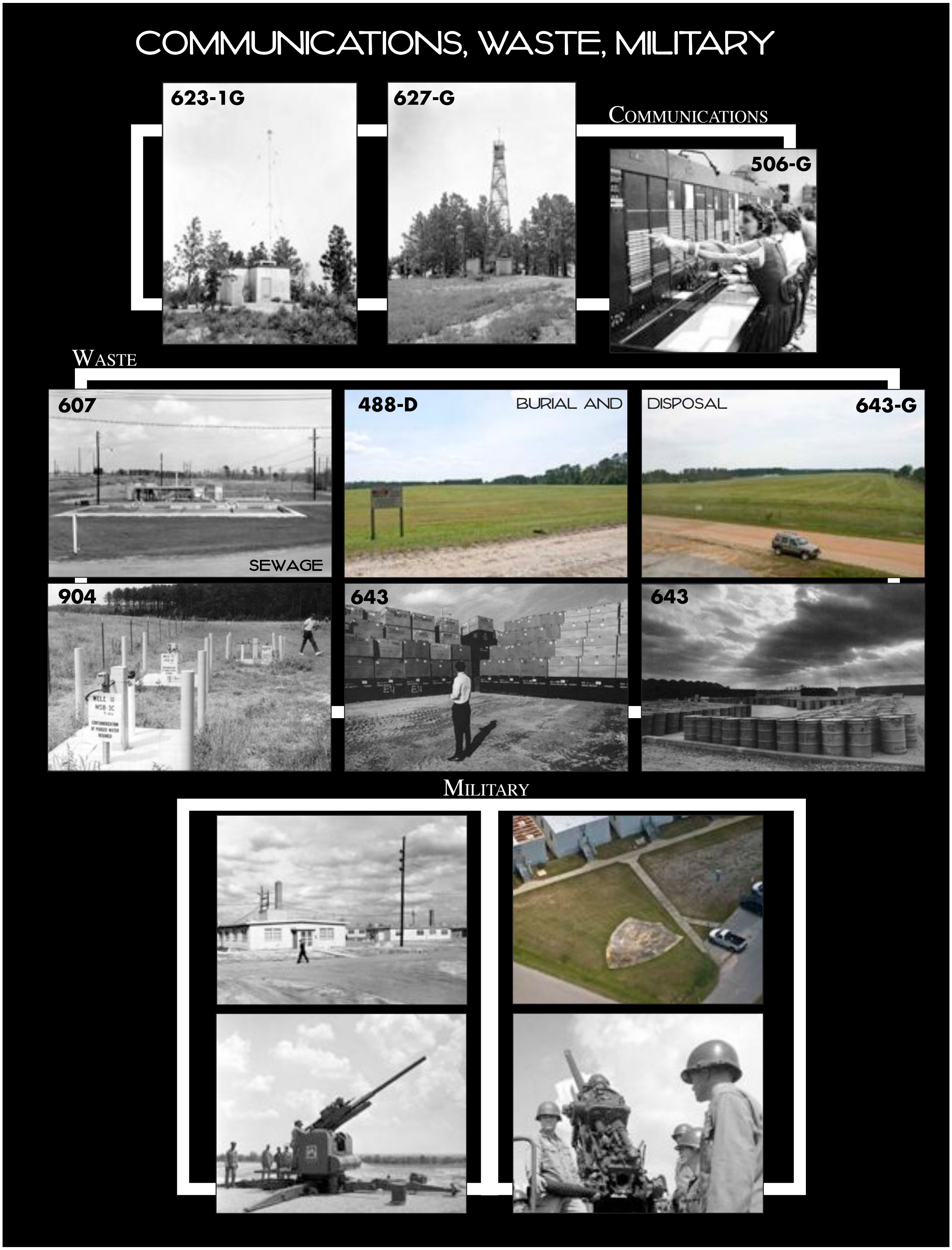
608-G
618-G
662-G
RIVER

POWER AND WATER

Electricity

Water


COMMUNICATIONS, WASTE, MILITARY
623-1G
627-G
COMMUNICATIONS
506-G
WASTE
607
SEWAGE
488-D
BURIAL AND
DISPOSAL
643-G
904
643
643
MILITARY

II. COLD WAR CONTEXT

The SRS, built by E. I. du Pont de Nemours and Company for the U.S. Atomic Energy Commission, had its origins in the early years of the Cold War as a facility for the production of plutonium and tritium, materials essential to the nation's nuclear arsenal. From the beginning, its mission was military. The Atomic Energy Commission (AEC)—later the Energy Research and Development Administration (ERDA) and finally the Department of Energy (DOE) designed it primarily to produce tritium, and secondarily to produce plutonium and other special materials as directed. Because of this mission, SRS has been an integral part of the nuclear weapons production complex. The production goal of the complex was to transform natural elements into explosive fissile materials, and to bring together fissile and non-fissile components in ways that would best meet the goal of Cold War deterrence. SRS provided most of the tritium and a large percentage of the plutonium needed for the production of fissile components from 1953 through 1988.

In addition to the Cold War defense mission, there was another, almost parallel, story of research and development using site technologies and products for peaceful uses of atomic energy. Such government-sponsored research was strongly supported by the AEC, which was a civilian organization independent of military control. Although many of the non-defense programs conducted at SRS did not develop as hoped in the 1950s and 1960s, this was not for want of effort on the part of the AEC, Du Pont, or the scientists who helped operate SRS.

The two basic missions at SRS, nuclear materials production for defense, and production for non-defense programs, are explored in greater detail below. Both were considerable achievements. The defense mission produced much of the material required for the nuclear bombs and warheads constructed during the height of the Cold War. The non-defense programs generated new materials and increased the general knowledge of nuclear science.

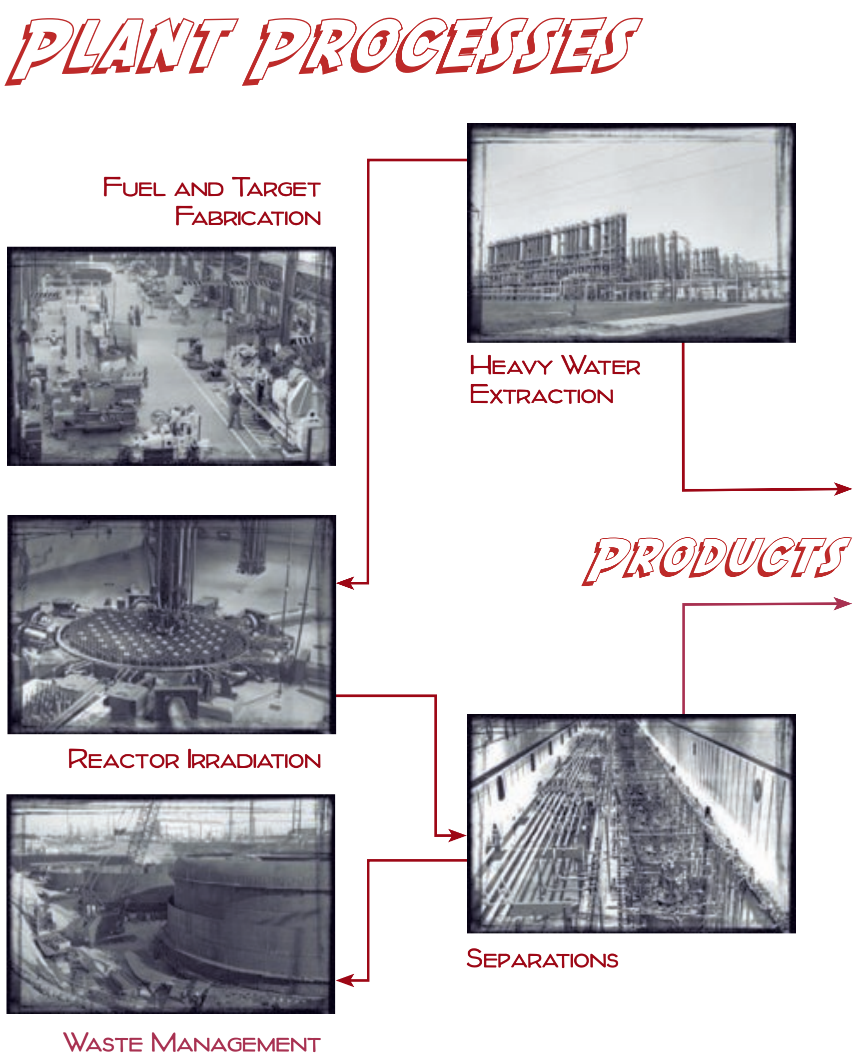
COLD WAR DEFENSE MISSION

The defense mission of the Savannah River Plant (SRP), as it was known prior to 1989, was an integral part of the AEC program to create weapons-grade plutonium and tritium for incorporation into fission and fusion bombs, known respectively as atomic and hydrogen bombs. The defense mission of SRP, and for that matter, the AEC, had its origins in the Manhattan Project, the World War II program that manufactured the world's first fission bombs, using both uranium and plutonium. It was the use of these devices against Japan in August 1945 that ended World War II, and ushered in the Atomic Age. The Manhattan Project, a vast and secret enterprise, set the tone for its successor, the AEC, even though the two were organized in different ways.

The Manhattan Project

The Manhattan Project, formally known as the Manhattan Engineer District (MED), was established in August of 1942, more than half a year after Pearl Harbor.[1] Its mission was to beat the Germans in what was widely assumed to be a race for the atom bomb.[2] Unlike other Army Corps of Engineers districts, the MED had no

We don't dig Uranium out of the ground, and we don't make bombs, but we do nearly everything in between.



Plutonium-238

Produced by neutron irradiation of neptunium-237, a byproduct of uranium irradiation. Valuable for its heat generating capacity.

Curium-244

Properties and applications similar to plutonium-238.

Plutonium-239

Used as a nuclear explosive, a breeder reactor fuel, or as the starting target material for production of heavier radioisotopes.

Tritium *(Hydrogen-3)*

A radioactive isotope of hydrogen, component of thermonuclear explosives, and a potential fuel for thermonuclear fusion power generation.

Cobalt-60

Known radiation source and has long been used for radiotherapy.

Californium-252

One of the rarest man-made isotopes, has great potential value in medicine, industry, research, and education.

Heavy Water *(D_2O)*

Important nonradioactive product of the Savannah River Plant. It occurs at a concentration of 0.015% in natural water and must be concentrated to 99+% to be useful in reactors as a neutron moderator.

And Other Radioactive Isotopes

Depiction of Plant Processes and Products Compiled from Savannah River Laboratory's Nucleonics of Tomorrow in the Making Here Today (Aiken, South Carolina: E. I. Du Pont de Nemours and Company, not dated).

specific geographical boundaries and virtually no budget limitations. General Leslie Groves was put in charge of the operation, and he was allowed enormous leeway. As Groves himself would state after the war, he had the role of an impresario in "a two billion dollar grand opera with thousands of temperamental stars in all walks of life."[3] In organizing the MED, Groves established a precedent that would carry over to the AEC: scientific personnel and resources would be culled from the major universities, but production techniques would be obtained from corporations familiar with the assembly line.[4] The Manhattan Project could not have succeeded without a willing army of brilliant physicists (many of whom were refugees from Hitler's Europe), the nation's huge industrial base of capital and personnel skills, and the leadership and construction skills provided by the Army Corps of Engineers.[5]

The last half of 1942 saw the groundwork laid for the development of the Manhattan Project. Groves and others selected the methods and sites to be used to produce the bomb. For both speed and economy, Groves wanted to concentrate on one single method for bomb production, but science would not oblige.[6] In the fall of 1942, there were a number of equally valid and equally untried methods for obtaining the fission material for an atomic bomb. There was even a choice of materials: uranium-235 and plutonium.

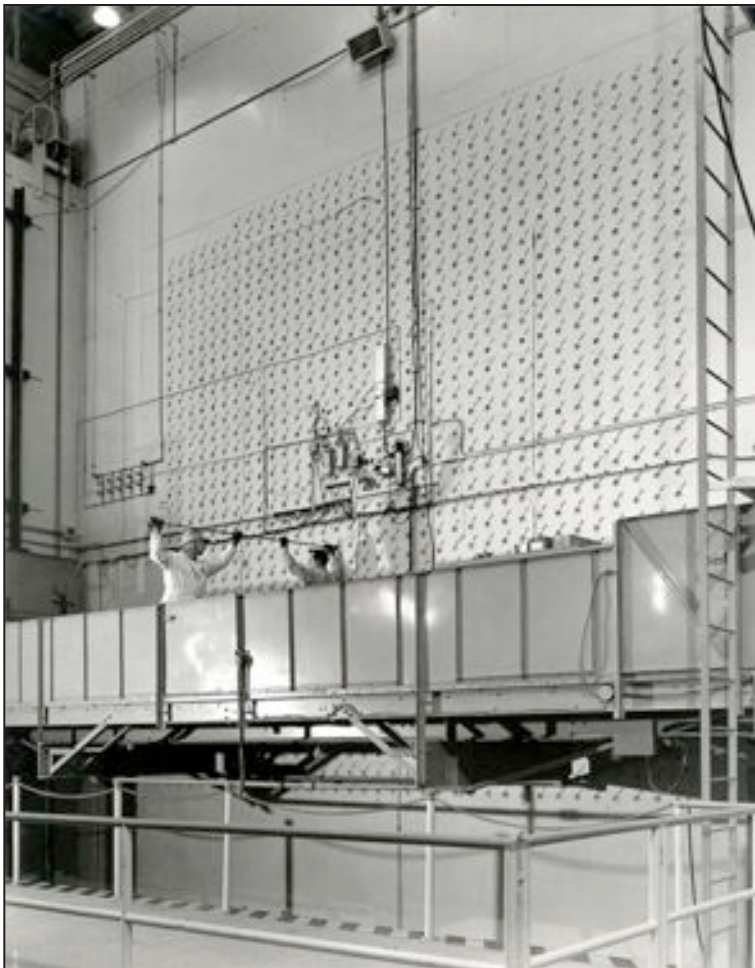
Commemorative Manhattan Project Button "A"Bomb Button. Courtesy of Oak Ridge National Laboratory.

The methods best known to the scientific community at the start of the Manhattan Project dealt with the collection of isotope uranium-235, which comprises only a very small percentage of natural uranium. There were at least four possible methods for removing uranium-235 from the matrix of natural uranium: the centrifuge method; thermal diffusion; gaseous diffusion; and electromagnetic separation.

To complicate matters, there was also a new method based on the production of a man-made element, plutonium, discovered and named by Glenn Seaborg and others in 1941. Plutonium could be produced by irradiating natural uranium in a pile or reactor, after which it could be separated from uranium chemically, something not possible with isotopes like uranium-235.[7]

General Leslie Groves (left), Manhattan Engineer District Leader and Robert Oppenheimer (right), Scientist, Los Alamos.

By the end of 1942, the field narrowed to three main methods in the race to produce nuclear materials: gaseous diffusion, electromagnetic separation, and plutonium production. In December 1942, when President Roosevelt gave his final approval for the all-out push, it was decided to proceed with all three.[8] The last of these methods certainly got a boost on December 2, 1942, when Italian refugee Enrico Fermi, working at the University of Chicago, created the world's first self-sustaining chain reaction in a graphite reactor.[9]



X-10 Pile Constructed by E. I. Du Pont de Nemours & Co. at Oak Ridge, Tennessee, Now Designated as a National Historic Landmark. Courtesy of Oak Ridge National Laboratory.

By this time, three huge test and production sites had been selected for MED's work. The first was Oak Ridge in Tennessee, then known as "Clinton Engineer Works," selected as the site for a full-scale electromagnetic plant (Y-12), a gaseous diffusion plant (K-25), and a plutonium pile semi-works (X-10). Constructed in 1943, X-10 became the world's first production reactor when it went critical on November 4, 1943. Hanford, in Washington State, was selected as the main plutonium production site, while Los Alamos in New Mexico, under the direction of Robert Oppenheimer, was chosen to be the nerve center of the project and the bomb assembly site.[10]

While Los Alamos may have been the center of the MED, Hanford was the key to the plutonium bomb, which required the new element in quantities unimaginable before the war. For the construction of the X-10 at Oak Ridge and the full-scale reactors to be built and operated at Hanford, Groves picked Du Pont. This was done not only because of Du Pont's history of explosives manufacture and its association with the U.S. military, but also because it was a large chemical firm that had the personnel, organization, and design capabilities required to do the job.[11] Most importantly, it had a tradition of translating scientific ideas and laboratory techniques into assembly line production.[12]

To do all this in the arena of nuclear physics, a field in which they were not expert, Du Pont depended heavily upon the Metallurgical Laboratory of the University of Chicago. Du Pont's key technical employees were sent to Chicago and to Clinton to learn from the research scientists about problems that would bear on the design and operation of the semi-works and the full-scale production plants. This dialogue between the industrial engineers and the academic scientists would be the basis for the selection of processes, and the design of the equipment needed to carry them out, at both the semi-works and at Hanford.[13]

Hanford's three reactors (B, D, and F) and two separations buildings were constructed in 1943-1944. The reactors, water-cooled and graphite-moderated, went on line between September 1944 and February 1945.[14] One of the first crises in the plutonium program occurred shortly after the Hanford B reactor went critical in September 1944.

The reactor would go critical and then shut down in a totally unexpected series of oscillations that threatened to ruin the production schedule. After frantic research, it was determined that the reaction had been killed by a periodic build-up of xenon that proved to be a huge neutron absorber with a nine-hour half-life.[15]

An engineering feature added by Du Pont was instrumental in solving the problem of xenon poisoning. When scientists at the University of Chicago's Metallurgy Laboratory insisted that only 1500 tube openings were needed in the reactor face, Du Pont added an additional 500 openings as a precaution. This spare capacity, built into every Hanford reactor, made it possible to load the extra openings and simply overpower the effect of the xenon.[16]

By early 1945, Hanford was shipping plutonium to Los Alamos for bomb assembly work.[17] With a detonation device based on implosion, which was more complicated than that required for the uranium bomb, the plutonium bomb had to be tested near Alamogordo, New Mexico, in July 1945. One month later, a similar bomb was dropped on Nagasaki, three days after the uranium bomb was dropped on Hiroshima.

The Manhattan Project had been a purely military undertaking, conceived and successfully concluded as a top-secret operation of the Second World War. In the year that followed the war, the project began to unravel as top scientists and others left the project to return to civilian life, and the government considered different proposals for dealing with the awesome power that had ended the war.

Onset of the Cold War

Relations between the United States and the Soviet Union, guarded during WWII, began to chill in the aftermath. The Cold War had its "official" beginnings in February and March of 1946, with three critical events. The first was Stalin's speech (February 9) to Communist Party stalwarts, reaffirming the Party's control over the Soviet Union, and promising more five-year plans and an arms race to overtake the capitalist powers. This was followed on February 22 by George Kennan's famous telegram describing the paranoid, expansionist worldview of the Soviet leadership, and suggesting "containment" as the best solution. Last but certainly not least, on March 5, was Churchill's "Iron Curtain" speech at Fulton, Missouri.[18]

The beginnings of the Cold War in early 1946 quickly derailed initial talk of international control of atomic energy. By the time the AEC was created by Congress in the summer of 1946, atomic energy had become the cornerstone of the nation's defense against the Soviet Union's preponderance in conventional land forces. For this reason, President Truman was shocked to discover that when the AEC took over Los Alamos in early 1947, the United States did not possess a single assembled working bomb.[19]

Between 1947 and 1950, during the chairmanship of David Lilienthal, the main mission of the AEC was the re-establishment of the nation's nuclear arsenal. The AEC was created as an umbrella agency to control all of the nation's nuclear research and materials production. In this capacity, by early 1950 the AEC oversaw a virtual nuclear empire that not only included old MED facilities at Oak Ridge, Hanford, and Los Alamos, but also encompassed offices in Washington, D.C. and facilities at Argonne National Laboratory (Chicago); Schenectady, New York; Brookhaven National Laboratory, New York; and the University of California Radiation Laboratory at Berkeley, in addition to other small facilities around the country.[20]

During this same period, international events conspired to make the AEC's defense mission even more critical, as international relations slid further into the deep freeze. Concerned that a devastated postwar Europe might drift into the Communist camp, the U.S. government introduced the "European Recovery Program," first espoused by George Marshall in June of 1947. The "Marshall Plan," as it was commonly known, was worked out between the U.S. and various European nations months before it passed Congress in April of 1948. Although offered to all European nations, Stalin saw to it that his side refused to participate. When middle-of-the-road Czechoslovakia expressed interest in the plan, the local Communists, aided by the Red Army, staged a coup in February 1948. This move also gave the Soviets direct access to the rich Joachimstahl uranium mines, desperately needed by Stalin's nuclear program.[21]

Unwilling to cooperate with the Western allies in the postwar reorganization of Germany, Stalin initiated the Berlin Blockade, which began in the summer of 1948 and lasted almost a year. It was the first direct confrontation between the United States and the Soviet Union, and it led to the creation of the North Atlantic Treaty Organization (NATO) in 1949.[22] Other crises soon followed. In May of 1949, the Chinese Nationalists, still devastated from the Japanese invasion during World War II, collapsed before Mao's Communist insurgents. Even more ominous, on August 29, 1949, the Soviet Union detonated its first atomic bomb (a plutonium device); an achievement that Truman and most of the U.S. nuclear establishment thought would elude the Soviets for years to come.[23] At the end of 1949 and beginning of 1950, in the wake of the Soviet bomb, Truman and the AEC made plans for the development of the hydrogen bomb, the so-called "Super."[24] Almost simultaneously, Klaus Fuchs, a German émigré who had served in the British Mission to the Manhattan Project at the highest levels of plutonium bomb research, confessed to spying for the Soviets. This revelation in February 1950 sent shock waves through the nuclear community in both Britain and the United States, and seemed to reinforce the decision for both the Super and tighter security. Senator Joseph McCarthy began his accusations just days after news of Fuchs' confession, and four months later, on June 25, 1950, communist North Korea invaded South Korea.

During the Korean War (1950-1953), the AEC's defense mission was paramount, as witnessed by the explosion of the first H-Bomb in November 1952, and the growth of the nation's nuclear arsenal from 300 to 1,000 bombs. The military mission remained strong long after the war, with the official U.S. policy of "massive retaliation" announced by Secretary of State John Foster Dulles in January 1954. The centerpiece of the nation's nuclear arsenal was the H-Bomb, a thermonuclear device that relied on a complex combination of fission and fusion, with fission required to heat and fuse atoms of hydrogen isotopes like tritium to release the high-energy neutrons required for the blast. During the 1950s, a number of thermonuclear devices were detonated, first by the United States and quickly followed by the Soviet Union. These new bombs required increased supplies of plutonium as well as tritium, which had a half-life of 12 to 13 years. The push for the hydrogen bomb led to the expansion or establishment of new AEC facilities, beginning in 1950. Foremost among these new or improved facilities were the Los Alamos Scientific Laboratory, the Lawrence Livermore Laboratory in California, and the Savannah River Plant in South Carolina.[25] The Savannah River Plant (SRP) was first conceived to produce tritium, but was designed to be versatile in its production capacity, accommodating the production of both tritium and plutonium, in addition to other nuclear materials.

The first U.S. thermonuclear device, Mike I, was detonated in November 1952, before the completion of SRP. However, for at least a decade after the first SRP reactor went critical in December 1953, the main, if not overwhelming, mission of the Savannah River Plant was the production of plutonium and tritium, in the percentages required by annual AEC quotas. SRP played a crucial role in the production of nuclear materials for both fission and fusion bombs, first for Air Force bombers, and finally for the long-range missiles that became prevalent in the late 1950s and early 1960s. During the period when the Cold War was at its peak, between the Korean War (1950-1953) and the Cuban Missile Crisis (1962), SRP was a main contributor to the AEC's defense mission.

Savannah River Plant as Part of the Big Picture

Cold War nuclear weapons production in the United States can be divided into four phases: (1) a research phase, (2) a growth and production phase, (3) a stabilization phase, and (4) a second growth and production phase. The first research phase lasted from the end of World War II until 1955. The second phase witnessed a period of growth and production that lasted from about 1955 through approximately 1967. It was in preparation for this production that the Savannah River Plant was constructed, and this period approximates the more productive era of reactor operations at the site. The primary mission of the Savannah River Plant has been first to produce tritium, and second to produce plutonium and other special materials as directed by the Department of Energy and its precursor organizations.

Complex-wide, plutonium production reached its peak in the early 1960s. The third period was one of stability, during which the concentration of effort was on the improvement of performance and operations of the nuclear arsenal; this phase lasted from about 1967 until 1980. During this period, eight of the nine Hanford reactors were closed down, and the ninth reactor that remained in operation was used to produce fuel-grade plutonium. This left Savannah River as the primary source of weapons-grade plutonium. The fourth phase was a second period of growth, which began in 1980 and saw the restart of L reactor at SRP and the return of Hanford's N reactor to weapons-grade plutonium production. In addition, SRP's C, K, and P reactors were used to produce super-grade plutonium that could be blended with excess fuel-grade plutonium produced in the Hanford N reactor. This phase ended in 1988, when all plutonium production ceased.

The following context, which is specific to Savannah River Site, is based generally on this chronological framework. The plant's construction (1950-1956) is treated as a separate phase in the site's history, followed by a stable period of production and performance improvement that lasts through 1979. Between 1980 and 1989, SRP experienced dramatic change. The decade began with expansion but this was soon sharply curtailed by shifts in the public's perception of nuclear technology and the abbreviation of the site's defense mission with the fall of the Iron Curtain.

SAVANNAH RIVER PROJECT

The Soviet Union detonated its first atomic bomb on August 29, 1949. Labeled "Little Joe" by American journalists, the bomb's unpublicized detonation was confirmed through the AEC's program of sampling rainwater. As a consequence, the Joint Chiefs of Staff who established new minimum requirements for the atomic stockpile, increased production needs. Programs that had been stalled were now begun with vigor. To accommodate the perceived production needs, new "production piles" were required and the Joint Committee on Atomic Energy (JCAE) decided to build new reactors rather than upgrade those at Hanford.

Enlarging the stockpile was the first response to the Soviet bomb. The second was the decision to produce a hydrogen bomb, a weapon many times more powerful than the uranium and plutonium devices dropped on Japan at the end of World War II. On January 31, 1950, Truman signed a presidential directive that directed the AEC to continue work on all forms of nuclear activity, including the development of the thermonuclear bomb, stating, "We have no other course." A program jointly recommended by the AEC and the Department of Defense to produce materials for thermonuclear weapons in large quantities received presidential approval in June. The AEC had already estimated the construction costs for a new production center at approximately $250,000,000 and Sumner T. Pike, Acting Head of the AEC, immediately began negotiations with Crawford H. Greenewalt, president of E. I. Du Pont de Nemours & Co. Truman requested funds from Congress for the construction of two heavy water reactors for the production of thermonuclear weapons on July 7 and shortly after the AEC drafted a letter contract framed in anticipation of Du Pont's acceptance of the project.

Du Pont Signs On

With the passage of the appropriations bill in early 1950, the AEC opened negotiations with E. I. du Pont de Nemours & Company to build and operate the new plant. Du Pont had built the X-10 reactor and semi-works for the separation of plutonium from irradiated fuel slug facility at Oak Ridge and had built and operated Hanford during World War II through 1946. The success of both ventures left an indelible print on Du Pont, headquartered in Wilmington, Delaware, and on Leslie Groves and the AEC. In the field of atomic energy industry, Du Pont was a seasoned player with a pennant under their belt. Crawford Greenewalt and his staff had participated in a period of intense creativity in which the labors of atomic scientists in their laboratories were duplicated on the production line under wartime conditions. Between 1942 and 1946, Du Pont's engineers and scientists had become experts within the atomic energy field. No other American firm could match Du Pont's expertise in the design and construction of production reactors and chemical processing facilities.

AEC representatives visited Greenewalt formally in May of 1950 to apprise him of the proposed project and on June 8th the Wilmington firm was asked to complete the site survey; to design, construct, and operate a new reactor installation; and to act in a review capacity for the technical aspects of the reactors and the processes for the production of heavy water. The Commission also asked Du Pont to find a location that would not warrant the construction and management of a "company" town, a significant departure from previous military atomic energy plants established by the government.

Du Pont replied that it would consider the project if it had full responsibility for reactor design, construction, and initial operation. The "flexible" reactor design specified by the Commission called for a heavy water moderated and cooled reactor and Du Pont wanted to delay commitment to the project until they were able to review initial plans, particularly for heavy water production, and get a sense of proposed schedule. Greenewalt added a final proviso - that Truman himself request Du Pont's involvement in the project because of its urgency and its importance to the nation's security - which was done in a letter dated July 25, 1950. Greenewalt's request was aimed at squelching any associations with the "merchants of death" label that had been leveled at the corporation in the 1934 U.S. Senate investigation of the munitions industry. Truman's letter, short and to the point, would become an industrial icon for Du Pont. On July 26, Du Pont's Executive Committee adopted a resolution to undertake the project. The internal resolution also established the Atomic Energy Division (AED) within Du Pont's Explosives Department. The AED would be responsible for the new project.

A letter contract, backdated to August 1, 1950, was signed between Du Pont and the AEC. It specified a top-secret scope of work to be done by Du Pont for the AEC. There would be five reactors (that number would fluctuate for several months) to run on regular uranium, a series of separations buildings, and tritium facilities. The letter, which would be superceded by a formal contract three years later, specified that there would be no "facility village" associated with the project and that Du Pont would not be held liable for any lawsuits that might result. On October 11, a letter contract was worked up for Du Pont, for the design, construction, and operation of a new plant. The contract, to be effective as of August 1, 1950, was labeled AT(07-2)-1. It would be the basis of Du Pont Project No. 8980, the construction of Savannah River Plant.[26]

Just days later, on October 18, 1950, Greenewalt wrote the company's stockholders that Du Pont would assume responsibility for the construction and operation of the new facility. As at Hanford, the government would pay all costs and receive any patents that might develop out of the work; Du Pont would get a fee of just one dollar. Some of the contractual clauses that were first written into the Hanford contract and were duplicated in the SRP contract would become standard in operating contracts undertaken in the modern nuclear industry.

At the time of the letter agreement, the AEC wanted Du Pont to build reactors to operate at an energy level of around 300 megawatts (MW). The AEC had selected the reactor type advanced by Argonne National Laboratory that was cooled and moderated with heavy water and Du Pont, after review, accepted the design. By 1950, heavy water reactors were considered more versatile than the graphite reactors Du Pont had built at Hanford, and had better neutron economy. As early as August of 1950, Du Pont's Atomic Energy Division had made preliminary improvements to the basic heavy water design proposed by Argonne and was on a pathway to construction.

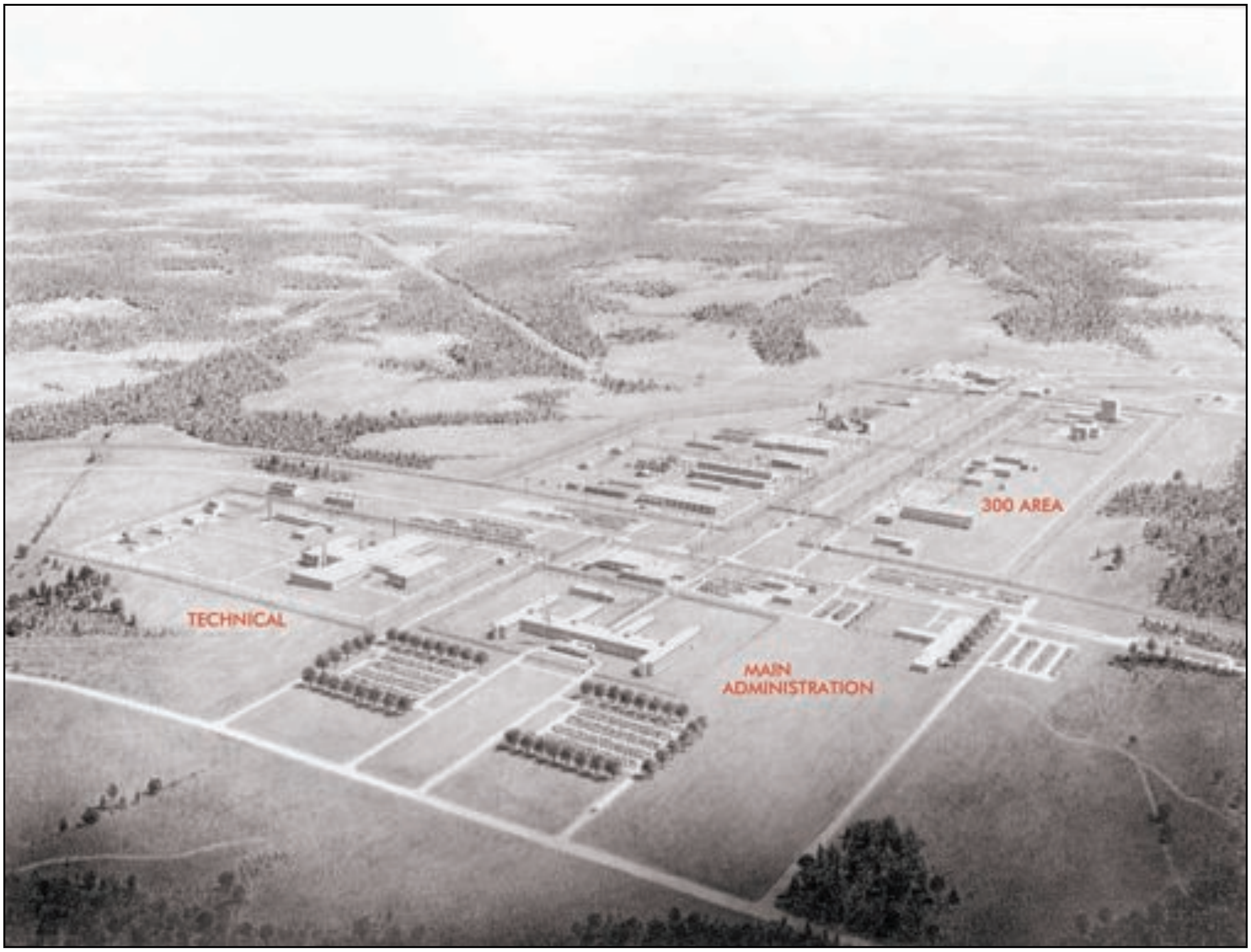
Subcontractors

It was recognized from the start that Du Pont Engineering Department would need supporting organizations to complete the project given its size and schedule. Temporary use was made of the Bush House located on Highway 19 as the Field Construction Office and a tenant farmer's dwelling was adapted for use as the Field Cost Office. The need for immediate construction buildings, while Du Pont was organizing, called for the hiring of a local architectural and engineering firm, Patchen and Zimmerman of Columbia, SC, to get things off the ground.[27] This firm's design work at the TC Area with its two massive cartwheel buildings and the adjacent cloverleaf created one of the most visually appealing layouts on site.

Engineering and design assistance on a truly massive scale was provided to Du Pont by the following subcontractors: American Machine and Foundry Company, Blaw-Knox, the Lummus Company, Gibbs & Hill, Inc, and Voorhees, Walker, Foley & Smith. Each of these firms had demonstrated experience in their respective areas and each made significant contributions to the equipment and SRP building stock.

Table 2. Subcontractors for Du Pont Project 8980

American Machine and Foundry (AM&F) - This firm was charged with the design and fabrication of special mechanical equipment for use in the 100, 200, 300, and 400 area process facilities. AM&F described their firm as manufacturers of machines for industry. In 1950 they were considered the world's largest manufacturer of cigarette and cigar making equipment, but they had other specialties too. In 1948, they had begun a program to capture military contracts for equipment manufacturing.[28]
The Lummus Company - This firm was requested to design and partially procure six "GS" units (towers 116' in height) including the DW and finishing plants for the 400 area heavy water production facilities. This firm brought strong petroleum, petrochemical, and chemical experience to the project. Self-described as a network of men, minds, and machines dedicated to transforming ideas and capital into profit earning processes and equipment, the Lummus Company, international in scope and headquartered in New York, were expert in the design of distillation processes.[29] The 400-area design benefited from an agreement between the Girdler Corporation, which had designed the Dana Plant, and the Lummus Company for the exchange of technological information gained from the Dana Plant that could be applied at SRP.[30]
Blaw-Knox Company - Design of process buildings and equipment required in 200 area facilities, and general area facilities (600 area) related to 200 area processes.
Gibbs & Hill, Inc. - Design of steam, water, and electrical facilities for process areas and the overall plant. This engineering firm, based in New York, was later subsumed by Dravo Corp of Pittsburgh in 1965 then later sold to Hill International, a New Jersey based firm.
Voorhees, Walker, Foley & Smith - This architectural/engineering firm, located at 101 Park Avenue in New York City, was responsible for the design for all "service" buildings including laboratories and general facilities. This included roads, walks, fences, and parking areas; the manufacturing buildings in the 300 area; laboratories; some design work for 200 areas and overall site clearance at SRP. This firm had a strong track record with the MED. They redesigned the MED laboratories at Columbia University and later completed work at Argonne National Laboratory for the AEC. This firm was also responsible for Du Pont's Experimental Station in Wilmington.[31]
New York Shipbuilding - This firm was responsible for fabricating the five reactor vessels that were transported by barge to SRP. Known as the NYX Program, this effort produced the cover plate of the reactor vessels, known as the "plenum" (a laminated steel plate 19 feet in diameter, four feet thick, weighing about 100 tons, and drilled with 500 4-inch tubes), the reactor vessels, and the primary piping.[32] Organized in 1899, New York Shipbuilding was located on the banks of the Delaware River in South Camden, New Jersey. The firm brought its experience in the fabrication of heavy industrial equipment and machinery to the task. A company history notes that the firm had taken on projects as "a public service where the facilities of the Yard provided the only available means for constructing unusual items. Its location on tide water, with weight handling equipment up to 300 tons, makes it possible to load assemblies which may be beyond the size or weight limitations for shipment by rail."[33] These qualities were probably well known to Du Pont, which also had a plant in the area of Camden, New Jersey.



Architectural Rendering of the Main Administration Area (700-A) and the Fuel and Target Fabrication Area by Architects Voorhees, Walker, Foley & Smith, circa 1951.

PEACETIME DEVELOPMENT OF ATOMIC ENERGY

The tug-of-war between military and non-military applications of atomic energy was present at the inception of the AEC. Senator Brien McMahon of Connecticut championed civilian control over atomic power, and his bill, which became the Atomic Energy Act of 1946, barely beat out others that championed direct Army control. [34] Congress passed the McMahon Bill in July, and Truman signed it into law the following month. According to this act, the AEC was to become effective December 31, 1946/January 1, 1947.

After advice or directives had filtered through the Commission, the Office of the General Manager carried out the directives, with work divided into various divisions, such as Production, Raw Materials, Military Application, Research, Engineering, Biology and Medicine, and Administrative Operations. [35] Even though the AEC's main mission was defense-related (peaceful use of the atom was not even a formal part of the Atomic Energy Act of 1946), civilian control meant that there was always a push at the AEC to justify atomic energy use for non-military purposes.

The early leadership of the AEC certainly demonstrated this interest in the non-defense mission. David Lilienthal, appointed as the first chairman of the AEC by Truman in October 1946, was himself a strong proponent of the peaceful use of atomic energy, taking his case to the public in a number of articles that tried to correct the popular perception that nuclear energy was just for bombs.[36] Among the peaceful uses of the atom listed by Lilienthal were the control of disease, new knowledge of plants and the workings of the natural world, and even incredibly cheap electricity provided by nuclear power plants.[37]

During the Korean War, 1950-1953, little was heard about the peaceful use of the atom. With the close of that conflict, however, President Eisenhower reopened this potential with his "Atoms for Peace" address at the United Nations on December 8, 1953.[38] In direct response to this initiative, Congress passed a new Atomic Energy Act in 1954 that essentially amended the original act to allow for international cooperation in the development of atomic energy and in the civilian use of atomic energy. This allowed domestic utility companies to build and operate nuclear power plants. [39] The 1954 Atomic Energy Act not only broadened the scope of the AEC, but also allowed nuclear energy to be used outside of its purview. While peaceful uses of the atom had always been an interest of the AEC, it was now an official part of its charter.[40]

Purely scientific studies, like the neutrino research conducted at SRP in 1955-1956, were just the beginning of the non-defense mission conducted at AEC facilities. In addition to the Oak Ridge School of Reactor Technology, established in 1950, the AEC sponsored a five-year reactor development program in the mid-1950s, designed to test five experimental reactors for potential use.[41] Out of this work came two broad agendas: the breeder reactor program, which was largely for the Navy, which was keenly interested in nuclear power for ships and submarines; and power reactor research for civilian use.

The use of nuclear power for the production of electricity was first done in December 1951 at the National Reactor Testing Station (later, the Idaho National Engineering Laboratory). In 1955, this capability was expanded to Arco, Idaho, the first U.S. town to be powered by nuclear energy.[42] The development of commercial power reactors soon spread to selected spots throughout the country, using reactor types that varied from the heavy-water cooled and moderated variety found at SRP and favored by the AEC, to the light-water reactors favored by the Navy. Other reactors, like Hanford's N-Reactor, were dual purpose, capable of both nuclear materials production and power.

The AEC favored the development of heavy-water power reactors, and the SRP was closely involved in the AEC plans to provide this technology to commercial utilities throughout the country. By the late 1950s, heavy-water power reactor studies were commonly produced at the Savannah River Laboratory, and these studies culminated in the design and construction of the Heavy Water Components Test Reactor (HWCTR), built and operated at SRP in the early 1960s.[43] During this same period, and drawing on technical data obtained from HWCTR, the Carolinas-Virginia Tube Reactor, near Columbia, South Carolina, became the first heavy-water moderated power reactor in the U.S.[44]

Despite AEC efforts to push heavy-water power reactors, the example of HWCTR and the Carolinas-Virginia Tube Reactor was not generally emulated in the United States (HWCTR itself was closed down in 1964).[45] As early as 1962 U.S. utility companies showed a clear preference for light-water reactors.[46] These reactors, using pressurized light water, were based on research that came out of the U.S. Navy's reactors program, especially the Navy's light-water reactor at Shippingport. Ironically, the AEC "Atoms for Peace" program, which provided partially enriched uranium to commercial reactors, worked against the AEC heavy-water reactor program: heavy-water reactors might have been more popular if utility companies had been forced to use natural uranium.[47]

Speaking in 1963, Lilienthal described Eisenhower's "Atoms for Peace" initiative as "still alive, but in a wheelchair."[48] While almost surely in reference to the international aspect of that initiative, Lilienthal's comment could be said to apply to the AEC's program to spread heavy-water power reactor technology to U.S. utility companies. Despite considerable research and achievements, the program simply did not progress in the direction intended.

With the reduction of the AEC's military mission in 1964, the stage was set for another series of programs to further develop the peaceful use of the atom. These new initiatives were two-fold: provide isotopic heat sources for the U.S. space program, then becoming a major national concern; and contribute to the transplutonium programs that were pushed by Glenn Seaborg, one of the discoverers of plutonium and chairman of the AEC from 1961 to 1971.

Among the isotopic heat sources produced for the space program was cobalt-60, desirable because it did not produce a decay gas.[49] Another isotopic heat source requested of the AEC was curium, and the production of this material dovetailed with the transplutonium program.[50]

The heavy-water reactors at SRP were pivotal to the transplutonium campaigns, which began with the production of curium during the Curium I program (May-December 1964). The successful attempts to produce curium and other heavier nuclides led to a succession of programs conducted at SRP and coordinated throughout AEC facilities nationwide. These programs included the High Neutron Flux program, both at SRP and at Oak Ridge, where the High Flux Isotope Reactor (HFIR) began operation in 1965.[51] Curium II (1965-1967) completed the required production of curium, and provided a start for the most ambitious of the transplutonium campaigns: the production of californium. The Californium I program (1969-1970) was designed to produce enough californium to make the isotope available to industry and private sector interests.

The production of californium went hand-in-hand with the Californium Loan Program, sponsored by the AEC to help create a potential industrial and medical market for this powerful neutron source.[52] Despite the best of intentions, however, most of this work was in vain. Even though samples of californium were distributed to willing participants throughout the country and elsewhere in the 1970s, no viable market developed for what was still an expensive isotope with a relatively limited application.

The problems inherent in the Californium Loan Program were ones that plagued other potential applications of atomic energy for non-military use: the expense was simply more than the limited market would bear. The transplutonium programs, while wildly successful as scientific endeavors, failed to take up the slack left by the reduction in the defense mission. In the case of SRP, the production reactors were just too expensive to maintain and operate for the production of non-defense nuclear materials.

When the defense mission when into eclipse in the late 1980s, the non-defense mission, especially that for production reactors, went into decline as well. The close of the Cold War in 1989 solidified the forecast for Savannah River and the other production sites. The rise of environmentalism in the 1970s had already made inroads into nuclear progress, changing American attitudes about the safety of nuclear production plants and nuclear power plants. The promise of nuclear energy was increasingly called into question and new regulators and environmental regulations were placed into effect. While the ramp up of military might under Reagan characterized the start of the decade, by its close, world affairs and changing public opinion created new missions related to environmental clean-up and restoration rather than nuclear materials production.

ENVIRONMENTALISM, EXPANSION, AND CHANGE

At the end of the Carter Administration and throughout the Reagan years (1980-1988), there was resurgence in the production of nuclear weapons materials. This reaffirmation of the nuclear weapons complex was opposed by the environmental movement and then halted by the end of the Cold War. All of this led to conflicting changes at Savannah River Plant, especially in the 1980s. The decade opened with new requirements set by the Department of Defense for plutonium and tritium that directly translated into physical change for the plant. New construction occurred in the process and administration areas to house new programs and personnel, worn facilities were repaired, and technical upgrades were made to operating systems and equipment. Updated security provisions and other physical changes were made with the installation of Wackenhut Services Inc. as the on-site security force.

While SRP expansion was gaining momentum, the environmental movement was also becoming a force that ultimately changed the nature of how the expansion would take place. The accident at Three Mile Island in 1979 drew national attention to the nuclear power industry and reactor safety. The environmental movement hastened change but it was the end of the Cold War in 1989 that shaped new missions for the Savannah River Site.

In December of 1974, the Environmental Protection Agency issued the first sanitary NPDES permit for the Savannah River.[53] While this was largely pro forma, it was a harbinger of things to come. In subsequent years, there would be an increase in environmental regulation on federal lands, and Savannah River was not exempt from this trend. In 1976, the Resource Conservation and Recovery Act (RCRA) gave the EPA authority to enforce environmental laws on all Department of Energy weapons-production sites. As a result, regulatory agencies began to weigh in on the previously "closed" controversy over the relative merits of confinement and containment at nuclear reactors, as well as the need for towers to cool reactor effluent water, a feature that was already standard for commercial power reactors.

Despite a promising collaboration in the early 1970s, environmental regulation and the nuclear community did not have the same agenda, and this became clear during the mid- to late-1970s. Environmental regulators soon moved beyond a balanced concern for the environment and the search for new energy sources, and began to micromanage commercial and DOE facilities solely for the benefit of the environment. The nuclear community, long sustained by public awe of atomic power, now began to find itself under attack by a public that increasingly feared the atom and its residual effects. By the late 1970s, the average environmentalist was antinuclear and environmental regulators were responsive to that shift.

Carter, an "environmental president," was the first to promote alternative sources of energy, such as solar and wind power. The exploration of such avenues was in fact one of the main reasons for the establishment of the Department of Energy in 1977. This exploration did not extend to the nuclear industry. In addition to banning the reprocessing of spent nuclear fuels for commercial reactors, Carter put a stop to the breeder-reactor demonstration program started by Nixon.

In the early 1980s, President Reagan would attempt to revive both the commercial reprocessing of spent fuels and the breeder reactor program, but by this time interest had flagged both in Congress and within the U.S. commercial nuclear industry. The demonstrated abundance of natural uranium certainly played a role in this shift of opinion, but the biggest change would be the accident at Three Mile Island. Even though it was the worst accident to befall the U.S. nuclear industry, its most disastrous impact was in public relations.[54]

The impact within the industry was great. Many of the energy concerns and conservation programs conceived in the early 1970s were simply abandoned by the late 1970s and early 1980s. Due to environmental regulations and a lessening demand for nuclear energy that was apparent even in 1979, there was less concern about the uranium supply or the discovery of new uranium sources. This spelled the end of projects like NURE, and effectively put an end to any real demand for the reprocessing of spent nuclear fuels for commercial reactors.

Three Mile Island also had an impact on the nation's production reactors. Up to that point, reactor safety had concentrated on the prevention of major accidents, with an acceptance of certain low-level risks as a requirement of the job. In the wake of Three Mile Island, however, more thought was given to low-probability accidents, and to ways of reducing reactor power levels as well as levels of radioactivity. With this new emphasis, "Loss of Coolant Accidents" (LOCA) became a major concern of the 1980s.[55] With LOCA raised to greater significance, there was a corresponding rise in the importance of Emergency Cooling Systems or ECS. The idea behind the Emergency Cooling System was that even after shutdown, the ECS could still supply cooling water to a reactor in the event of an emergency. Throughout the nuclear industry, and certainly at Savannah River, Emergency Cooling Systems were added to reactors or were augmented in the years after 1979.[56]

At the other end of the nuclear process, Three Mile Island also focused attention on the problem of radioactive waste, a dilemma that had never been permanently resolved. There were two types of radioactive waste, low-level and high-level, and both had their unique problems and potential solutions. The Low-Level Radioactive Waste Policy Act of 1980 made every state responsible for the low-level waste produced within its borders. Even though the solution to most low-level waste involved burial, progress in implementing this law was so slow that Congress was forced to amend the act to give several states more time to comply.[57]

The problems associated with high-level waste, especially those of the defense industry, were greater and more intractable. Here, simple burial was not adequate, even though the idea of "geological disposal" of high-level waste had been proposed in underground salt deposits and at Yucca Mountain, Nevada, since at least 1957. Storage in high-level radioactive waste tanks was the preferred method of disposal, but this was recognized to be a temporary solution, and never more so than when the first serious leaks began to compromise the tanks in the early 1970s.[58] By the end of the decade, it was acknowledged that there would have to be some sort of "Defense Waste Processing Facility" to provide a more permanent solution to the problems of storage.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, also known as the "Superfund" legislation, helped provide the resources to clean up radioactive waste sites around the country. The money came with strings attached. The EPA and the states under authority delegated by the EPA were given more authority to regulate DOE weapons production sites. The Nuclear Waste Policy Act of 1982, which President Reagan signed into law in January 1983, followed this law two years later. Robert Morgan, manager of SROO between 1980 and 1988, played a significant role in carrying out this act, which required the Department of Energy to establish a long-term site for the permanent disposal of the waste generated by nuclear power plants.

III. SITE SELECTION AND GEOGRAPHICAL ORGANIZATION

The proposed site, referred to as "Plant 124," was selected after a six-month investigation launched by Du Pont's Engineering Department and aided by the U.S. Army Corps of Engineers (COE). President Truman had advised AEC's Gordon Dean not to brook any political pressure in the decision-making process and the selection process began on June 19, 1950.[1]

The AEC had first contacted the COE and asked them to prepare a list of sites including government-owned lands that might be suitable. This preliminary data was reviewed in the Cincinnati Corps Office of the Great Lakes Division but was found lacking in definition. The following methodology was agreed upon: all rivers with a recorded minimum flow of 200 cubic feet per second (c.f.s.) were marked on sectional maps prepared by the Corps and locations within 20 miles of these rivers were considered. Bands were drawn along selected rivers and potential sites were located within these bands. The preferred site would also be located in the "The First Defense Zone" for strategic reasons imposed by the Department of Defense. This zone encompassed an area that stretched from Texas to Virginia and north to Illinois. Embracing the central portion of the Southeast, it included 84 candidate sites. A second band of area that stretched from Arizona to New Hampshire was considered the "Second Defense Zone." The latter had six candidate sites. C. H. Topping, Principal Architect and Civil Engineer within Du Pont's Design Division, further described the selection process that was guided by "basic site requirements" that were jointly arrived at by Du Pont and the AEC. The requirements were: a one-square mile manufacturing area; a 5.6 mile buffer zone enclosing the manufacturing area; a 10-mile distance to neighboring communities of 500 individuals and a 20-mile distance from communities with 10,000 individuals; presence of supporting populations to absorb the incoming workforce; ample water and power supplies; accessibility by rail and highways; favorable meteorology and geology; and positive conditions for construction and operating costs.[2]

Site Selection Map Showing Military Defense Zones and the Location of Candidate Sites

All of this established the basic importance of sheer distance as the main ingredient in reactor safety. In the late 1940s and early 1950s, when atomic reactors were few and policies such as confinement and containment were unknown, geographic distance was the only real security from a nuclear blast or a poisonous radioactive leak.[3]

Sixty-five sites were eliminated when progress in reactor design studies established that the minimum acceptable water supply was 400 c.f.s. By August 2, the list was pared down to seven sites. Members of the Atomic Energy Commission, Army Corps of Engineers staff, and the Du Pont team, between August 6 and 17, chose these as candidates for a field inspection. Three local sites made it to this shortlist: two in South Carolina and one in Georgia. The site in Georgia was eliminated when it was learned that the Clark Hill reservoir would put a portion of the desired site under water and a site in northwestern South Carolina was considered too isolated. Site No. 5 in Aiken and Barnwell counties stayed in the running.

Changing water requirements also led to searches in colder climate areas both within and outside of the Second Defense Zone. These sites were put into the selection mix and similarly eliminated as the selection criteria were applied. In mid August, the requirement for the minimum water supply was increased to 600 c.f.s. The Special Committee of the National Security Council on Atomic Energy had called for the construction of three additional reactors.[4]

A final evaluation of sites using the original and expanded criteria focused on four locations. These were Site No. 125, which was located along the Texas and Oklahoma border on the Red River; Site No. 59 which was located on the border of Illinois and Indiana on the Wabash River; Site No. 205 which was located on the shores of Lake Superior in Wisconsin; and Site No. 5 located in Aiken, Barnwell and Allendale counties on the Savannah River in South Carolina. Essentially, three factors were compared. The first was the availability of large quantities of reasonably pure water for process capability, the second was the presence of towns of sufficient population that could absorb the proposed labor force but were at a sufficient distance to minimize any impacts, and third, the presence of sufficient land that was suitable to the construction of production areas. During the week of August 24th, these sites were field checked by the AEC's Site Review Committee composed of five experts drawn from American engineering firms such as Black and Veatch, Sverdrup, etc., that were authorities on site selection.

Site No. 5, a rural site along the Savannah River in South Carolina, was recommended to the Site Review Committee on November 13, 1950 as the final selection. In the words of Du Pont Engineer, C. H. Topping, it "more nearly meets the requirements than do the others."[5] The Site Review Committee concurred with the recommendation and Site No. 5 was selected. The AEC formally confirmed the decision on November 28 and the public was notified by an AEC press release on the same day. AEC's Curtis A. Nelson was named as the plant's first local manager in August. Nelson, a Nebraska born civil engineer and colonel in the Manhattan Project, was familiar with heavy water technology through his work as a liaison with Canada's Chalk River Plant. He also brought strong construction experience to the new project from his years in the Civilian Conservation Corps and as engineer in the Corps of Engineers where he had supervised the construction of the Joliet Illinois Ordnance Plants.[6] He was charged, along with Bob Mason, Du Pont's Field Manager for Construction, with moving the project off the Du Pont Company's and their subcontractor's drawing boards and placing nine industrial plants into the rural South Carolina landscape. Mason, a Hanford veteran, was assigned to the project on September 25.

Meeting at Ellenton Auditorium, December 6, 1950. The U.S. Corps of Engineers real estate officers responsible for the land acquisition called a public meeting in Ellenton. A representative from each family was asked to attend the question and answer session. Reportedly, over 500 individuals attended what appears to have been a segregated meeting with attendees, both black and white, spilling out of the main hall into the building entries and lobby. Courtesy of SRS Archives, SRS Negative 1221-1.

ANNOUNCEMENT

The swiftness and military execution of the site selection announcement attests to the months of planning involved in its preparation. At 11 o'clock on Tuesday morning, November 28, 1950, the announcement was made simultaneously at press conferences held in Atlanta and Augusta in Georgia; at Columbia, Charleston, and Barnwell, in South Carolina; and to mayors, presidents of chambers of commerce, state, city, and county officials. During the day, teams representing both AEC and Du Pont called on city, county, and state officials in Atlanta, Columbia, Augusta, Aiken, Barnwell, Ellenton, Jackson, Dunbarton, Snelling, Williston, White Pond, Windsor, and Blackville. Later in the day further details were released concerning the project by the AEC in Washington, D.C. Teams gathered that evening in the office of the Du Pont Field Project Manager at the Richmond Hotel to compare notes.[7]

AEC Field Manager Curtis Nelson and Du Pont's Chief Engineer formally delivered the news to Governor Strom Thurmond and Governor-elect James F. Byrnes in Charleston, South Carolina, where they were attending the Southern Governors Conference. Governor Thurmond invited Georgia's Governor Herman Talmadge to join in the press conference prepared for the journalists covering the conference. The timing of the announcement for what could only be forecasted as a regional economic success story was excellent for both Thurmond and Talmadge. Byrnes was well versed in atomic energy development for military purposes. He had acted as Franklin Roosevelt's "assistant President," running the country while FDR fought the war and he was Truman's Secretary of State.[8] All three men were major figures in national and Southern politics and it is unlikely they watched the site selection process unfold without knowledge or interest.


The Augusta Chronicle
$260,000,000 H-bomb material facilities will be constructed in S. C. near Augusta
Allies facing 'new war'
Grim note is voiced by Gen. MacArthur
Aiken-Barnwell site is selected for plant
Shocked officials seek urgent steps
Plant means big boom for Augusta
Ellenton's residents stunned, but accept news patriotically

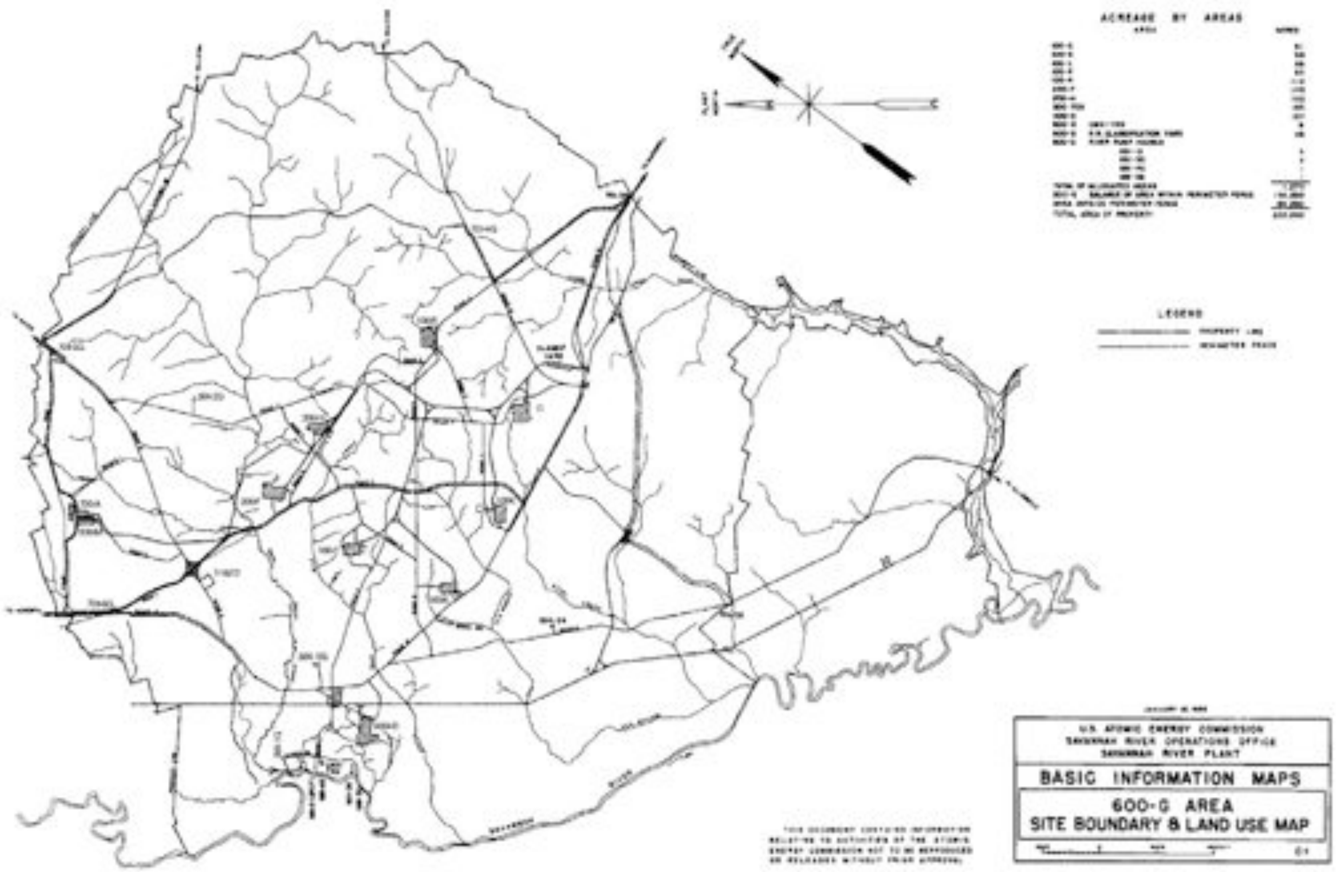
Front page of The Augusta Chronicle, November 29, 1950, reported on the announcement from several angles reflecting the many meanings the plant would have for the country, the CRSA, and for those displaced by the proposed land acquisition.

The public announcement of the project signaled a new era in which the American public's right to know was at least partially fulfilled. Previous military atomic energy undertakings had been done in total secrecy as part of a wartime defensive effort. The Savannah River Project was complex and atypical as it was to be constructed during peacetime, its mission still required secrecy, and a government town was not to be constructed. The latter meant that the surrounding communities, which were fairly settled, were to absorb the new workforce estimated in the thousands and to create the infrastructure and services needed for this population increase. Public disclosure was warranted and unavoidable. A straightforward approach was chosen in which public outreach and partnership initiatives were advocated. Public meetings, lectures, project managers working with community development and business leaders, and the airing of a movie called The Du Pont Story in Augusta for business leaders and new employees were just some parts of the AEC and Du Pont's well-orchestrated strategy for strong and positive public relations.

GEOGRAPHICAL ORGANIZATION

SRP was originally organized into nine manufacturing areas, a central administration area, and two "service"-building building areas known as the Temporary Construction Area (TC Area) and Central Shops. Between building areas, buffer areas were forested, masking the earlier landscape and providing a sense of distance and isolation.

Each area was given a number and a unique letter designation (Table 2). Function was reflected in the area numbers; letters identified site geography. This code-like system, used first at Hanford for the identification of building areas and their associated facilities, and the road lettering system heightened the anonymous and utilitarian character that evolved at the site.



1956 Basic Information Map - General Areas

Table 2. Area Nomenclature

100 - Reactor Areas	100-R, P, L, K, and C
200 - Separations Areas	200-F and H
300 - Fuel and Target Fabrication Area	300-M
400 - Heavy Water Production Area	400-D
500 - General (lighting, transmission lines, substations, etc)	500-G
600 - General	600-G
700 - Administration Area	700-A
900 - General	900-G

Each 100 Area, 100-R, 100-P, 100-L, 100-K, and 100-C, was situated within the manufacturing core in the central part of the site, aligned in an arc. After considerable discussion, the reactor areas were purposely dispersed at 2.5-mile intervals from each other and 6 miles from the site boundary to minimize the impact of an "atomic blast." Early maps show the site layout process and the reservation of space or alternative sites for future expansion. The Engineering and Design History[9] notes that much discussion occurred between Du Pont and AEC consultants on where the process buildings should be located, however it was the U.S. Air Force that had the final word on their dispersal, suggesting that the pattern chosen had military ramifications. Two river water pump houses, one at the mouth of Upper Three Runs Creek and a second two miles upstream from the first, supplied water to the 100 Areas, primarily for cooling the heavy water coolant.

The two 200 Areas, 200-F and 200-H, were also centrally located within the site's core area, approximately 2.5 miles from the closest reactor area and about 6 miles from the project area perimeter. The canyon buildings, massive concrete buildings, dominate each separations area. F Area contained four process buildings originally and was built to be self-sufficient. H Area did not contain the same process buildings but space was allotted for future expansion. Water to both 200 Areas is supplied from deep wells.

The 400-D Area, located near the site's southwest perimeter, approximately one mile from the river, housed heavy water production units and support buildings. Resembling an oil refinery, the 400 Area was characterized by three steel tall tower units, a flare tower, a finishing facility and other support buildings including a powerhouse. After SRP was closed to the public, this area was viewable from outside the site boundaries and the GS towers and flare tower was the visual image most area residents connected with SRP. A river pump house supplied water to 400 Area.

The 300-M Area was situated near the northwest perimeter of the project area where it was laid out in a rectangle that adjoins the 700 Area. It contained testing and fabrication facilities for reactor fuel and targets. Two buildings, 305-M (now 305-A) and 777-M (later 777-10A), contained test reactors that were used to test the components manufactured in the 300 Area and to aid development and testing for SRP reactor design.

The 700-A Area would be SRP's administrative and "service" center. It would contains the main administration building noted in the excerpt above, the medical facility, communications facilities, patrol headquarters as well as a variety of maintenance and storage buildings. A Area also contained 773-A, the Main Technical Laboratory, now Savannah River National Laboratory, in which plant processes were researched, designed, and tested, and other research facilities.

Finally, two pilot plant facilities, CMX and TNX, were to be located near the 400 Area. The former was designed to run corrosion tests on heat exchanger equipment installed in the reactors and to investigate what types of water treatment processes were needed for plant operations. A small pump house accompanied it. The latter was a pilot plant for processes completed in the 200 Area canyons.

The first generation of buildings at SRP was simply designed using a functional ethic. The AEC's specification that the project's buildings be spartan in their design was a done deal given the climate of American post-war industrial architecture. The choice of building materials, reinforced concrete and TransiteTM paneling, were mandated by the building code. Articulated in reinforced concrete or steel frame with Transite panels, the majority were beige or gray boxes built for maximum flexibility and for government service. Their uniformity in color, their number and size, and their geometric forms create a harmonious grouping of buildings within an ordered industrial landscape.

UNFOLDING SCOPE OF WORK AND FLEXIBLE DESIGN

By Hanford standards, the 38 months from the start of SRP construction to the operation of C reactor was quite slow. However, by the standards of a later generation of nuclear engineers, such a pace is incredibly rapid. The placing of R reactor in operation in December 1953, when the conceptual design had only been sketched out in December 1950, seemed to later nuclear specialists a remarkable achievement in engineering and management.[10]

The scale, shape, and funding of the Savannah River Project and the mix of plutonium, tritium, and other radioisotopes to be produced in its reactors was determined by the AEC. The schedule was set by world events. Du Pont's design team, in association with their primary subcontractors, was responsible for translating the larger conceptual design outline by the AEC into reality within an atmosphere of "urgency and commitment."[11] Du Pont designers accomplished their goals using a "flexible design" approach. This approach operated at two levels: the first entailed postponing design decisions until the best design could be determined by research or through consultation, and the second was to build in the potential for future design options should AEC policy change.

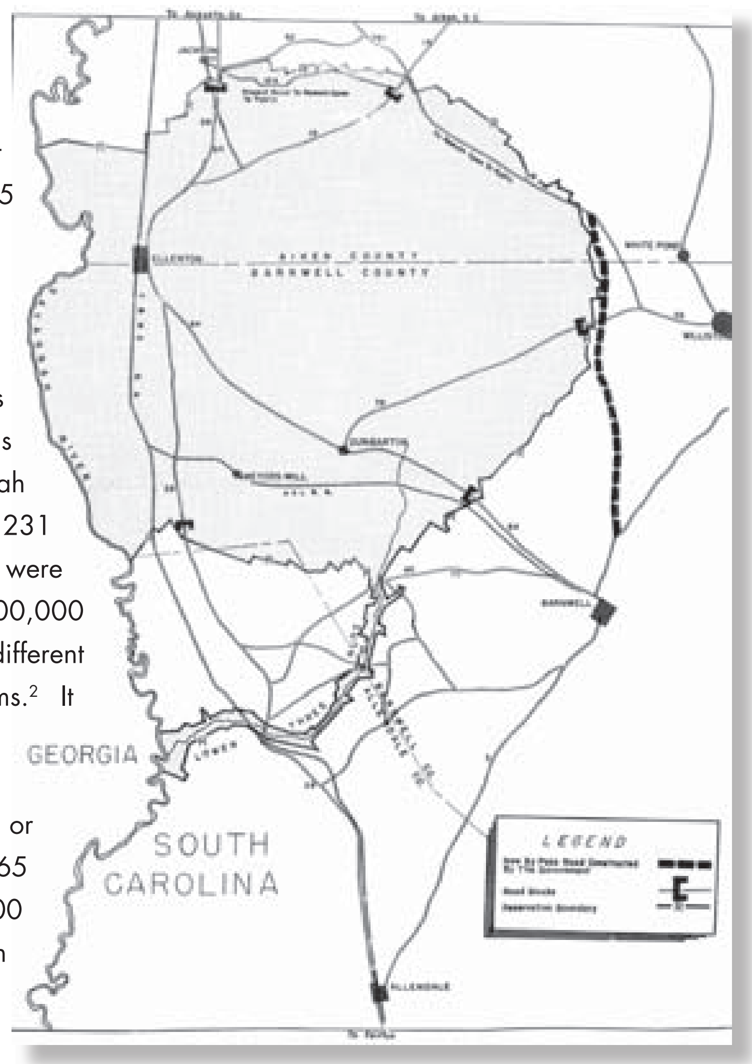
In the first scenario, Du Pont designers based some design decisions on their experience from previous atomic energy plant construction projects and from scientific research completed at the AEC's national laboratories. This allowed them to move forward with production in some areas while alternative design choices were researched for others. In the second scenario, postponement of design was necessary as part of the current and future client-contractor relationship. AEC directives, based on Department of Defense guidance on what product or product mix was needed for its weapons program, directly translated into design decisions. Du Pont recognized this as an integral feature of their contract and responded with aplomb to an evolving scope of work. Their ability to do so was characteristic of the firm's management that had an internal set of departmental checks and balances and well-honed procurement strategies.

IV. SRP INFRASTRUCTURE LAYOUT

ENVIRONMENT AND LOCATION

As the previous chapter demonstrated, the decision to put the new nuclear facility at Site No. 5 in South Carolina was made by Du Pont and was then approved by the AEC. The location was within the First Defense Zone, which was furthest from the reach of possible Soviet bombers, but the site was selected mainly because of the Savannah River. The site had to be within 20 miles of a river with a sustained flow of at least 400 c.f.s., later raised to 600 c.f.s. This amount would be essential for cooling the reactors. The area for the plant had to have a low population density to prevent disruption, but it had to be close to a city, in this case, Augusta, Georgia. In fact, the proposed plant was 20 miles southeast of Augusta and 15 miles south of Aiken, South Carolina. It was also close to military bases. Camp Gordon, Oliver General Hospital, and its annex, Daniel Field, and the Augusta Arsenal were less than 26 miles from the proposed site. The proposed dimensions of the plant were about 22 miles both north-south and east-west, anchored along the east bank of the Savannah River. Elevations ranged from around 125 feet above sea level at the river, to as much as 385 feet towards the east end.[1]

There may not have been many people within the boundaries of the new plant, but there were at least 6,000, representing some 1,500 families and four communities. The largest of these was Ellenton (600), located close to the Savannah River. The second largest was Dunbarton, with 231 people. By the time the boundaries of the plant were settled in the mid-1950s, it encompassed over 200,000 acres, which had originally comprised 1,706 different property tracts, 1,250 of which had been farms.[2] It has been estimated that one third of the site area was covered by open land (farms and pastures), while the other two-thirds consisted of woods or cutover woodland.[3] There were also around 165 cemeteries within the area, including some 6,000 graves, some unmarked. During the Construction period, it was found necessary to remove 124 of these cemeteries, with 4,980 graves.[4]



Map of SRS, date unknown, SRS Negative M-1574

View of Ellenton, SC, date unknown, SRS Negative M-131-2

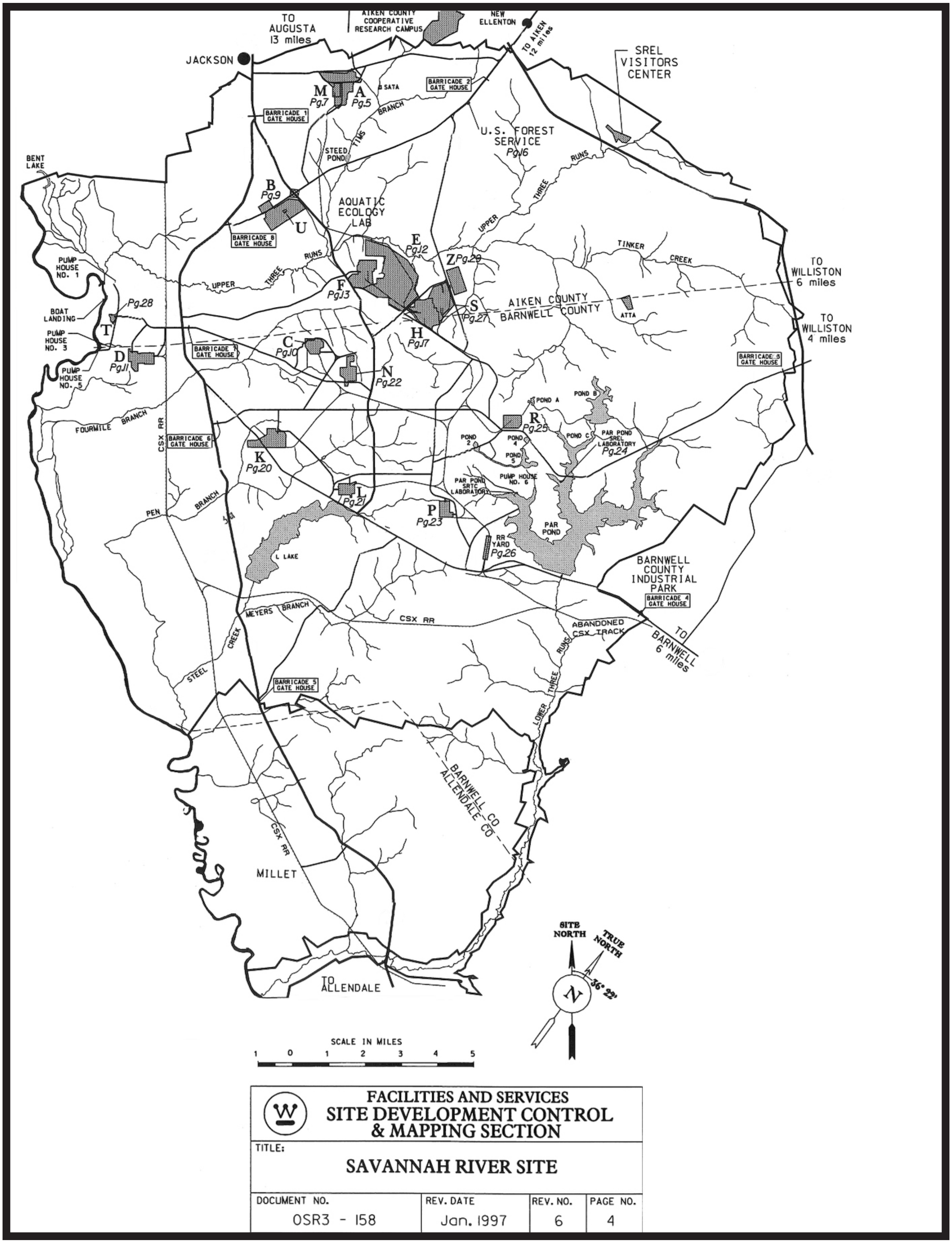
View of Dunbarton, SC, date unknown, SRS Negative M-642

Important features of the local landscape were the six streams that drained almost all of the Savannah River Plant and flowed from east to west, to the Savannah River. From north to south, those streams were: Upper Three Runs Creek; Four Mile Creek; Pen Creek; Steel Creek; Hattie Creek; and Lower Three Runs Creek. The largest of these streams were the northern-most and the southern-most: Upper and Lower Three Runs Creeks.[5] These streams were important, not just as obstacles to be overcome with road and railroad bridges and culverts, but also as conduits for the reactor cooling water that would exit the reactor buildings as effluent and flow back to the Savannah River.

The site was good for the requirements of the reactors, but less so for the infrastructure that would have to support the reactors, the separations operations, and indeed every sort of activity that might occur at Savannah River Plant. There was no need for large bridges, but there would have to be a number of smaller ones. The road system would have to be reworked, and that was certainly true of the railroad system. The electrical system would have to be built from scratch.[6] The use of this huge tract of land as a safety buffer would also make it difficult to construct the infrastructure needed to support the nuclear facility. The five reactors and the two separations areas would be situated in a tight circle inside the plant boundaries, but the infrastructure would have to connect them all and tie them to the outside world.

Everything built in the way of infrastructure at Savannah River Plant would have to connect all of the separate work areas, and provide them with services that were absolutely essential to their function. Without roads and railroads, electricity and water, nothing was going to happen anywhere. Infrastructure was so important that it effectively had its own area, know as "G Area"; G Area represented the whole plant outside the limits of the other individual work areas.

Due to the urgency of the Savannah River Plant, it was essential that the plant facilities be erected as quickly as possible. Since infrastructure work had to be completed before anything else, it was essential to begin this work immediately after the announcement of the plant. In fact, infrastructure work began just days after the public announcement, in December of 1950, and continued throughout the following year. Much of it was basically complete by 1952. The big design challenge of the infrastructure work was not knowing the full range of what would be required. In 1950 and 1951, Du Pont Design and its various subcontractors were still hashing out the details of the overall system. In many cases, infrastructure had to be installed without knowing exactly how everything would mesh, or even what the final design would be. It was therefore essential to keep everything as simple and open-ended as possible.



Modern Map of SRS Showing Major Streams, SRS Atlas

Roads had to be consolidated or constructed first, followed in rapid succession by the railroads, the electrical facilities, and the water facilities. Not only was the construction of these facilities virtually simultaneous, it was on a large scale. Savannah River Plant was the size of a city, with an infrastructure that was much more complicated. It was also constructed with the effects of an atomic blast foremost in mind. This required a special kind of construction, based on what was expendable and what was not.

This led to the development of three different classes of construction that encompassed every single building or structure at Savannah River. The first, called Class I, was construction built to be blast proof with a nuclear detonation 2000 feet above ground and some 2500 feet away horizontally (it was assumed that nothing would survive a direct hit). Class II was considered friable construction, with a blast proof frame but an expendable building skin. Class III was normal construction, which was considered completely expendable.[7]

TWO ERAS: CONSTRUCTION AND OPERATION

Work at Savannah River Plant was divided into two main periods: Construction and Operation. The Construction Era lasted from early 1951 to 1954-55, depending on the area. Operations took over after the plant was complete, and continues on to this day. The plant's infrastructure not only had to be ready for Construction, it was more heavily used during Construction than it would be later. The roads and railroads, in particular, had to be ready before other work could commence. At the peak of Construction, in September of 1952, there were 38,582 workers on site, by far the greatest number that would ever work at the plant. By January of 1954, the number of Construction workers would drop to 16,667, with Operations at 6,193, with an AEC staff of another 260. Operations would later increase to just over seven thousand.[8] With Construction workers going to and from work every day, and with huge quantities of building supplies coming in, the roads and railroads of the plant got their greatest work-out in the very first years.

Du Pont Planning

A massive facility like Savannah River Plant could never have been built so quickly without a huge amount of planning. Du Pont was known for this sort of planning, and they had experience. Du Pont had constructed the Hanford plant in Washington State during the Manhattan Project. These were the main reasons Du Pont was selected to construct and operate the Savannah River Plant facility.

Du Pont considered "design" to be just as important as "construction" and "operation." The company insisted on being in charge of all three arenas, even if they subcontracted the work to other firms. Proper design was essential for the efficient functioning of every major building and piece of equipment, and it was essential for the development of infrastructure too.[9] With so many details still unresolved in the design features of many of the buildings and processes, it was essential that Du Pont keep the infrastructure design as simple and versatile as possible. This made the "unit system" essential to the infrastructure features of the plant. As practiced by Du Pont, the unit system was the idea that numerous smaller engines or units of work would be more efficient and practical in the long run than just one large engine. If a large single unit breaks down, the entire system is down. In the unit system, a single unit can be repaired or replaced while the other units carry on the work. As it turned out, this proved to be a valuable concept. This was particularly true in the Power facilities, where it was found economical to run the powerhouses and the river pump houses with a number of relatively small boilers or pumps, rather than invest in large machines.

Du Pont also had the experience of running a number of different industrial facilities. Hanford, of course, was the key to Du Pont winning the Savannah River contract. It was one of the first nuclear facilities in the world, and many of the arrangements ironed out at Hanford would also work at Savannah River. Du Pont also ran the Dana Plant in Indiana, which was basically under construction about the same time as Savannah River. The techniques used to produce heavy water at Dana would be employed to do the same thing at D area at Savannah River Plant. There was another connection with Dana, especially with infrastructure. Many of the official specifications used at Savannah River were cribbed directly from Dana, often without even changing the title. This applied to the construction of roads, railroads, and even parking arrangements.[10] Even Don Miller, who would serve as plant manager from 1953 to 1957, was pulled directly from the Dana Plant.[11]

Other, more local Du Pont facilities proved useful to infrastructure as well, since they shared the same climate. The May Plant "Orlon" acrylic fiber unit on the Wateree River in Camden, South Carolina, usually referred to simply as the Camden Plant, was often used as an example of what to do for such infrastructure features as roadways.[12]

SRP Departments

Du Pont had an organizational scheme for Construction that was markedly different from Operations. Under Construction, the SRP departments included Layout, Earthworks, Pipe, Electrical, Paint, Transportation, Mechanical, Sheet Metal, Boilermakers, Testing and Inspection, Field Engineering, Control, Carpentry, Structural Iron, Labor, and Engineering Office, among others.

When Operations took over, the departments were, in no particular order: Traffic and Transportation, also known as T & T (Traffic, Automotive, Railroad, Labor and Heavy Equipment, and Equipment Maintenance divisions), Reactor, Reactor Technology, Health Physics, Separations, Separations Technology, Project (for varied engineering services), Methods and Standards (for improved quality and cost reduction), Raw Materials (300 Area), GS (heavy water), Works Technical (which included the Laboratory, Metallurgical Technology, and D Area Technology), Power (responsible for generating electricity), Electrical (delivering electricity and maintaining generators), Maintenance (including carpenters, welders, mechanics), Personnel, Instrument, Security (Security and Patrol divisions), Service (fire protection, safety, laundry), and Employee and Public Relations.[13]

For the infrastructure study, the focus is on Traffic and Transportation, Power, Water, Electricity, Security, and Service.

Du Pont Subcontractors

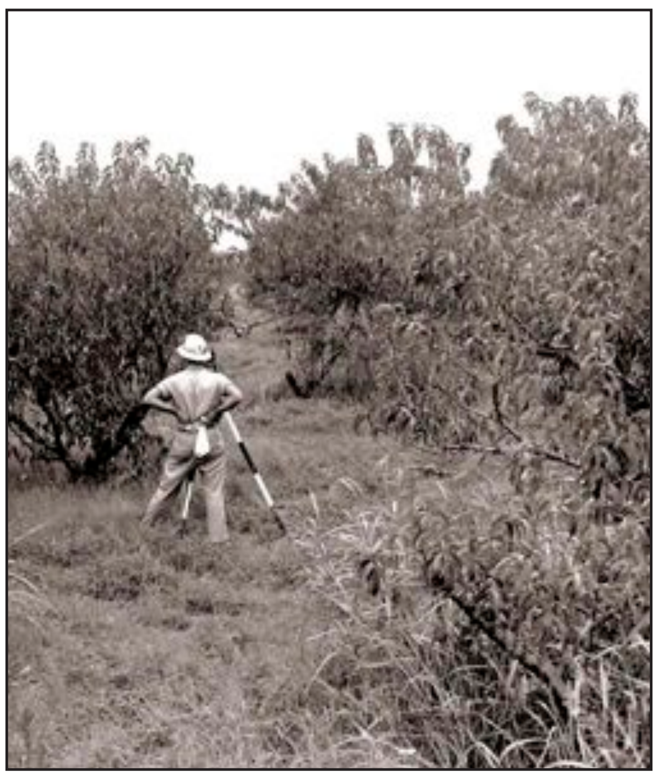
Du Pont may have controlled the overall development of the plant, but the company required the services of a number of different subcontractors to complete the design work and the construction. Lummus did work in the 400/D Area, and Blaw-Knox did much within the 200 areas, but the biggest subcontractors doing infrastructure work were Gibbs and Hill (GH) and Voorhees Walker Foley & Smith (VWFS). Gibbs and Hill were responsible for most of the electrical work, which included the boiler houses and the steam facilities, communications systems, alarms, even fencing and road lighting. VWFS were responsible for most of the service features, including the roads, railroads, walkways, fencing and parking.

Gibbs and Hill, founded in 1911, had specialized in electrical design work ever since they electrified the Pennsylvania Railroad in the 1930s. By the time of the Savannah River Plant, the company had great experience in the use of transit systems and electrical infrastructure.[14] Gibbs and Hill opened a field office at SRP in early 1952. The field office closed two years later after the completion of their work.[15]

Du Pont also worked closely with Voorhees Walker Foley & Smith, based in New York. Each company sent representatives to the other's headquarters to ensure the smooth workings of the service facilities planning, which began in April of 1951.[16]

Beyond design work, Du Pont had a number of subcontractors who were essential during the Construction Era. The two most prominent companies were Miller-Dunn Electric and B. F. Shaw. Miller-Dunn was responsible for installing the electrical set up at Savannah River. They were active as workers and linemen throughout the site, and did the electrical hook-ups at each of the individual areas. B. F. Shaw did the piping work, which ranged from large river water pipelines, to steam lines within individual areas. Both Miller-Dunn and Shaw were very prominent on site during the Construction Era. It is also interesting to note that both Miller-Dunn and Shaw usually fielded the best baseball teams in regular competition with other construction teams, such as those representing Du Pont's carpenters, the patrol, and the individual areas of the plant.[17]

In addition to Miller-Dunn and Shaw, as well as "Du Pont Crafts," there were other subcontractors hired out to fulfill the needs of particular niches that Du Pont could not otherwise handle. These included the Johns-Manville Sales Corporation for asbestos siding; Inter-State Painting; and at least two lump sum Unit Price Subcontractors, such as Kolinski Concrete Company and Suber and Company for roadwork.[18]



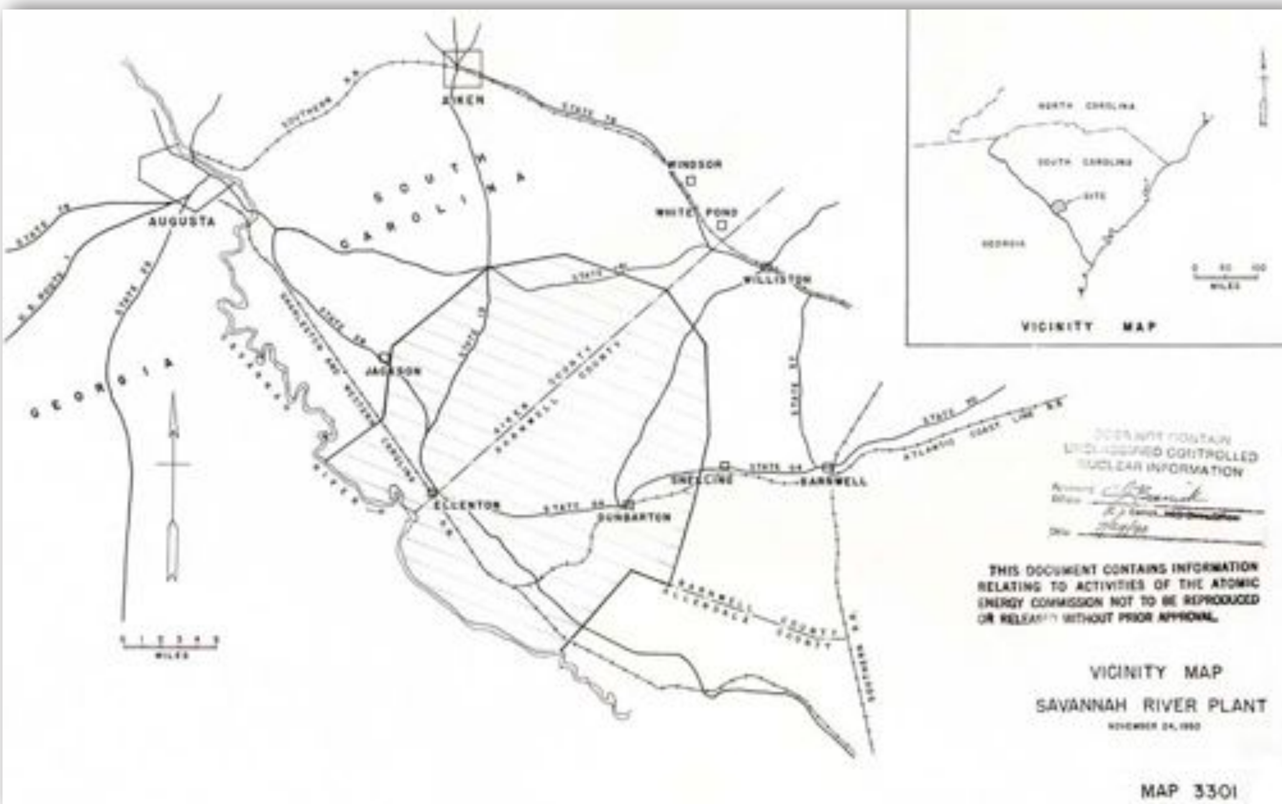
Unidentified Surveyor in Peach Orchard, August 13, 1951, SRS Negative M-241.

INITIAL SURVEYS

In order to turn a predominantly rural landscape into a nuclear facility dotted with industrial areas, it was first essential to thoroughly map the project area and lay out the areas to be developed. This also required laying out the roads and railroads, electrical lines, and the water facilities that would be essential for the operation of the whole. This required a complete survey of the project area, showing existing features, contours, and waterways. Foremost among the existing features were the small towns of Ellenton, Dunbarton, and Meyer's Mill. These towns, and their cemeteries, were in the process of being removed during the first two years of Construction.

Even though Ellenton and Dunbarton were slated for demolition, both areas lived on as transportation nodes, if only because Construction crews congregated there in the early days and because they were both located on pre-existing rail lines. Ellenton became more or less the site for CMX-TNX and for D Area, while the Dunbarton area became the railroad center for the plant. Existing state roads, such as No. 28 along the Savannah River, No. 19 from Aiken, No. 781 along the northwest margin of the site, and No. 64 out of Barnwell, were all incorporated into the new plant road system. The same was true of the pre-existing railroads, of which there were two: the Charleston and Western Carolina Railroad (C&CW) which paralleled the river, and the Atlantic Coast Line (ACL) which ran east-west through Dunbarton to connect with the C&CW at the crossroads of Robbins, near the southwest corner of the site.

General Vicinity Map 3301, date unknown, SRS Archives



Plant Layout Established

The first step in the layout of the Savannah River Plant was establishing the location of the industrial and manufacturing areas. These areas in particular had to be surveyed accurately. Much of this work had already been done during the close field inspection for "Site No. 5," done on October 16-18, 1950 by R. K. Mason, George Dutcher, and A. J. McCullin, of Du Pont's Design Division.[19] It is worth noting that a little over a month later, McCullin would begin a working diary covering the SRP Construction Era, one of the few that has come to light over the years. This invaluable resource has been used frequently below.

Du Pont's survey technical advisors conducted a field inspection of Site No. 5 by land, air, and boat in October 1950. A lifejacketed and capped Robert Mason, future Field Project Manager for the Savannah RIver Plant, is in the center standing on a Savannah River dock. The other men in the photograph may be Andrew McCullin and George Dutcher who were also part of the Du Pont team. Courtesy of the Mason Family.

The "close field inspection," also known as the "Mason survey," established the basic production and process areas that would be used at SRP, from "A" to "M." At the time, it was thought that there would be five 200 areas and six 100 areas, and all of these were basically arranged. The 300/M manufacturing area was not sited, even tentatively, since this was not considered essential at that stage of the process. The temporary construction (TC) headquarters was proposed at a site two miles west of Dunbarton, but it is clear that the TC headquarters was not located at that site, but rather at a location further north. The fire tower, later designated 627-G by Du Pont, was used by the Mason survey to reconnoiter the area, which was noted to be marked by tenant farms, fields, and woods. It was also noted that the local road network would have to be greatly improved before it would be serviceable for Construction.[20]

The layout established in October 1950 was firmed up in December, since it was imperative to determine this before the aerial and ground surveys began. The big issue in early December was the location of the 300 Manufacturing Area. Some early schemes had this by the river, but it was ultimately decided to put it with the 700 area at the north end of the site, where it would be equidistant from both Augusta and Aiken.[21]

On December 19, it was recorded in McCullin's diary that the final decision was made on the distance between the different reactor areas and the separations areas, which would be set 2.5 miles apart and arranged in a circle. This had to be firmed up before the survey got underway. Another standard that had to be established was the distance from this circle and the outside boundary of the site. That distance was set at 6 miles from the reactors, and 5 miles from the separations areas. This led to a reduction of 32,000 acres in the total area that needed to be purchased.[22]

The overall plant layout was worked up by Du Pont on December 22, and was approved by the Atomic Energy Commission six days later. Two months earlier, on September 27, 1950, Public Law No. 843 gave the AEC the authority to acquire land for the new plant. The Corps of Engineers would supervise the process, and a letter from the Chief of Engineers to the Division Engineer in Atlanta, dated December 1, 1950, instructed him to proceed on the basis of total land acquisition within the project area. On December 15, a local office was opened for the purchase of land.[23]

The first property was acquired on December 29, 1950, beginning a process that would be completed by the end of June 1952, with the acquisition of 1,706 separate tracts, for a total acreage of 200,742.[24] The map that showed those limits, which was necessarily ragged since the AEC did not want to break up existing lots, was basically the map of the external boundaries of the site,[25] with the exception of the later acquisition of Lower Three Runs Creek, an acquisition that will be discussed later in the report. There were smaller details that were still left to be resolved in 1951, which included the final location of Central Shops, determined in February, and the exact position of the 300/700 area, which was basically determined in mid-March.[26]

Aero Service Corporation

The second major step in the site survey was the work of Aero Service Corporation, which took aerial photos of the entire area during 1951. Negotiations with this firm and others began as early as November 30, 1950, just two days after the public announcement of the plant. It is in fact the subject of the very first entry in McCullin's diary.

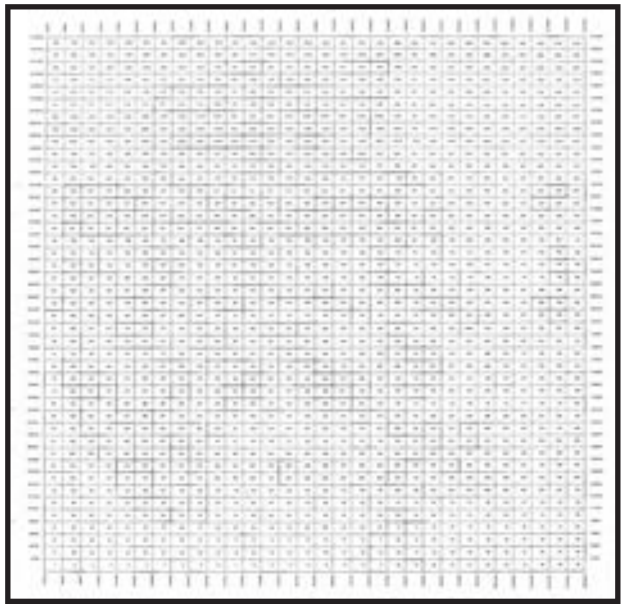
Because of the size of the aerial survey, it had to be put out for bid, attracting the interest of six firms. Bids were received as early as December 14, 1950, and it came down to a contest between Aero Service Corporation and Lockwood, Kessler, and Bartlett. Aero Service was ultimately chosen on December 19th.[27]

By the terms of the contract, Aero Service was to photograph three specific areas within the site boundaries that corresponded to the main industrial areas along the river and in the interior. Two of these areas, along the river and in the vicinity of what is now 300/700 area, were to be photographed with enough detail to be able to provide contour intervals of two feet. A much bigger area within the interior, 52,000 acres, roughly corresponding to the reactor and separation areas, were to be shot at five-foot contours. Maps were to be made of these areas as soon as possible. The remaining areas were to be photographed only, with enough detail to allow for five-foot contours. These areas were to be mapped only as needed by Du Pont.[28]

The aerial survey was to be conducted with a special photographic plane and crew, which was fortunate to be able to work in the winter, when the foliage would be down. The aerial photos were to be suitable for stereo-photogrammetric mapping. The baseline for the horizontal control and for the coordinate system was to be the centerline of the Charleston and Western Carolina Railroad north of Ellenton. Station 00+0 was to be the intersection of that line and the centerline of the main east-west road at Ellenton: Coordinate N70000 – E25000. Vertical control was to be based on U.S. Coast and Geodetic Survey data.[29]

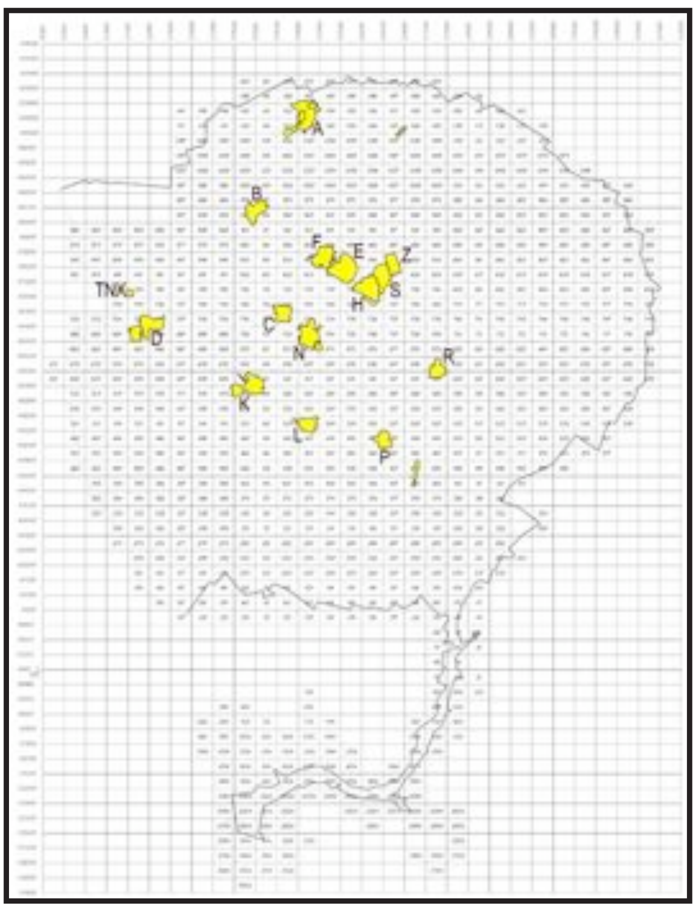
Ground control would be established with permanent markers set every 1,000 feet along the base line coordinates. It was also noted that "written descriptions and sketches of all permanently marked stations and bench marks with their references, shall be furnished du Pont. The location of all stations and benchmarks shall be shown on the topographic map." It was further noted that field notebooks were to be kept, and they were to become Du Pont property at the conclusion of the survey. At the end of the aerial survey, all topographic maps were to be drawn on 31 x 43-inch sheets, with an inside dimension of 28 x 40 inches, in accord with Engineering Standards C-1-A and C-3-A. The scale of the finished map was to be 1 inch per 100 feet.[30]

Aero Service carried out this work in the course of a year, between December 1950 and December 1951,[31] using as its base some of the first maps ever made of the project area, namely Map 3303, and its revisions 3301 and 3304, compiled in December of 1950 and January of 1951. Aero Service began its fieldwork phase in late December, with mapping and survey work well underway in 400 area by January. At that time, there were five survey parties at work, with 49 miles of bench levels done, 128 benchmarks set, 38,000 linear feet of permanent baseline established, and 5.5 miles of traverse accomplished. The aerial photography itself began on January 4, 1951. The complete photo mosaic of the site was finished in late February of 1951, at a scale of 1 inch to a mile. The topographic sheets, based on the aerials, were for the most part complete by the middle of the year.[32]



Map 3303, date unknown, SRS Archives

This work led to the establishment of the permanent grid system, used at Savannah River Plant that first year and ever since. Site coordinates were based on the Lambert projection system normally used for USGS quads, with regular northing and easting readings. The grid, however, is also numbered for easier use, with each grid rectangle (north-south 2,800 feet, east-west 4,000 feet) assigned a single number. The numbering system starts in the south and moves north, so that the Railroad Classification Yard, located near Dunbarton, is covered by Grids 408 and 438, while the 300/700 area, far to the north, is partially covered by Grids 1123 and 1153.[33]



Modern Grid Map of SRS, date unkown, SRS Archives

One of the last services performed by Aero Service was the creation of a large relief map of the entire project area, plus at least one duplicate. This relief map was compiled from the photo aerials at the company's headquarters in Philadelphia. Completed in early April 1951, it was delivered to Du Pont on April 9. The duplicate was to follow in May.[34] At least one of these two relief maps still exists and is currently curated in the SRS Cold War Historic Preservation Program.

Soil Studies

Almost simultaneous with the Aero Service work were the soil studies that had to be done before any buildings could be constructed. This included core borings and other load-bearing studies to determine whether the locations on the map were actually suitable for massive concrete structures. Some of this work predated the selection of Site No. 5, since soil surveys were part of the original site selection process that occurred earlier in 1950.[35] This work became more localized to specific areas as planning progressed, to ensure that the heavy reactor buildings and separations buildings had the proper soil foundation. It was also important to study the local "sinks," probably referring to the Carolina bays, to make sure these did not pose a problem for construction.[36] A map of the core borings was produced very early in the planning process, and it was completed by around the 3rd of January, 1951.[37]

Fences & Boundary Changes

The issue of security fences around the core of SRP was discussed early and often, according to the McCullin Diary. The need for fencing was first mentioned on December 15, 1950, without record of any particular resolution. Just five days later, it was decided that the boundary fence would be a standard four-strand barbed wire farm fence with steel posts. The localized area fences would be standard chain link, eight feet high, with barbed wire on top. The original fence specifications were then written by VWFS early in January 1951. The use of steel posts for the boundary fence was changed to treated lumber in April, and this information was passed on to VWFS.[38]

Despite these initial plans, it does not appear that a boundary fence was actually constructed. It is possible too that what was initially called a boundary fence in the diary was the same as what was later referred to as the perimeter fence. Either way, an article and map in the *SRP News and Views*, dated to June 5, 1953, indicates clearly that the outer boundary line of the plant was not fenced, even though it was a no trespassing zone. The real barrier was the perimeter fence, located well inside the boundary line.[39]

Because of the cost of the chain link fence, it was considered essential to have the perimeter fence cover the minimum distance possible. For this reason, the final location of this fence was not determined until September of 1951, with the exact spots to be picked by both Du Pont and AEC. By October, the exact location of the fence was still undetermined, but it was decided to have three strands of barbed wire on top of the fence rather than four. It was also decided not to have guard towers along the perimeter fence. By November 1951, the location of the fence had pretty much been determined, and it would have a length of 45 miles.[40]

By this time, a new problem had arisen, and it had to do with a major boundary change for the site. The original site boundary, as delineated in November 1950, was much larger than what was finally determined in 1951. The original site shape was basically a big blob, without distinct borders, which could not be determined exactly until the determination of the final distance needed between the reactor and separation areas and public lands. Even before that determination was made, in September and October of 1951, the communities of Jackson and Snelling, on the edge of the original project boundary, were excluded from the project area as a money saving measure. That decision was made as early as January of 1951.[41]

The next major boundary change occurred over the issue of the R reactor effluent flow. More will be said about this issue later in the report, but suffice it to say here that it was finally determined that the R effluent flow should go down Lower Three Runs Creek rather than the initial route of Four Mile Branch. This required the purchase of the floodplain along the entire length of Lower Three Runs Creek, all the way to the Savannah River.

The first discussion of the new land purchase was mentioned in McCullin as early as June of 1951.[42] The decision to go with Lower Three Runs was formally made on September 14, 1951.[43] By mid-October, there were negotiations with Aero Service to do the survey work required by the new acquisition. This required an alteration of the original Aero Service contract, AXC 13-1/2, and the work began before the month was out. By early 1952, it had been decided to base the acquisition area on the 50-year flood line rather than the 100-year line under consideration earlier.[44] The new expansion, covering some 6,000 acres, was announced to the public on May 15, 1952.[45] By the time the dust settled, in September of 1952, it was noted that total land acquisition for SRP now came to 200,693 acres.[46]

The new corridor opened up the question of whether to include any or all of Lower Three Runs Creek within the perimeter fence. This was not done, but there were other adjustments that had to be made. The Atlantic Coast Line Railroad had to be relocated further south of P reactor, and the new track also had to be outside the perimeter fence. A few years later, the installation of military sites required the relocation of part of the perimeter fence, particularly around Gun Site 816 and 12. The final version of the perimeter fence came out as Map 3321, Perimeter Fence Map, March 22, 1956.

Perimeter Fence Map 3321, date unknown, SRS Archives

The perimeter fence was not the only security fence on site. Each individual area had its own fence, or series of fences, as did many other specialized locations, such as the Railroad Classification Yard, the CMX facilities, the river pump houses, and the electrical substations. All of these fences, designated "Building 605," were chain link, with three strands of barbed wire on top, in addition to a number of gates.[47] Before April 20, 1951, the chain link fences were designed to have a top rail, but after consultation with the AEC, Du Pont decided to leave off the top rail, since a ragged fence top was considered a better security measure.[48] Otherwise, chain link fences, just like those at Dana, were constructed as per Standard Engineering Specification SC-1-F. In addition, all fences were designed with grounding for lightning protection.[49]

V. BUILDING AND FACILITY CONSTRUCTION

This chapter discusses infrastructure-related properties by type and function. As the layout of SRS progressed, buildings and other facilities soon materialized. Roads were constructed according to typical standards of the period, using concrete slabs with expansion joints topped with asphalt and bituminous surfaces. Permanent buildings adhered to state of the art industrial designs honed from engineering advancements developed during the war.[1] Along with Du Pont, Voorhees Walker Foley & Smith were at the forefront of industrial architectural design, creating facilities that were functional as well as ideal in form with regard to purpose. Industrial facilities required (then as now) an "orderly and efficient layout" of support infrastructure, from which the structural and aesthetic patterns would grow.[2] Within SRS, infrastructure facilities were constructed with materials standard for industrial construction of the day, including concrete and reinforced steel, with necessity guiding the appearance not only of individual facilities, but also of the site layout as a whole.

Infrastructure properties at SRS can be categorized into six major groups: transportation, power, communications, waste, burial and disposal grounds, and military sites. Included in transportation are roads, railroads, and river facilities. Power encompasses electrical facilities, such as power houses, substations, boiler houses, and transmission and distribution lines. Other properties, such as pump houses, reservoirs, cooling towers, waterlines, steamlines, and wells, are also associated with power production. Communication facilities include telephone systems, radio stations, the fire observation tower and the fire alarm system. Under waste, sewage treatment and management of sanitary, process, and storm sewers is addressed. Burial and disposal includes the ash disposal basins and the contaminated burial grounds. Military sites include four barracks sites, 20 gun sites, and a concrete pad located in B-Area. The following discussion describes representative types within each of the six major categories of infrastructure facilities located at SRS; Table 3, below, identifies the different infrastructure resource types within the SRS perimeters.

Table 3. SRS Resource Types

Resource Type	Location	Facility No.	Survey No.
TRANSPORTATION			
Roads			
Fence and Road Lighting	All Areas	501-G	
Roads	All Areas	603-G	
Walkways	All Areas	604-G	
Parking Areas	All Areas	613-G	
Truck Scale House	Near A Area	616-G	R/03/2463
Gas Stations***	G, P	715-G, 715-P	
Rain Shelters	All Areas		

Resource Type	Location	Facility No.	Survey No.
Railroads			
Standard Gauge Railroad Track	All Areas	601-G	
Standard Gauge Railroad Rolling Stock	All Areas	602-G	
Track Scale House	Railroad Classification Yard	608-G	R/11/0383
Locomotive Shop	Railroad Classification Yard	618-G	R/11/0388
Diesel Oil Storage Tanks	Railroad Classification Yard	619-G***	
River			
River Loading Dock	G	662-G	
POWER			
Electricity			
Primary Substations	C	151-1C	R/11/0206
	K	151-1K	R/11/0240
	L	151-1L	R/11/0267
	P	151-1P***	R/11/0294
	R	151-1R***	R/11/0319
	C	151-2C	R/11/0207
	K	151-2K	R/11/0241
	L	151-2L	R/11/0268
	P	151-2P***	R/11/0295
	R	151-2R***	R/11/0320
	F	251-F	R/03/2638
	H	251-H	R/03/2545
	D	451-D	R/11/0171
Secondary Substation	C	152-C	R/11/0206
	P	152-1P***	R/11/0296
	R	152-1R***	R/11/0321
	K	152-K	
	L	152-L***	
	F	252-F	
	H	252-H	
Power House Power Maintenance Facility** Valve House**	K	184-K	R/11/0245
	L	184-L***	
	P	184-P***	
	R	184-R***	
	F	284-F***	R/03/2654
	H	284-H	R/11/0425
	D	484-4D**	R/11/0180
	D	484-9D**	R/11/0182
	D	484-D	R/11/0183

Resource Type	Location	Facility No.	Survey No.
Cooling Tower	K	185-K***	R/11/0247
	L	185-L***	
	P	185-P***	R/11/0302
	R	185-R***	
	F	285-F***	R/03/2655
	H	285-H***	R/03/2567
	D	485-D	R/11/0184
	A	785-A	R/03/2445
Reservoir and Pump House Reservoir (Ground Tank)	F	282-F	R/03/2651
	H	282-H	R/11/0424
	A	782-A	
Electrical Control Building	D	483-3D	R/11/0176
Transmission and Distribution Lines	All Areas	503-G	
Switching Station	G	504-1G	
	G	504-2G	
	G	504-3G	
Control House and Primary Substation	A	751-A	R/03/2424
Diesel House	A	751-2A	R/03/2415
Steam Generation Plant	A	784-A	R/03/2444
Pipe Supports	All Areas	801-F,H	
Overhead Steam Lines	All Areas	802-F,H	
Water			
River Water Pump House	G	681-1G	R/03/2467
	G	681-3G	R/11/0390
	G	681-4G***	
	G	681-5G	R/11/0391
Par Pond Pump House	G	681-6G	R/11/0392
Par Pond Pump House Equipment Building	G	681-7G	
Underground Water Pipes	All Areas	901-G	
Wells and Pumps	All Areas	905-G	
Chlorine (Chemical) Building***	A	905-A	
COMMUNICATIONS			
Fire Alarm System	All Areas	505-G	
Telephone Cable and Instruments	All Areas	506-G	
Safety Alarm System	All Areas	507-G	
Patrol Radio Station		623-1G	
Fire Observation Tower		627-G	
Telephone Building	A	702-A*	R/03/2315

Resource Type	Location	Facility No.	Survey No.
WASTE			
Sewage Treatment Plant	A	607-1A***	
Sewage Lift Station	A	607-2A***	
Comminutor	A	607-3A***	
Sanitary Sewers	All Areas	903-G	
Process Sewers	All Areas	904-G	
Storm Sewers	All Areas	907-G	
Burial and Disposal			
Ash Disposal Basin	D	488-D	
Burial Ground	G	643-G	
MILITARY			
Concrete Pad - Anti-Aircraft Artillery Insignia	B		
Barracks		Site 12***	
		Site 51***	
		Site 72***	
		Site 92***	
		Site 95***	
Gun Site		Site 008***	
		Site 102***	
		Site 103***	
		Site 113***	
		Site 115***	
		Site 120***	
		Site 209***	
		Site 305***	
		Site 314***	
		Site 317***	
		Site 404***	
		Site 510***	
		Site 606***	
		Site 720***	
		Site 812***	
		Site 816***	
		Site 91R***	
		Site 920***	
	Near 701-3G	Unidentified Site ***	
	Near 701-2G	Unidentified Site***	

* Treated in the A Area Thematic Study
** Associated with Powerhouse
*** No Longer Extant

TRANSPORTATION

Roads

A network of 410 miles of state and county roads crossed through the site prior to SRP development. South Carolina State Highways 28, 19, 39, 781, and 64 all provided access to the area chosen for the plant site, as well as having nearby junctions with main interstate highways. All five state highways were constructed with bituminous surfaces. South Carolina (SC) 28, which ran from Allendale, South Carolina to Augusta, Georgia, entered the site at the southeastern corner, running along the Western Carolina Railroad for approximately twenty miles. About two miles southeast of Ellenton, SC 28 joined SC 64, and nearly three miles northwest of Ellenton it joined SC 19. From that point, SC 19 ran northeast and finally north to Aiken, joining SC 781 at the northwest edge of the site. SC 39 ran between Williston and Dunbarton, joining SC 64 at Dunbarton. SC 64 ran for nearly sixteen miles through the site. Entering west of Snelling, SC 64 then ran west to Dunbarton and on to Ellenton. SC 781 connected White Pond and Beech Island, where it joined SC 28. The highway ran west from its junction with SC 19 through the site for approximately seven miles, and was left open to the public. An extensive network of county maintained dirt roads, used mainly for agricultural commodity transport, were also preexisting in the area.[3]

Fence and Road Lighting (501-G)

501-G was the classification code for all fencing and road lighting, installed as a safety precaution. The fencing and road lighting system consisted of wire, cable, poles, and luminaries located around the river pump houses, the CMX Area, the Railroad Classification Yard, the five perimeter gatehouses, and 41 road intersections. Lighting was controlled automatically by astronomical time switches, as well as manual controls. Approximately 13 miles of road lighting and two miles of fencing were installed. Construction on the facility began September 3, 1951. Final acceptance by Operations occurred August 19, 1955.[4]

Roads (603-G)

603-G was the classification code for all facilities that provided a means for vehicular traffic to operate within the plant area. The road system consisted of approximately 167 miles of 14, 20, and 40 foot-wide primary roads. Approximately 106 miles of 20 foot-wide roads with two-inch asphaltic concrete surface were constructed, and this figure included double mileage for dual lane roads. In addition, nearly 17 miles (including double mileage for dual lane roads) of 20-foot with bituminous surface were constructed. Approximately 42 miles (including double mileage for dual lane roads) of existing road were re-surfaced with two-inch asphaltic concrete, and 20 miles of existing road were incorporated into the system without further improvement. The road system also encompassed sleeper lanes, aprons, and various intersection types, including a cloverleaf, the first in the state. Seven bridges were constructed as well. Suber and Company, Incorporated, performed the road system construction. All roads were constructed in accordance with SRS Specification No. 3021. Work was begun on the road system February12, 1951, with initial acceptance occurring on July 24, 1953. Final acceptance occurred on March 15, 1954.[5]

1. *Cloverleaf Construction, August 27, 1951, SRS Negative M-257-03*
2. *Road Surfacing Machines, September 20, 1952, SRS Negative M-1389-01*
3. *Progress of Bridge Assembly, August 22, 1956, SRS Negative 3583-10*
4. *Cloverleaf Construction, August 27, 1951, SRS Negative M-257-06*
5. *Road Cut; C Road at Upper Three Runs, December 23, 1952, SRS Negative M-1763-03*

Intersection of Roads C&B, January 12, 1955, SRS Negative DPSPF-1518-4

Emergency Turnout on Roadside, March 14, 1952, SRS Negative M-630

Walkways (604-G)

604-G was the classification code for walkway facilities, the function of which was to provide avenues for pedestrian traffic between area buildings. The total system consisted of approximately 830 linear feet of concrete sidewalks located between various facilities within SRS (specifically CMX and the Classification Yard areas). One hundred sixty-five linear feet consisted of three-foot wide and four-inch thick sidewalk; 260 liner feet consisted of four-foot wide, four-inch thick sidewalks; 295 feet consisted of six-foot wide, six-inch thick sidewalk; and finally 110 linear feet consisted of eight-foot wide, six-inch thick sidewalk. Construction on 604-G began on March 1, 1952 and final acceptance was received from Operations on December 10, 1953.[6]

Parking Lot, May 17, 1955, SRS Negative DPSPF-2242-6

Parking Area (613-G)

613-G provided vehicular parking at the entrance to CMX, the pistol range, and the railroad classification yard. 6-13A provided parking at the plant entrance, as well as for individual buildings within A Area. Completion of the parking area consisted of layout, excavation, grading, bituminous treatment, one-inch asphaltic concrete paving, directional signs, painted lines indicating parking lanes, and concrete car stops. Construction of the parking areas began on April 9, 1952 and final acceptance occurred on February 11, 1954.[7]

Truck Scale House (616-G)

616-G is located on SRS road 1-A at the northwest entrance to the 700-A Area. This facility was constructed to provide for the weighing of truck shipments to SRS, and consists of a singe-story, Class II structure. The scale house measures approximately 8 feet by 8 feet. Structural details include a wood frame set on a four-inch, reinforced concrete floor slab foundation, with flat cement asbestos board siding and a built-up roof. Begun on January 11, 1952, the facility was completed and fully accepted by Operations on October 24, 1952. Although the facility had been substantially completed by mid-July of 1952, certification of the scales by the South Carolina Division of Weights and Measures was not granted until almost four months later.[8]

Gas Station (715-G and 715-P)

No longer extant, both 715-G and 715-P functioned as gasoline storage and dispensing facilities for cars used by personnel housed in the 705, 706, and 720 buildings. The service station consisted of two standard gasoline pumps, underground storage tanks, and a 10-foot by 12-foot skid shack to house the attendant. The station was originally given a bituminous surface treatment and was classified as a TC facility. The station was accepted by operations February 28, 1955 on an "as is" basis.[9]

Typical Rain Shelter, September 2010

Rain Shelters (All Areas)

Rain shelters were constructed and installed by the site's interior intersections to provide shelter from the elements for company employees as a safety feature. No early examples were located however a drawing from 1960 indicates they were small, rectangular, frame, three-sided structures on concrete slabs with corrugated metal gable roofs and siding. The simple structures (12 feet by 5'8") featured a bench and waste can. Purchasing records indicate that prefabricated kits may have been purchased from a dealership in Augusta. The kit was known as "Model 10" within the stock of Atlind Steel Buildings, manufactured by Childers Manufacturing Company and Atlantic Industries out of Houston and Savannah. Notably, the order notes that the Model 10 was sold to Du Pont and was to be delivered to Dunbarton, SC.

Traffic & Transportation (T&T) Activities (Rail Yard, Engines and Cars, Support Buildings, and Constructuion), July 8, 1958, SRS Negative DPSPF-5281-5

Railroads

Two railroads, the Charleston and Western Carolina (C&WC) Railroad and the Atlantic Coast Line (ACL) Railroad, provided rail service to the area prior to construction of SRP. The C&WC ran between Savannah and Augusta, crossing into the site at the southeast corner, and extending almost twenty miles along the South Carolina side of the Savannah River. The ACL ran from Barnwell, joining the C&WC at Robbins, serving Dunbarton and Ellenton through a special track usage arrangement with C&WC. The ACL line crossed into the site near Snelling and connected to the Southern Railway at Barnwell.[10]

Railroads (Standard Gauge Railroad Track) (601-G)

601-G was the classification code for linear rail facilities located within SRP. Railroads provided transportation of incoming and outgoing rail freight from SRS, as well as the movement of heavy or large items and processed materials between the areas in the plant. Within the rail system at SRP were approximately 223,000 linear feet

Railroad Construction Near Dunbarton, May 31, 1951, SRS Negative M-132-2

(42 miles) of standard gauge, equating to 446,000 feet of rail. All track was 90-pound rail, with the exception of 100-pound rail located along the main line from Dunbarton to P-Area. Within G-Area, the railroad connected the various manufacturing areas, the classification yards, and the main lines of the commercial railways serving the plant. Also in G-Area, the rail line required the construction of one timber trestle, 140 feet long and supported by six piles and 15 bents. Railroads were constructed in accordance with Specification No. 3015.[11]

Work began immediately on the permanent track in G-Area so that the rail line could be utilized during the construction of SRP, thus minimizing the need for TC track. Consequently, only 2,200 linear feet of TC track was laid in G-Area, with the exception of track laid in the set-off yard and Central Shops, which connected to the subcontractor's asphalt batch plant. On April 2, 1951, construction began on the rail system and the work was nearly complete by June 21, 1951, when the subcontractor, W. A. Smith Construction, left the project. The permanent railroads went into use on August 6, 1951. Operation gave final acceptance, with some exceptions, on November 17, 1953.[12]

Railcars in Front of Powerhouse, February 24, 1959, SRS Negative DPSPF-5773-2

Standard Gauge Railroad Rolling Stock (602-G)

602-G was the classification given to the railroad rolling stock, which was purchased by Construction and used for the movement of materials and process equipment within SRS. The following table identifies the type and quantity of rolling stock acquired by Construction (see Table 4, below).[13]

Table 4. SRS Standard Gauge Railroad Rolling Stock

Equipment	Quantity	Date Accepted
Diesel Locomotives, 120 Ton	4	January 26, 1955
Diesel Locomotives, 80 Ton	4	January 26, 1955
Gondola Cars	2	December 13, 1954
Box Car	1	December 13, 1954
Flat Cars	16	December 13, 1954
Hopper Cars	5	December 13, 1954
Well-Type Cask Cars	4	January 26, 1955
S/S Tank Car	1	January 26, 1955
High Chrome Tank Cars	5	January 26, 1955
Section Motor Cars	20	January 26, 1955

Source: Du Pont Construction, Volume 4, pp. 319-320.

Track Scale House (608-G)

Located in the Rail Classification Yard, the track scale house provided for the weighing of all rail shipments entering and departing from SRP. 608-G is a single-story, Class III structure, with a steel frame set on a reinforced concrete slab foundation and sheathed in cement asbestos siding and roofing. Measuring 11 feet by 26 feet, the construction on the building began on July 23, 1951. The building was substantially complete by June of 1952, and was used by the traffic division until it was finally accepted by Operations. Partial acceptance by Operations occurred on January 21, 1954. Completion and full acceptance by Operations occurred on March 2, 1954.[14]

Locomotive Shops (618-G)

Construction of Railroad Shops (618-G), October 23, 1951, SRS Negative 6-163

618-G provided service and repair space for all railroad rolling stock at SRS, as well as an area for the complete overhaul of diesel-electric locomotives, and office space for SRS railroad personnel. The building consists of a two-story shop bay adjacent to single-story administrative, lunchroom, and locker facilities, on which is a partial second story that housed the dispatcher's office and fixed radio transmitting-receiving equipment for the plant railroads operations. Both single and two-story sections of the building are Class III construction, measuring approximately 142 feet by 87 feet, with a steel frame structure set on a reinforced concrete floor and reinforced concrete spread-footing foundation. The building is sheathed in corrugated cement asbestos siding, which also acts as roofing over the two-story shop bay. The single-story and partial second-story section of the building is roofed with concrete slab. Begun on July 6, 1951, construction was substantially completed by June 1952. Although 618-G was partially accepted by Operations on January 14, 1952, final acceptance was delayed until August 23, 1954, due to changes in the power and lighting systems.[15]

Diesel Oil Storage Tanks (619-G)

The diesel oil storage tanks provided storage, as well as a dispensing point, for diesel fuel oil required by SRP locomotives. The two tanks each had a 20,000-gallon capacity and were set on a structural steel platform with access stairs and hand railings. Construction of the tanks began on August 9, 1951, with partial acceptance occurring on January 21, 1954. Final acceptance by Operations was received March 2, 1954; final acceptance, however, was contingent on the inspection and approval of other required facilities located in the Railroad Classification Yard. 619-G was utilized by Construction from March 1952 until March 1954.[16]

River

River Loading Dock (662-G)

Construction of Savannah River Boat Landing, May 31, 1952, SRS Negative M-931-01

The river loading dock provided suitable berthing and unloading for river barges carrying special units for the 105 buildings during the construction of SRS. Once construction of the plant was complete, the dock served as a loading and unloading area for heavy equipment and materials shipped to and from to the plant by barge freight. The facility consists of a 225-foot dock constructed from m-116 interlocking type sheet piles, each 50 feet long, situated along the riverbank between 24-foot returns (also constructed of sheet piles). The total dock area is approximately 380 feet by 140 feet. Originally, a 125-ton capacity stiff leg derrick, fabricated from four gin poles and mounted on three piles and reinforced concrete pads, was located next to the dock. An 18-foot by 28-foot, by 15-inch thick, reinforced concrete platform supported by timber piles provided a staging platform for the materials unloaded from docked barges. The hoist and motor for the derrick were housed in a wood frame shed, measuring 18 feet by 30 feet. The working surface of the dock was covered with asphalt prime surface material, and a 20-foot wide asphalt paved road, with necessary culverts, posts, and guardrails, connected the dock with the SRS River Road. Construction on 662-G began on April 14, 1952. Partial acceptance occurred on November 17, 1953, with final acceptance occurring on December 24, 1954.[17]

100-Ton Concrete Block Used for River Dock Construction, June 25, 1952, SRS Negative M-1054-07

POWER

Electricity

Prior to the construction of SRS, the area was supplied with power by the South Carolina Electric and Gas Company, the Aiken Electric Cooperative, and the Salkahatchie Electric Cooperative. At the time of the SRS site announcement, South Carolina Electric and Gas Company was in the process of constructing a 115 kv transmission line through the site. It consisted of a single circuit on an H-frame, consisting of wooden poles with two static protection lines. The line ran parallel to, and approximately three miles east of, the C&WC Railroad. Power was purchased from South Carolina Electric and Gas and the other companies during the Construction Era. The practice of buying electricity certainly continued and grew even after the site's power facilities were completed.[18]

Primary Substation (151-C)

Primary substations receive power from the 115 kv transmission system. They then reduce the voltage for distribution within the corresponding area. Except for C-Area, where no power is generated, the primary substations also transform electric power generated by area powerhouses to suitable 115 kv transmission voltages.[19] Within C-Area, 151-C receives 115 kv transmission and reduces the voltage to 13.8 kv for distribution throughout that particular reactor area.[20]

Building 151-C consists of a Class I reinforced concrete control house, which contains all electrical equipment that requires indoor installation. The control house is an L-shaped, one-story building that measures approximately 57 feet long and 37 feet wide. The outdoor component of the facility consists of strain structures, switch structures, oil circuit breakers, and transformers, as well as appurtenances and line material. Construction on the facility started December 8, 1952. Partial acceptance was granted August 8, 1954, with final acceptance by Operations occurring on October 11, 1954.[21]

Primary Substation (451-D)

451-D transforms the electric power generated by the turbo-generators in the 484-D powerhouse from 13.8 kv to suitable 115 kv transmission voltage. The facility contains a Class I, single-story building, which measures approximately 26 feet long and 22 feet wide. The foundation, slab floor, walls, and roof slab are all reinforced concrete. The switchyard adjacent to the building is approximately 686 feet long (running north and south) and 220 feet wide, surrounded by a chain link fence. Located within the switchyard are structural steel bus towers, strain structures, switch stands, oil circuit breakers, and auxiliary transformers. Mounted on concrete foundations between firewalls and also enclosed with a chain link fence, at the east side of 484-D, are seven power transformers with 15/13.8 kv capacity. Construction on 451-D began on July 18, 1951. The facility was completed and full acceptance granted by Operations on April 1, 1953. [22]

Secondary Substation (152-C)

Secondary substations transform electric power from 13.8 kv to 480 v for use in area buildings. A double-ended, unit type outdoor substation, created by two 500 kv, 13.8 kv/480 v transformers and six air circuit breakers, located in each 100 area. Each substation is supplied by 13.8 kv underground feeder and is enclosed by fences. Construction of 152-C began on November 24, 1953, with final acceptance by operations occurring on September 3, 1954.[23]

Powerhouse (184-K)

184-K provides electrical power and supplementary stand-by power to the transmission system in K-Area. It also provides process steam for the area. The powerhouse is a Class III type structure, semi-exposed and irregular in shape. The building measures approximately 135 feet by 77 feet, and contains four primary floors of operation. Other building details include a structural steel frame clad in asbestos siding (for closed construction), a concrete slab roof, and a reinforced concrete spread footing foundation. Operational components within the powerhouse consist of steam generation facilities, fuel handling and storage facilities, dust and ash handling, a feed water system, and turbo generators and axillaries. 184-K contains two 12,500 kw, high-pressure turbo generators, along with two steam generators capable of producing 140,000 pounds of steam per hour. Two 35,000-gallon capacity condensate tanks, as well as a stack and coal silo, were constructed adjacent to the powerhouse. The silo also contains a locker room, office space, a conveyor, and chemical feed space. Construction on 184-K began on July 31, 1952 with partial acceptance occurring on June 22, 1954. Final acceptance by Operations occurred on August 31, 1954.[24]

Powerhouse (484-D)

The 484-D powerhouse supplied power to the 400-D Area, as well as the 681-5G pump house and supplemental stand-by and start-up power required by the 100 Areas. The building measures 243 feet long, 242 feet wide, and 105 feet high and is considered Class III construction, with a structural steel frame set on reinforced concrete, spread footing foundations. It is the oldest and largest of all the SRS powerhouses. Special reinforced foundations were constructed for heavy equipment and equipment whose operation would create hefty vibration that would be installed in the building, such as turbo generators and pumps. The ground, main operating, and supporting floors consist of reinforced concrete. The exterior walls are sheathed in corrugated asbestos siding. The roof is standard girder beam construction with a roof truss over the turbine room, all capped in corrugated asbestos.[25]

Aerial View of 484-D Powerhouse, April 16, 1956, SRS Negative 3410-29

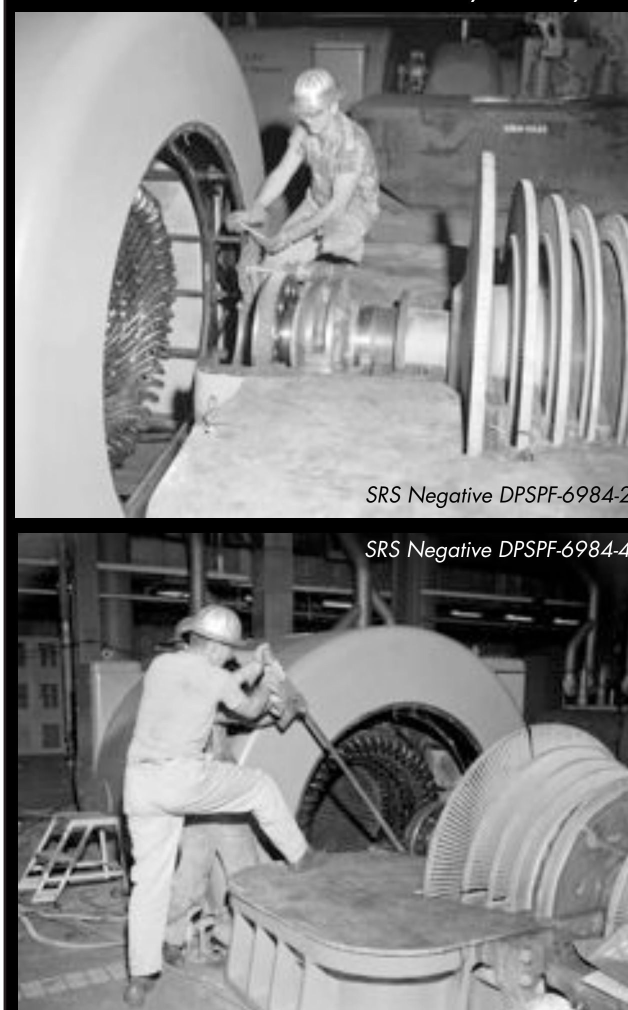
The building consists of two main operating floors, along with several intermediate floors and platforms. Steel grate platforms were constructed over the turbo generators and other crucial locations to allow ventilation. Stairways are steel structures with steel grate treads. Reinforced concrete walls surround electrical equipment, including the cable vault, the auxiliary switchgear room, the cable room, and the oil room. The east wall of the switchgear room, and the exterior finger walls separating the primary transformers located at the east end of the power house, are all constructed from reinforced concrete as well.[26]

The principal equipment installed in 484-D includes steam generating units, fuel handling and storage systems, dust and ash handling and disposal equipment, a feed-water system, turbo generators and auxiliaries, controls, piping, and other miscellaneous equipment. There are four boilers, the largest ever installed in any Du Pont constructed plant, encompassed in the steam generating system. Each boiler requires ducts, breeching, forced-draft fans, tanks, motors, and a stack. Each of the four stacks measure 15 feet interior diameter (I.D.) at the bottom, 10 feet outer diameter (O.D.) at the top, and 125 feet high. Each boiler has a capacity of 330,000 pounds of steam per hour at 900 pounds per square inch gauge (p.s.i.g.) and 900 degrees Fahrenheit. The Combustion Engineering Company erected the boilers, while J. Y. Thorpe laid the brick for the boilers. The International Chimney Corporation erected the stacks.[27]

The three high-pressure turbo generators produced 7,500 kw each at p.s.i.g. Steam is released into the process area by these turbo generators at 385 p.s.i.g. and 720 degrees Fahrenheit. The four low-pressure turbo generators provide 10,000 kw each, exhausting steam into the outside steam lines at 130 p.s.i.g and 55 p.s.i.g. These generators are complete, each fitted with condensers, pumps, motors, and tanks. A 50-ton crane is situated in the turbine room for the manipulation of heavy equipment.[28]

The coal handling system in 484-D is capable of handling a minimum of 350 tons of coal per hour. The compete system is made up of belt conveyors, motor drivers, scales, a hopper, bunkers, car-pullers, and a car shaker, and pulls from a coal storage area capable of containing 243,000 tons. Each boiler is equipped with three pulverizers, two of which operate at any given time to furnish the boiler with efficient coal for full operation, with the third acting as a spare. Dust and ash is removed from the boilers by a jet-propelled system, consisting of hoppers, pumps, drives, and piping. After that, the residue is deposited in the ash-settling basin.[29]

TURNING DEVICE FOR #3 TURBINE IN 484-D POWERHOUSE, OCTOBER 4, 1960



SRS Negative DPSPF-6984-2

SRS Negative DPSPF-6984-4

Construction of 484-D was begun on June 19, 1951. The powerhouse was completed and fully accepted by Operations on April 27, 1953. Construction delays occurred due to late delivery of valves and piping. In order to meet the required start-up of the second unit, carbon steel pipe was substituted between the 900# and 400# PRV station, in place of the originally specified chromemoly pipe. Once available, chromemoly pipe was used to replace this section of carbon steel pipe. A temporary elevator was also installed during construction, to facilitate the placement of heavy equipment on various levels of the building.[30]

Cooling Tower (485-D)

485-D cools the water used for circulation in the 484-D powerhouse surface condensers, and is controlled by switchgear located in the switchgear building. The building is a Class III, two-cell structure capable of delivering 18,500 gallongs per minute (g.p.m.). Constructed on a reinforced concrete foundation, forming the cold-water basin, the framework, casing, and baffles of the building are manufactured from California redwood lumber. The building measures approximately 51 feet wide, 65 feet long, and rises 47 feet above the basin floor, with 10-inch thick walls and floor. Adjacent to the north end of the cooling tower is a pump well, measuring 22 feet by 28 feet, with 12-inch thick walls and floor. The switchgear building consists of a Class III, single story structure, measuring 24 feet square, with a structural steel frame set on a reinforced concrete spread footing foundation, clad in asbestos siding and roofing. Construction of 485-D and the associated switchgear building began on February 13, 1952. The facility was fully accepted by operations on May 25, 1953.[31]

Cooling Tower (and Chlorine Building) (785-A)

785-A supplies cooled and chlorinated water for the condensers in the 789-A refrigeration building. The building is made up of two Class III structures, a 22,000 g.p.m. capacity cooling tower and a chlorine building. The cooling tower is rectangular and measures approximately 91 feet long, 53 feet wide, and 27 feet high. Constructed of California redwood, the cooling tower is erected over a reinforced concrete water circulation pit and pump well. The pump well measures 105 feet, six inches wide by 52 feet, eight inches long, and varies in depth from 7 to 14 feet.[32]

The chlorine building is also rectangular and measures approximately 26 feet long and 16 feet wide. The foundation consists of reinforced concrete spread footing and grade beam. The building has a concrete slab floor, a structural steel framework clad in flat asbestos board siding, and a rigid roof with corrugated asbestos cement board roofing.[33]

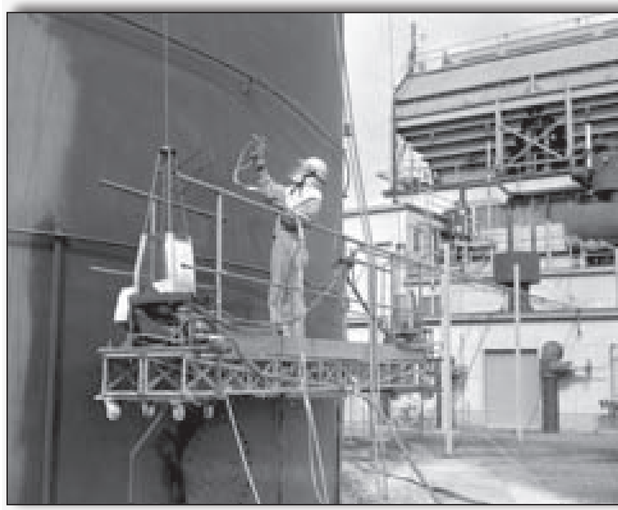
Construction of 785-A facility began January 16,1952 and was nearly complete by September 15, 1952. Final acceptance was granted by Operations on March 20, 1953.[34]

Reservoir and Pump House (282-H)

This facility supplied boiler feed water to the H powerhouse. It also provided water throughout the 200-H area for process applications, fire control, and domestic use. The facility consists of two, pre-stressed, concrete ground storage tanks in each area. Tanks for the storage of domestic water measure 24 feet in diameter and 25 feet high, with a holding capacity of 100,000 gallons each. Tanks for fire and service water storage measure 65 feet in diameter and 24 feet high, and can contain up to 600,000 gallons each. Construction on 282-H began on July 16, 1952 with partial acceptance occurring on October 6, 1954. Final acceptance by Operations occurred October 31, 1955.[35]

Reservoir (Ground Tank) (782-A)

782-A acts as a storage facility for fire control, as well as domestic and service water systems in the 300/700 areas. The reservoir consists of a cylindrical, steel ground tank, with a 27 foot outer diameter inner tank and a 50 foot outer diameter outer tank. The outer tank stands 37 feet tall, from grade to the top of the convex head. The inner tank holds domestic water and has a capacity of 150,000 gallons. The outer tank holds service and firewater and has a capacity of 350,000 gallons. The foundation consists of crushed stone. A steel guardrail and ladder provide access to the steel catwalk at the top of the tank. Construction of the facility began on January 10, 1952 by Hammond Iron Works, Incorporated, of Warren, Pennsylvania. Operations granted final acceptance of the reservoir on November 25, 1952.[36]



Finishing the Exterior of 782-A Reservoir, date unknown, SRS Negative DPSPF-6513-1

782-A Reservoir Construction, August 28, 1952, SRS Negative 7-417

Transmission and Distribution Lines (503-G)

The 115 kv transmission lines connect with the three switching stations and all the primary substations to provide connectivity between power sources and loads, forming a unified power structure between all areas of the site. After step-down at the primary substations, 13.8 kv electricity is distributed for power to outlying deep wells, gatehouses, air monitoring buildings, railroad shops, and the pistol range. Electric voltage is stepped down even further for individual buildings within the site. The entire system contains nearly 90 miles of 115 kv transmission line and 41 miles of 13.8 kv distribution line, along with nearly 65 miles of supervisory control cable, underground and overhead. H-frame, wooden pole-type structures, with appropriate grounding and lightning protection features, support the 115 kv lines. About two miles of 13.8 kv line is carried on treated 30 to 35 foot yellow pine poles between 451-D and 681-1G, 681-3G, and 681-5G. The remaining 13.8 kv line is suspended on 35-65 foot treated yellow pine poles. Except in swampy areas, where the cable is carried by pole, the supervisory control cable runs underground.[37]

504-3G, January 13, 1953, SRS Negative 5-129

Construction of 503-G began July 16, 1951; the facility was partially accepted by Operations on June 13, 1955. Various circuits were completed and accepted by Operations between July 9, 1952 and August 19, 1955. TC facilities received electric service from the South Carolina Electric and Gas Company from September 15, 1951 until February 28, 1954. Operations began receiving commercial power from the South Carolina company on February 10, 1954.[38]

Electrical Linemen in 300/700 Area, March 7, 1952, SRS Negative M-609

Switching Station (504-1G)

The three switching stations at SRS (504-1G, 504-2G, and 504-3G) linked all electrical power sources to insure maximum reliability in power supply to crucial areas within SRS, as well as providing flexibility in power supply source to 200-F, 200-H, 100-C and 300/700. The primary power source for 504-1G is the 400-D Area powerhouse, but like the other switching station, all were connected to off-site power sources as well. Incorporated into the facility are strain and suspended bus structures, including "special miscellaneous switching and potential transformer supporting structures.[39] A 27-foot square control house is located within the substation yard, and facilitates the relay and supervisory board, switchgear, MG set, battery, and charging set, cabinets, panels, and other electrical equipment required for indoor installation. The control house is a single story, Class I structure with a reinforced concrete foundation, and a slab floor, walls, and roof also of reinforced concrete. The substation yard is fenced and measures 337 feet long and 250 feet wide, with one three-foot gate and two 16-foot gates. The interior of the yard is surfaced with crushed stone. Construction on 504-1G began on August 14, 1951, with partial acceptance occurring on December 12, 1952. Final acceptance occurred on July 22, 1954, although Operations had occupied the substation since July 4, 1953.[40]

Control House and Primary Substation (751-A)

Building 751-A converted power from 115 kv to 13.8 kv for the 300/700 Areas. It also served as a central control point for power generation and transmission. The facility consists of a Class I control house and diesel generator, and a Class III switchyard. The rectangular control house measures 81 feet long and 16 feet wide.

The diesel generator house is also rectangular, measuring 18 feet long and 16 feet wide. Class I structures have reinforced concrete, spread-footing foundations, walls, and roofs. Roofs have been treated with built-up roofing and insulation. The switchyard measures 125 feet by 140 feet, and is enclosed by 480 linear feet of eight-foot high, chain link fence.[41]

751-1A, November 10, 1958, SRS Negative DPSPF-5537-1

Within the load dispatcher's station is a supervisory control board, which incorporates a telemeter board that controls the entire 115 kv system. A 30 kw emergency generator is connected directly to a four-cylinder diesel engine, which supplied power to 751-A and 784-A in the event of a normal power outage. Construction on the facility began August 13, 1951. Final acceptance by Operations occurred on February 25, 1954, and the station was energized on September 8, 1952. [42] In later years, 751-A was sometimes redesignated 751-1A.

Steam Generation Plant (784-A)

784-A supplies steam for process and heating requirements in the 300-M and 700-A areas. At no point did it produce electricity. The building is a Class III structure with an irregular shape, measuring 67 feet long and 62 feet wide. The building also contains three operating floors, each with ten feet of vertical clearance. The foundation of the building consists of reinforced concrete spread footing and grade beam, on which a structural steel frame is set. The building is clad in asbestos board siding and a concrete slab roof with built up roofing. There are two boilers installed within the building, as well as necessary ducts, breeching, forced-draft fans, tanks, and motors. Each boiler has the capacity to produce 60,000 pounds of steam per hour at 325 p.s.i.g. both dry and saturated. A concrete chimney, measuring 12 feet 7 inches outer diameter at the bottom, 6 feet inner diameter at the top, and 75 feet in height, is also associated with the boilers.[43]

The coal hauling equipment associated with 784-A is made up of a track hopper with an electrically driven reciprocating feeder and belt conveyor, a weightometer, a crusher, a magnetic pulley for tramp iron, a buck elevator, a stocking-out chute, a screw conveyor situated across the coal bunkers and Bindicators, and a car-puller for placing cars. The ash removal is effected by a pneumatic type system that employs a steam jet aspirator. This discharges the ash collected from the boiler grate and hoppers, stack, and dust collectors, into an overhead concrete ash silo. A rotary unloader controls the feed rate of the ash, eliminating excess dust when ash is transferred into cars or trucks from the silo. A reinjection system collects cinders and fly ash from under the boiler section and from the primary hoppers of the dust collectors.[44]

Construction of 784-A began on August 3, 1951, with final acceptance by Operations occurring on February 4, 1953. The facility first produced steam from Boiler 1 for the 300-M area on September 27, 1952; Boiler 2 was put into service October 13, 1952. The boilers were constructed by Combustion Engineering-Superheater, Incorporated, the refractory brick lining was installed by J. T. Thorpe, Incorporated, and the concrete chimney and silo were built by the International Chimney Company.[45]

Pipe Supports (801-F, H)

These supports carry the overhead steam distribution lines outside the power block to various area buildings, and also carry condensate return lines, instrument airlines, and chlorine lines within the power block limits, along with the air sluicing lines. The supports consist of creosoted wood poles with three-inch by eight-inch wooden side arms bolted to the uprights, supported by flat bar stock braces. Concrete was used to construct the ash sluicing lines.[46] These supports are similar to those used throughout SRS.

Insect Spraying Under Steam Pipe Supports, August 28, 1957, SRS Negative DPSPF-4597-5

Steamlines and Pipe Supports, July 11, 1955, SRS Negative DPSPF-2731-4

Construction on 801-F began July 23, 1952, with full and final acceptance occurring on December 28, 1953. Construction on 801-H began October 17, 1952 with partial acceptance occurring on December 15, 1954. Final acceptance of the facility was granted by operations on August 19, 1955.[47]

Overhead Steam Lines (802-F, H)

The steam lines convey steam at 300 p.s.i.g from buildings 284-F ands 284-H to various points within those areas. Within the steam distribution system, seamless steel pipes ranging in size from 1.5 to 12 inches are incorporated with valves, traps, and insulation. Construction on 802-F began August 18, 1952, with partial acceptance occurring on December 15, 1953. Final acceptance of the facility was granted by Operations on March 1, 1954. Construction on 802-H began April 4, 1953 with partial acceptance occurring on December 15, 1954. Final acceptance of the facility was granted on August 19, 1955.[48]

Pipe Supports in D-Area, August 13, 1953, SRS Negative 4-515-04

Water

River Water Pump House (681-1G)

In combination with 681-3G, 681-1G supplied chlorinated river water to the 100 areas. The facility included an underground pump house, air intake shaft, access shaft, intake structure, inlet channel, substation, and a small guard patrol house. The intake channel measures nearly 1,900 feet long, ten feet wide at the bottom, with side slopes of one-to-four, except at the river and pump house ends. Approximately 2,200 linear feet of chain link fence surrounds the pump house area. The actual pump house building is a Class I structure, irregularly shaped, measuring about 185 feet long, 121 feet wide, and 79 feet high, with 26 feet above grade and 53 feet below grade. The building is constructed from reinforced concrete, set on spread footing foundations. Construction of 618-1G began on August 13, 151 with partial acceptance occurring on March 27, 1953. Final acceptance was granted by Operations on March 2, 1954.[49]

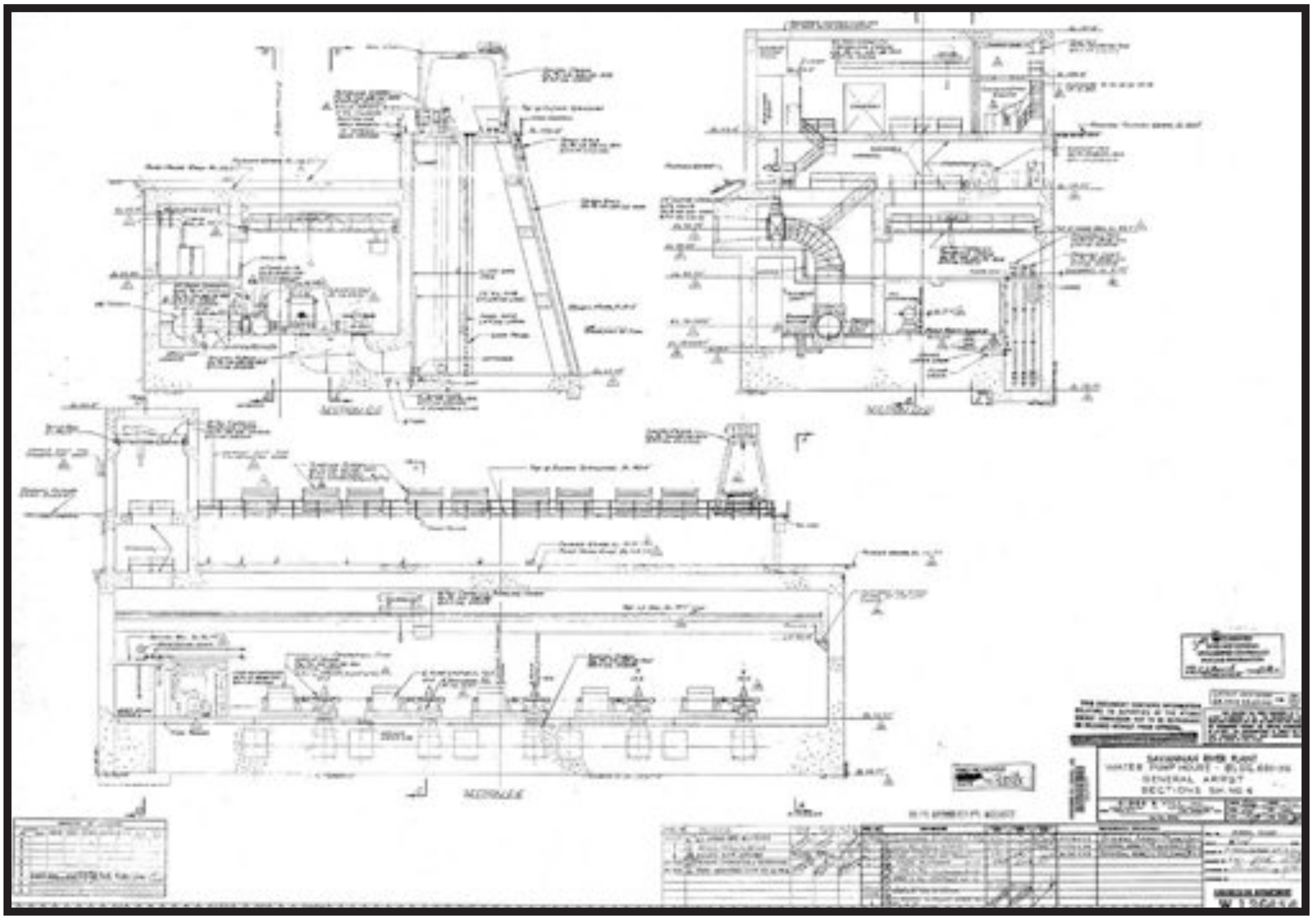
Interior of 681-1G Pump House, date unknown, SRS Negative M-3193-01

River Water Pump House (681-3G)

681-3G is identical in construction to 681-1G, with two exceptions; 681-3G measures 82 feet in height with a 1,500 foot intake channel. Construction of 681-3G began on November 23, 1951 with partial acceptance occulting on July 21, 1953. Operations granted full acceptance of the facility on August 13, 1954.[50]

681-3G Pump House Intake, March 28, 1953, SRS Negative 6-249-02

Interior View of 681-1G Pump House, March 20, 1956, SRS Negative DPSPF-3178-3-11



681-3G Pump House Cross Sections, SRS Negative W136656

River Water Pump House (681-5G)

681-5G supplied D Area with chlorinated river water for steam generation, process applications, service, fire control, and non-potable domestic use. The entire facility consists of two pump wells fed by the intake channel on the river. Over these is an operating platform with a structural steel frame, supporting two ten-ton hoists. Steel columns were erected on reinforced concrete footings, while interlocking steel sheet piling forms the two pump wells, with walers and braces providing reinforcement for the structure. A 12-inch reinforced slab, at elevation 73 feet ASL, forms the floor of the pump wells. The pump wells are each 19 feet wide, 43 feet long, and 52 feet deep. The operating platform is irregularly shaped, but measures 84 feet by 62 feet at its widest and longest points. A 120 foot intake channel brings water from the river, and varies in size from 10 feet at the bottom with a two to one side slope at the river end, to a bottom width of 37 feet with a one to one side slope at the pump house end. Access to the facility is provided by a 20 foot wide road constructed at an elevation of 113 feet to allow for high water. An eight foot square guard patrol house was built as part of the facility at a later date than the facilities construction. Construction began on 681-5G on April 16, 1951 with partial acceptance occurring on July 8, 1952. Operations granted full acceptance of the facility on December 17, 1952.[51]

Par Pond Pump House (681-6G)

The Par Pond facilities were designed to supply 37,000 g.p.m. of cooling water, which was distributed to the 100-R and 100-P Areas. The pump house was designed at an ultimate capacity of 200,000 g.p.m., with an initial capacity of 150,000 g.p.m. Seven vertical pumps, each with a capacity of 22,500 g.p.m. at 167 feet total dynamic head (t.d.h.) were installed at the pump house. A low velocity intake channel with a submerged water entrance was also installed, in order to draw the coldest water possible from Par Pond. The intake channel has a bottom width of 300 feet and an invert elevation of 180 feet mean sea level (m.s.l.) that extends nearly 2090 feet into the pond. A prefabricated metal structure (681-7G) served as the equipment building for the pump house, and contains miscellaneous electrical switching and control equipment, an air compressor and receiver, and water treatment and storage facilities. Power was supplied to the facility by the 115 kv tie line between R and P Areas. An 8000 kva transformer, adjacent to the pump house, reduced the voltage to 4160 v for use by the pump motors.[52]

681-6G consists of a reinforced concrete structure measuring nearly 46 feet wide by 109 feet long, and 32 feet below grade. On the southern end of the structure two wing walls angle out at 45 degrees, flanking a trapezoidal entrance slab. Although ten wells for vertical suction pumps were provided, only seven were used. At elevation 201 feet m.s.l., a pipe trench for a 78-inch steel header extends longitudinally through the structure, covered with steel grading which provides access to the header and valves. In addition to the main trash rack over the water entrance slot, fixed screens in guides were also provided for each suction well as temporary protection during start-up.[53] Construction on the pump house began September 15, 1957 and was completed in January 1959. Final acceptance by Operations occurred on March 9, 1959.[54]

Par Pond Pump House Equipment Building (681-7G)

681-7G is a four-room, prefabricated building measuring 36 feet wide by 48 feet long and 17 feet high. The building is erected on a concrete slab foundation with corrugated metal siding and roof. Housed in the building was 4160-volt Allis-Chalmers switchgear, a motor control center, lighting panels, a D.C. battery rack, Vicicide point case, air compressor and receiver, two chlorinators, and two evaporators, as well as two cable pits, the larger of which is located behind and below the switchgear. Electric heaters were installed in three rooms; no heaters were installed in the switchgear room. Lavatory facilities were also installed in the building.[55]

The building structure was reused from previous buildings resulting in various alterations to members of the purlins and bents necessary for adherence to the new dimensions. The two chlorinators were also reconditioned equipment transferred from the 100-K and 100-K Areas. Construction on 681-7G began May 25, 1958, with final acceptance occurring on March 9, 1959.[56]

Underground Water Pipes (901-G)

This piping system was constructed to deliver river water from 681-1G and 681-3G to the five 100 Areas, and from 681-5G to the 400-D Area. Approximately 48 miles of specially fabricated, lock-joint, reinforced concrete pipe, varying in diameter from 48 inches to 84 inches, along with access manholes, air valves, blow-off valves, cut-off valves, reducers, Venturi meters, and retention basins, comprise the waterline system. Joints are comprised of steel and rubber. Dual lines connect 681-1G and 681-3G with the Ellenton Header, located approximately one mile from and parallel to the Savannah River. The lines then run another five miles to the five 100 Areas. One independent line, 60 inches in diameter and 4,750 in length, connects 681-5G to 483-D.[57]


Well Drilling Between F And H Areas, January 23, 1961, SRS Negative DPSPF-7265-6

All of the valves within the system are enclosed within valve pits, consisting of concrete boxes that extend above ground and are roofed with built-up roofing, or in valve houses, comprised of small wood frame structures with corrugated asbestos siding and roofing. The system contains a total of 24 valve pits and 24 valve houses. Pipe located outside of fenced areas is buried at a two-foot minimum, while pipe located within fenced areas is buried at a three-foot minimum. The 16 retention basins contained within the system are all rip rapped and adjacent to special air valves, preventing erosion when the valves are discharged. These basins are drained with integrated piping and ditches. All lines are connected in a modified loop system and sectionalized for operational flexibility. Construction of this facility began April 4, 1951. Full and final acceptance of the entire system by Operations occurred on February 23, 1954.[58]


Laying Water Lines, April 3, 1952, SRS Negative DPESF-712-08

Wells and Pumps (905-G)

The wells and pumps provide domestic water for use in the locomotive shops, two pump houses, five perimeter gatehouses, and the rifle and pistol range. The wells are deep artesian-type wells located close to the buildings that they facilitate. Each well is equipped with a turbine deep well pump with an electric motor drive (with the exception of those located at the pump houses, as they are included with the installation equipment of those buildings), auxiliary equipment, and a storage tank. In addition, all pumps (with the exception of those at the pump houses and at the locomotive shops) are enclosed and have concrete slab floors and foundations. Each of the pump buildings measures approximately seven feet by seven feet and is a Class III structure.[59]

Chlorine (Chemical) Building (905-A)

No longer extant, 905-A provided and treated all water requirements in the 300-M and 700-A areas. The building was a one-story, Class III structure that measured approximately 15 feet by 16 feet. Structural details included a reinforced concrete slab floor, structural steel framing, flat cement asbestos siding, and corrugated cement asbestos roofing. Water was supplied by three wells at 685 feet, 455 feet, and 680 feet deep with capacities measuring 210 gallons per minute (g.p.m.) and 780 g.p.m. to 1500 g.p.m. respectively. Construction began on April 28, 1952 with partial acceptance by Operations occurring on October 8, 1953 and final acceptance on December 8, 1954.[60]

COMMUNICATIONS

Southern Bell Telephone and Telegraph Company, and the Cassels Telephone Company provided communication services to the area prior to the construction of SRP. Southern Bell operated two pay stations in Dunbarton, and a privately operated line from the forest ranger station two miles west of Dunbarton, between the station and Dunbarton. Cassels operated a private franchise, serving the majority of the area including Ellenton, Leigh, Myers Mill, and the southern portion of the site. Cassels operated out of Ellenton, serving 180 subscribers, with facilities to serve 1,000 using the most up to date equipment and dial telephone system.

Access to telegraph service was available at railroad stations in Ellenton and Dunbarton, and by phone in Augusta. Although an American Telephone telegraph line crossed the site along the northern portion, the line did not provide service to the area. Small United States Post Offices operated in Ellenton, Dunbarton, and Myers Mill, while the post office in Augusta provided direct airmail service.[61]

Fire Alarm System (505-G)

The fire alarm system was installed to provide alarm signals at plant fire stations, 709-A and 709-F, in the instance of a fire emergency in any of the areas. The system was incorporated with the plant telephone system. Installation of the system began May 22, 1952 with final acceptance form Operations occurring on June 27, 1955.[62]

Telephone Cable and Instruments (506-G)

506-G facilitated telephone communication within SRS, connecting all permanent plant areas through the main exchange located in 702-A. The system was comprised of both overhead and buried telephone cable, along with the required pole supports, switchboards, and telephones. A 202 pair cable entered the site from the Bell network and was distributed throughout the plant in various pairs as required. Approximately 85 miles of telephone cable were installed in G-Area. Installation began April 9, 1951. Final acceptance by Operations occurred May 13, 1955.[63]

Safety Alarm System (507-G)

The safety alarm system provided security warning signals, as well as autocall signals, to personnel in the various areas of the plant. Consisting of alarm horns and cables mounted on power and light poles at strategic junctures within the developed areas, there were also loud speakers that could broadcast radio messages, or those from telephone circuits. The system could be activated locally, or within the entire area, if necessary. The central station controlling the system was located at patrol headquarters in A Area. Construction in A Area began in March of 1952 and was completed in October of the following year.[64]

Fire Observation Tower, January 10, 1953, SRS Negative 6-234

Patrol Radio Station (623-1G)

623-1G housed radio transmitters that facilitated communications between patrol headquarters and SRS patrol vehicles. Transmissions were controlled by the central console located in 720-A. Emergency transmission was facilitated from five other buildings. 623-1G is a single story, Class I structure and measures approximately 12 feet by 14 feet. The attached generator house measured approximately 7 feet wide and 8 feet long. The entire facility, foundations, floors, walls, and roof, is constructed of reinforced concrete. Construction on the facility began November 30, 1951 with partial acceptance occurring on March 3, 1953. Operations granted final acceptance on July 29, 1955.[65]

Fire Observation Tower (627-G)

The tower was used to observe, detect, and locate potential forest and grass fires within SRS. A standard Forestry Service tower, 627-G was already in place prior to the start of construction. Within the tower were two radio transmitter receivers, one set to the South Carolina Forestry Commission channel, and the other set to the SRS patrol channel. The facility was accepted by Operations on June 7, 1954.[66]

WASTE

Sewage Treatment Plant (607-1A)

607-1A disposed of sanitary sewage produced in the 700-A Area. The building was a Class III structure constructed from reinforced concrete, created from three sections. The first section was a sludge digestion tank, measuring 20 feet interior diameter and 25 feet deep. The second section was a pump and pipe room, measuring 16 feet by 24 feet. The third section contained a primary sedimentation tank and wier box measuring 38 feet by 12 feet, as well as a drying bed divided into four sections and measures 32 feet by 83 feet. Construction of the facility began July 18, 1951, with full and final acceptance by Operations occurring on October 10, 1952.[67]

Sewage Lift Station (607-2A)

607-2A was a lift station and booster from the administration area to the sewage treatment plant. The building was a rectangular Class III structure, constructed of reinforced concrete, and measuring 15 feet wide, 16 feet long, and eight feet high. The pump floor was 14 feet below grade, and the entry consists of a steel stair enclosure of structural steel and flat cement asbestos board siding. Construction on the facility began November 5, 1951, with full and final acceptance by Operations occurring on September 29, 1952.[68]

Comminutor (607-3A)

607-3A was automated to constantly reduce coarse sewage material into smaller solids that would settle more easily, in order to eliminate excessive maintenance on pumps and to induce better digestion of sludge in the sewage treatment plant. The comminutor was motor driven and set in an open concrete pit located in the trunk line of the sanitary sewer, just before the line enters the sewage treatment plant. Construction of the facility began on July 18, 1951, with full and final acceptance by Operations occurring on October 10, 1952.[69]

Sanitary Sewers (903-G)

903-G is the classification code for the sanitary sewer system, which moves sanitary sewage from area buildings and facilities to disposal locations. The sanitary sewers contain approximately 3,600 linear feet of six and eight-inch vitrified clay pipe, 400 linear feet of six-inch cast iron pipe, and 12 brick manholes. The sewer lines were installed at depths between three feet to four feet six inches below grade. Sewer lines were installed in the vicinity of buildings 678-G and 679-G in the CMX Area, at the locomotive shops in the Railroad Classification Yard, at five perimeter gatehouses, and at two pump houses. Construction on this system began in various areas starting May 27, 1951. Final acceptance for all sewer lines by Operations occurred June 28, 1955.[70]

Process Sewers (904-G)

904-G is the classification code for the sewer lines that carry process waste from buildings and facilities in the process areas to disposal locations. The process sewer consists of steel, vitrified clay, and reinforced concrete pipe, as well as open drainage ditches that carry the effluent flow to streams in the plant area. Many of the drainage basin sides were rip rapped with stone. In addition, manholes, headwalls, and catch basins were also constructed as part of the system. Construction on the process sewer began June 24, 1951. Partial acceptance occurred on June 3, 1953 and final acceptance by Operations occurred in June 28, 1955.[71]

Storm Sewers (907-G)

907-G is the classification code for the storm sewers that carry storm and surface water from plant areas in order to maintain accessibility to those areas. The storm sewers are made up of steel, reinforced concrete, and vitrified clay pipes. The pipes were installed between three and 12 feet deep. In addition, concrete gutters, head walls, catch basin, and manholes were also constructed. Construction of the facility began September 2, 1951. Partial acceptance occurred on March 2, 1955 and final acceptance by Operations occurred on June 28, 1955.[72]

Burial and Disposal Grounds

Ash Disposal Basin (488-D)

488-D was constructed to facilitate the handling of all ash waste from the four boiler units in the D-Area powerhouse. The ash disposal basin was comprised of two basins, each 1,850 feet long by 525 feet wide, surrounded and divided by 9,000 linear feet of dykes. The excavation of the basins provided all fill material for the dykes. Two 10-inch ash sluicing lines carried waste ash sluicing water from the powerhouse to the basins. At the west end of the basins, two 30-inch concrete pipes set in concrete blocks provided for overflow. Construction of the facility began November 13, 1951, with full and final acceptance by Operations occurring October 16, 1952.[73]

Burial Ground (643-G)

643-G is the classification code used for the burial ground used to entomb contaminated solid waste, materials, and equipment from the entire plant. The area measures approximately 800 feet by 3,000 feet. The land was cleared, fenced, and equipped with a wood frame skid shack, which served as office space. The skid shack measured 10 feet by 15 feet. A secondary dirt road and a railroad spur provide access to the area. Construction of the facility began on October 20, 1952. Partial acceptance from Operations occurred January 13, 1953; final acceptance occurred July 29, 1955.[74]

643-G Burial Ground, November 6, 1956, SRS Negative 3911-31

MILITARY SITES

Preliminary plans for the installation of 75 MM and 90 MM antiaircraft gun sites within SRS boundaries began in 1954. As part of the inclusion of the military within SRS, renovations were planned of TC buildings to facilitate military barracks and cafeteria needs, as well as the construction of several new buildings. The 30 planned 75 MM gun sites were each to include 20 foot by 48 foot prefabricated new construction capable of housing three to 11 men, as well as gun revetments, latrines, water, roads, and electrical power. Each of the eight planned 90 MM gun sites were to include concrete block barracks capable of housing 120 men, as well as a mess hall, administration building, a command post, a motor pool area, gun pads, roads, and utilities.[75] Although some of the modified TC buildings are standing and have been altered for other uses, none of the gun sites are extant. Within B-Area is a concrete slab in the shape of a United States military anti-aircraft artillery insignia. There appears to be a hole for a flagpole located in the center of the slab.

1. *Barracks Site 51, date unknown, SRS Negative S51-AA-11-06*

2. *Barracks Site 92, February 11, 1956, SRS Negative M-4085-01*

3. *33rd Battalion Anti-Aircraft 90mm Gun Enplacement, September 29, 1955, SRS Negative DPSPF-2886-8*

4. Mess Hall Kitchen, May 4, 1955, SRS Negative DPSPF-2214-8-1

5. Barracks Site 92, Interior of Barracks, February 11, 1956, SRS Negative M-4085-07

6. Barracks Site 92, Interior of Mess Hall, March 6, 1956, SRS Negative AA-14-12

7. Military Personel Outside of Unidentified Barracks, May 4, 1955, SRS Negative M-3954-03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VI. TRANSPORTATION SYSTEM

Traditionally, Du Pont has always considered roads and railroads to be two divisions that were part of a single department called "Traffic and Transportation."[1] This was certainly true during the long Operations era. During the Construction Era, this was usually the "Traffic Department," set up as early as December 1950, with a Traffic superintendent in charge of both roads and railroads.[2] That same month, the basic site areas had been established. The first roads and railroads were laid out on paper as early as January 1951, despite a number of specific issues yet to be resolved.[3] This led to Map 3306 for railroads and Map 3308 for roads, both issued on February 5, 1951.[4]

Even though roads and railroads were subsumed under the Traffic and Transportation Department during Operations, roads and railroads were always treated separately due to their different functions and personnel requirements. These two modes of transportation will be treated separately here as well. Roads will be considered first, since they were one of the first infrastructure topics to be given serious consideration in the early planning days of the Site.

Transportation Engineers Cost Reduction Poster, July 2, 1953, SRS Negative M-2650-2

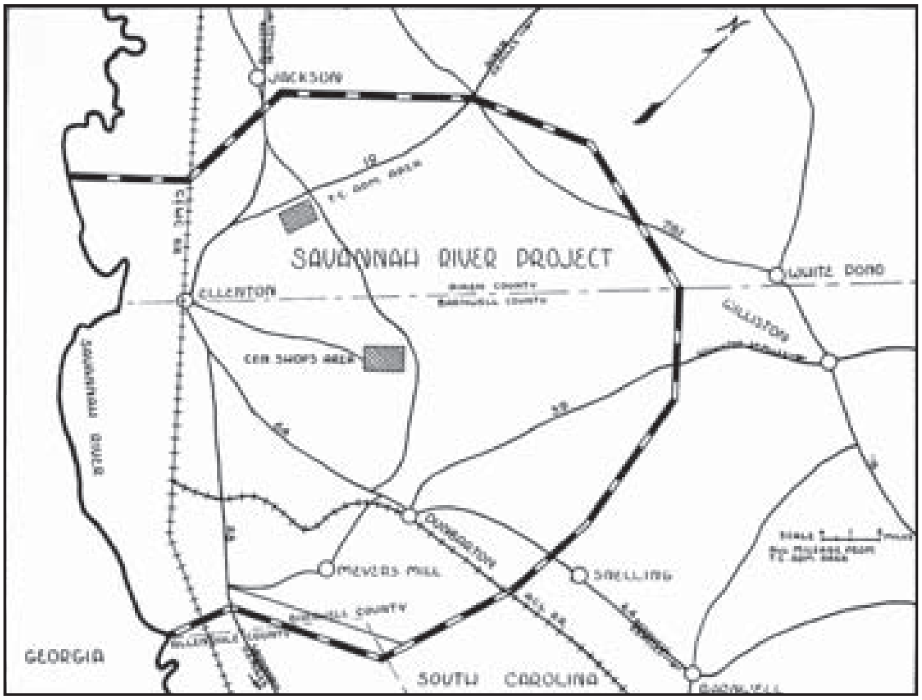
Transportation Engineers Cost Reduction Poster, July 2, 1953, SRS Negative M-2650-03

PLANT ROADS

Roads were absolutely essential to repair and manage in the early days of the plant's construction, and in the many years that followed. The very success of Project 8980 hinged on roads that were well maintained and well connected. As was often said in the T & T Department, "you can't run the reactors if you can't get to them," and the only way to do that was over a road system that connected all areas of the plant, and with adequate connections to the outside world.

Existing Road Improvements

At the time of the plant's announcement, in late November 1950, there were some 410 miles of state and county roads on what would soon be SRP property.[5] Among the major paved roads, there were five South Carolina state highways. They were Primary State Road 28, which ran north-south just east of the Savannah River and the Charleston and Western Carolina Railroad. This was the main route to Augusta. State Road 19 entered the site from Aiken before terminating at its junction with Highway 28. State Road 64 connected Barnwell with 28, passing through Dunbarton. State road 39 extended east from Dunbarton, while Secondary State Road 28 connected 28 with 64, through the community of Meyers Mill. State Road 781 extended through the northeast corner of the site, but did not go into the interior. Almost all of the other roads were basically unimproved farm roads maintained at the county level.[6]

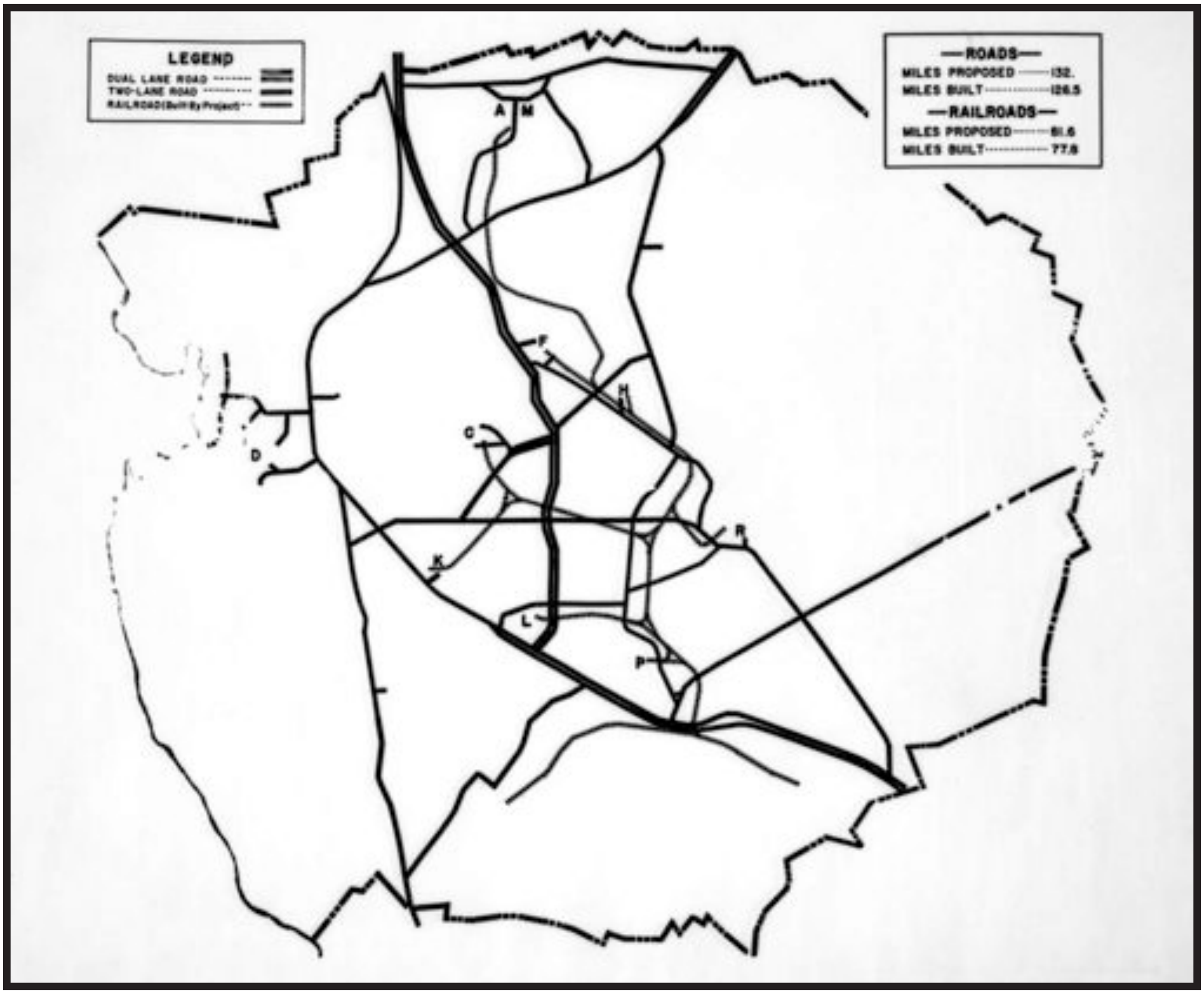


Project Map, Existing Roads and Railroads, circa 1950-51, SRS Negative M-2758

In order to save time and money, it was decided early on to use the existing road system whenever possible.[7] Traffic conditions were expected to be bad during Construction, and become so very quickly. With over 30,000 construction personnel traveling in an estimated 10,000 cars coming in and out every day, it was imperative that roads be in place and in good working order.[8] There was no time to completely re-do the road system.

Highway 64 at Dunbarton, View Looking Northwest, February 15, 1952, SRS Negative M-565

Highway 19 at "Johnson Crossroads", Just North of SRP Boundary, February 11, 1952, SRS Negative M-575



Project Roads and Railroads, July 2, 1953, SRS Negative M-2650-07

By the end of the Construction Era, there were 158 miles of permanent paved roads constructed on SRP, and 247 miles of temporary roads. Of these temporary roads, 83 miles were paved, the rest were dirt. And that did not count the improvements made to the roads and highways that led into the plant from the neighboring towns and cities. All totaled, just over 49 miles of these improvements were made to the local highway system.[9]

Among the early road constructions was the expansion of the existing highways that connected the site with Augusta and Aiken. For the Augusta connection, the north end of Highway 28, a two-lane road, was expanded to become Highway 125. Using money from the Federal Defense Access road funds, the 19.6 miles from U.S. Highway 1, outside Augusta, was made into a four lane all the way to SRP. This work began in January 1951 and was completed by the end of June that same year. Highway 19, the two-lane route from Aiken to the plant, a distance of 11 miles, was made a four-lane about the same time. Both routes were improved in other ways too, particularly with an extra bridge to help traffic flow at the north end of 125. The route from Barnwell into the plant, State Road 64, originally a two-lane road, was also increased to four. The rest of Highway 28, below Highway 125, was left two lanes for a distance of 12.5 miles.[10]

781 Beech Island Overpass, March 28, 1952, SRS Negative M-687B

Highway 1 Toward Aiken, SC, Overpass, March 28, 1952, SRS Negative M-689

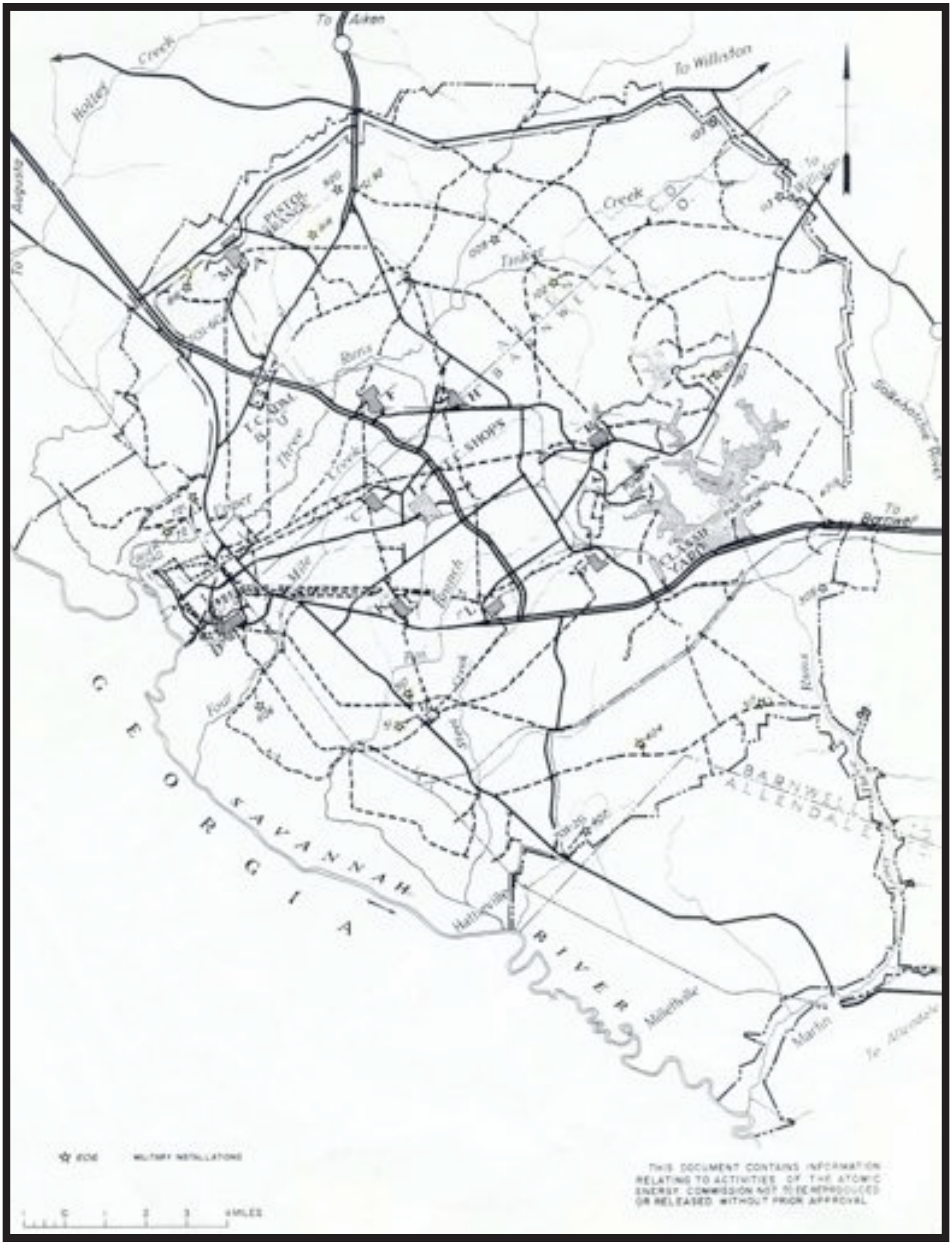
The four-lane conversion of Highway 19, work that was done by the SRP Roads Division and South Carolina Highways, was scheduled for completion in July. The Barnwell Highway (No. 64), which was scheduled for four-lane conversion from Road 8 to the east border of the site, followed soon after.[11]

New Roads

It was understood from the beginning that there would have to be a number of new roads, in addition to the re-working of existing roads. Road specifications for new road construction were compiled in late January and early February 1951.[12] Specifications for grading work, such as excavations, fill, and borrow pits, were also established during that same period, following contemporary industry standards.[13] Suber and Company, Inc., did most of the road construction, under contracts AXC 366 and AXC 39867. The use of Suber as a subcontractor proved economical, since the company used its own equipment and staff.[14] Road construction at SRP and vicinity was conducted throughout 1951, beginning in March of that year. By March of 1952, roadwork on site was almost complete, with some 150 miles of improved roads.

The first detailed road plans were prepared by Voorhees Walker Foley and Smith, which began working on the road system with Du Pont in late 1950 and early 1951. Since detailed topographic maps were not yet ready from Aero Service, USGS quadrangles were used to layout the routes. This resulted in Map 3308 for the roads and Map 3306 for the railroads, both dated to February 5, 1951. This information was later added to the SRP topographic maps when these were ready.[15] The initial lines of sight for these roads were cut in late February. The road system as it was finally formulated is shown on the opposite page.

SRS Military and Anti-Aircraft Gunsites, 2007, SRS Archives



Four-Lane Highway (Road C), the Cloverleaf, and Bridges

View of Cloverleaf at SRS, March 10, 1953, SRS Negative DPESF-2085-01

The continuation of the south end of Highway 125 was the route that would access the heart of the new plant. Even though there had been an older road in that vicinity (State Secondary Road 148), it was effectively useless for the new plant. The route would require a total re-working to accommodate the influx of thousands of cars. Planned from the beginning as a four-lane highway, it would soon be designated Road C. This 13 mile-long road was to be the jewel of the plant's road system. During the Construction Era, it was simply known as the "Four-Lane Road." This route continued off from Road 125 near the northwest edge of the site, extended over the Upper Three Runs Creek, and then extended uphill to the plateau that held F and H areas, before running through the heart of the reactor areas.

North of Upper Three Runs Creek, The four-lane road (C Road) joins with the road from Aiken, Highway 19 (Road 2 inside the plant), creating what would be the busiest intersection on site. Roads C and 2 were the two major arteries into the plant from the two largest regional population centers. These roads and their connection would receive great attention in both design and construction.

For the intersection of roads C and 2, a relatively new solution was proposed. As early as March of 1951, there was discussion of an overhead bridge and cloverleaf to unite the two.[16] In a meeting between Du Pont Design and G. P. Church of the Construction Division, the matter of the cloverleaf was again raised. Church was not in favor of the overpass and cloverleaf, favoring instead a more traditional traffic circle. Since the Construction Division was allowed to make the final decision,[17] Church was either overruled or changed his mind. The cloverleaf and overpass were duly constructed, and were the first to be built in the state of South Carolina.

View of Cloverleaf Intersection, February 11, 1952, SRS Negative M-621

Initial Road Survey, New Road (Road C) to Three Runs Bridge, June 28, 1951, SRS Negative M-168

New Road Cut at Three Runs Bridge, View Looking West, July 9, 1951, SRS Negative M-187

New Road Cut, Three Runs Bridge, July 26, 1951, SRS Negative M-213-4

New Road Cut, Three Runs Bridge, July 26, 1951, SRS Negative M-213-03

Preparation of Cement Forms for Three Run Road, September 12, 1957, SRS Negative M-285-06

Four Lane Road After Completion, January 27, 1958, SRS Negative 4967-32

While the specifications for most roads within the SRP system were fixed early on, the four-lane road presented extra problems. In particular, there was the crossing of Upper Three Runs Creek, and the road gradient on both approaches to the bridge.[18] The design work for this problem was done by the firm of Patchen and Zimmerman and extended into the summer of 1951.[19] During that period, the shoulder width of the four-lane road was increased from 4 to 8 feet in the cut areas, and 10 feet in the fills. To accommodate the bridge, the stream was slightly re-routed. Bridge width was increased by 2 feet over that of the normal road surface.[20]

Road, Culvert and Rip-rap at 39 and G Roads, December 17, 1952, SRS Negative M-1733-01

Bridge and Culvert at Four Mile Creek, May 31, 1951, SRS Negative M-146

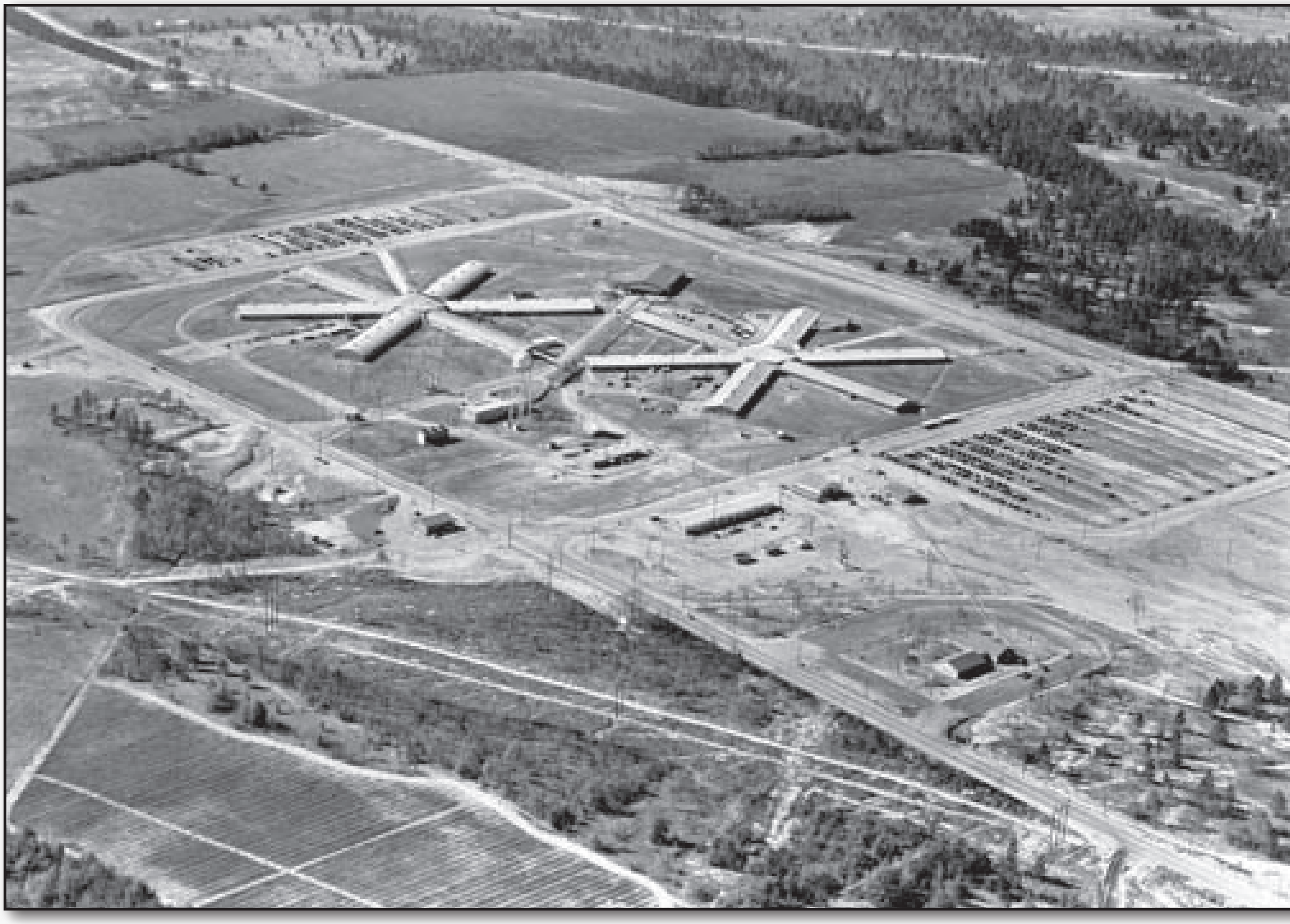
Example of Pre-fab Bridge at SRP, January 4, 1957, SRS Negative 4022-02

The bridge over Upper Three Runs Creek was by far the biggest bridge construction on site, and probably the most important. It is the only one mentioned specifically in the McCullin diary. The bridge location was fixed on February 22, 1951. The following day, there was a meeting to discuss the issue of the grade on the south approach to the bridge. The original plan called for an eight-percent grade, while the AEC preferred seven-percent, to which Du Pont acceded.[21]

Of course, there were other bridges at SRP. Seven new bridges were required, and two of these were located on the four-lane road.[22] Most bridge design work at SRP was handled by the Construction Division of Du Pont's EAD. Many streams on site were not large enough to require a bridge, and the necessary culverts were provided by Armco Company, as noted in a June 1951 entry in the McCullin diary.[23] In most cases there was no rush to replace the original bridges, but Du Pont had a policy of replacing the original structures, almost all of which were wooden bridges or trestles, with concrete bridges and culverts. This work was still underway as of May 1953.[24]

Other Roads and Central Shops

Some early roads gained notoriety. These were usually routes to the TC Administration Area, D Area, CMX, even F Area, all of which began construction early. Since many of these facilities were close to Ellenton, there were a number of roads there already. Some of these roads developed nicknames, or simply kept their original name. Hogan Road was one of the very first, and it went from Ellenton to Central Shops, and then on to the four-lane road (Road C). Later, part of Hogan Road was widened and paved, and became Road 3.[25]



Construction Headquarters at the TC Administration Area, March 10, 1953, SRS Negative DPESF-2085-02

The best known of the local roads, however, was the "Burma Road," located between Ellenton and F Area. This route, which goes past electrical switchyard 504-1G, was and still is a dirt track, named for the primitive Burma Road to China made famous during World War II.[26] On August 7, 1951, McCullin mentioned the need for an "escape road" from F area.[27] This may have been a reference to the local Burma Road.

During this period, Central Shops became the focus of the road-building effort, especially after it became the headquarters for Transportation. One of the first Construction departments to move to the site, Transportation occupied facilities at the Bush House in the very early days of the project. After construction of the TC Administration Area in early 1951, it moved there, relocating again to Central Shops in June of 1951.[28] Central Shops, located within the circle formed by the five reactors and two separations areas, was ideally situated as a transportation headquarters. Central Shops was one of the first permanent facilities to be set up at SRP, and Bud Hartnett, one of the interviewees for this report, was instrumental in laying it out.

The transportation facilities at Central Shops were impressive. Thousands of people worked there and thousands more were directed from there. It was home for fleets of dump trucks and other construction vehicles, such as power-line trucks, water trucks, drinking water trucks for construction crews, and sanitation trucks. There were also automotive repair shops, fuel storage facilities, shuttle buses, and rolling filling stations to ensure that all vehicles had fuel.[29]

Road Surfacing

The mechanics of laying out a road was certainly well understood, and as a rule, little was said about that aspect of road construction. A major exception was road surfacing. Road surfacing was done almost simultaneously at both Dana and SRP,[30] and it certainly appears that the specifications for roadwork at Dana, worked up by VWFS and Girdler, were the same used at Savannah River. Those specifications call for a road surface to be made of 2-inches of "asphaltic concrete," on top of an 8-inch gravel base.[31]

This may have worked at Dana, but it led to problems at Savannah River Plant. The initial search for concrete aggregate in 1951 found nothing that was suitable within a hundred miles of the plant. With an estimated demand for 1.5 million tons, local suppliers were hard-pressed to provide the required supply.[32] On March 19, 1951, McCullin noted that a decision was made to use one-inch asphaltic concrete in all parking areas, and a less expensive bituminous surface treatment on the "patrol roads." The following day, it was decided to use one-inch asphaltic concrete on all surfaces, due to the problems Du Pont encountered at the Camden Plant.[33]

Later that same month, Du Pont was petitioned by the Southeastern Bituminous Company of Augusta, for a change of the road specifications to allow for the use of "tar cement." In early April 1951, Du Pont decided against tar cement, since it was the policy of the South Carolina Highway Department not to use it. It was, however, approved as a primer, and for use on patrol roads.[34]

Resurfacing Highway 19, October 16, 1953, SRS Negative M-2971-10

As for the asphaltic concrete supply issue, this was at least partially solved by establishing asphalt batch plants directly on site.[35] This solution worked out well enough so that the basic SRP road paving was completed by July of 1953. That same month, it was noted that much of the road construction equipment left over from this work would be purchased and turned over to Operations.[36]

Other Road Features

Another type of work that was on-going, even at the end of the Construction Era, was the addition of so-called extra road features, such as shoulders, guard rails, parking lots, and walkways. Traffic engineers hired by Du Pont handled much of this work. The first were hired in late 1951 and advised Du Pont until 1954. Their work helped fine-tune a system that was already in place, with channelized intersections, one-way traffic flow at peak hours, speed limit guidelines, the placement of center lines and passing lanes, intersection lights, and various pedestrian features.[37] As early as July 1951, road shoulders were established as 4 feet to a side and 8 feet at intersections. This was soon changed to 8 feet per side regardless. Highway guardrails were called for whenever road fill stood at over 6 feet, according to a decision made on June 20, 1951.[38]

The decision to make standardized sidewalks is virtually as old as the project itself. Walkways were even assigned their own number (Building 604), and were "to provide lanes of pedestrian communication between area buildings." In R area, there were between 1,500 and 2,000 linear feet of concrete walks, four feet wide. Some 500 linear feet were six feet wide. The other reactor areas were basically the same. The linear footage was far greater in both the separations areas and in the 300/700 area, which would have a greater concentration of workers. Here, the walkways were four feet, five feet, or six feet wide, depending on the estimated number of employees in the vicinity.[39]

Parking areas (Building 613) were also an integral part of the road system. During the Construction Era, there were vast parking lots at each of the individual areas. There was even a "clock alley" at each parking lot to facilitate checking in and out from work. At the TC Administration Area, the parking lots had lanes that were 50 to 60 feet wide, separated by 5 to 10-foot wide walkways.[40]

Parking Lot in 700 Area, circa 1953, SRS Negative DPSPF-1035-1

Car Pool Pick-up in 700 Area, circa 1953, SRS Negative DPSPF-1035-7

Surfacing at the construction parking lots might be "temporary," usually with some form of bituminous material, but permanent parking for Operations personnel would have concrete paving. In addition, there would be a concrete curb, four-inch wide painted lines, and other features detailed in Specifications 3021. Provisions were also made for future parking expansion.[41]

Landscaping (Building 698) was a feature of the SRP road system that was not always recognized, but was vital to roadbed longevity. While much of this work was associated with sod and grass planting around buildings—and this was certainly done at Savannah River—landscaping was also an integral part of the roadscape. Road specifications called for grass planting and seeding along the bank slopes, as well as rip-rap under the bridges, and this work was recognized as vital to road construction.[42]

Slope protection along roadways and railroad grades was probably the most important function of landscaping. Du Pont even came up with its own special recipe for the prevention of bank erosion: an exposed area was covered with two to three inches of topsoil and then seeded with a mixture of Bermuda, rye, and lespedeza grass seeds. After watering, it was then covered by a spray that resulted in a thin asphalt coating. The concoction would hold until the grass germinated and broke through the covering.[43]

As for the areas around the buildings, landscaping was generally limited to laying topsoil and planting grass. This was done "for the sole purpose of dust control," rather than for visual improvement.[44] Du Pont began this work by laying six inches of topsoil, which was their standard at other facilities. Later, the AEC insisted that just three inches would do, and Du Pont agreed to this, but only in areas that had not yet been graded. In areas that had already been graded to six inches, they insisted on using the standard six inches of topsoil.[45]

Among the last of the features added to the SRP road system were the turn-outs (also called pull-outs) provided for the 300/700 area in 1954.[46] These facilitated the loading and discharge of passengers from the various car pools that were such a dominant feature of the SRP workday in the 1950s and 1960s. These pull-outs were placed in the 700 area, particularly near the 703-A parking lot entrance, and in front of the cafeteria.[47]

Road Numbering System

A road numbering system of some sort was in place by January 1952, but was understood to be temporary. McCullin noted that there was interest in making that road numbering system permanent to prevent confusion, but it does not appear that this was done.[48] On July 3, 1952, C. H. Peden, the general superintendent for roads, announced that there would be new road signs and road designations. According to a report in the construction newspaper, letters would identify roads that trended north-south, while those that trended east-west would use numbers. The new road signs would have black lettering on white, and would read "SRP-A" or "SRP-2." They would be placed at the shoulder of the roads, at a height of 7 feet, with additional warning signs before any juncture with another road.[49] In later years, the "SRP" prefix would be dropped, leaving just the letter or number.

View of Junction C, July 2009, SRS Negative 0901195009

Even the intersections were numbered, at least in the early days. A 1964 report stated that in the 1950s, each intersection was assigned a discrete number, such as Intersection 32, which in this case was the juncture of roads 6, 7, and G, near R area. By the time of the report, the intersection numbering system had been dropped.[50]

Permanent and Temporary Roads

The road construction program was a huge success, and led to a system of temporary and permanent roads throughout the Savannah River Plant. Temporary roads were the first roads established.

Example of Primary Road Near R Reactor, September 23, 1959, SRS Negative DPSPF-6240-3

These were in use during the construction period, and were usually graded and overlaid with a combination of sand and clay. If that was insufficient due to erosion or over-use, then they might be covered with a bituminous coating, or two inches of asphalt-mix pavement. There were a total of 250 miles of temporary roads on the site, and of these 85 miles were paved.[51]

There were 167 miles of main roads, also known as permanent roads. These had widths of 14, 20, or even 40 feet, depending on whether they were two-lane or four-lane. Du Pont counted 106 miles of 20-foot wide new roads, surfaced with "asphaltic concrete" two inches thick. In this tally, Du Pont counted each four-lane twice. In addition, there were 17 miles of 20-foot wide new roads, surfaced with a bituminous surface treatment. There were another 42 miles of previously existing roads, paved with two inches of asphaltic concrete, and a final 20 miles of existing roads with no additional improvements made.[52]

During the Operations era, these temporary and permanent roads generally became secondary and primary roads, respectively. The primary road system, which was always paved, provided the main connections between individual areas on site. Secondary roads, most of which were not paved, were reserved for the use of "service groups," such as the Patrol, Fire Protection, Health Physics, Electrical, Power, Maintenance, Traffic and

Transportation, and Forestry. By this time, secondary roads were also called "patrol roads." By 1957, it was noted that many regular employees were using these secondary roads to take short-cuts to and from work, putting a strain on a road system not designed for such traffic. There was a campaign to curtail that problem, and the first 35 mph speed signs were put up throughout the secondary road system to discourage that sort of use.[53]

Both primary and secondary roads are shown in Map SM5-G-109, even though secondary roads are given top billing in this particular map. It is interesting that this system of secondary roads show the north and south series of large river water pipelines that connect the river pump houses with the five reactor areas. There will be more about those pipelines later in this report. This map also shows the location of local bridges and identifies them by number.

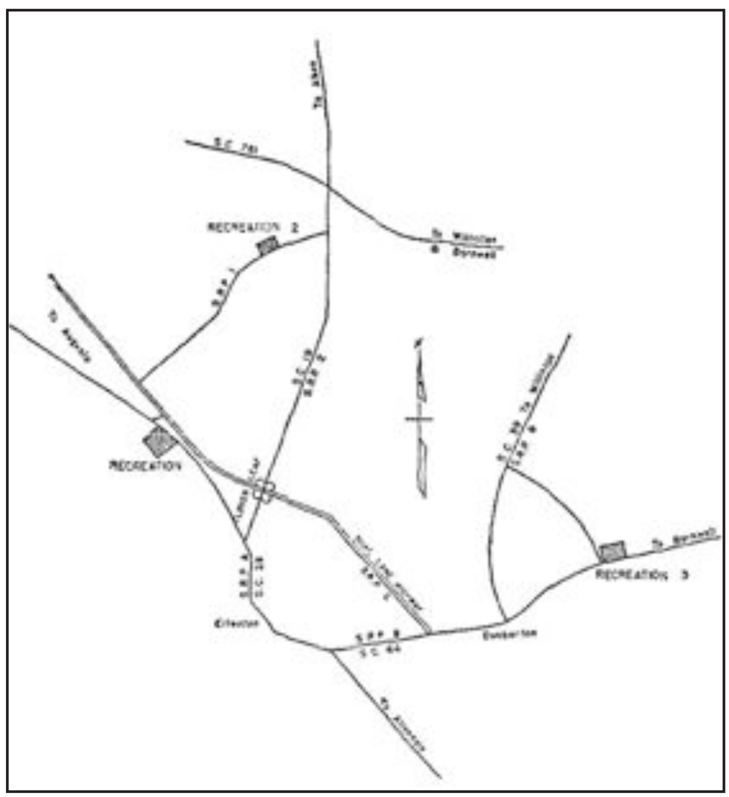
Map SM5-G-109, Archer 1954

Federal Acquisition and Public Closure

The Federal acquisition of public roads within the boundaries of the site began in 1951 and continued into 1952. This was the final step in the closure of the plant to outside traffic. The town of Ellenton had been effectively shut down early in that year, as had the other communities within the boundaries.[54] The state of South Carolina wanted compensation for the loss of its roads within the site, but the Federal government countered that the costs of the replacement roads along Routes125 and 19 out of Augusta and Aiken more than made up the difference. Aiken County surrendered its roads without much issue, but Barnwell County did not. The Army Corps finally condemned those roads in September of 1952, and took possession by a Federal court order on November 5, 1952. In early December, it was announced that, "the project area would be officially closed to the public on December 14, 1952."[55] This included Highway 28 between Jackson and Allendale; it would be 15 years before that route would be re-opened to the public. The only roads that crossed SRP boundaries that would remain open to the public were SRP-1, between the Aiken and Augusta highways, and State Highway 781, that skirted the border on the north east side of the plant.[56]

Buildings and Constructions Associated with the SRP Roads

The Savannah River Plant road system tied together all of the major work areas of the site, but it provided access to many relatively small places, many of which no longer exist. During the Construction Era, there were a number of recreational parks within the boundaries of the plant. Three were under construction in July 1952 and opened the following month: one close to Jackson on Road C, close to Road 1(Pecan Grove Park); a second near the Aiken entrance on Road 1, one mile from Road 2 (Pine Grove Park); and a third near Snelling (Oak Grove Park) on Road B.[57] Each of the three had parking lots, baseball diamonds, slides and swings and other facilities for children, extensive barbecue pits, tables, vending machines, and even emergency radios.[58] All of these facilities are now gone, even though they did survive for a few years after the SRP highways were closed to the general public.



Map of Three Parks, July 18, 1952, SRP News and Views

One of the important structures associated with the road system is the boat and barge dock on the Savannah River, Building 662-G. This was specifically built to receive the reactor tanks and other equipment sent by barge from New York Shipbuilding Corporation of Camden, New Jersey.[59] The dock area was stabilized with gigantic concrete blocks, after which a

125-ton capacity stiff-leg derrick was installed to hoist up reactor tanks and other materials from the barges that would come up the Savannah River. These would then be loaded onto "low-boy" trucks for delivery to the reactor areas.[60] This was an important event in the early life of the road network, and it was certainly the single most important event to occur at the dock. In the years that followed, this was the home of the "SRP Navy": two inboard and three outboard boats used by Health Physics to survey the river every other Friday.[61]

Constructon of Savannah River Boat Dock, June 25, 1952, SRS Negative M-1045-01

View of Workers at Boat Docks, November 4, 1955, SRS Negative DPSPF-2950-01

Another structure more integral to the working of the road system was the small and unobtrusive facility on the west side of A-Area immediately south of Road 1-A. Known as 616-G, this was the truck scale house. The function of the truck scale house was to weigh truck shipments, using control and recording equipment. This facility was requested as early as June 1951, and final specifications were provided the following month. On August 28, 1951, it was requested that the building be moved off of the four-lane road that it was on (later known as Road 1-A) to allow for future expansion.[62] Sketches of the house were requested in October of that same year, with working drawings approved in December of 1951. The non-operating equipment list was received in January of 1952. The scale platform, with a 30-ton capability, is located in the pit below the road surface in front of the scale house.[63] The completion date of this building is given as October 24, 1952.[64]

View of River Dock, November 4, 1955, SRS Negative DPSPF-2950-3

RAILROADS

During exactly the time that roads were under construction, the SRP railroad system was designed and constructed as well. Railroads were in fact just as important to the overall success of the project. The work force may have used roadways to access the site, but most of the materials used to construct the site were transported by rail. The site could already be reached by commercial railroads, but it was imperative to build an internal SRP rail system to serve each of the work areas being prepared for the site. This railroad was in place and ready for the first train as early as August of 1951.[65] By 1952, there were 66 miles of track within the SRP rail system.[66] This system not only had to function on its own, but also it had to coordinate activities with the much larger commercial systems that served the region.

Railroad Survey Workers, June 23, 1952, SRS Negative M-1036-11

Existing Railroads, 1950

At the time the plant was announced in November of 1950, there were two rail lines that crossed land that would become part of the site. These were the Charleston and Western Carolina Railroad (C & WC), which ran parallel to the Savannah River, and the Atlantic Coast Line Railroad (ACL), which joined with the C & WC on the south side of the plant. A third railroad, the Southern Railroad, did not pass through the site, but was close by, connecting with the ACL in Barnwell, six miles east of the site.[67]

The Charleston and Western Carolina passed through Ellenton, but it would be more accurate to say that Ellenton grew up around the railroad. The town did not exist before the railroad came through in the years after the Civil War. Despite the name, the Charleston and Western Carolina did not connect with Charleston, but rather with Port Royal, joining that place with Augusta and beyond. The later Atlantic Coast Line, constructed in 1899, came to the area from Florence, South Carolina. It joined with the C & WC at a point about seven miles south of Ellenton, at the railroad junction of Robbins. The small community of Dunbarton began to grow along the ACL.[68] By 1950, the C & WC line had at least three regular stops along its portion of the track within the new site: from north to south, Ellenton, Leigh, and Robbins. Along the ACL, there were, from west to east, Robbins, Meyers Mill, and Dunbarton.[69] There were additional service stops along the C & WC: Hattieville, Bush, and Cowden.[70]

The Charleston and Western Carolina Railroad had service facilities in Ellenton, and these were employed to bring construction materials into the site in the early days before the SRP rail system was constructed.[71] This facility had connections to the enormous Harrisonville Yards in Augusta. Operated by Georgia Railroad, this yard processed over 400 rail cars per day.[72]

Securing the cooperation of these railroads was one of the first tasks of the Savannah River Plant, and they were contacted within days of the public announcement of the plant. The ACL would have an additional task; as early as January of 1951, ACL officials were told that 6.5 miles of their track, basically that part of the line between Dunbarton and Robbins, would have to be relocated to an arc south of the existing line.[73]

The relocation of the ACL rail line was required by the demand that all commercial rail facilities had to be at least three miles from any of the reactors, and the ACL line was too close to what would later be P reactor. Negotiations continued throughout 1951 about the length of track to be relocated, with at least one source giving the figure as nine miles.[74] In the end, only about five miles were actually moved.

The ACL realignment was a major issue in McCullin's work diary, where the reconnaissance survey for the realignment was discussed as early as February of 1951. By April, Du Pont was ready to submit its plans to the ACL, with the total length to be effected covering some five miles. At that time, it was noted that traffic on that portion of the line included some 7 to 10 trains per day. In May, ACL proposed that the new rail line should be 115 pound strength, even though the existing rail line was rated at 100 pound. This issue was still under discussion in late June 1951.[75] The relocation was completed by early 1952, when it was noted that the new track lay outside the SRP perimeter fence.[76] At that time, Du Pont and the AEC was still negotiating the issue of who would pay for the 115 pound new rail, when the old line had been served by 100 pound or even 85 pound.[77]

The Southern Railroad also contemplated a new spur line, this one running onto the site from their facilities in Barnwell. This was a promising proposal in December of 1950, but nothing came of this development. On March 13, 1951, McCullin recorded in his diary that the Southern Railroad "will not be serving the Savannah River Plant."[78]

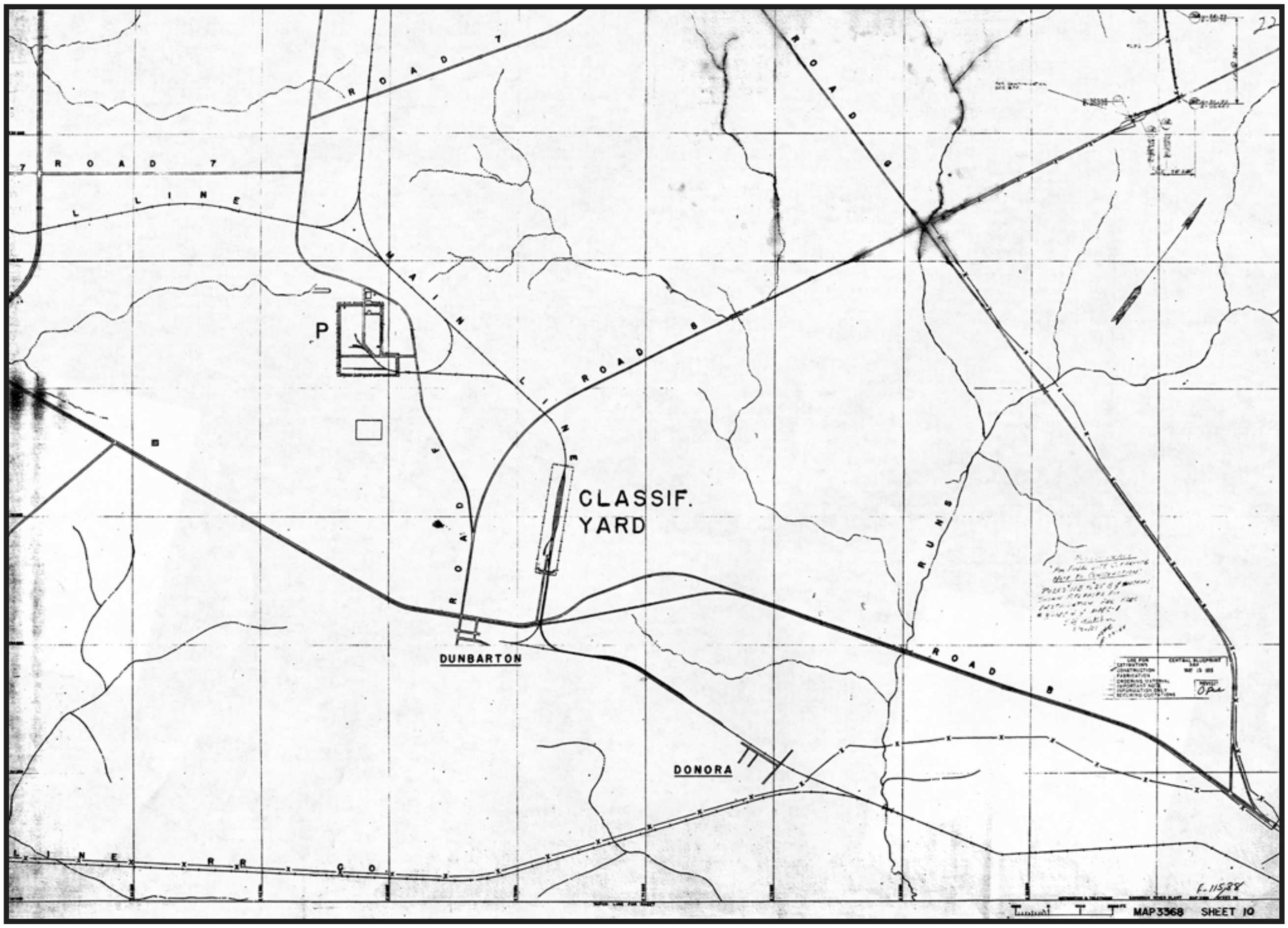
The only place that remained virtually the same during this period was the station at Robbins, site of the junction of the ACL and the C & WC lines, located near the south end of SRP. Virtually the only thing at the spot was the railroad station, and this was still true in the mid-1960s. At that time, it was noted that the only permanent employee at Robbins was Henry Carroll, who had served at that location since 1948. He commuted to work every day from his home in Millet, South Carolina, and was basically unaffected by the growth of the plant.[79]

SRP Railroad Classification Yard

Unlike Robbins, the area around the reactor and separations areas—the core of the plant—was a hive of railroad activity, beginning in early 1951. Foremost among these areas was the Railroad Classification Yard, located south of the reactors. According to the man in charge of the early SRP railroad, Robert Snapp, the yard was:

> A system of tracks within defined limits, provided for the making up of trains, storing of cars and for other purposes, over which movement not authorized by Train Order, may be made, subject to prescribed signals and rules, or specific instructions.[80]

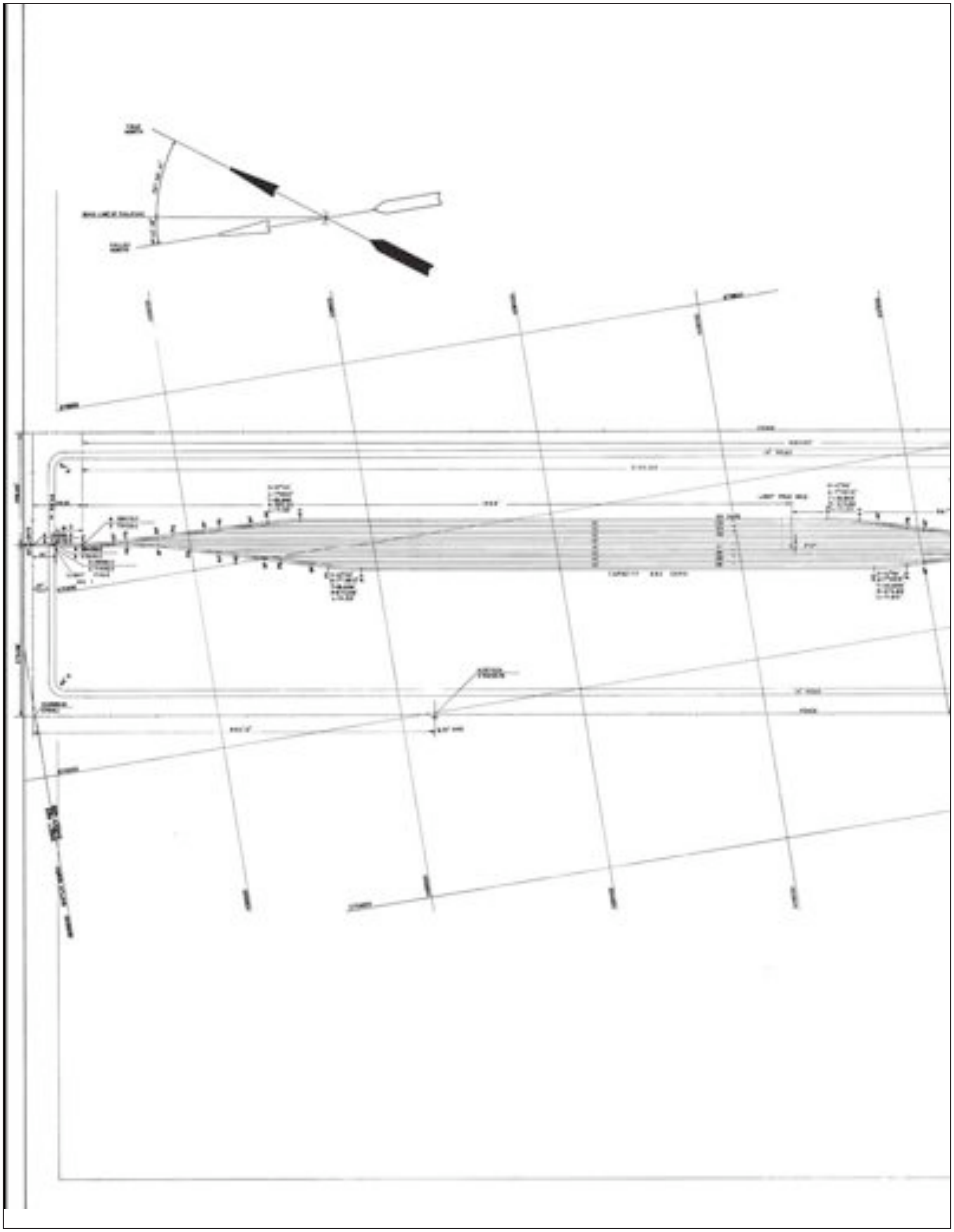
The Railroad Classification Yard was immediately north of the old ACL line that was in the process of being relocated. It was also very close to the old Dunbarton community; in the early days, the yard was often referred to as the "Dunbarton Yard."[81] In addition to this yard, there appears to have been another facility, known as the Set-Off Yard, that was located just south of the classification yard during the Construction Era. This was a staging area for the construction materials used to build the site. This facility was dismantled at the end of Construction.[82]



Map 3368, date unknown, SRS Archives

The Railroad Classification Yard was one of the first facilities constructed on site. The general location was determined as early as December 27, 1950.[83] The first definite concepts for the yard were worked up in January and February of 1951. At that time, railroad specifications were assembled, and the yard was designed for the storage of some 400 to 450 rail cars, with capacity soon increased to 700-750 cars.[84] The first formal lay-out was shown on Map 3307, dated to February 23, 1951. In March, J. Brooks of Voorhees Walker Foley and Smith, was given the Du Pont specifications so that he could work on the yard lay-out in New York. At this point, all railroad specifications were set to agree with practices already standard with the ACL and the Southern Railroad. This resulted in Map 3315, which superceded Map 3307, and was delivered to Du Pont by Voorhees on March 21, 1951.[85]

Map 3315, date unkown, SRS Archives




3315
LAYOUT MAP
CLASSIFICATION YARD
SAVANNAH RIVER PLANT
REFERENCE DRAWINGS
ENGINEERING DEPARTMENT
MAP 3315 SHEET 1


Railroad Classification Yard, View Looking South, July 8, 1956, SRS Negative DPSPF-5218-10

Construction work began on the Railroad Classification Yard almost immediately, even though there were some final revisions to consider from Robert Snapp. In late March and early April, Snapp and others gave consideration to reversing the yard's lay-out by 180 degrees, a move that would have saved on a certain amount of excavation work. Apparently plans were too far along to make such a radical change, and nothing was done on the matter.[86] The Railroad Classification Yard was completed by the late summer of 1951, in time for the first trains to begin service over the SRP rail system.

By far the largest building in the yard is 618-G, the maintenance building for the locomotives. According to at least one source, it is the oldest building still standing on Savannah River Site today.[87] Apparently, the earliest plans for the building, dated to February 1951 gave its designation as 718-G, modeled after a similar construction at Hanford. Thought was also given to putting the locomotive and automotive repair shops within the same building, but this idea was soon dropped. By mid-February, it was decided to put the Yardmaster's office at roof level on top of the low bay portion of the building. On March 1, 1951, the building number was changed from 718-G to 618-G, with preliminary building drawings worked up by the end of the month.[88] From the Map 3315 revision sheet, it would appear that the building was completed quickly, probably before May of 1951.[89]


Interior View of Building 618-G, July 2009, SRS Negative 0901190020

Known as the "Locomotive Shop," Building 618-G was an expendable Class III construction. The building's function was to provide a shop for service and repair of the diesel-electric locomotives that served the SRP system. It also was equipped with change facilities for the railroad workers. There was a dispatcher's office for the control of the trains within the yard, and a yardmaster's office for policing the classification yard itself. There were lunch facilities for around 75 people, other supervisory offices and communications facilities, as well as a stores facility and tool room. Building 618-G was basically one large single story structure, with a high bay, and a two-story portion on the east side. The outside foundation of the whole building measured 85'10" by 141'10". The high bay covered an area 141'10" by 49'10".[90]

Building 608-G, the Track Scale House, is almost as early as the Locomotive Shop. The function of this building was to weigh railroad shipments. The building contained the control and recording mechanisms for the track scale. The scale platform itself was installed in a pit underneath the railroad tracks, just outside the building. 608-G was conceived and designed in mid-March 1951, based on the scale house used at Hanford's railroad system. The working drawings were approved in April, and were issued for construction the following month.[91] This building too was constructed before May 1951, since the first building revisions were dated to May 3, 1951.[92]

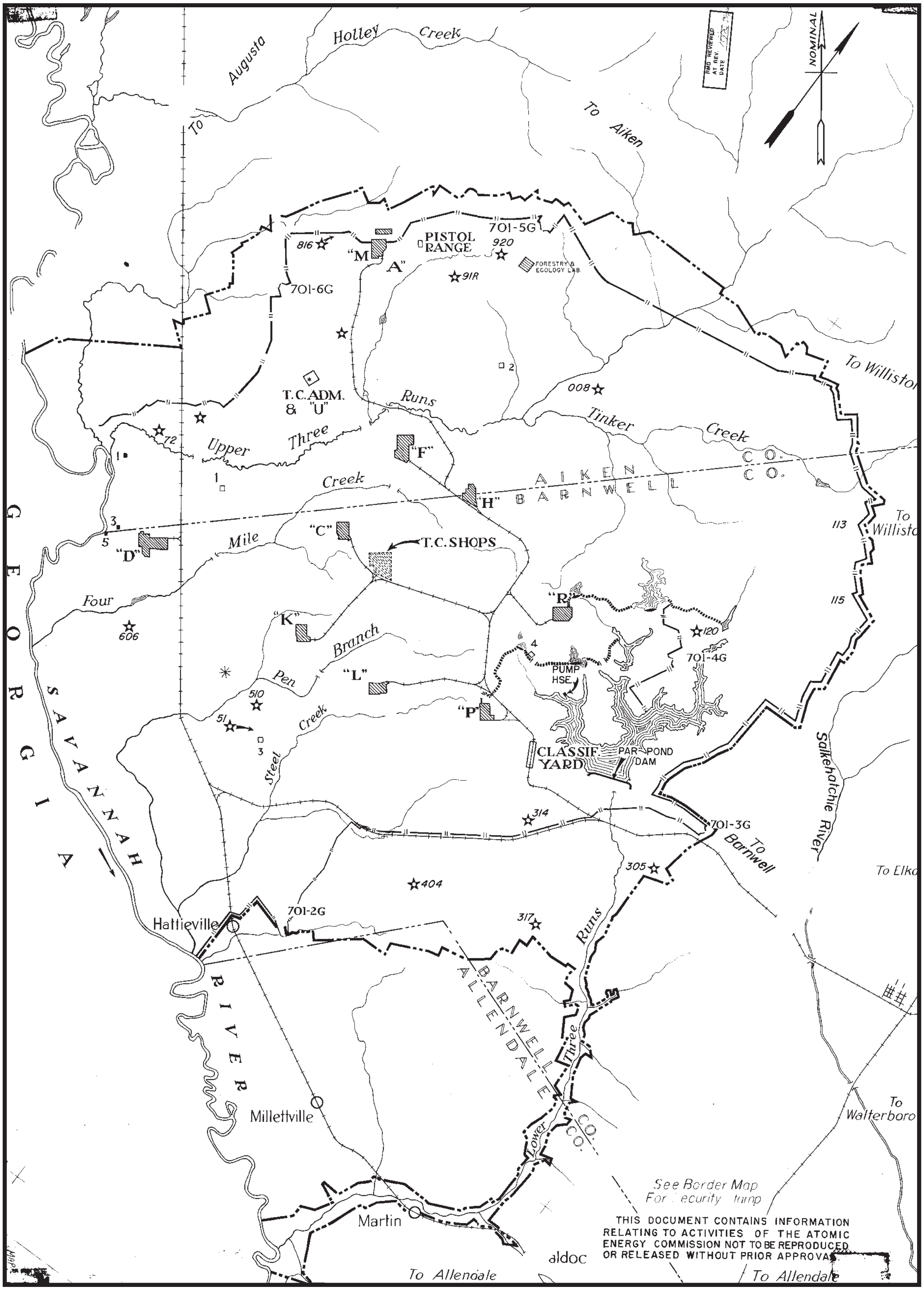
Building 608-G (Track Scale House), East Elevation, September 10, 1954, SRS Negative DPSPF-1785-5

Building 619-G, the Diesel Oil Storage Tank, was designed to store oil for the locomotives. The original concept, dated to February 1951, called for one 12,000-gallon tank. In mid-April, this was increased to two tanks of 12,000 gallons each. At that point, Snapp requested that the two 12,000-gallon tanks be replaced with a single 20,000-gallon tank.[93] Before the end of the month, the capacity was increased again to two tanks of 20,000 gallons each. The reason for the increase was the decision to use diesel oil to heat the huge 618-G building, rather than fuel oil, thus eliminating the need for a separate fuel oil storage tank at the railroad yard.[94] This two-tank building was constructed in June of 1951.[95]

Building 609-G (Railroad Classification Yard), April 23, 1959, SRS Negative DPESP-68-01

In March of 1954, long after the rest of the Railroad Classification Yard was completed, a separate 30-car parking area was added to the site, located outside the yard security fence. At the same time, it was decided that there would be no guard house or security detail stationed at the yard.[96] The last building to be added to the Railroad Classification Yard, 609-G, was built in December of 1956. This was so late that it was not considered a part of Du Pont's original Project 8980, but rather was constructed under a separate contract, No. 85122-10.[97]

Map of SRP Railroads, circa 1960s, Based on Much Larger Map 3306, Railroad Map (Courtesy of Scott Youell)



Layout of SRP Rail Lines

Simultaneous with the construction of the classification yard, was the layout and construction of the rail lines that connected the various areas of the site. These were obviously tied to the classification yard, which in turn had direct ties with the ACL line. Basically, the SRP rail lines consisted of a main line that extended through the reactor and separations areas to F area. There were then a series of spur lines that connected the main line with the individual production areas. The spur lines were feathered to provide access to a number of different facilities within each area. In the reactor areas, for example, there were rail connections to the assembly area, disassembly, and coal storage.

As early as January of 1951, it was determined that the main line had to be at least one-quarter mile from any of the reactor areas, to protect it from accident.[98] By February 1952, when Map 3306 was created, the main line was basically laid out extending north from the classification yard. Each spur line was identified by the area it served: R, P, C, H, etc. Some spur lines, like K Line, came off of other spurs, like C Line, but all had access to the main line. All rail line connections had triangular junctions that would allow trains to move in any direction along the main line.

The only commercial railroad connection to this system was through the Railroad Classification Yard and the Atlantic Coast Line. The only exception was D Area and the other facilities near the river, which were served by the Charleston and Western Carolina. It had initially been proposed that the north end of the main line should connect with the C & WC, and that a spur from the C & WC should connect with the 300/700 areas. In late June of 1951, long after work had begun on the SRP rail system, the Construction Division proposed a direct connection between the separations areas and 300/700. This idea appears to have been accepted in early July, which required a revision of the existing maps. This was the origin of the "M" Line, which was basically an extension of the Main Line all the way to the 300/700 area. The drawback to this scheme was the need for a trestle bridge over Upper Three Runs Creek, as well as the crossing of Road 2.[99] Later, there were serious erosion problems associated with the M Line. In the summer of 1952, the Bituminous Company of Mobile, Alabama, was called in to stabilize the situation. They seeded the area and then shot it with an emulsion agent that is recorded to have worked well.[100]

Railroad Construction and Use

Construction on the SRP railroad system began with a Du Pont subcontract (Subcontract AXC 348) awarded to William A. Smith Construction Company, on March 26, 1951. Smith Construction, based out of Texas, began the work in early April, using Mexican labor. Smith Construction had its own asphalt batch plant on site. Work began first at the set-off yard, followed by the Railroad Classification Yard, and then the main line and its spurs.[101] All total, 82.2 miles of permanent railroad track was constructed at SRP. The main line, including the M line, was 18 miles long. Then there were numerous branches and spurs off of the main line.[102] It is recorded that the first train to travel over the new lines, did so in early August of 1951, a period of construction that lasted just around five months.[103] Despite this, work continued for almost another year. Smith Construction did not leave the site until June of 1952.[104]

Smith Construction Company Personnel Receiving Award, June 17, 1952, SRS Negative M-993

Last Passenger Train Stop at Ellenton, South Carolina, Charles Watts, Du Pont Traffic Supervisor (on left), Robert Swapp (second from left), SRS Negative DPESF-741-01

View of Locomotive Inside Building 618-G (Locomotive Shops), date unknown, Photograph Courtesty William Hinson

There were basically two eras in the development of the SRP rail system: Construction and Operations. The rail system was actually larger during the Construction Era, since there were a number of temporary construction sites that had to be served in addition to the permanent industrial areas. The rail lines and spurs described above are all part of the permanent SRP rail system, but there were a number of other temporary lines and spurs that connected all of the various work sites that sprouted up at the Savannah River Plant during the Construction Era. There were a number of temporary lines to the ACL and the C&CW lines, as well as lines to the asphalt and concrete batch plants, the temporary warehouses, and various fabricating shops set up around the site. The set-off yard itself was temporary. All of these temporary tracks were set up with 90 pound steel, but some had 100 pound in D Area. Later, more than 50 percent of the temporary construction was taken over by Operations as permanent track. In fact, permanent track was laid in G Area, to minimize the amount of temporary track that would have to be laid at the site.[105]

The Construction Era saw the greatest use of the rail system. In 1953, it was recorded that 220 cars were received on site in a single day, with the average being 80. The estimated number of car movements required to finish the plant was given as 320,000.[106]

While much of the track might have been temporary, there were no other temporary railroad facilities. The buildings, the railroad cars, and the other equipment were purchased as permanent. By foregoing any temporary equipment, Du Pont realized a savings of around $75,000. The locomotives were also modern diesel engines, the industry standard by the middle of the 20th century. In 1953, the SRP rail system boasted four 120-ton diesel locomotives and four 80-ton diesel electric locomotives.[107]

There were also passenger trains that still passed through on the commercial lines. It was in the middle of the Construction Era, on April 12, 1952, that the last scheduled passenger train made a stop at Ellenton, after which it was noted that, "Ellenton now officially ceased to exist." This event was witnessed by a number of railroad officials, including Charles Watts, Du Pont Traffic supervisor, and Robert J. Snapp, Du Pont's superintendent of railroads and traffic.[108]

R. J. Snapp, who remained in charge of the SRP rail system for the rest of his career, was closely involved in the planning and design of the rail system.[109] He was one of the first Du Pont employees to come to SRP, arriving in December of 1950. His previous credentials included a degree from Virginia Polytechnic Institute, a stint with a commercial railroad company, and then work with Du Pont. During World War II, Snapp was in charge of Du Pont's Construction Traffic Division at Hanford. His assistant was C. N. Collins, who was pulled in from the Atlantic Coast Line railroad.[110] Another employee who was there from the early days was William Hinson, one of the people interviewed for this project. During an earlier 1990 interview, when Hinson was in charge of the SRP rail system, he stated that, "working railroad employees is kind of like rearing children. I use the T & T Method—you have to train 'em and trust 'em. I don't tell employees how to do, but what to do; they are already trained." He also stated that, "Always remember, there is no 'little accident' when it happens on the railroad. All accidents are 'big accidents.'"[111]

Railroad Employees - Red Smith, Geeche Smith, and Unidentified Switchman, circa 1952, Photographs Courtesy William Hinson

To ensure that there were as few accidents as possible on the rail system, there were a number of railroad specifications to guide design and construction. Just as at Dana, SRP would use standard gauge railroad, 4 feet 8.5 inches, in accord with Standard Engineering Specification SC-1-D.[112] The track was made with 90 pound rail; only a small section from the Classification Yard to P Area was done with 100 pound rail. There was one railroad timber trestle, 140 feet long, over Upper Three Runs Creek. All was done according to Specification 3015.[113]

The railroad signal system was discussed as early as January of 1951 in the McCullin Diary, and was considered a high priority. This job was turned over to Gibbs and Hill, Du Pont's main electrical subcontractor, with input from Snapp. By June of 1952, there were even railroad specifications worked up for the 100 areas, where it was required to have a passing track long enough for four cars.[114]

At one point in November of 1952, consideration was given to having locomotive repair facilities at the railroad tunnels going into the separations buildings in F and H. In the end, it was decided not to do this since there was already a comprehensive repair shop, 618-G, at the Railroad Classification Yard.[115] By that time, almost 70,000 carloads of materials had been brought into the site. It was said at the time that if the cars had been formed into a single train, it would have stretched from South Carolina to Delaware.[116] By the summer of 1953, when construction was closer to the end, it was noted that there were just 42 miles of permanent track in the system, with a cost to date of $5 million. This included a cost per linear foot of $11.51; the cost of the relocation of the ACL line – a linear foot rate of $15.39; and the cost of bank protection for all the railroad lines, which came to $45,284.[117]

In later years, it was recorded that during the height of construction, the SRP rail system handled six thousand rail cars per month. These were brought in by eight locomotives and were processed by a total of 72 employees. During the entire Construction Era, it was noted that more than 100,000 cars were used to bring in rock, sand, cement, and steel, all the basic building blocks used in the construction of Savannah River Plant.[118] Atlantic Coast Line brought in 400 hopper cars to help bring in the aggregate material, while one thousand covered hoppers were purchased to handle the cement.[119]

The sorting out of construction materials was a giant task. Most material, except for the largest items, was processed through Central Shops, particularly the Receiving and Stores Department. Most materials came in via the railroad, and this included the giant bubble tray towers used in D Area, brought in by deep-well double truck rail cars, and the large steel plates that would be used to form the waste tanks in F and H areas. These were among the biggest single items ever moved by rail. There were also special deliveries, such as the machined graphite blocks for use in the 305-M building, delivered in November of 1951. These blocks came from Hanford, and were transported in brand new cars to prevent contamination, and were guarded by AEC security.[120]

The transition from Construction to Operations occurred in late 1953 and early 1954. Railroad personnel were transferred to Operations in December of 1953. The system itself was transferred over on January 4, 1954.[121] At that time, the system included the original SRP locomotives, the diesel-electric American Locomotive Company engines.[122] At the beginning of Operations, there were eight locomotives: four 120-ton engines and four 80-ton, each with a two-way radio. There were also two gondola cars, one box car, 16 flat cars, five hopper cars, four well-type cask cars (for use at the 105 buildings), one stainless steel tank car (for 221-H), five high-chrome tank cars (for the 211-F A-Line), and 20 section motor cars to be used by inspection teams.[123]

At the beginning of Operations, it was noted that a typical railroad crew would have consisted of one conductor, one locomotive engineer, and two switchmen (except in D area, where there would have only been one). During the earlier Construction Era, a crew would have had a similar composition, with the exception of the addition of a locomotive tender. It was also noted that the conductor was referred to as a "foreman" during the Construction Era. In the early days of Operation, there were at least 80 total personnel working on the railroad. These included: 1 chief supervisor, 1 yard master, 1 general foreman (track maintenance), 4 foremen (track maintenance), 4 dispatchers, 2 clerks, 6 conductors, 6 locomotive engineers, 15 switchmen, and 40 trackmen. The positions from chief supervisor to dispatcher were considered "supervision." Those from conductors to trackmen were wage roll.[124]

In the later 1950s, the main function of the SRP railroad was to move radioactive materials out of the reactors and deliver them to the 200 Separations areas. This was done with lead-shielded cask cars that each weighed more than 70 tons. Another major responsibility was to deliver coal to the nine plant power houses.[125]

The operation of the SRP rail system was not governed by the Interstate Commerce Commission, but those rules were followed anyway, as well as those mandated by the Association of American Railroads and the Master Car Builders Association.[126] According to the SRP railroad safety and rule book, there were prescribed hand and lantern signals, horn and whistle signals, instructions on how to compose railroad orders, maintain the track, etc.[127]

Section Crew Performing Maintenance on Intersection Signal, March 3, 1952, Photograph Courtesty William Hinson

During this period, there were eight four-man crews, a total of 32, with an additional two relief workers. There were four shifts, labeled A through D. Conductors and engineers made $2.64 an hour, while switchmen made $0.40 less.[128] These people comprised the Railroad Division, one of the five divisions within Du Pont's Traffic and Transportation Department at SRP (the other divisions were Traffic, Labor and Heavy Equipment, Automotive, and Equipment Maintenance).[129]

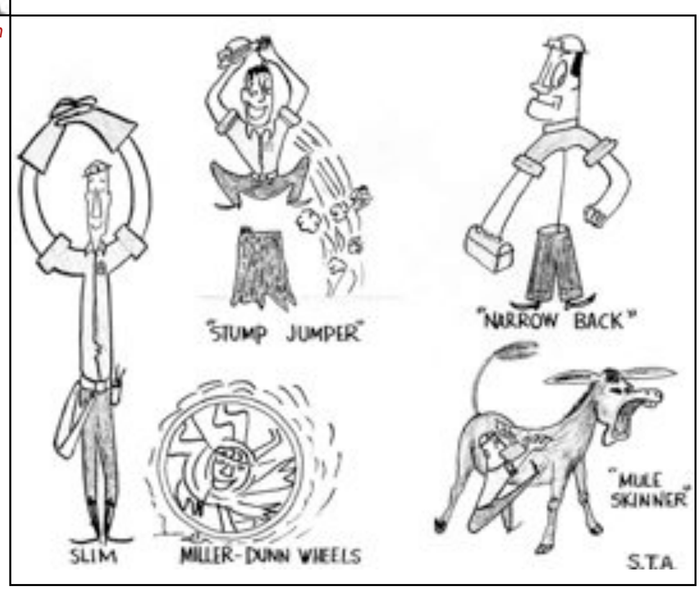
Bit by bit, the SRP rail system shrank over time, as some spur lines were found to be redundant, but the system remained in full operation for as long as the reactors did. By moving radioactive materials from the reactors to separations, and providing a means of moving heavy materials around the site, the railroad at SRP made the functioning of the plant possible. It was truly one of the pillars of the entire process.

VII. POWER SYSTEM

While all of the SRP infrastructure systems were essential, the one that actually ran the nuclear process was electricity. Electricity was the "life-blood of SRP," and the people that secured that lifeblood, known locally as the "wires and pliers brigade," were among the most important on site.[1] Neither the reactors nor the separations areas could work without electricity, and it was understood from the beginning that a great deal of it would be required to run the plant. In fact, it was estimated that the SRP electrical system would rival that of the entire state of Delaware. The safe and continuous working of the plant would require a number of power houses that would have to be built by Du Pont, a series of high-voltage transmission lines looped in such a way that reactor and separation areas would have access to more than one source of electricity, and a state-of-the-art supervisory cable and relaying system to control the entire arrangement.[2]

Sketch of SRP Electrical Work from Construction Cost Reduction Poster, December 21, 1953, SRS Negative M-3195-04

SRP's electrical facilities had to be constructed before anything could be put to industrial use. Electrical construction began on February 1, 1951, when South Carolina Electric and Gas was asked to provide 30,000 kw of power for the project. This work began in the 400 Area, moved to the 300/700 Area, before switching to the reactor and separations areas, starting with R, and them moving down the line in the order of P, F, L, K, H, and C. Electrical facilities at D Area, particularly the 484-D powerhouse, the first and largest at SRP, began construction in June of 1951 and were on line by the second half of 1952. Construction of 784-A began in August of 1951 and was on line about the same time. R Area electricity was on before that year was out, while C, the last to be completed, was finished by late 1954.[3] Without electricity, no water could be pumped and no reactor could be cooled.



Sketch of SRP Electrical Work from Construction Cost Reduction Poster, December 21, 1953, SRS Negative M-3195-03

As essential as electricity was to the entire process, it is amazing to consider that out of all the basic infrastructure elements at SRP, it is by far the youngest. In 1950-51, when SRP was first conceived, electricity as we know it, with alternating current, transmission lines, and motors and lights, was not even 60 years old. In order to appreciate something of the electrical achievement at Savannah River Plant, it is essential to understand some of the workings of the electrical system, and how that system came to be.

DEVELOPMENT OF COMMERCIAL ELECTRICITY

The first practical application of electricity came with the development of the telegraph in the 1840s. By the time of the American Civil War, the major cities of Europe and the eastern United States were connected by a network of metal wires on wooden poles over which messages could be relayed by means of a weak electric current.[4] In the 1870s, the communication network tightened with the invention of the telephone by Alexander Graham Bell. At that time, all electrical systems for telegraph or telephone operated with direct current (DC), with electrical current passed in one direction along a wire or circuit from a positive pole to a negative pole by means of batteries.

Despite these advances, electricity hardly existed for the general public. This began to change in the mid-1870s with the development of electrical dynamos and arc lights. The 20-year period between 1875 and 1895 was period of incredible flux and innovation in electrical generation, a period that went from arc lights powered by direct current, to incandescent lamps and induction motors powered by alternating current.

One of the first steps in this process was the development of the incandescent light bulb, one of the great achievements of Thomas Edison. The first successful incandescent bulb was energized on October 19, 1879 and burned for 40 hours.[5] Subsequent experiments extended the life of the lamp several times over.

Riding on the success of the incandescent lamp, Edison moved almost immediately to a project of enormous complexity, a plan to light lower Manhattan with incandescent lights, using underground DC power lines. Edison's Manhattan electrical system required a level of care and wiring expertise that had not been needed with arc lights. He had to invent most of the materials needed and supervise their manufacture. These materials included the tubing, lamp sockets, switches, meters, fuses, and a galaxy of other related materials.

By 1885, the Edison Machine Works shop in New York City was becoming too cramped, and Edison sent out assistants to look for a new location. In 1886, Schenectady, New York, was selected as the new headquarters of the whole Edison operation, and within a just couple of years, this sleepy town in the Mohawk Valley became one of the great industrial centers of America.[6]

Even though Edison seemed to dominate the decade, his companies received stiff competition from a number of other firms. The Thomson-Houston electrical system, for example, was considered by many to be better than the Edison system. Another important rival was George Westinghouse. In 1884, he established the Westinghouse Electric and Manufacturing Company, which would prove one of Edison's strongest competitors.[7]

The development of motors in the 1880s took electricity beyond the realm of lighting and into the world of serious electric power. Soon electric companies had to stay open throughout the day, rather than simply operating at night. Electricity was also pushing up against the limits of direct current transmission. This propelled the research and development into "alternating current" (AC). Alternating current was a wholly new method of electrical generation that exhibited traits of almost incredible flexibility. AC voltage could be stepped up (and the amperage reduced), enabling it to be transmitted longer distances. AC quickly became and remains today the cornerstone of the electrical grid.

The device that stepped up voltage or could likewise step it down, was first known as an induction coil, but was soon dubbed a "transformer." It was based on the principle first established by William Faraday that current created in one set of coils could be "transferred" to another parallel set of coils through induction. The ratio of the windings in one coil to the other determined whether the voltage was stepped up or down, and to what degree. AC power developed hand-in-hand with transformers.

In 1886, Westinghouse came out with his first transformer patent. By 1887, Westinghouse had patented the first oil-insulated ventilated transformer coil. Soon Westinghouse took out a patent for single-phase AC motors. These were the first practical induction motors, created around 1887 and based on earlier work by Nikola Tesla. They operated on the principle of electro-induction repulsion, whereby magnets were alternately attracted and repulsed under the influence of alternating current. This alternating attraction and repulsion actually turned the motor, providing mechanical force.

Single-phase AC motors had their own limitations. Unlike DC motors, they could only be operated if they were fully synchronous with the powering generator. They could not be started and stopped independently of the generator. This led to a new type of motor, the polyphase AC motor, the first that could compete with DC motors. Also known as multi-phase or three-phase, the patent for this motor was issued to Nikola Tesla as early as 1888. Westinghouse quickly secured the American rights to this patent.

Early AC power was generally geared for lighting, which did well at the high frequency used at the time, usually 133 cycles. The high frequency ideal for lighting was rather poor for motors, which operated best at around 20 to 30 cycles. This led to a frequency compromise of around 50 to 60 cycles that was found to be satisfactory for both lights and motors. It is a compromise we still live with today.[8]

In the end, AC power won out over DC. Edison, the last major hold-out for DC power, conceded as much in the early 1890s. This led to the merger of the Edison companies with Thomson-Houston in 1892. The new corporation became the General Electric Company, which was devoted to AC power.

After years of confusing technological innovation, electrical generation and transmission entered a period of rapid standardization, based on what was found to be the best in a sea of inventions stretching over the previous 20 years. Incandescent lamps replaced arc lights for interior lighting, and alternating current replaced direct, with the exception of special functions. Transformers became the basis of electric transmission lines, which were stretched to greater and greater lengths. All this led to enormous changes in industry. Induction motors and wiring systems replaced the elaborate shafting and belting that had once been standard in factories powered by falling water or steam. This freed industry from the need to be near waterfalls and coal mines. Factories could now be situated anywhere within the reach of electrical lines. And power and light companies began to proliferate across North America and Europe. This process was barely complete in rural South Carolina by the time Du Pont and the AEC selected SRP to be the site of the nation's new nuclear facility.

BASIC ELECTRICAL SYSTEM AT SRP

It was understood from the beginning of the Du Pont program that every aspect of the local infrastructure would have to be enhanced in order to carry out the mission. And this was particularly true for the electrical system. Serious additions were required to the local electrical grid, which in 1950 was barely able to handle its rural customers, much less the much greater industrial capacity of the nation's premier nuclear facility.

The first power determinations were made for SRP in December of 1950, just days after the public announcement. The entire system was worked up in the months that followed, with Du Pont establishing the guidelines. Gibbs and Hill, Du Pont's main electrical architect-engineer subcontractor, then worked up the details. Du Pont sent out a letter of intent to Gibbs and Hill as early as December 12, 1950. Outside consultants were also brought in, such as Phillip Sporn of the American G & E Company, an authority on integrated power systems. By April of 1951, if not before, it was decided that the transmission system would operate with a voltage level of 115 kilovolts (kv), set on "H" frame poles; there would be oil circuit breakers with an interrupting time rating of five cycles; and that the protection mechanism for the 115 kv transmission system would be pilot wire relaying.[9] By 1953, there were some 128 miles of overhead power lines, sitting on 2,250 poles, capable of providing some 400,000 kva, enough power for a city of half a million.[10]

In many regards, the electrical system set up at SRP was like many others. Certainly the basic features were common enough. There would be generating stations that would produce electricity at 13.8 kv. From there it would be stepped up to 115 kv, which was the voltage used on all the transmission lines. The transmission lines were those that transported the electricity over long distances, basically anything over a mile or more. At SRP, there would be some 90 miles of transmission lines. These lines were all routed through the three large switching stations, identified as 504 buildings. These switching stations allowed electricity to be sent to individual production areas a number of different ways, if service on any single transmission line was interrupted.

Once 115 kv power reached the production areas, it had to be stepped down for local use. This was done at the transformer stations identified as primary substations. They were the "Fifty-One" series buildings in the Du Pont nomenclature: 151 buildings in the reactor areas, 451 in D Area, 251 in Separations areas, and 751 in A/M Area. The "Fifty-One" series primary substations received power from the transmission lines at 115 kv and stepped it down to 13.8 kv. This process also worked in reverse; any electricity produced at the reactor power houses and not used by the reactor building, were stepped up for the transmission system, for use elsewhere.

The Fifty-One series buildings were very important to the entire system. They were the connection between the high-voltage transmission system and the lower voltage distribution system that served each area. The reactor buildings received voltage at 13.8 kv, as did most of the manufacturing buildings, with power stepped down as needed at small building substations. The "Fifty-Two" series buildings (152, 452, 252, 752) received power at 13.8 kv and stepped it down again to 0.48 kv (480 volts). This was then sent to other facilities in that area that required electricity. This power went out over distribution lines that were different from those used by the transmission system. In the service buildings that required the normal 110-120 volts used by most office lights and motors, this level was achieved by dry transformers located in each building.[11]

There was nothing terribly unusual in this arrangement as laid out above, but the electrical system at SRP was fraught with special problems. First and foremost, the plant had to produce most of its own electricity. In 1950, the local electrical grid was not up to the challenge of powering the plant, and it was also essential to have a complete electrical back-up in case of any emergency. Because SRP was a nuclear plant, it was subject to possible nuclear or conventional attack. Like everything else at SRP, the electrical system had to be designed with blast protection in mind. Transmission lines and switching stations had to be a certain distance from the reactors, and from each other, so that a blast in one area would not wipe out facilities in another. There also had to be special control measures implemented throughout the system to ensure that electric current could be re-routed in the case of a blast or some other sort of accident.[12] This was made more complicated too by one of the characteristics of the distribution system, which had a great number of terminals and many short line sections.[13] To accommodate all of these issues, the SRP electrical system would have to be seriously over-built, and it would have to be done quickly, often without knowing exactly how the different elements of the system would mesh.

Du Pont approached this problem by hiring the best available electrical subcontractor to handle the work. This was Gibbs and Hill, which coordinated its work with Du Pont Power Design. Gibbs and Hill were responsible for the designs for the boiler plants, the river water pump houses, and the large river water pipelines. In fact, the entire electrical system, even into the production areas, was in their domain. The only exceptions were the reactor buildings themselves, and some of the 200 areas.[14] Gibbs and Hill worked up their own specifications for the system by June 1951.[15]

In addition to supervision, Du Pont established the ground rules. No major electrical facilities, such as switching stations, generating plants, or primary substations, could be within 2.5 miles of each other. In most cases, no two transmission lines could be within 2.5 miles of each other. Each production area had to be served by at least two different lines. All energy, either produced on site or purchased from outside, had to be "pooled" and thus available to any area of the site.[16]

Another feature of the electrical system was the way Du Pont approached design, not just in electrical work but in other design work as well. The power houses were planned and constructed based on the small unit system. Rather than rely on one large boiler or pump, it was determined to be more economical and certainly more versatile to plan for a series of smaller units that could be added to or subtracted from as needed. This was particularly important when many different aspects of Savannah River Plant were going up simultaneously, and often without full knowledge of how the different components would work together. Smaller units could also be repaired more quickly, without disabling the entire system.

One of the first things to be sorted out was the electrical load anticipated for each production area. This would determine the size of the electrical facilities. From the beginning, it was known that there would be three classes of electrical service: emergency power, on-line power; and production power. Emergency power would be provided to the site by 30 diesel generators located in different areas; on-line power was back-up power for the reactors, through diesel generators located in the 108 buildings. By far the greatest of these three classes of power was production, located in the 100 areas, 200 areas, and 700 areas. It would absorb the vast majority of the available electricity, an estimated 90 percent. The reactors and the river pump houses alone would take 70 percent of the total power. Within that 70 percent, the greatest requirement would be to move river water through the reactors and move the heavy water coolant through its closed loop system.

One of the issues that had to be worked out right at the beginning of electrical design, was the driving power for the heavy water system. This would have a direct bearing on the amount of electricity required at the reactors. From the very beginning of the project, there were two possible ways to move the heavy water: hydraulic and electrical. The "hydraulic scheme" was to use the force of the river water moving through the system to drive the turbines required to power the heavy water system. This would have required long outflow tunnels on the effluent side of the reactors to provide sufficient suction pressure for the system to work. The "electrical scheme" had the heavy water moved by conventional electrical pumps. After some debate on this issue, the electrical scheme won out, because it was the most flexible, and would not require the long outflow tunnels.[17] It would, however, require more electricity.

Once this issue was settled, it was possible to estimate the total electrical load, and the loads needed in each area. One of the early estimates of the total load, made in April 1951, assumed a need for 220,000 kw. This was broken down into 100,000 kw for the five 100 areas, 47,800 for the 400 area, and 49,600 for the river pump houses.[18] The power requirements for the 200 areas and for 300/700 were basically similar. Both required a large distribution system, but did not have many critical loads. Most of the smaller elements of the distribution system in the 200 areas were handled by Blaw-Knox, the subcontractor in charge of most of the separations work. Gibbs and Hill handled the larger elements of the electrical system in those areas: the substations, boiler house, reservoir, pump house, cooling tower, and chemical feed building. These were located in an area within each 200 area known as the "powerblock."[19]

Electrical load tallies were commonly worked up in the first two years of construction, when the entire plant system was still in flux and many of the details had not been worked out. Even so, the final tallies, prepared in October of 1952, were basically similar to the very first ones, prepared in December of 1950. Between the first date and the last, the power requirement in 400 area was increased from 40,000 kw to 48,000. The reactor numbers also increased, from 89,000 kw to 100,500. The power requirements of the two river water pump houses remained virtually the same: from 27,600 kw to 27,000. The power needs for the 200 areas and for 300/700 increased dramatically, but the total kilowatt needs were still very low compared to the reactors; all of these areas required less than 10,000 kw. The tiny CMX required just 600 kw, and the construction effort itself, 10,000 kw.[20]

DETAILS OF THE ELECTRICAL SYSTEM

Presented above were the basic power needs of the SRP project. Also discussed briefly was the need for greater control and flexibility within the working of the electrical system. How all of these needs were met, is best discussed by the separate functions of the electrical system, and these are: purchasing and generating power, transmitting power, distributing power, and finally controlling power. All of these topics are discussed in greater detail below.

Purchasing Power

From the very beginning, Du Pont had a preference for purchasing electrical power, if possible. This, however, was not possible, at least not in the early 1950s, and this became apparent during the first electrical surveys. There were three power companies within the area that could possibly sell power to the SRP. They were South Carolina Electric and Gas Company, Aiken Electrical Cooperative, and Salkahatchie Electric Cooperative. Slightly further a field, but accessible, were the South Carolina Public Service Authority, which operated the Santee Cooper, and the Southeastern Power Administration (SEPA), which was set to deliver power from the Clark Hill Dam, then nearing completion.[21]

An initial survey of the available electrical supply was conducted before Site No. 5 had been selected. Even then, none of the options for purchasing power was considered adequate. The cooperatives were too small, the Santee Cooper too distant, and the SEPA was not yet on-line and even then an electrical diversion would require Congressional approval. This left South Carolina Electric and Gas. It was within the service area, it was connected to the other regional providers, and it had a new 115 kv transmission line then under construction within the project area. Furthermore, it wanted the work. In the short term, however, it could not provide the necessary kilowatts to run the plant. It could, however, provide 10,000 kw for construction use, and this was made available almost immediately.[22]

The first contract with SCE&G was effected very early in 1951 to provide 10,000 kw for the construction effort. A year later, on January 23, 1952, another contract was done that required SCE&G to provide 30,000 kw, and build a second connection to the SRP system from its Urquhart Station, located in Beech Island.[23] This connection would go directly to the northern-most switching station, 504-2G. Additional contracts followed. In January of 1955, the kilowatt level was raised to 40,000 in summer, and 50,000 in winter. Beginning in May 1956, there were a series of kilowatt increases that reached 95,000 by 1966.[24] These amounts were far in the future in 1950-51, and even these would not have been sufficient for the plant's need. Du Pont would have to generate most of its own power.

Generating Power

Because of the urgent need to generate electricity, the power houses were given special and early consideration in all of Du Pont's plans. Since the early demand for electricity was also pushed by the demand for more heavy water, power construction was scheduled to begin in the 400/D Area, which was devoted to the production of heavy water. As a result, the 484-D powerhouse was the first and largest of the power generating facilities at Savannah River Plant.

By April 1951, the basic progression for the construction of the power houses was laid out, with D Area to be done first, followed by 300/700, and then the five reactor power houses, beginning with the first, R, and then going down the line: P, L, K, and C. These would be followed by power houses in F and H. On May 23, 1951, it was decided to have a total of four boiler turbo generator units in 484-D, and put two boilers and turbo-generators, each rated 11,500 kw, in each of the areas R, P, and L. At that time, nothing was decided for K and C.[25] Later it was decided to put two boiler/turbo-generator sets in K for the production of electricity and steam, but these at a slightly higher power rating of 12,500 kw for the generators after it was discovered that a regular 11,500 kw turbine could power the larger generator. A decision was also reached that no electrical power generation was required for C, since there seemed to be enough produced on site, and because the additional power promised by SCE&G was soon scheduled to come on line. Even so, two boilers were added to C for steam production.[26] It is important to remember, though, that all of the power houses, without exception, produced steam for local industrial and heating uses.

In addition to the reactor areas, boiler houses were also constructed in each of the two 200 areas and in the 300/700 area. These had either two or three boiler units each. Originally, there were three boilers in 284-F, two in 284-H, and two in 784-A.[27]

More details of each of these power or boiler houses will be presented immediately below, but it might be good to establish the production of each, the final number of boilers placed into each building, and the dates on which each of the houses were started up and put onto the electrical system. It should be noted that 484-D was originally slated for three units, and that fourth was added during construction. Something similar happened at 284-F, where a third boiler unit was added before start up. These power houses are presented Table 5, below, in chronological order of start up:[28]

Table 5. Powerhouse Types and Start-up Dates

Powerhouse	Type of Power Generation	Power Units	Start-up Date
484-D	Electricity and Steam	4 boiler units	July 11, 1952
784-A	Steam	2 boiler units	September 23, 1952
184-R	Electricity and Steam	2 boiler units	March 26, 1953
184-P	Electricity and Steam	2 boiler units	July 17, 1953
184-L	Electricity and Steam	2 boiler units	October 8, 1953
284-F	Steam	3 boiler units (4 after1957)	October 28, 1953
184-K	Electricity and Steam	2 boiler units	May 27, 1954
184-C	Steam	2 boiler units	September 2, 1954
284-H	Steam	2 boiler units	November 24, 1954

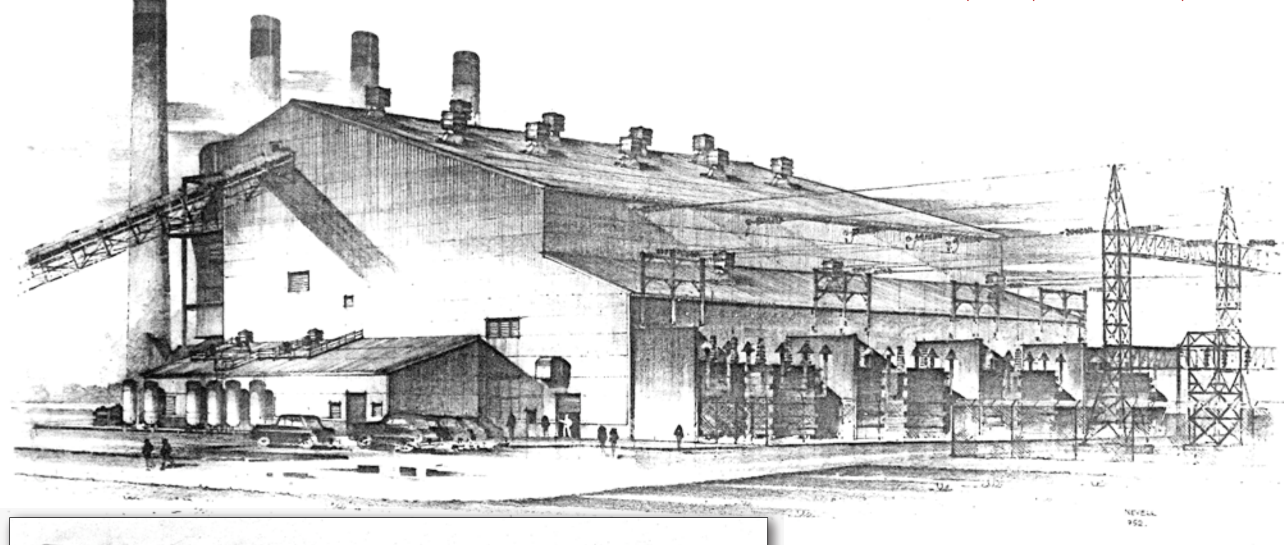
It would be useful to discuss briefly the characteristics and equipment in each of the power or boiler houses listed above, but it is essential to discuss the first one, 484-D. Though it was in many ways unique, it was also the prototype for the others.

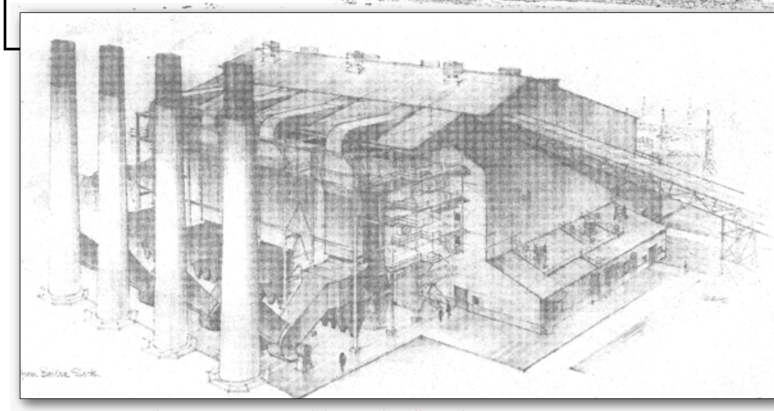
The 400 Area Facilities

The decision to proceed with 484-D was made very early in 1951. The orders for the boilers and the other equipment were made in February. Since large boilers could not be had within the time frame needed, it was decided to place a series of smaller units together to generate the power needed. Du Pont preferred this arrangement anyway.[29]

The heart of the 484-D building was the boilers. They were designed and built by Combustion Engineering Superheater, Inc. The initial order for three of these boilers was placed on February 6, 1951. At the time, the boilers were rated to produce 325,000 pounds of steam per hour, at 900 p.s.i. and 750 degrees F., "first time through" (FTT). That order was modified on August 2, 1951, to include a fourth boiler, but all four were to be rated 333,000 lbs/hr, 900 p.s.i., and 900 degrees F. FTT. Temperature control was also changed from manual to automatic.[30] Based on the unit system, each boiler had its own set of generators and full complement of auxiliary equipment. For example, the first three boilers each had their own high and low-pressure turbo generator (high pressure non-condensing turbo generator, and low pressure extracting condensing turbo generator). The fourth boiler only had one low-pressure turbine. Each of the four units had its own connection to the four 13.8 kv bus sections located on the west side of the power house. It was initially hoped that 484-D could have a completely outdoor design for the turbo generator sections, but it was not possible to obtain that sort of equipment due to the tight schedule. As a result, the power house had elements of both, with much outdoor equipment and an indoor turbine room.[31]

484-D Powerhouse, 1954, Gibbs and Hill, Volume 2





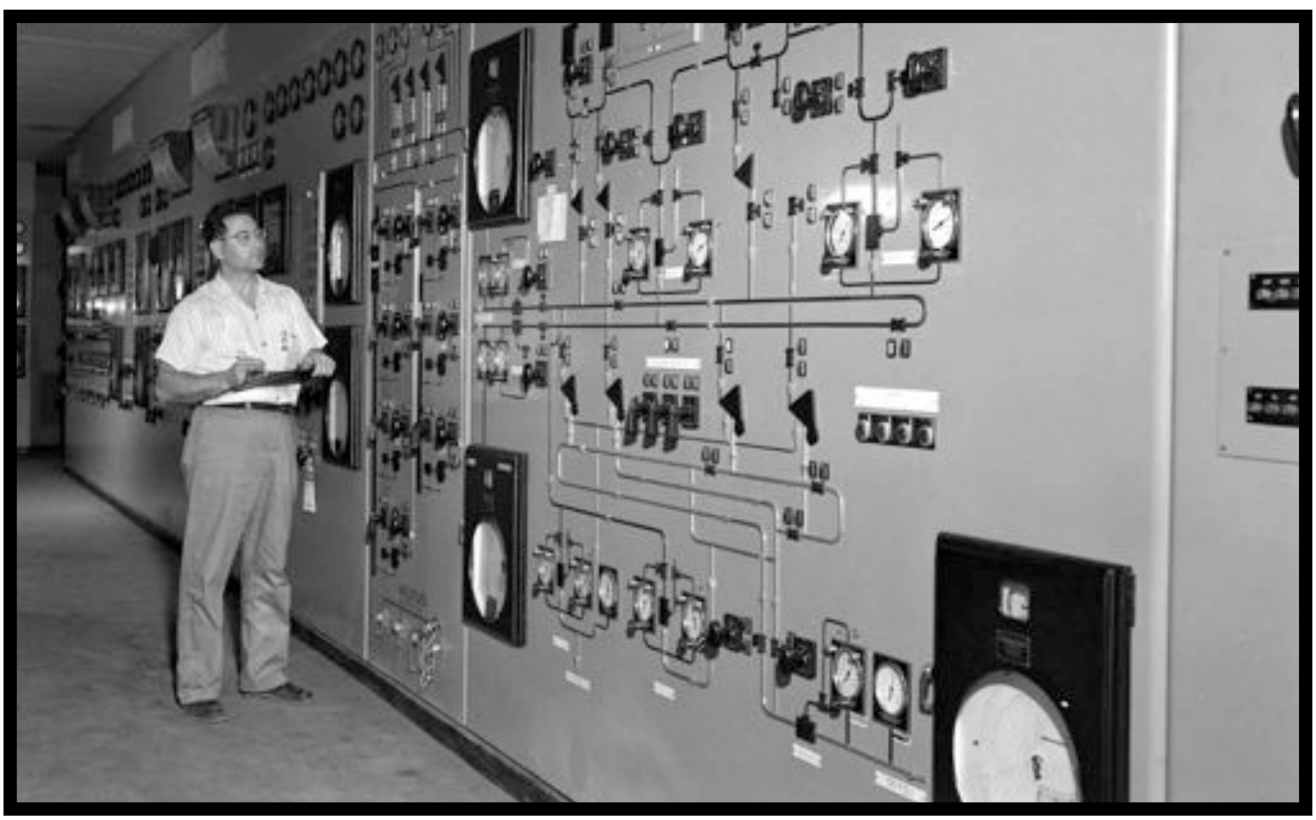
484-D Powerhouse, 1954, Gibbs and Hill, Volume 3

Many service buildings around 484-D were required by the needs of the low-pressure turbo-generators. The first three low-pressure units pulled condensing water from the reservoir in Building 483-D. The fourth condensing turbo-generator had to add recycled water to its system, and this required a cooling tower, 485-D.[32]

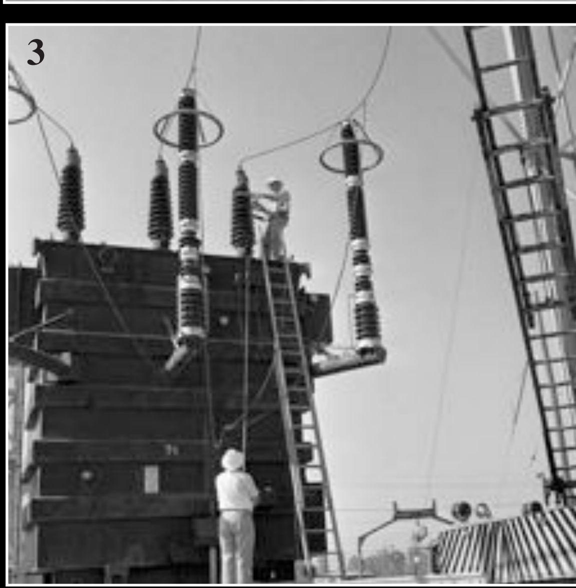
In a powerhouse as large as 484-D, the coal handling was an important component of the operation. The contract for coal handling was awarded to Haworth Engineering Company, on July 17, 1951. It is recorded that the contract was amended at least eight times to achieve results satisfactory to Gibbs and Hill and to Du Pont.[33] In the end, the coal handling system had to work with the pulverizer, which is believed to have been a medium-speed roll and race pulverizer.[34]

Because 484-D was the first of the SRP powerhouses to go on line, it had to provide electricity to D Area, as well as make it available to the electrical grid. As a result, it was equipped with the full range of electrical switching facilities and primary and secondary substations for dealing with voltage adjustments. Building 451-D had the elements of both a primary substation, taking power at 13.8 kv and stepping it up to 115 kv for the transmission lines, and a switching station that could control power to the river water pump houses to be located on the river nearby. The building was an outside construction, surrounded by a fence, located almost immediately west of 484-D.

484-D Powerhouse, D-Area Towers in Background, March 1, 1956, SRS Negative 3142-08



484-D Powerhouse Control Panel, March 5, 1953, SRS Negative DPSPF-236-12

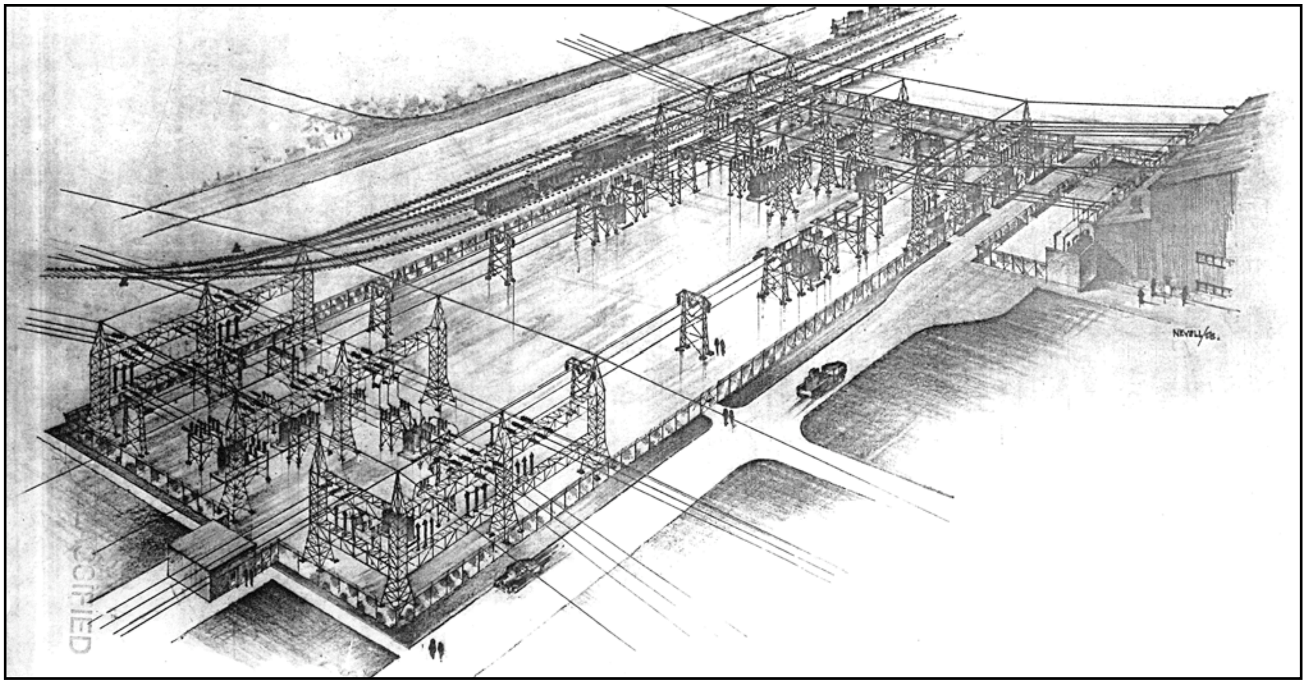


1. 484-D Powerhouse, August 23, 1957, SRS Negative 4587-05

2. View of Powerhouse from Coal Yard, July 30, 1952, SRS Negative 4-415

3. Electrical Transformers at 484-D and 451-D, October 26, 1954, SRS Negative DPSPF-1868-5

4. Electrical Transformers at 484-D and 451-D, October 26, 1954, SRS Negative DPSPF-1868-1



115 kv Substation at 451-D, 1954, Gibbs and Hill, Volume 2

The transformers for the substation were obtained from Westinghouse. It was originally hoped to get units with a 20,000 kva capacity, but it was soon found to be easier to obtain banks of 10,000 kva units. These were obtained from Westinghouse at a cost of around a half million dollars.[35] The four 13.8 kv buses at the west end of 484-D, were then connected to the four13.8/115 kv transformer banks in 451-D.[36]

The switchgear equipment was also obtained from Westinghouse.[37] The design of the switching station was basically established by March of 1951. There were two 115 kv buses, identified as A and B, located at opposite sides of the yard. Rather than trying to provide any protection from either the weather or from sabotage, it was simply decided to stockpile equipment to make it easier to repair any damage. There was, however, a small blast-proof building on the south side to house the supervisory control switchboard and the local control switchboard.[38] The 451-D building, unlike any of the other "fifty-ones," was soon connected to the 115 kv loop system by way of four transmission circuits, two to 504-1G and two to 504-3G.[39] This was what made it a switching station, comparable to the 504 buildings themselves.

The 452-D building, the secondary substation, took 13.8 kv power either directly from 484-D or from the transformers of 451-D, and then lowered that voltage for use throughout D area.[40] This portion of the process was like that performed by any of the other "fifty-two" series buildings.

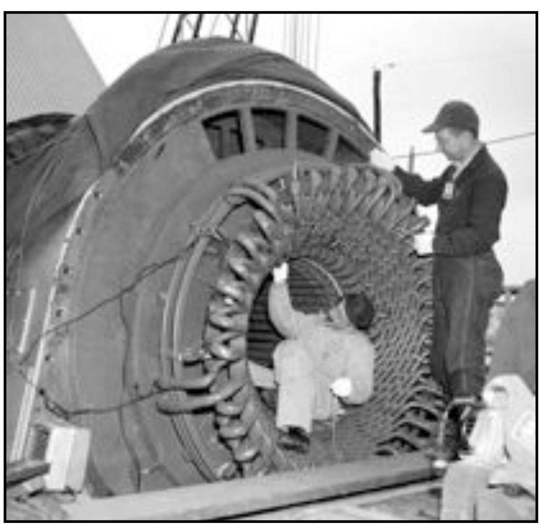
The 100-R, P, L, and K Area Facilities

The next major powerhouse facility that produced both electricity and steam was 184-R, the first of the reactor area powerhouses. In almost all details, the other reactor area powerhouses were just like this one, which is often used as the example for the powerhouses in the other three production areas as well. The C reactor powerhouse is different, as will be seen shortly.

1. 184-R Powerhouse, January 6, 1953, SRS Negative 1-737
2. 184-R Powerhouse, February 11, 1953, SRS Negative 1-757-1
3. Control Room Panels, May 23, 1956, SRS Negative 3510-04
4. Firing Aisle in 184-P Powerhouse, July 23,1956, SRS Negative DPSPF-3627-3
5. Furnace Doors in 184-L Powerhouse, December 22, 1960, SRS Negative DPSPF-7216-1
6. Control Room, 184-L, May 23, 1956, SRS Negative 3510-03
7. View of Piping Below Firing Aisle in 284-F, March 16, 1956, SRS Negative DPSPF-3178-2-6A

Building 184-R was designed with most of its facilities open to the air, but the basement, the control room, pumps, fans, motors, offices, and the firing aisle (also known as the firing floor) were enclosed from the weather. The operating floor, located 17 feet above grade, also contained the firing aisle. Most of the auxiliary equipment was located in the basement. The boilers and turbines were situated outside, just on the exterior side of the firing aisle. As with 484-D, the boilers and the turbo generators were designed on the unit system, with each unit having its own set of equipment and cooling tower cell. Building 184-R produced both electricity and steam, the former at 13.8 kv for use in R reactor, with any excess sent over to one of the 151 buildings for step up to the transmission system. Steam was produced at both 190 psig and 40 psig for industrial and heating use in R area.[41]

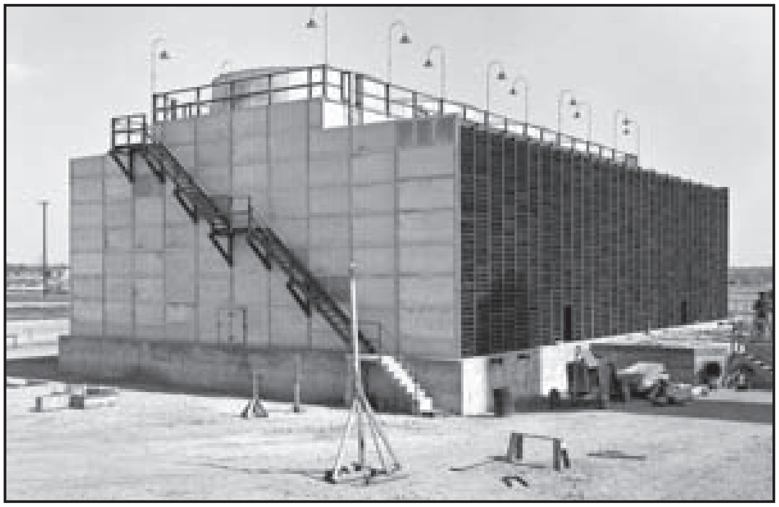
Generator Housing in 184-K Powerhouse, December 10, 1956, SRS Negative 3943-20



Generator Repairs, January 14, 1958, SRS Negative 4934-4

The two Riley boilers in 184-R were each rated 140,000 pounds per hour of steam at 625 psig and 825 degrees F. total temperature. The boilers were fired using spreader-type stokers, and provisions were made in the side walls for the installation of oil burners in case of future expansion (which incidentally never happened). Coal was brought to the powerhouse directly from railroad cars or from the local coal yard to the 720-ton capacity concrete silo. From the silo, mechanical feeders and conveyors brought the coal to two storage bunkers or hoppers, one above each stoker. From the 17.5-ton capacity bunkers, coal was fed to the stokers. The stokers transmitted the coal to the traveling grate and the boiler front. After the coal was consumed, ash came out the other side on the traveling grate and then to the ash hopper located at basement level in front of each boiler. Fly ash from the economizer and the dust collector hoppers joined this ash by way of the hydro-vactor. The ash is then mixed with water and pumped to an ash basin some 2000 feet away.[42] It should be noted that pulverized coal was not used at the 184 powerhouses. The only place it was ever used at SRP was in D Area.

The turbo generators were located outside, but a steel housing was placed over each unit to provide some protection from the elements. For each turbo generator unit, there was an exciter, a turbine, and a generator. Each of the two generating units in R, P, and L were rated at 11,500 kw; the only difference in K was the use of two generators rated at 12,500 kw. The boilers were the same regardless. Under normal circumstances a gantry crane would be used to service such turbo generator units, but there was a two-year wait for these in the early 1950s. A hand-operated A-frame on rails, and a mobile crane, were used instead.[43]



185-L Cooling Tower, October 1, 1952, SRS Negative 1-577

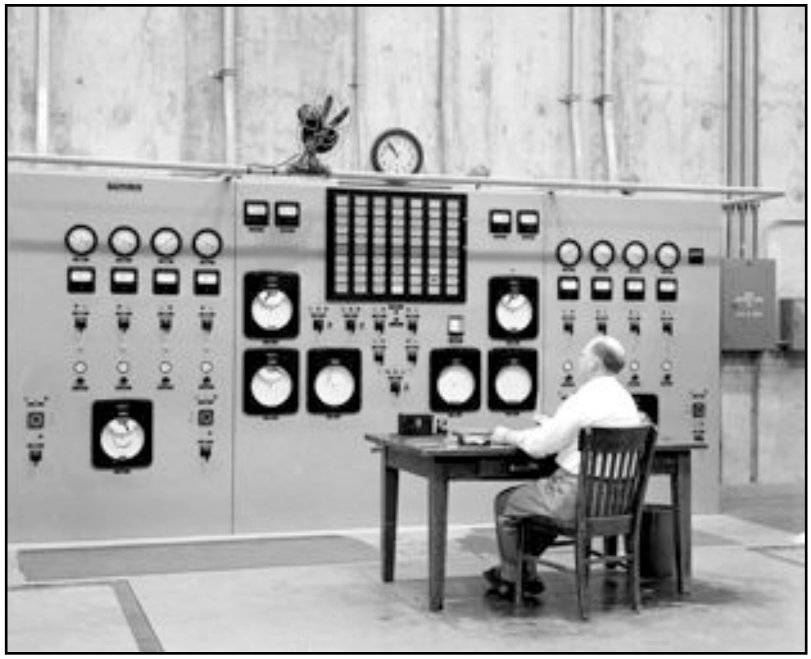
Because the turbo generator condensers required cooling water, it was essential to have cooling towers. This is basically why each of the 184 power houses had a 185 cooling tower.[44] The 185's provide condenser circulating water for the power houses. This was found to be more economical than the alternative, which was a once-through system using river water.[45] The C Area powerhouse, which did not produce electricity, was the only reactor area without a cooling tower.

C Area Steam Generating Plant (Boiler House) (184-C)

In the following section, it will be worthwhile to discuss the steam-only boiler houses as a sub-set of the power houses. While most reactor area boiler houses produced electricity and steam, the C Area house only made steam, and this was true for the boiler houses in the two separations areas and in the 300/700 area. Since steam production had a few special issues of its own, it would be good to discuss this matter at this point.

184-C Boiler House (left) and C-Area Reactor (right), July 27, 1959, SRS Negative DPSPF-6098-15

The decision to forego electrical power generation in C Area was made in the summer and fall of 1951. It was decided to proceed with electrical generation at K, bumping that up to 25,000 kw generation with two 12,500 kw capacity generators rather than the 11,500 kw units employed at the earlier reactor areas. At the same time, it was decided that electric generation at C was redundant, since the plant would soon get 30,000 kw from SC Electric and Gas Company.[46] Since there would be no electrical generation at C, this boiler house would be made similar to those designed for the 200 areas.[47]



184-C Control Room, March 20, 1956, SRS Negative DPSPF-3178-4-21

Because there would be no electrical generation at C, and because of the presence of powerful motors in the reactor building, great attention had to be paid to grounding. This was done primarily for the protection of the 105-C 3,000 horse-power motors. The solution to this problem, reached in the fall of 1952, was to have one grounding transformer and associated resistor on each of the two main 13.8 kv buses.[48]

Other Steam Generating Plants (Boiler Houses)

The other boiler houses were basically the same set up as that of C Area, with the exception of 284-F. One of the earlier boiler houses, 284-F was the one most modified, both in the planning stages and shortly after construction. Originally designed for two boilers, a third was added before final construction was completed. A fourth was added in 1957. By that time, the design output called for saturated steam at 300 p.s.i.g. Combustion Engineering Company provided three of the four boilers in 1953; the fourth, similar to the first three, was by Riley Stoker Corporation. The building was modified so that two future units could be installed if necessary, but this was never done. All four boilers were used during the winter; three for summer loads.[49]

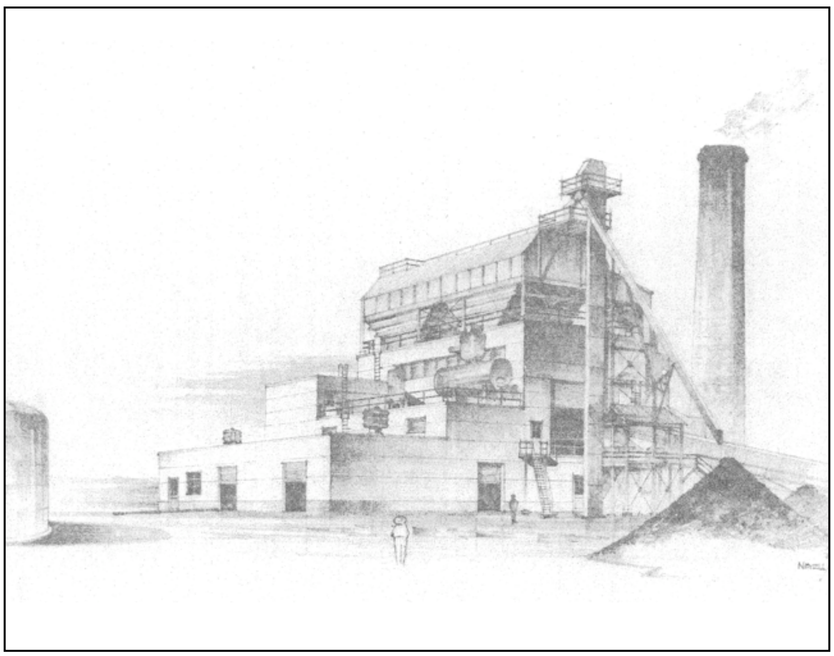
Each of the four units had a spreader stoker and its own coal bunker, forced-drive (FD) and induced-drive (ID) fans, a boiler feed pump, and combustion control system. Each pair of units also had a deaerator and a stack. Like all of the other power plants, Building 284-F had a semi-outdoors design, with the firing aisles inside and the steam boilers and generators outside. Also located outside were the air heaters, dust collectors, the fans, the ash-handling equipment, and the deaerators, located on the roof, above the firing aisle. Located on the ground floor, below the firing aisle or floor were the feed pumps, instrument air compressors, chemical feed pumps, and other related equipment. There was also a coal silo, with a coal section and conveyor gallery in the upper portion. In the middle of the silo was much of the boiler treatment chemical feed equipment and ventilating equipment. Below that, but still within the silo, were the offices and meeting rooms, located on the same level as the operating floor (firing aisle). On the silo's ground floor were the locker rooms and other communal facilities.[50]

With four boilers, the coal requirements could be almost 300 tons of coal per day. Link-Belt Company provided all of the coal handling equipment. After the coal was brought to the area, it was dumped into track-hopper reciprocating feeder belts. These sent coal to the conveyor belt, where a magnetic pulley removed any loose iron. The coal then went to the crusher, and after that to the bucket elevator. This took it to the silo or to the yard beside the boiler house. The storage yard could hold 60 days worth of coal. From the silo, the coal went to reciprocating feeders and eventually to the stoker hoppers at each boiler.[51]

The ash-handling system removed ash from the cinder hoppers at each boiler, and removed fly-ash from the dust collectors and the stacks. Water jets were then used to clean out the cinder hoppers, while fly-ash and dust were removed by the hydro-vactor.[52] Eventually, all the ash was then mixed with water and sent to pumps, after which it left the building via ash lines for the basins that were located some distance from the boiler house.[53]

Boiler house 784-A was similar to this arrangement, but only in a general way. There were two boilers, with only one used in warm weather. To accommodate this arrangement, the two boilers were tied to a common header, with steam exiting the building via overhead lines for use through the 300/700 area. The silo arrangement was also different. The electrical needs of the boiler house were relative small, even though they were increased from an estimated 5,000 kw to 8,300.[54]

An interesting if relatively minor problem arose in the boiler houses in early 1953. Due to a Gibbs and Hill design oversight, the 184 buildings in R, P, L, and K, were constructed with vapor escaping from the system via floor drains, not to an outside closed sewer line, as Du Pont preferred. Gibbs and Hill maintained that this arrangement was adequate as built; Du Pont wanted it changed to satisfy Operations. This issue was mentioned in the McCullin diary, but it is not certain which way the decision went on this matter.[55] In all likelihood, Du Pont got its way.


784-A Boiler House, 1954, Gibbs and Hill, Volume 1

There was nothing special about the steam lines except their length and their number. That was certainly special enough. At Savannah River Site, steam lines seem to be everywhere. Steam was used in industrial applications and for general heating in winter. There were special poles and hangers for the lines, which were heavily insulated. The lines themselves were bent at regular intervals to prevent unwanted expansion and steam hammering. Frequent release valves expelled water condensate.[56]

The pipe supports were important enough to have their own number, 801. With the exception of the ash sluicing lines, all pipelines suspended above ground were hung from single or double rod pipe hangers that were in turn suspended from the cross arms of single pole or double poles. The goal here was to provide support, but also prevent rigidity that might contribute to steam hammer. The hanging supports were also used to keep the hot steam pipes away from the wooden poles. Where steam lines crossed roads, the supports were more substantial.

In R area, for instance, the largest steam line was the 16-inch steam header from 184-R to the reactor building. Smaller branch headers went out to other parts of R area, as needed. The same basic arrangement was found at all of the other reactor areas.

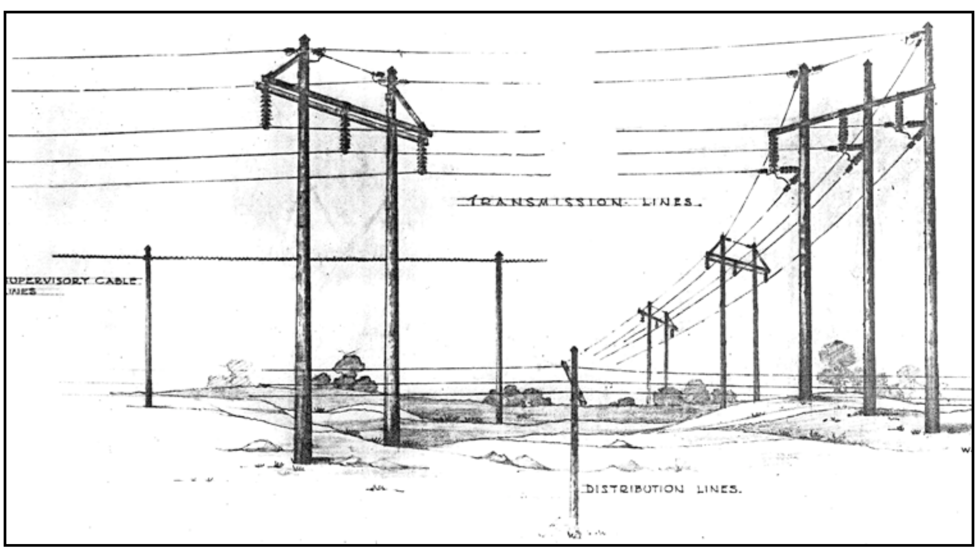
Steam lines, identified as 802, distributed high and low pressure steam. The 802 lines also transported gas and even air, as needed. The 16-inch steam header from Building 184-R could deliver a maximum load of 48,850 pounds of steam per hour at 25 p.s.i.g. and at 290 degrees F., to the reactor building. A four-inch branch header also delivered steam to Buildings 110-R, 122-R, 704-R, and 701-R. A four-inch steam header from the reactor building itself brought steam to the 183-1R, the 190-R, and183-2R buildings.[57]

According to the original set-up, when each production area had its own powerhouse, most steam lines were restricted to their respective areas. This changed in the 1980s, when it was deemed cheaper to run long-distance steam lines from 484-D to some of the reactor and separations areas, rather than re-start the old power houses.

Transmitting Power

Transmission Lines and Loop Connections

Any modern electrical system is based on high-voltage carrier wires, in this case operating at 115 kv. The use of 115 kv was largely predetermined, since that was the voltage already used by South Carolina Electric and Gas. Most modern transmission lines now operate at much higher voltages, but 115 kv was certainly a standard in 1950. There were other ways in which the SRP electrical system had to conform to the grid. Polyphase power synchronization on the 115 kv line between the plant and SCE&G had to be established before they two could be connected, and this occurred on February 9, 1954.[58]



503-G, Typical Transmission Line, 1954, Gibbs and Hill, Volume 2

High voltage wires are an integral part of any transmission system. At Savannah River Plant, there were 90 miles of 115 kv transmission lines. Although it was initially thought to have steel towers for the high voltage lines, it was later decided to use regular wooden "H" frame structures, with grounding and lightning protection.[59] The "pole H frame" was used rather than steel as an economy measure, and because steel was in short supply at that time. Gibbs and Hill did the design work for the entire system in April of 1951, after Du Pont formulated the electrical load that would be required for each area. As for the line itself, Gibbs and Hill wanted a capacity of at least 100 megavolt ampere (mva), which required a copper equivalent of 250 thousand circular mills (MCM). The material finally selected was "aluminum cable, steel reinforced," or ACSR. The poles themselves would be Class 3 material, and up to 75 feet in height, with cross bracing where necessary.[60]

Electrical Lineman Training Class, Februrary 9, 1956

SRS Negative DPSPF-3107-15

SRS Negative DPSPF-3107-8

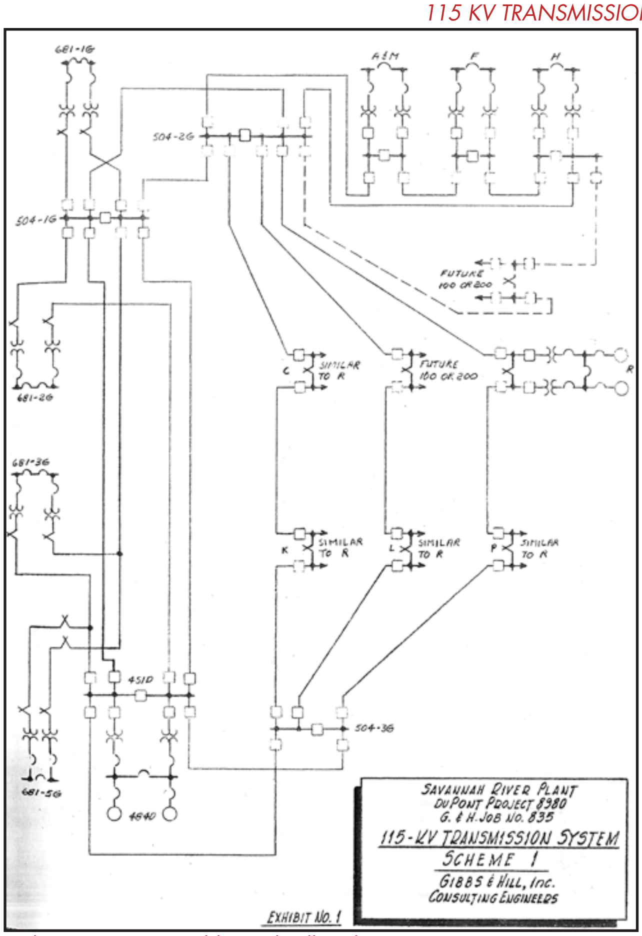
The basic mechanical standards of the 115 kv transmission lines either conformed to or surpassed those of the National Electric Safety Code, as required for Grade B construction. This was considered more than sufficient to deal with any unexpected wind or ice problems. Lightning was also an important consideration, since it was anticipated that there would be on average 55 days of thunderstorms in the area. The goal was to keep lightning outages down to two per 100 miles of line per year. The initial solution called for the construction of two grounded conductor wires located above the transmission lines. To decrease ground resistance and allow the lightning surge better access to the ground, counterpoises were buried around the transmission poles.[61]

The possibility of buried power lines was explored during the design of the river pump houses. During the early planning period, when there were still plans for three main river water pump houses, the aerial lines to each would have put them well within the 2.5 mile limit, which was unacceptably close. During that period, buried power lines were considered a way around the issue. Finally, after a determination was made that only two main river water pump houses were required, 681-1G and 681-3G were placed far enough apart to allow for aerial lines.[62]

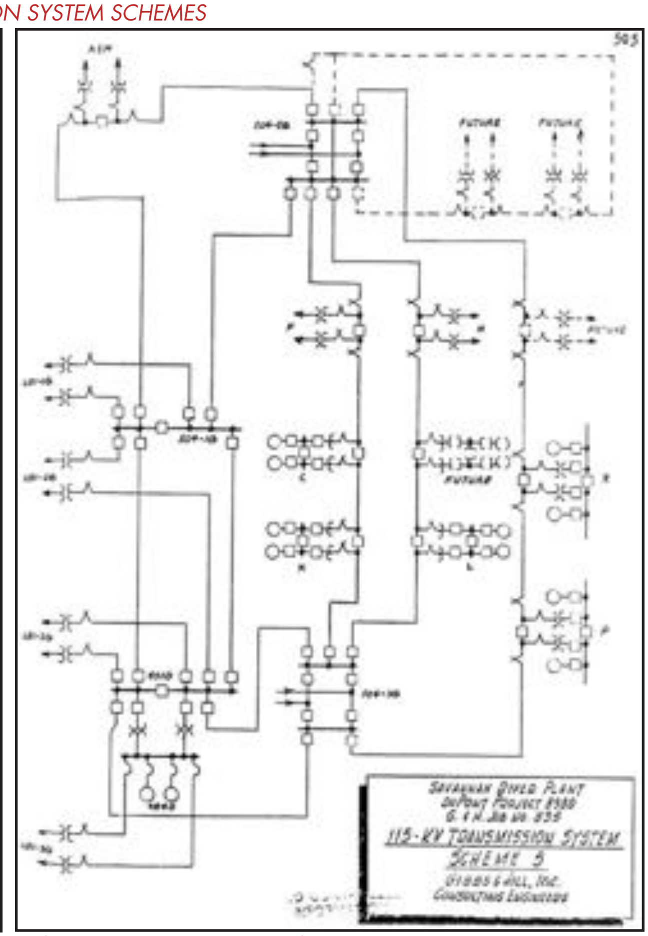
An important part of the electrical system at SRP required a high degree of redundancy in the supply lines. The power supply for each area had to be available through at least two different lines, in case there was an accident or sabotage. This was the basic premise behind one of the most important features of the SRP transmission system, which called for each production area to be interconnected by a series of loops of transmission lines, all tied together by the large switching stations or switching yards, identified as 504 buildings. The 504 buildings will be examined in the section that follows, but the loop system will be discussed here.

In the very early days of the electrical design, there were a number of options considered for the development of the electrical transmission system. It was quickly determined that the plant would be supplied from a combination of its own generated electricity and purchased power, and that there should be redundant parallel lines controlled by switching stations. It still remained to be seen how all of these facilities would be tied together. The various "loop schemes" that were considered were identified from No. 1 to No. 5.[63]

115 KV TRANSMISSION SYSTEM SCHEMES

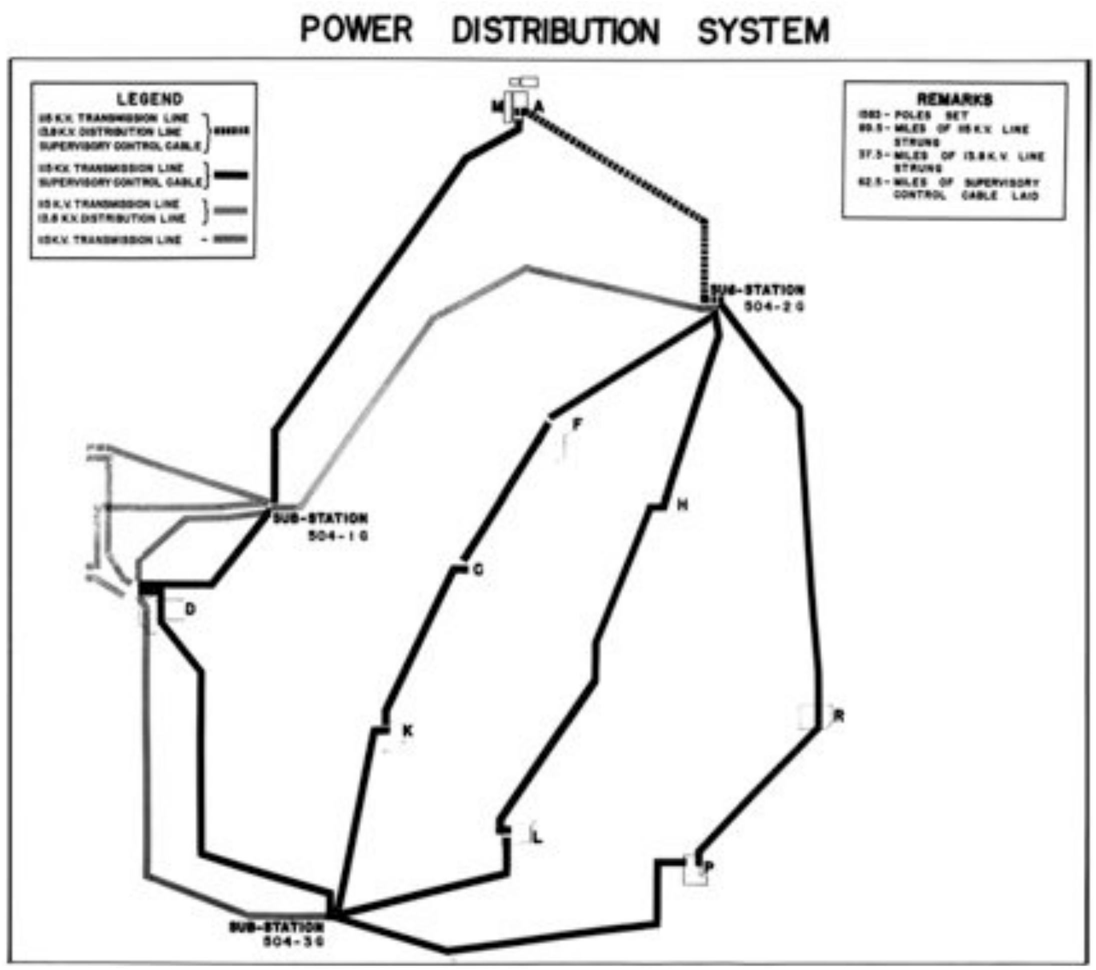


Scheme 1, 1954, Gibbs and Hill, Volume 2



Scheme 5, 1957, Du Pont, Volume 6

All were variants on the same basic theme, with transmission lines through all of the production areas, with the various lines tied together by the 504 buildings. The differences for the most part dealt with details in the 504 locations, and the arrangement of the loops. Scheme 1 and 2 basically had the 300/700 area and the F and H areas on the sidelines, with separate connections to 504-2G. The scheme that was eventually selected was No. 5, specifically Scheme 5-C, which had all reactor areas and separations areas tied together in long loops that ran between two of the 504 buildings, 504-2G in the north and 504-3G in the south. Gibbs and Hill and Du Pont tentatively approved scheme 5-C as early as March 8, 1951, even though the final agreement was not made until later. According to this scheme, it was determined that D area and the river pump houses would have their own connections to 504-1G, and this switching station would have connections to the other two 504 buildings: 504-2G and 504-3G.[64]



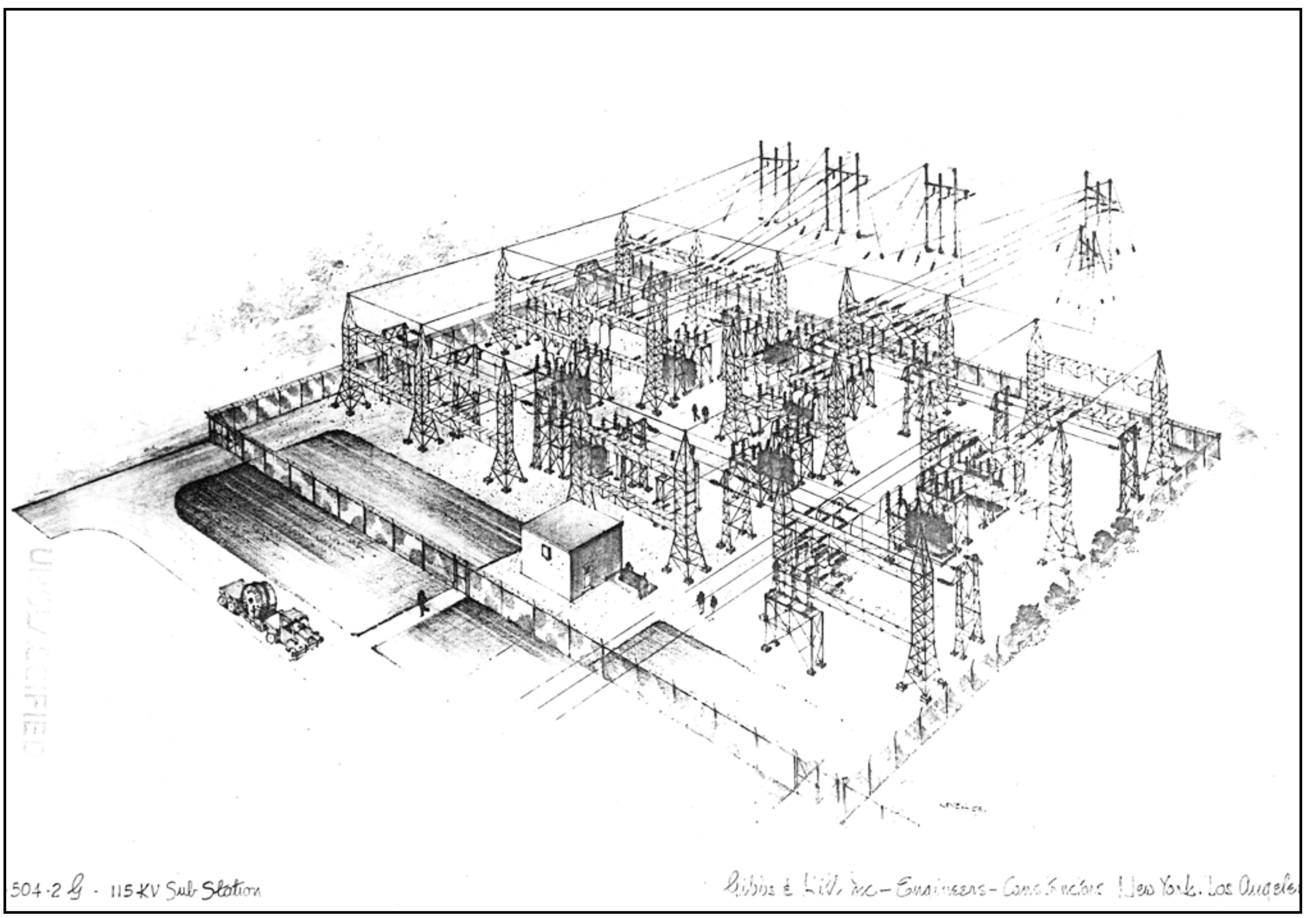
SRP Power Transmission Map, July 2, 1953, SRS Negative M-2650-05

As finally approved, three switching stations, known as Buildings 504- 1, 2, and 3G, anchored the transmission loop system. Each reactor and separations area was tied to one of three lines that ran between 504-2G in the north, and 504-3G in the south: the most direct line ran through K, C, and F. The loop further to the east ran through L and H, while the loop furthest to the east ran through P and R. On the west side, there was a line that connected all three switching stations, with 504-1G in the middle. Building 504-1G, adjacent to the old town of Ellenton, had additional connections with D area and with the river pump houses. A line to the north, between 504-2G and 504-1G, provided a connection to the 300/700 area.[65]

Switching Stations, 504-1, 2, and 3G

The basic purpose of the 504 switching stations was to control the flow of electricity through the transmission loop system, and receive power from outside utility companies as needed. These 504 stations also allowed the power to be switched from line to line. As we have seen, the basic arrangement was worked up in the first half of 1951. By June of 1951, it was determined to have three transmission lines coursing through the main part of the plant, connecting all reactor and separations areas. It was also decided to have three 504 buildings, with purchased power going to one or more of these. Not only were there three 504 switching stations, but 451-D was basically set up to function the same way as a 504 facility. This allowed a complete tie in of all the major production facilities across the plant.[66]

Each switching station had two 115 kv buses, labeled A and B, located at opposite sides of an enclosed fence. Each bus was connected by means of an independent bus-tie breaker, making for two independent ring systems. Each could be operated separately, if necessary.[67] Each outgoing feeder from the buses was protected by a 115 kv, 1,200-amp oil circuit breaker. The buses and most of the other line equipment were set on latticed steel towers and trusses, fed in with copper cable with a 250,000 circular mil. Lightning arresters and overhead ground wire shielding provided protection from electrical storms. In addition, there were over-current relays, referred to as the "last ditch" protection of the system.[68]



504-2G 115 kv Substation, 1954, Gibbs and Hill, Volume 2

The smaller electrical needs of the 504 buildings, such as lighting, air compressors, and the like, were met with 13.8 kv distribution lines brought in from other areas. After some study, it was determined more economical to run those extra lines than to install special transformers at the 504's to meet their own small-scale electrical needs. Buildings 504-1G and 504-3G were served by lines from the 400 area, while 504-2G was served from the 300/700 area. Also, each 504 had emergency power and its own diesel-powered generator.[69] There was also a small concrete structure inside the fence line that contained the switchboard materials.

Work began on the three 504 buildings in August and September of 1951, and was basically finished by the end of 1952 and the early part of 1953. Final acceptance of the construction came the following year.[70]

Distributing Power

Once power reached each area, it had to be stepped down so that it could be used by regular machinery and lights. The first step down was from 115 kv to 13.8 kv, and it often went much further. How power is apportioned below the level of 115 kv is normally called the distribution system, to distinguish it from the higher voltage transmission system. Once power was stepped down, it could only be used in that area, even though any excess could always be stepped back up for the transmission system.

The first stage in the distribution of electrical power occurred in the "Fifty-One" series buildings (151s, 251s, 451 and 751). Here, power was stepped down from 115 kv to 13.8 kv. In the reactor areas, this power was then fed to the reactor buildings. In all the areas, some of that 13.8 kv power to fed to the "Fifty-Two" series buildings, where it was stepped down further for use in other local buildings. The Fifty-One series buildings will be discussed first, with particular emphasis on the 151s. This will be followed by a shorter discussion of the Fifty-Two series buildings.

The core of the Fifty-One's were the 115/13.8kv transformers, with forced air-cooling, that were required in each area. Ten such transformers were ordered for the 100 areas, four for the 200 areas, two for the 400 area, six for G Area (at the river pump houses), and two for the 700 area.[71] Many of the Fifty-One series buildings simply did the job of stepping down the power to 13.8 kv. Things were more complicated at the 151s, and much more complicated at 751-A, as will be seen below. Since 751-A is more intimately connected with supervisory control, it will be discussed at that point, further in the report.

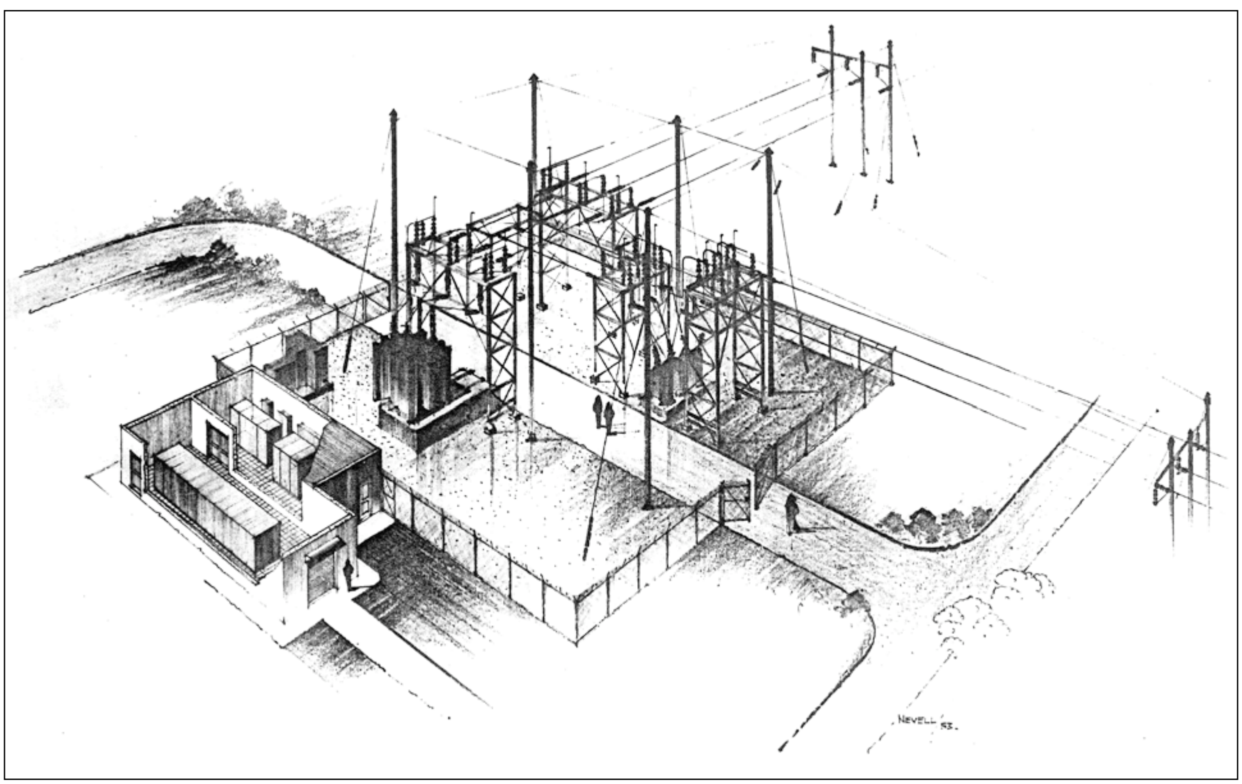
Building 151 and Other Primary Substations

It should also be noted that each powerhouse in the R, P, K, and L reactor area produced power at 13.8 kv, and fed power to the reactor buildings at that voltage. As a result, the distribution system in most of the reactor areas was powered from the 151 step-down transformers, or directly from the local powerhouse. This dual source of power was the origin of the two 151 buildings (151-1 and 151-2) located in each of the reactor areas. One primarily provided power from the transmission system, while the other provided power from the powerhouse, even though both could be used interchangeably if needed.

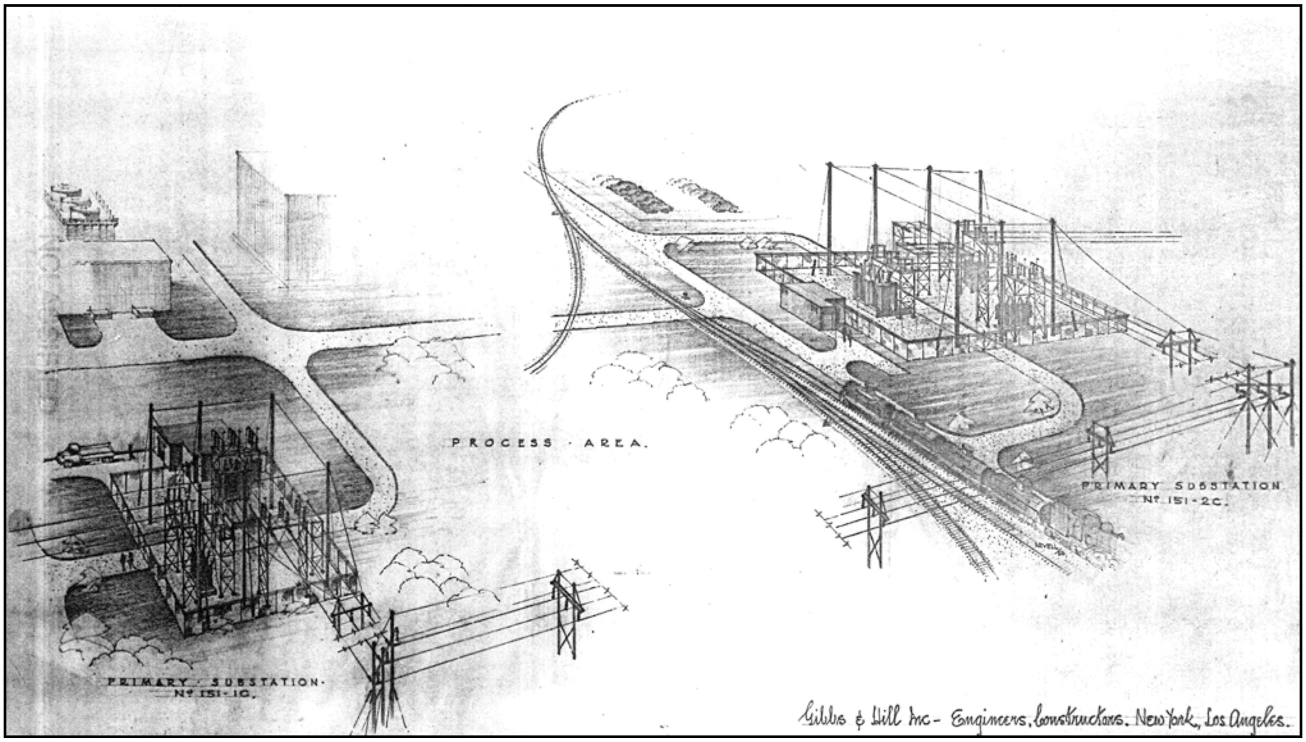
151-1R, September 23, 1952, SRS Negative 1-560

151-1R, October 28, 1952, SRS Negative 1-610

Because they served different purposes, 151-1 and 151-2 were located on opposite sides of the reactor building. This arrangement also provided for greater electrical stability. Each had feeders to the reactor building in the form of continuous, un-spliced cables. In R, P, K, and L areas, the 151-1 building pulled power off the transmission system. The 151-2 building was associated with the 184 powerhouses, and was the conduit from there to the reactor building. Any power not needed by the reactor building, was shunted off to 151-1 for further distribution or transmission.[72] Even though no electrical power was generated in C Area, it was found useful to have both a 151-1C and a 151-2C, so that each could carry the load pulled off the transmission system.[73]



151-1C, 115kv Substation, 1954, Gibbs and Hill, Volume 2



Rendering of Primary Substations 151-1C and 151-2C, 1954, Gibbs and Hill, Volume 2

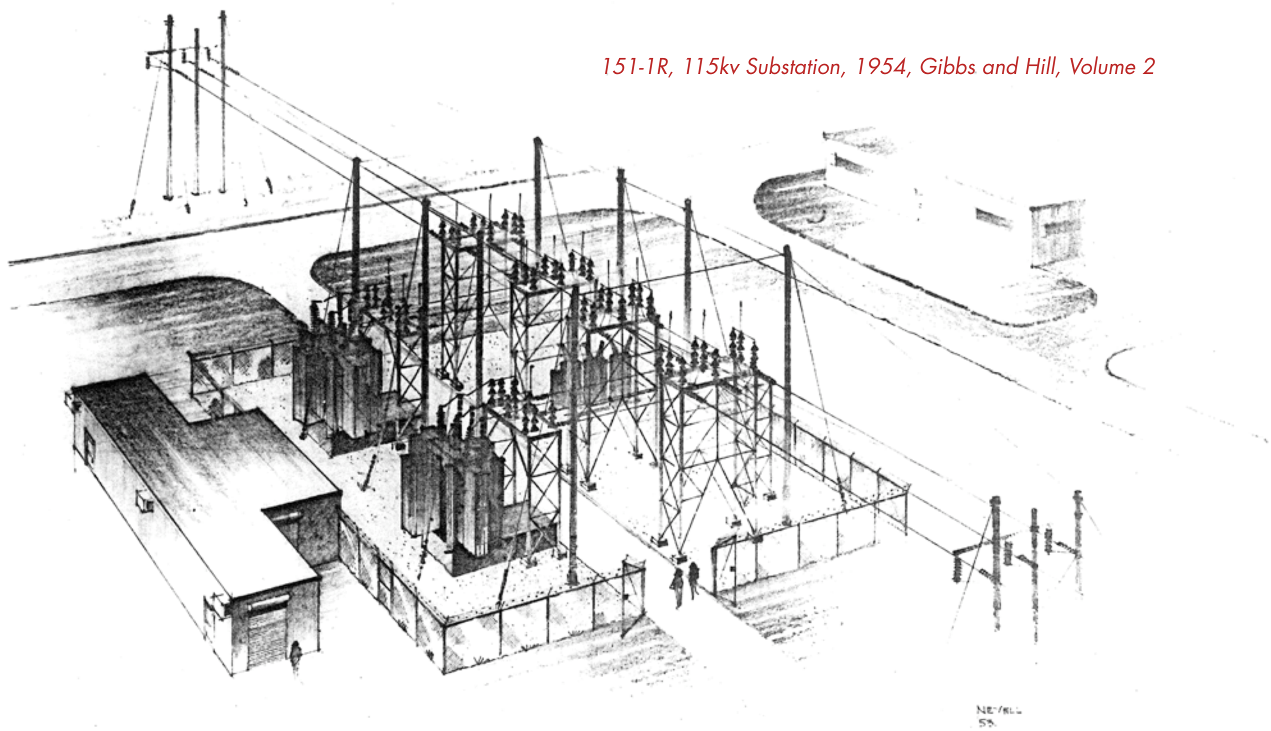
In early 1951, the original idea was to have the 151-2 building be an actual part of the 184 powerhouse. As the design of power houses progressed, and as power estimates ramped upward, this was seen to be a poor idea. By August of that year, the two facilities were separated, and by September they were placed at least 70 feet apart from each other.[74]

The rest of the 151 design was fairly straight-forward. Basically the building had two parts: an outside switchyard and a concrete switchgear building, also known as a control house. The concrete building was made blast-proof, with a center-dividing wall. In June of 1951, a decision was made to turn the switchgear around in the building so as to not have to increase the size of the building. Final specifications were written and issued that same month.[75]

The electrical cables in and out of the building were to be buried three feet below grade, and at least two feet apart. This led to the creation of a wide cableway that required some two feet clearance from other obstructions. This cableway was buried as much as possible along rectangular coordinates in order to make the route easier to map and later relocate.[76]

The switchyard part had two transformers to pull power from the 115 kv transmission system. Even if the local powerhouse was not in operation, any single 151 could pull enough power to run the reactor on its own, if it had to. There was great need for grounding at all of the 151s, but this was particularly true at C Area. This was primarily to protect the reactor motors. Due to differences in the electrical distribution system in the other areas, it was not essential to have that same level of grounding in the 700 area, or even the 200 areas.[77]

151-1R, 115kv Substation, 1954, Gibbs and Hill, Volume 2



To provide a high level of grounding, a grid of 4/0 cable was buried in the ground some three feet deep, with each cable 30 feet apart. Each intersection of the grid was connected to ground rods 20 feet long. This pattern established the "low system ground resistance" needed throughout the SRP area; as was discovered much earlier by local utility companies, the whole general area is subject to grounding problems.[78]

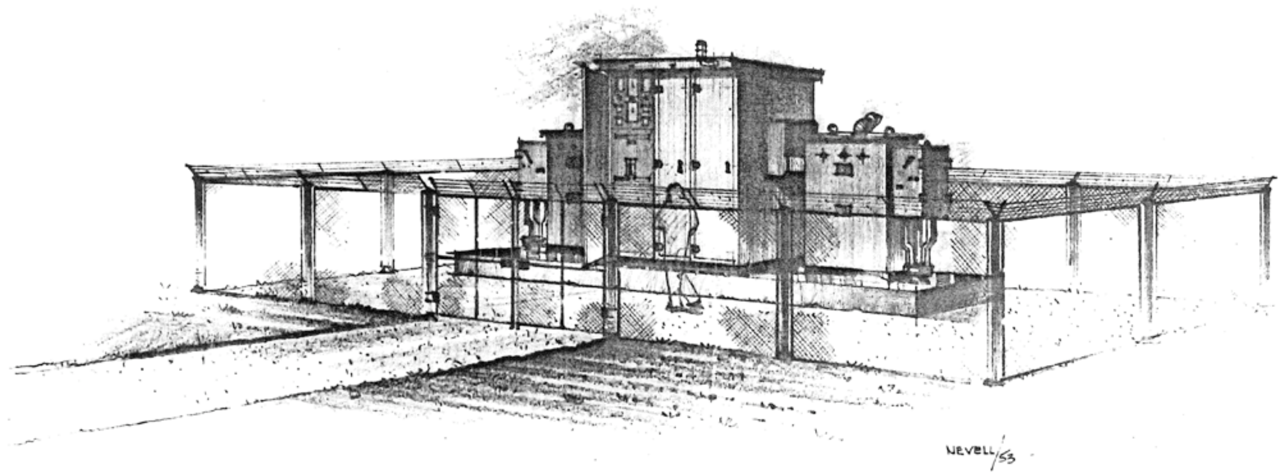
The underground grid was then attached to the overhead ground wires. These wires were placed over the entire switchyard. Here, copper-weld cable was used, except in the 400 Area, which had a potential problem with corrosion; there, Calsun Bronze cable was used.[79]

Building 152 and Other Secondary Substations

For the electrical needs of other buildings within the local production areas, the Fifty-Two series buildings pulled 13.8 kv power from the Fifty-One's, and stepped it down further, usually from 13.8 kv to 480 volts. Smaller dry-type transformers within the individual buildings decreased the voltage further so that it could be used with regular lights and office appliances. These buildings also provided power to road and fence lights.[80]

At 152-R, for example, there were two 500 kva-13.8kv/480v transformers, along with six air circuit breakers, all enclosed with a security fence. An underground feeder that came from 151-1R supplied the 13.8 kv source.[81] The five 480v feeders that came out of 152-R served the electrical needs of every service building within the R Area, even the guardhouse at the Williston barricade (701-4G). In later years, there was even a line to the Par Pond dam.[82]

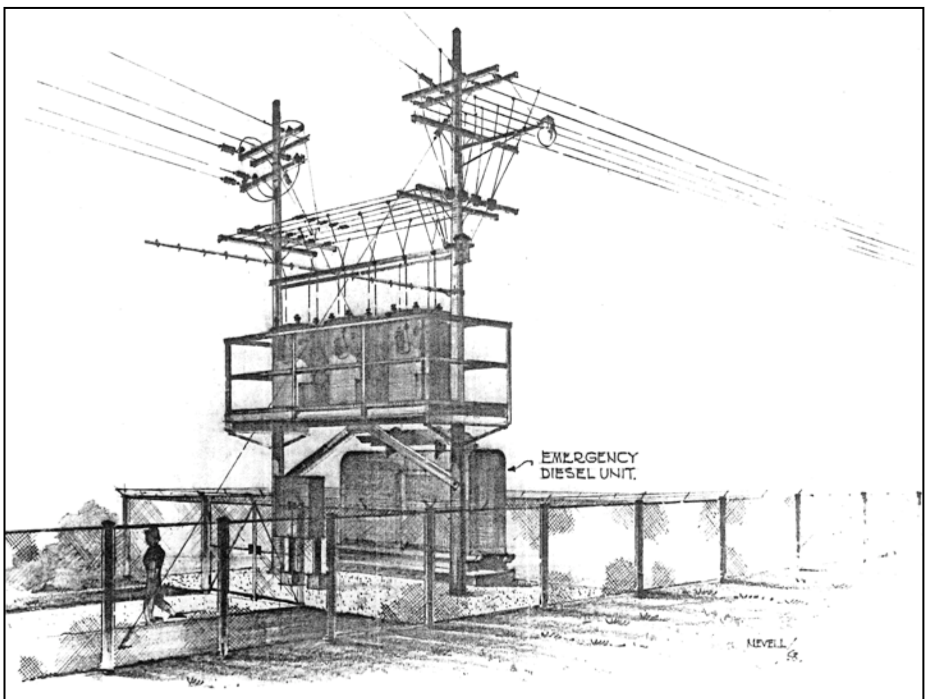
Because the voltage was lower, the distribution lines that fed these areas were not as elaborate as those used in the transmissions system. These were industry-standard wooden poles, supporting open wires in a regular overhead arrangement.[83]



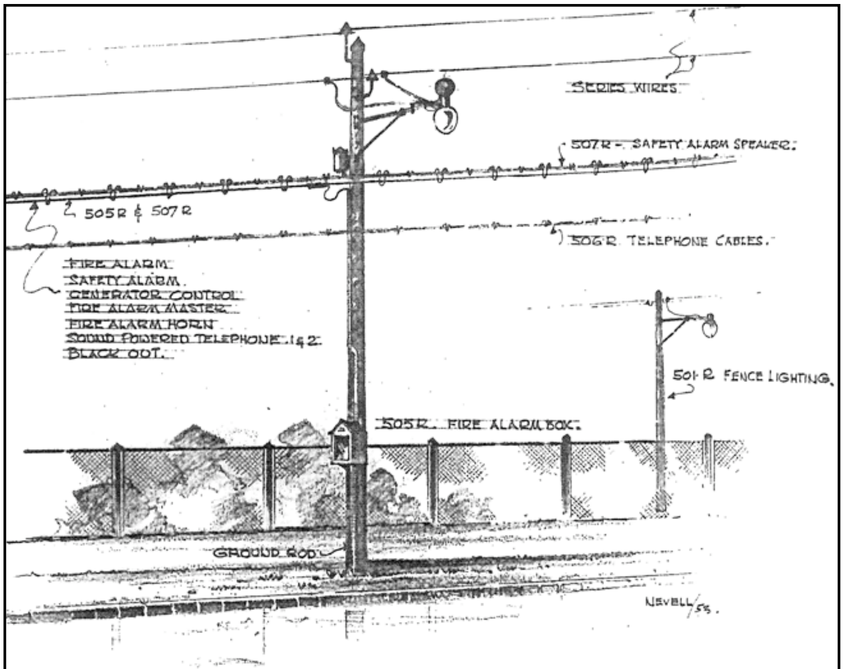
152-R, P, L, K, & C, Secondary Substation, 1954, Gibbs and Hill, Volume 2

Fence and Road Lighting (501)

There were basically two kinds of lighting at SRP: for buildings and for fences and roads. Building lights, like most of the other appliance outlets, were standard features and were the responsibility of each of the major contractors in their particular areas, including Du Pont. Specifications, however, had to be written for the fence and road lighting. In the beginning, only roads that might have pedestrian traffic were to be lit. Patrol roads (secondary roads) were to have none at all. The main plant roads, on both sides of the gates, were to be lit for security reasons. No primary roads were to be lit outside the gate and main areas. Later it was decided to light up the major road intersections.[84] By August of 1955, in addition to lighting at the major production areas, there was fence and road lighting provided at the river pump houses, at CMX, the Railroad Classification Yard, the five perimeter gate houses, and at 41 road intersections. Most of these were controlled by automatic time switches, with some level of manual override. By the end, it was estimated that there were 13 miles of road lighting alone.[85] There were even scattered diesel engine-driven generators for emergency power.[86]



501-R and 503-R, Fence and Road Lighting, 1954, Gibbs and Hill, Volume 2



501-R, 505-R, 506-R, and 507-R Cross Section, 1954, Gibbs and Hill, Volume 2

Controlling Power

The redundancy of the SRP electrical system was designed so that a much higher level of control could be exerted on the system than would ever be expected under normal circumstances. The electrical loop arrangements were a part of this system, so was the doubling of the 151 buildings at each reactor area. Still, it was a system that could not work automatically, even though it had many automatic features. The entire transmission/distribution system had to be controlled from a central point, and that point was Building 751-A.

Building 751-A (Control House and Primary Substation) and the Load Dispatcher's Office

A portion of 751-A, like every other Fifty-One series building, was a primary substation. In this case, it served the 300/700 area. Like the other Fifty-One buildings, this was in an outside yard, surrounded by a security fence, with transformers to step down power from the 115 kv transmission line. The switchgear equipment associated with this yard was also in a concrete building, just like the other Fifty-One's. There was, however, much more in this particular building, for this was the location of the Load Dispatcher's Office, and it was here that one single individual could control the entire electrical system of the Savannah River Plant. From the Load Dispatcher's Office, control of the cable system was close to other administrative functions in A-Area, but far from the primary substations and the other production areas. This was ideal for blast protection.

Throughout the SRP system, there were problems that arose from having to lay out a city's worth of infrastructure simultaneously, when many of the system details had not yet been resolved. And this was certainly true of the Load Dispatcher's Office, which required a number of untried features combined in new and untried ways. The miracle was that, when it was all put together, the system worked.[87]

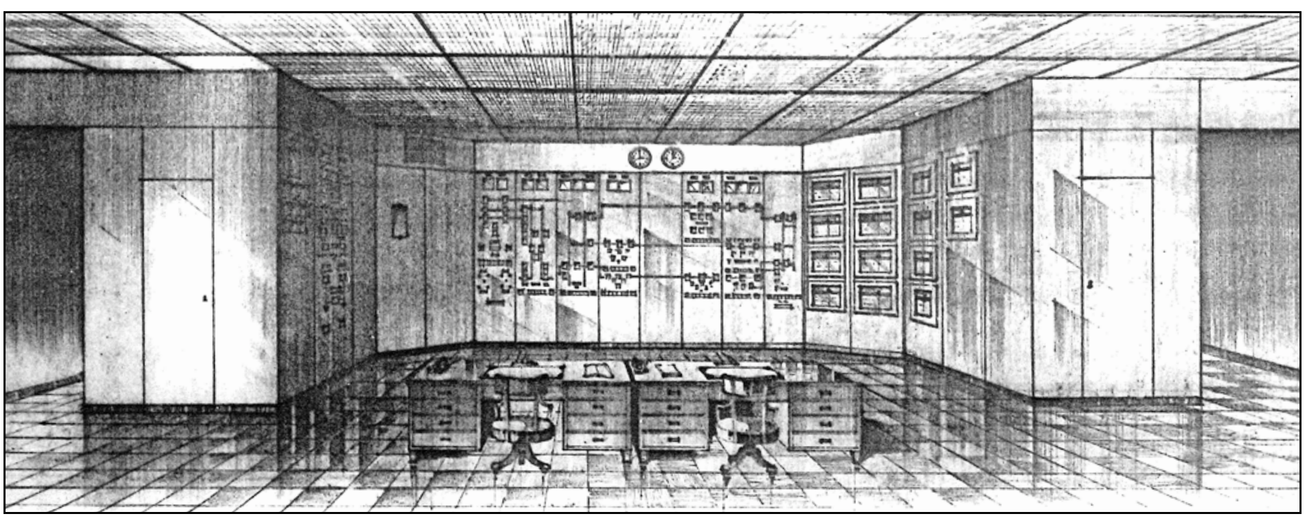
The Load Dispatcher's Office was the subject of a small article in a 1957 issue of the plant newspaper, where is was mentioned that Building 751-A was the "heart of the plant," with the power to control the electric flow to all plant facilities.[88] From a desk in the Load Dispatcher's Office, a single controller could manipulate the 115 kv current throughout the production areas by means of the supervisory control cable, the pilot wire circuit system, and the Load Office telephone system.[89] The electrical specifications for all of these items were sent out on bid in mid-June of 1951. The Westinghouse proposal was accepted and this led to Purchase Order AXC-2177-1/2, dated August 24, 1951.[90]

Telemetering at 751-A, April 29, 1957, SRS Negative 4391-03

Supervisory control, and the associated telemetering, was achieved by means of a supervisory control cable that was bundled with telemetering wires. Also included in the bundle were the Load Office telephone lines, as well as other Westinghouse "Visicode" supervisory control equipment. With this system, it was possible to operate the 504's and the primary substations, the Fifty-One series buildings, without having anyone present at any of those facilities.[91]

The Load Dispatcher's Office was basically divided into two parts: the Load Dispatcher's Desk and the Supervisory Control Board. There was also a control panel for the 751-A primary substation; ironically, this was the only primary substation that was not connected to the supervisory cable, but had to be controlled directly. This was done for the simple reason that the controller of the whole system was right there anyway.

The Supervisory Control Board was of a duplex or tunnel type, of otherwise standard design. The controls were on the front face of the panels, with relays and telemetering equipment on the back. The width of the board was about 200 inches, with nine panels, arranged in a "U" shape. The control switches had indicating lights that were arranged on a mimic bus to resemble the layout of an actual station. Gibbs and Hill worked hard to make the board as intuitive as possible, so that a wide range of workers, some of who might not be specialists, could use it.[92]



751-A Load Dispatch Office and Supervisory Control Board, 1954, Gibbs and Hill, Volume 2

Supervisory Control Cable System

From the very beginning, at least three options were explored to effect supervisory control. The more traditional method was through wire circuits, but the use of power line carriers and microwave radio was also examined. In the end, it was decided to go with wire circuits as the most economical. For the cable, it was decided to use a single, high quality, multi-conductor, in which all of the functions, supervisory control, telemetering, protective relaying, and the Load Office telephone lines, could be bundled together. It was then decided to bury this line rather than hang it overhead—which would make it both harder to sabotage and to repair. By the end of June 1951, it had been decided that the supervisory cable would be buried at the edge of the right-of-way for the transmission lines.[93]

The cable order went out on bid sometime in June of 1951, and was won by the Anaconda Cable Corporation. Anaconda won primarily because its cable had protective polyetheline insulation and a synthetic cable jacket. Their competitors had proposed paper insulation, or cable sheathed in lead. As the bid specified, the cable would have to be buried, whether in ducts, conduits, or cable trays; it had to survive immersion; and had to have an outer jacket. The wire pairs in the cable had to be identified by numbers and by a rudimentary color scheme.[94]

Several lengths of this Anaconda cable were field-tested in September 1952. After that, it was decided that all spliced portions of the cable would have to be placed above ground in special "concrete pedestals with concrete cast covers." The rest could be plowed into the ground, to a depth of 30 inches using a cable plow from American Telephone and Telegraph Company. Where the ground was more likely to be wet than not, it was decided to string the cable overhead, "lashed by wire spinning to a pole-line supported messenger."[95]

A serious problem was discovered during the field-testing. Water was found to be inside the cable itself. After some investigation, it was discovered that moisture had entered during the final stages of manufacture, when the cable was passed through water during the cooling process. Unfortunately, this was not discovered until 275,000 feet of cable had already been sent to SRP. After some consultation with Anaconda, it was decided to expel the moisture by using a vacuum at one end of the cable, and the introduction of dry nitrogen at the other. Both ends were then sealed with nitrogen at atmospheric pressure.[96]

In April of 1953, tests were done to determine whether it was feasible to use inert gases to help supervise the condition of the cable line, as was the normal practice of the time. This idea was abandoned after the cable proved to be too long, with pressure and temperature changes making the whole process unworkable.

As for the individual elements bundled into the cable, each of them had issues that had to be solved or resolved. Supervisory control was only as good as the raw data brought back to the Load Dispatcher's Office by the telemetering system. Telemetering basically provided the information needed to compile the total MW and MVAR generation at each powerhouse, and the voltage figures at each 115 kv and 13.8 kv bus. This was designed to work over a pair of telephone-type wires, along with the pilot wires for the protective relay system.[97]

The perfecting of the telemetering system was an on-going process. First put in at D and R areas, these areas were first telemetered independently from each other. When the entire system was placed in parallel in late May 1953, it was found not to work so well. After a number of meetings in June, Westinghouse agreed to fix the matter, found to be related to heat and other environmental issues along the cable line.

Another important feature was the telephone system, which was built into the supervisory cable. For security reasons, this had to be made an independent system, without connection to the regular telephone system. It did, however, have special features: it was possible to have conference calls. Northern Electric Company, a subcontractor to Westinghouse, worked up the cable telephone system. In May of 1953, it was discovered that conversation was difficult on the longest of the loops, and Northern Electric had to develop special repeaters to improve the sound quality.[98]

Pilot wire relays, also known as protective relays, were considered the watchdogs of the electrical system. They protected the system, and to do this, the system had to be divided into segments separated by circuit breakers. Their purpose was to discern special conditions that might impede current flow, such as faults or other transmission line flaws. These relays could then begin the correction process via circuit opening equipment.[99]

Lengths of Electrical (Possibly Supervisory Control) Cable in D-Area, April 9, 1952, SRS Negative DPESF-732-05

In 1951, there were two ways to arrange protective relays. The first was carrier-current relaying, which became popular in the mid-1930s. The second was a system that gained favor a few years later: pilot-wire relaying. Overall, carrier-current was considered best for long transmission lines, while pilot-wire was favored for short transmission lines. Since the SRP electrical system was characterized by a number of short line sections, it was decided to go with pilot-wire relaying. In one of the many weighing of alternatives that was done at Savannah River Plant, it was noted that:

> The cost of pilot-wire circuits increases directly with the length of the line, whereas the cost of carrier-current protection is practically unaffected by the length of the line. However, terminal equipment required for the carrier-current is considerably more expensive than the terminal equipment required with pilot-wire protection.[100]

One of the last changes to the supervisory control system occurred in 1955, when it was discovered that switching off the DC power on the control board would create a surge that would travel through the pilot wire supervisory circuit to trip the PS-13 relay, which would then trip a series of breakers. The problem was resolved by modifying the line, and by increasing the restraint on the tripping element of the relay so it would not trigger when the control board was shut down.[101]

Water: For Many Uses, Many Machines, "Savannah River Plant News", Friday, March 30, 1956

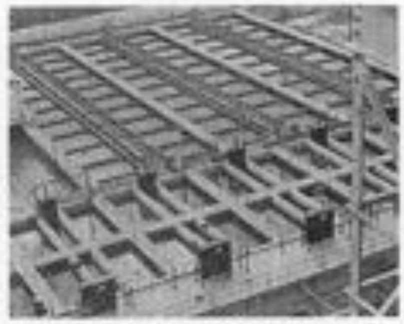
Water for Plant use is pumped from Savannah River (inset) to reservoirs, like one above. Many tests are given to all water used.

WATER

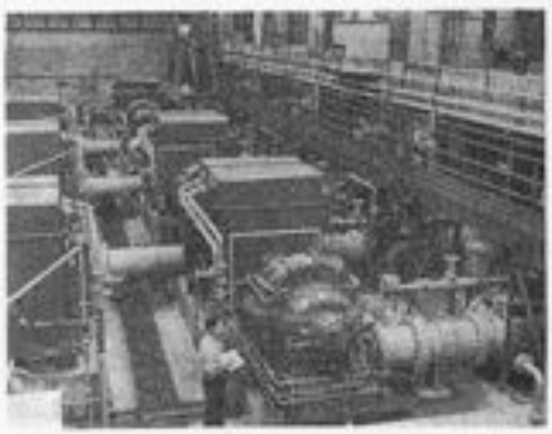
For Many Uses, Many Machines

Water is the life-blood of SRP. Besides its name, the Plant derives from the river more water than is used by the city of New York and returns to the river a like amount, first making sure of its purity. Other water comes from underground wells. Uses of water at the Plant are varied. It's used in making steam for power plants, as a raw material and for cooling processes. Water is the principal business of hundreds of Power Department employees. These scenes show some of the jobs they do.

Process raw water pumps take their suction from this reservoir for supplying D Area needs. Water comes from the river pumping stations.



Water enters clarification plant (upper right). From there it goes to gravity filters (foreground), where final traces of suspended matter are removed.



2000 HP motor's temperature in river pumphouse is being checked by Jon[illegible] Harley, one of Power Department's many employees who work with water.

Deionization units and control valves, checked here by Thomas Alston, H Area, purify the water before it is added to steam boilers.

They Keep Water Flowing to Thirsty Plant Areas

[illegible] adjusts diagram of plant water distribution system. Pipe ranges from [illegible] to [illegible] inches in diameter.

John [illegible], one of a group of water engineers, is shown making a periodic performance test on a deep well pump.

[illegible] makes adjustments on a process cooling chlorinator. Chlorination prevents [illegible] in cooling towers.

[illegible] keeps check on control board in one of the main pumphouses between reservoirs and production areas.

Oscar W. Underwood checks amount of chlorine in drinking water to insure adequate [illegible].

VIII. WATER SYSTEM

One of the main functions of the Power Department was the control of water, and SRP, when it was in full operation, would use more water than New York City. Raw water was required in D area for the production of heavy water, and the five reactors would require huge amounts for cooling. Every boiler in the powerhouses required clean water, and the same was true for the cooling towers. With thousands of people on site for Construction and later Operations, there would also be a need for drinking water and sanitation water. Water, in all of its various functions and states of purity, would have to be available at every operating area of the site.[1]

EARLY USE OF WELLS

It was understood from the beginning that the lion's share of the plant's water needs would have to be provided by the Savannah River. This was in fact, the very reason the site had been selected. Even so, this water supply was not readily accessible during the Construction Era, and during that period it was essential to use wells to supply the needs of the Construction work force. This turned out to be so successful that wells remained in use in many areas throughout the Operation period as well.

Geology at Savannah River Plant was favorable to the development of well water. From an elevation of around 125 feet above sea level at the Savannah River, ground level rose to a height of almost 400 feet above sea level on the east side. Because the site is located close to the Sand Hill region that extends in a band along the fall line from North Carolina to Alabama, it was thought that the area might have potential for deep wells.[2] Local residents certainly had shallow wells, and knew that water from natural springs fed many of the local creeks. Further examination led to the discovery of two subsurface ground formations favorable to well development. The first, suitable for shallow wells, was the McBean Formation, located at a depth of between 80 and 160 feet below surface. The second, good for deeper wells, was the Tuscaloosa Formation, found at between 150 and 350 feet below surface.[3]

The digging of these wells was essential for the success of the Construction effort, since there was no way the pre-plant local infrastructure could handle the influx of thousands of workers. The chronological development of well facilities at SRP closely followed the progress of construction itself.[4]

Because 400/D area was the first to be constructed, it was the first to have wells. The basic water supply for construction was provided by two wells that were so successful that they were retained for permanent use. Dedicated to providing general service water, they were given official numbers: 905-1D and 905-2D. Since huge amounts of water were needed for heavy water production, Building 681-5G, the river water pump house that served D area, was the first constructed at SRP. It was designed to serve heavy water production needs, and the needs of a power house with three boiler units. When the fourth boiler unit was added to 484-D, it was decided to add a water re-circulating system with a cooling tower (485-D) as the most economical change to the system.[5] This water came from a well.

It was quickly discovered that wells worked in most other areas too. Wells were dug very early on in the 300/700 area, and throughout G area. They were not however used much in the 100 areas, at least not big wells, especially after a decision was made by the "105 Building Structural Design Group" and the Army Corps of Engineers that well construction might be detrimental to soil structure and settlement in the highly sensitive areas around the reactor buildings. Anyway, it was understood from the beginning that these areas would have to be served by huge quantities of river water.[6]

In the beginning, it was not certain whether the 200 areas would be better served by river water or deep wells. Early estimates for water needs were fairly high in these areas: 15,000 g.p.m. for F area and 10,000 g.p.m. for H area, and it was not certain that wells could provide that amount.[7] In July of 1951, consideration was even given to a dam and reservoir along Upper Three Runs Creek to provide for the water needs of the 200-F and 200-H areas.[8]

By late 1951, it was found that deep wells were sufficient for the needs of the 200 areas, especially when used in conjunction with a re-circulating system. Most wells there were dug hundreds of feet deep, with an outer casing of 18 inches diameter, 8 inches inner-diameter.[9]

CONDITION OF SAVANNAH RIVER WATER

Deep wells were essential to the success of the Construction effort, and have been in use ever since in many of the production areas. They were not, however, an adequate source for the quantity of water needed to cool the reactors. It was estimated that the amount of heat that needed to be removed at each working reactor, would be something on the order of over a trillion BTUs per hour. Only river water could handle that, and it would take a lot, since it was noted that the Savannah River was not exceptionally cold. By the end, after the river water pump houses were constructed and fully operational, they took one-quarter of the entire river flow to cool the reactors.[10]

Much was at stake with the Savannah River water, so it was essential to study its properties carefully. Some of this work had already been done before the site was selected, since it was on the basis of the river flow that the site itself had been chosen. The water was known to be turbid, largely due to suspended fine silts, with few dissolved minerals, and a neutral pH that could be corrosive to mild steel. Algae could be a problem during most parts of the year.[11]

Even so, there were always unexpected problems, and this was certainly the case at Hanford, where the clear cold water of the Columbia River was found to produce a gel inside the heat exchangers. A river water testing facility called "CMX" was then created at Hanford to correct this issue with chemical treatment. Fear of something similar at SRP caused Du Pont to set up a CMX facility on the Savannah River to test the water for unexpected problems. Even from the beginning it was assumed that the turbid river water would have to be "clarified" before entering the reactors.

Another uncertainty in the early days was the impact of the Clark Hill Dam on the Savannah River water. Located 40 miles upstream above Augusta, the dam and reservoir were still under construction in 1951. River flow would be reduced to 4,000 cubic feet per second (c.f.s.) during the fill-up period, and then be increased to an estimated 5,300 c.f.s. thereafter.[12]

As it turned out, Clark Hill Reservoir was probably a blessing. It tended to keep the water cool, which was always good for the reactors, and it reduced the turbidity by blocking silt run-off from the upper reaches of the river. CMX soon discovered that silt levels in the river water did not adversely impact the heat exchangers, and in fact were a favorable addition, serving to clean the metal surfaces rather than clog them. Bacterial growth was another matter, and that had to be controlled with periodic chlorination.[13]

Because it was initially assumed that the river water would have to be clarified, an elaborate clarification basin, 183-R, was constructed at R area, the first of the reactor areas to be constructed. After CMX determined that clarification was not necessary, the 183 clarification facility was eliminated at the other reactor areas. As we will soon see, this is just one of a number of water flow problems that would distinguish R area.

DIFFERENT WATER COOLING SCHEMES

Even though it was a given from the beginning that the reactors would need river water, it was not certain how best to use that water once it got there. There were at least two possibilities. One was a "once-through" system, and the other was a re-circulating system. At R, the first reactor, it was decided to use the once-through method since it was the easiest to construct. The other four reactors were studied further for possible re-circulating systems using large cooling towers and river water as a make-up source. In the end, the once-through system was used at all of the reactors. Before the end of 1951, Du Pont engineers had found that a re-circulating system might be slightly cheaper, but a once-through system would have fewer maintenance costs. By the time this decision was made, the water requirements for each reactor had been increased from an estimated 80,000 g.p.m. to a possible 96,000 g.p.m.[14]

Another issue that had to be resolved during this same period was the nature of the drive for the re-circulating heavy water pumps used in the reactor buildings. The two choices were hydraulic power and electric power. This issue has already been discussed in the electrical section, since it had a great bearing on the electrical load required for each area, but it should also be mentioned here. While the choice would have had little impact on the amount of water required from the river, the implementation of a hydraulic drive would have required a tunnel for the out-flow of effluent water from each reactor in order to create the pressure required for the hydraulic drive. In the end, this was not done, because Du Pont considered it less secure than an all-electric system, and probably because it would have required a huge amount of excavation work.[15] The decision to go with an all-electric drive was made on April 7, 1951.[16]

Since Du Pont did not have much experience with the proposed hydraulic drive, it secured the services of consultants to study the issue. One such expert was S. Logan Kerr, who was brought in to deal with the possible hydraulic turbine drive, but stayed to work on butterfly valves and hydraulic gradient work.[17] This of course, is not to slight the Du Pont engineers who worked on all aspects of the water system design. One of the foremost of these was George Alves. Based in Wilmington, Delaware, he did work on all aspects of the SRP cooling system, including the large river water pipelines that will be discussed later in this section.[18]

DESIGN AND LOCATION OF THE RIVER WATER PUMP HOUSES

Once the basic design concepts for the water system had been worked out, the next order of business was the design and the location of the river water pump houses. Since the design of these facilities was closely related to their locations on the river, it is essential to discuss those two aspects together.

Even though the Savannah River Plant extends more than 16 linear miles along the Savannah River, there is only a small stretch of the river bank that could be used for pump houses, a section only about two miles long, beginning in the north just below the mouth of Upper Three Runs Creek, and extending to the south just below D area. This was the only segment where the river flowed adjacent to high ground. The rest of the South Carolina side is a thick belt of swamps.

Du Pont engineers were well aware of this issue. D area, and its pump house, 681-5G, were placed at the extreme south end of this stretch, so that it would not interfere with the design work and construction of the main river water pump houses that would serve the reactors. Pump house 681-5G was the first one constructed at SRP. It had no intake channel, but rather pulled water directly from the river by means of six pumps. Basically, everything at this pump house was exposed to the exterior, with a guard shack and spotlight facing the river. Gibbs and Hill prepared the plans for this pump house as early as February of 1951.[19] Because it had to be put up fast, pre-existing designs and equipment were used. In fact, the design was cribbed directly from a Du Pont river pump house in Victoria, Texas.[20]

681-5G Under Construction, January 14, 1953, SRS Negative 6-237

The other river water pump houses, which would supply the reactor areas, would be erected with much more care and attention to detail. Initially, it was assumed that there would three of these, labeled from north to south: 681-1G, 681-2G, and 681-3G. To maximize the use of this stretch of high ground, 681-1G would be as far to the north as possible, adjacent to the mouth of Upper Three Runs Creek, while 681-3G would be right beside 681-5G at the south end. Somewhere in the middle was the small CMX facility and the small open-air pump house that served it, 681-4G. It was always assumed, at least in the beginning, that the CMX facility would be temporary and could be relocated if necessary. The locations of the three large river water pump houses were the main issue to be resolved in this portion of the site, and this matter was given considerable attention at an early date.

At appears that the design of the pump houses was not nearly so important as the location vis-à-vis the river. In particular, the intake channel was one of the most important considerations. There were at least four different options in the placement of the pump houses and their intakes. The first option was near the river, with a separate intake channel or canal to each pump house. The second option was to have the pump houses on the lower reaches of Upper Three Runs Creek, closer to the 100 areas, an option that would require dredging back to the river. The third would set the pump houses further back from the river, with a large and long intake channel that they all would share. The fourth would have the pump houses adjacent to the river channel, with the navigable part of the river itself relocated further west for security reasons. Out of these options Du Pont chose the first, for basic economic reasons. The separate intake channels, however, were made long, each well over 1000 feet in length, with the mouth of the channel blocked for security.[21]

Even after this decision was made, there was some discussion in late November 1951, of diverting the mouth of Upper Three Runs so that it would enter the Savannah River as far upstream as possible from 681-1G. Presumably this was to prevent silting near the mouth of the intake channels. While this was certainly considered, Charles Topping, one of the chief site engineers, raised objections and it appears that this was never done.[22]

In June of 1951, after the basic locations of the pump houses had been established, the Army Corps checked for possible subsidence problems.[23] At this time, the middle river water pump house, 681-2G, was still on the design books, but was dropped the following month, in July of 1951.[24] Certainly one of the reasons for dropping the idea was the issue of the power lines to the pump houses. If all three were constructed, the above-ground power lines would be so crowded that they would have to be buried. This was an issue already discussed in the section on electricity. The main reason, though, was the decision to drop the requirement that each pump house had to carry the full load of the 100 areas, if necessary. When it was decided that one pump house would only have to carry a half of that load, then it was possible to drop the middle pump house.[25] By late October and early November 1951, when there was great deal of discussion about the design and location of the pump houses and their channels, there was no longer any real discussion of 681-2G. From this point forward, the only river water pump houses for the reactor areas slated for construction were the northern-most and the southern-most: 681-1G and 681-3G. In McCullin's diary, 681-2G is occasionally mentioned even in early 1952, but after that it appears to have been taken off the list of possibilities.[26] As it turned out, it was never constructed. SRP made do with just two river water pump houses for the reactor areas: 681-1G and 681-3G.

DESIGN CONCERNS FOR 681-1 & 3G

As with so much else at SRP, there were a number of options for the building layout and the nature of the pumps to be used at the river water pump houses. The first possibility called for vertical shaft turbine pumps. The second was based on centrifugal pumps located in the bottom of a circular well. The third option entailed horizontal centrifugal pumping units placed in rows. This was the option that was finally selected, probably because it meshed with Du Pont's prior preference for unit design.

In elaborating on the horizontal centrifugal pumping arrangement, it was decided to place the pumps lower than the water intake, so there would be no need for priming equipment. The concrete buildings that housed these pumps would have to be blast proof, Class I construction, but they also had to withstand external water pressure. To work on the pumps, there had to be a crane above the pump gallery.[27]

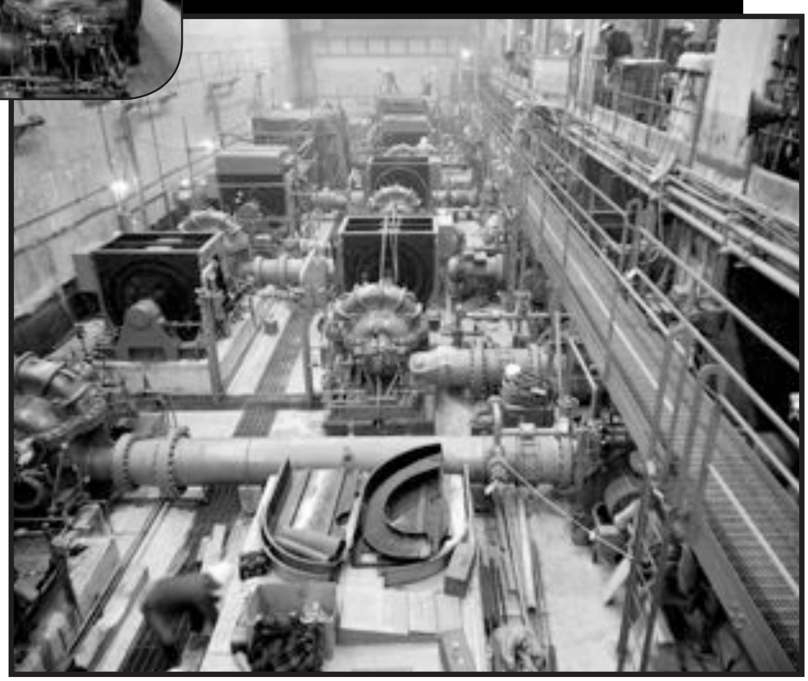
In almost all details, Buildings 681-1G and 681-3G (Nos. 1 and 3) were virtually identical. The few differences can be summarized quickly. The intake channel is slightly shorter at No. 3, and No. 3 is also three feet lower than No. 1, but that was due mostly to the difference in the river elevation itself between No. 1 and No. 3. Inside the No. 3 building, the pumps were lower by 2.5 feet. There were also pressure relief wells below the center of No. 1 due to artesian pressure in that area.[28] In all other respects, the two pump houses are the same.

Interior View of Pump House, Clean-up Operation Showing Bottom Level, December 15, 1954

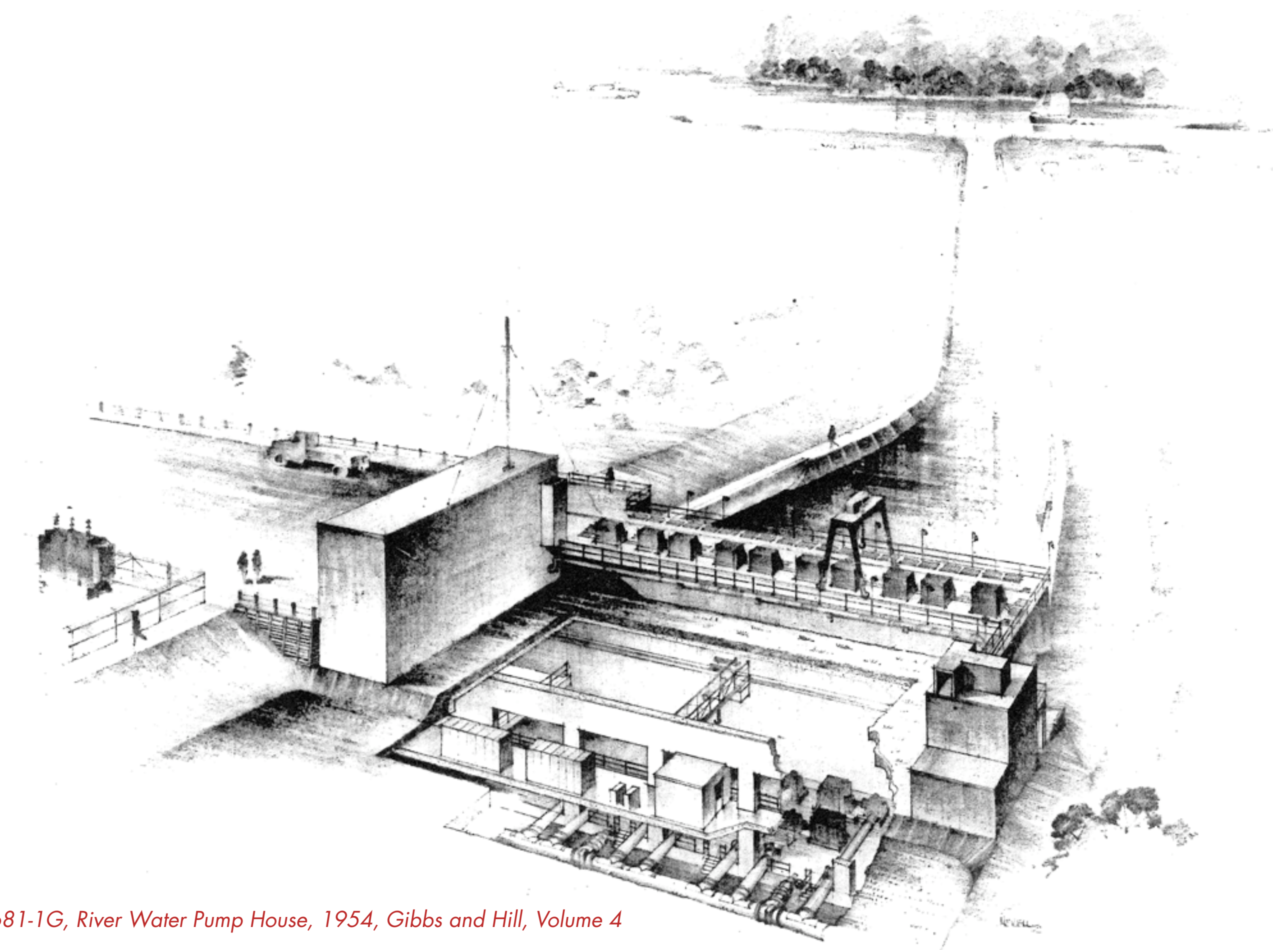
SRS Negative DPSPF-1507-4 (Top)

SRS Negative DPSPF-1505-5 (Middle)

SRS Negative DPSPF-1507-2 (Bottom)



The design called for a rectangular structure. The first or bottom level, called the lobby, contained the pumps and the pipe header. The second level, which was basically only a half level located on the east side, was called the control floor. It contained all of the control equipment and the control room itself. The third or top level was the penthouse. This provided access to the ground level and to the 20-ton crane. There were also a series of catwalks between levels 1 and 2, and also above level 2.



681-1G, River Water Pump House, 1954, Gibbs and Hill, Volume 4

Even though the basic lay-out of the intake channels had been agreed upon, there were details to be fixed right up to the advent of construction. Silting at the intake channels was a constant threat, and studies were done of the river current to determine the minimum speed needed to keep silting from occurring.[29] There was even a change in the size of the rip-rap required to stabilize the banks of the channels. The original specifications called for rocks to be sized 0.5 to 5 cubic feet. This was changed to "one man" sized rock that weighed between 50 and 150 pounds each. This, like so many others, was an economy measure.[30]

Each pump house had eight induction motors rated 3,000 horse-power (HP), with a voltage rating of 4,160 volts (4.16 kv). This was unique in the SRP electrical system, and for this reason power from the 115 kv transmission system was stepped down at the pump houses to 4.16 kv rather than the usual 13.8 kv. The 3,000 HP motors were designed to be started from the switchgear located on the second level, with only back-up controls located on the motors themselves. As induction motors, they were easier to start up and to run than synchronous motors, which were also considered. The motors themselves were cooled by air-to-water heat exchangers with double-tube construction. Two separate switchgear sections, without any bus interconnection, provided motor control. Each section controlled four motors, with connections to allow the motors to work off of either of the two transformers outside.[31]

The two outside transformers and the electrical intake presented problems of their own. The initial idea was to have the transformers located on top of the roof, at the south end of the building, but that idea was discarded in May of 1951 due to safety and structural concerns. The new location was on the edge of the approach road at least 75 feet from the building.[32] Later, protective barriers had to be erected in front of the transformers, to protect them from vandals who might shoot at them from the river (in the 1950s, there were no trees standing between the river and the pump houses). There was also the issue of the transformer cables. There were 36 1500 MCM cables per transformer that had to be brought into the building from the outside, to the 4,160 volt switchgear on Level 2. These had to go through the east wall of the pump house at a point below the high flood-water level. This area had to be secured with special water-proofing.[33]

Emergency power was reserved for valve operations, ventilation, and lighting, but not the operation of the motors. Batteries were initially proposed for the emergency power, but it was later decided to install diesel engine generators just in case the batteries were not sufficient.[34]

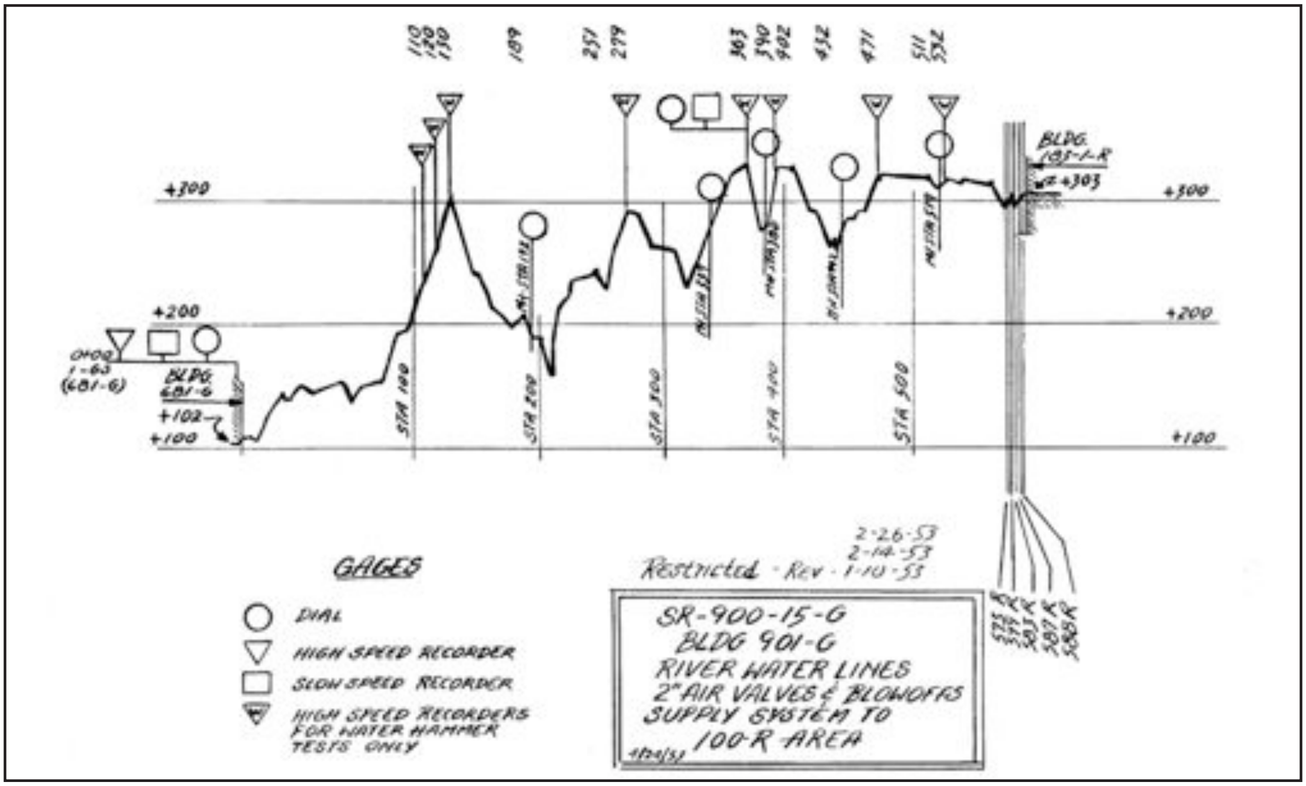
Beyond the motors were the pipes that pushed the water into the huge header pipe, also located on the bottom level, on the east side. This header directed water to the north and south ends of the building, then up towards the surface, after which it went out in giant pipelines parallel to and just below the surface. One reason for this north-south diversion was to avoid the electrical wiring at the center of the east wall. The header at the bottom level was a 66-inch diameter pipe with two 60-inch gate valves at the center, with two discharge lines, one at each end of the pump house.[35] The two vertical header pipes were 54 inches in diameter, with shutoff valves that were made by Philadelphia Gear Works.

One issue that greatly worried the hydraulic engineers was "water hammer." This was an explosive vibration in the water line caused by unwanted surges in the water pressure, a common problem in large hydraulic systems. One solution was to install cone valves in each discharge line just beyond the water pumps to help regulate the water flow.[36] Other measures were implemented along the river water pipelines, as we will soon see. Due to corrective measures, water hammer turned out not to be the problem that was initially feared.

The first permits for construction of the pump houses were requested from the Army Corps as early as August 1951. The final details of the 681-1G design, including those of the intake channel, were agreed to by November 9, 1951. Approval for 681-3G followed shortly thereafter.[37] Construction of the pump houses, which entailed the use of coffer dams, began before the year was out.

RIVER WATER PIPELINES (901-G UNDERGROUND WATER PIPES)

To get the river water from the pump houses to the reactors, it was necessary to design and construct a series of large pipelines capable of transporting the water to each of the five reactor areas. The distance from the pump houses to the closest reactors, C and K, was 6 miles. The distance to R Reactor, the furthest from the river, was 12 miles. Since this system, like most of the others designed by Du Pont, required a high degree of redundancy, the total pipeline mileage came to around 48 miles. If it was not the most difficult, it was certainly the lengthiest of all the construction programs at Savannah River Plant.



River Water Pipeline (901-G Underground Water Pipes) Elevation Diagram, April 15, 1953, SRS Negative M-2259

Ironically, the very first river water pipeline was not part of this system. It was the 60-inch diameter pipe that brought water from 681-5G to D area. This pipeline was separate from the others, and was designed and constructed very early in the program. In fact, it was under construction as early as April of 1951.[38] The rest of the pipeline system was still on the drawing board at that time.

Plans for the large river water pipelines were prepared throughout the first half of 1951. The first routes were proposed by July of that year.[39] By that time, it was known that the pipeline sizes would vary, depending on the location of the pipeline and the expected speed of the flow. The pipes out of the two pump houses would meet at a header near the old town of Ellenton, and then two sets of pipes would go east; the northern set towards C and R, the southern set toward K, L, and P. The reason there were sets was the need for redundant lines to C, K, and L. In this fashion, if any one line failed, water could reach any reactor via another line. To provide redundancy for R and P, the system was made into a loop, with a pipeline connection between R and P. The largest section of the pipeline, between the Ellenton header and the first reactors, would be 84 inches in diameter. The line would be reduced to 72 inches by the time it got to R. Throughout that route, the line and the water that it carried, would have to go up-hill, and there would be issues of unprecedented scale, such as water hammer, that had to be resolved.[40]

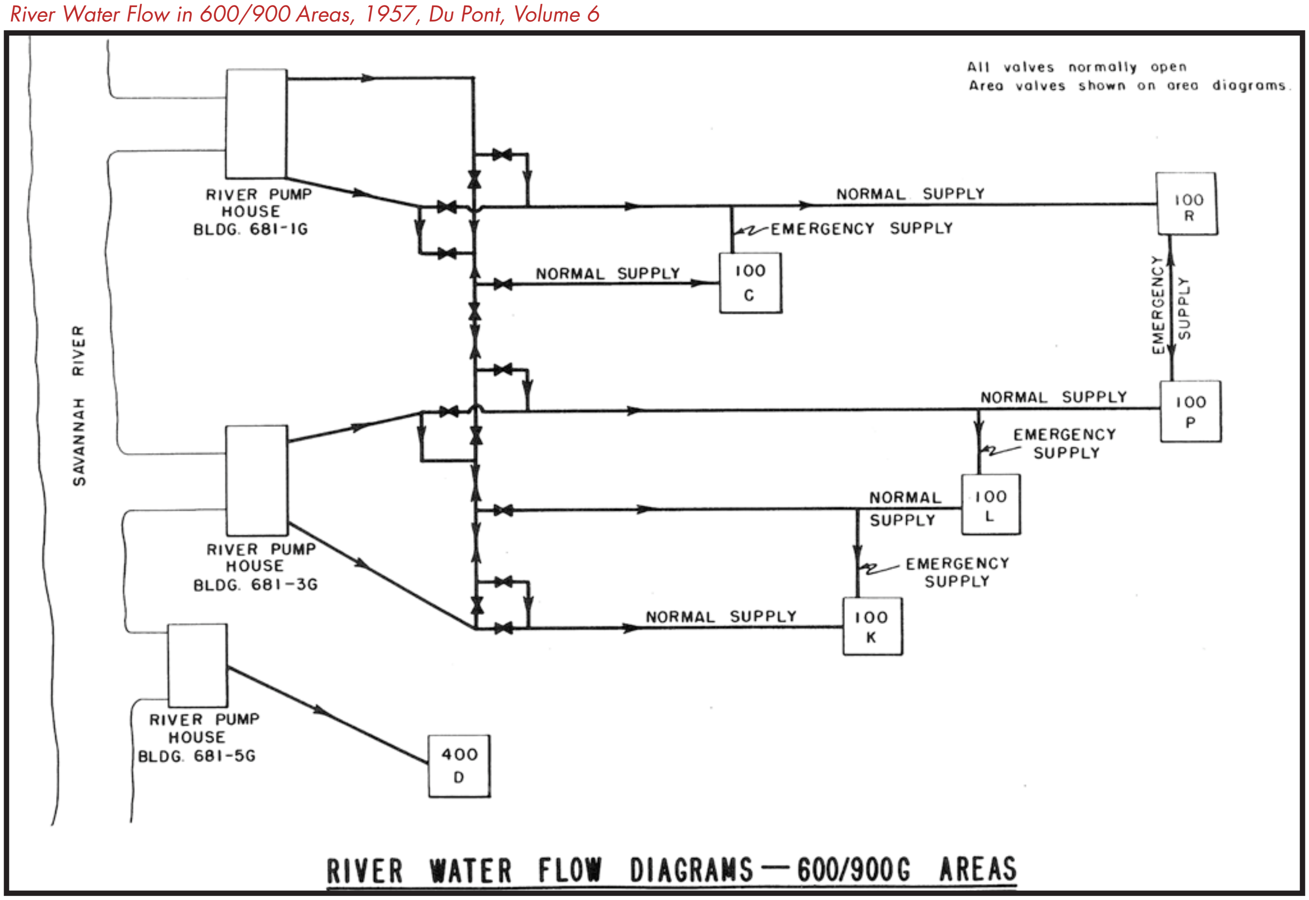
Because of the unusual nature of the pipeline project, consultants such as Sheppard T. Powell were secured to help with the design. The calculations for the pipeline on such matters as water volume and movement were so daunting that Gibbs and Hill acquired expert Paul F. Kruse to help with the numbers. This was particularly true for the requisite calculations for hammer surge.[41]

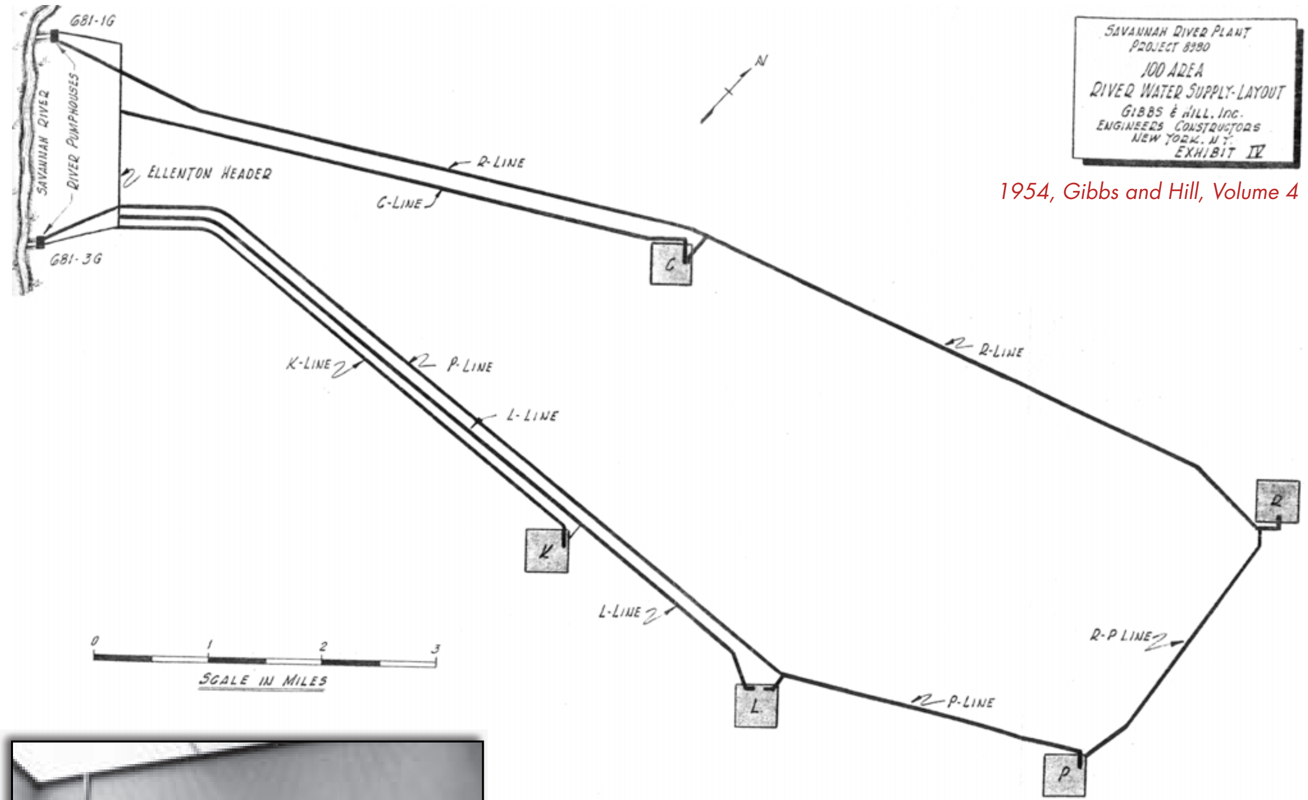
It was originally thought that the spacing between the different lines within each set would be a half mile apart, but topographic constraints reduced this drastically to just 500 feet.[42] Fine tuning of the line locations was occurring as late as October of 1951, when it was discovered that the proposed pipes to K and L passed too close to the 400 and TC areas, requiring some relocation on the maps.[43]

By the time the pipeline plans were completed, it was an impressive system that pumped water from the river water pump houses, up over two hundred feet to reactor areas that were many miles away, and fairly widely separated. Water left the two pump houses in 72-inch pipes, where they co-mingled at the Ellenton header, which was an 84 inch pipe. The lines that went east from there were also 84 inches, dropping down to 72 inches by the time they reached R and P. The pipelines within the reactor areas would drop down to a diameter of 48 inches. The river water would be dumped into the huge 186 reservoirs, then pumped by the 190 buildings into the reactor buildings. The only exception to that arrangement was at R, where the water first went to the 183 clarification basin.[44]

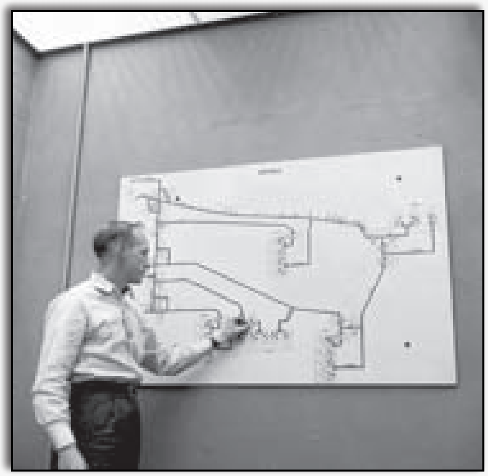
There are a number of stylized maps that show the basic location and arrangement of the river water pipelines.[45] These show the pump houses, the Ellenton header, and the lines that go east to the reactors. Each reactor area had its own line, but there were also connections between them, so that water could reach any single reactor from two directions. The system was basically a loop, and the only escape for the water was through the reactor buildings and out their effluent channels.

River Water Flow in 600/900 Areas, 1957, Du Pont, Volume 6





1954, Gibbs and Hill, Volume 4



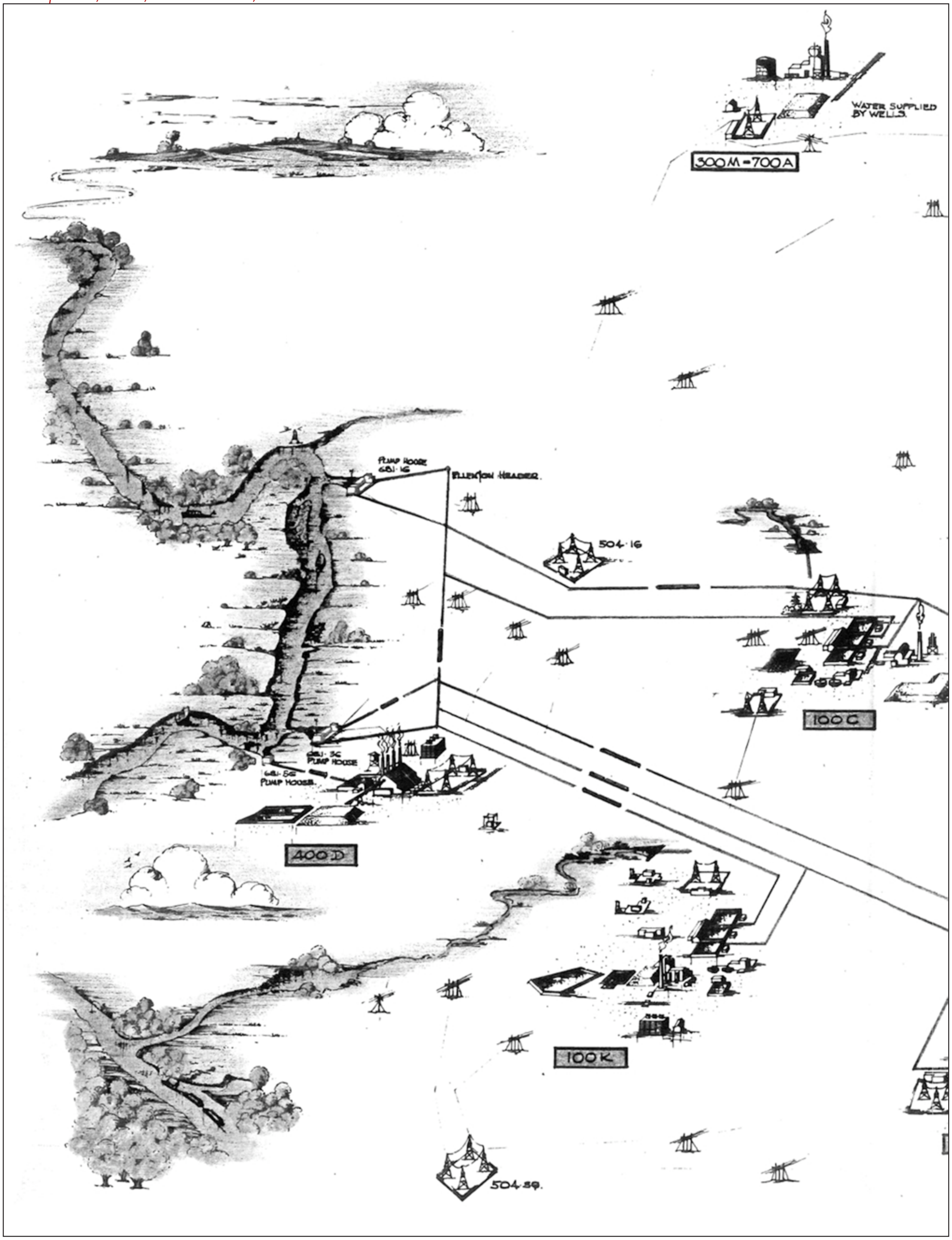
Pipeline and Site Water Flow, March 20, 1956, SRS Negative DPSPF-3178-5-14

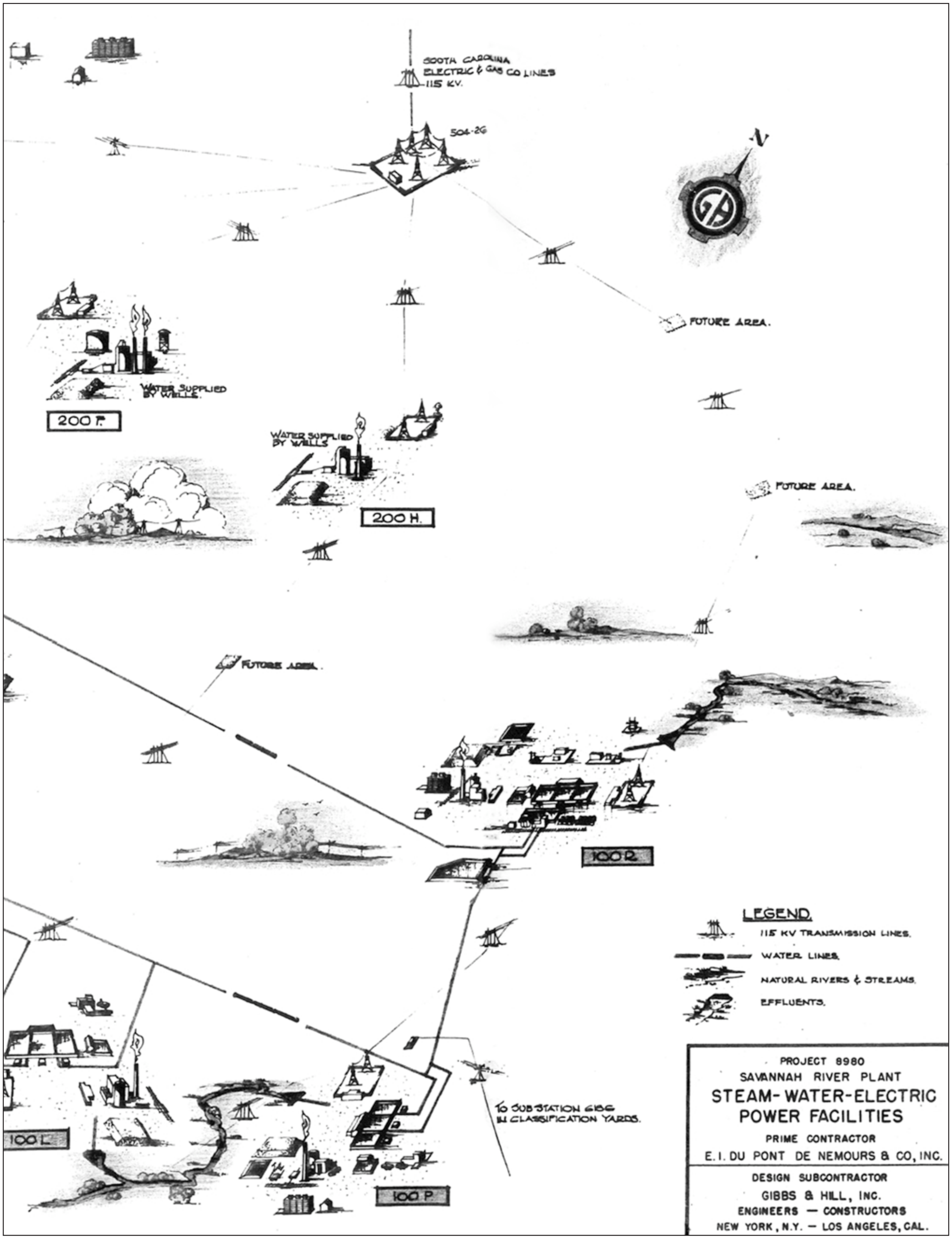
The next stage in the process was to actually construct the pipelines, and this began with the pipe. It had to first be determined the type of material to be used. The options were steel, cast iron, or reinforced concrete. Steel proved to be too difficult to deliver due to supply shortages, cast iron was too expensive, leaving reinforced concrete as the best alternative.[46]

Bids were solicited for the manufacture of the huge reinforced concrete pipe, but it appears that the Lock Joint Pipe Company was the hands-down favorite from the beginning. The company had a patent on what was considered the best joint used to connect the pipe segments–a rubber and steel devise known as a "lock joint." The company even promised to make the joint available, without a license fee, to any firm that might win the contract. To further their own chances, Lock Joint joined with American Pipe and Construction Company to form "Joint Venture Pipe Company," a subsidiary created for the sole purpose of making SRP pipe.[47]

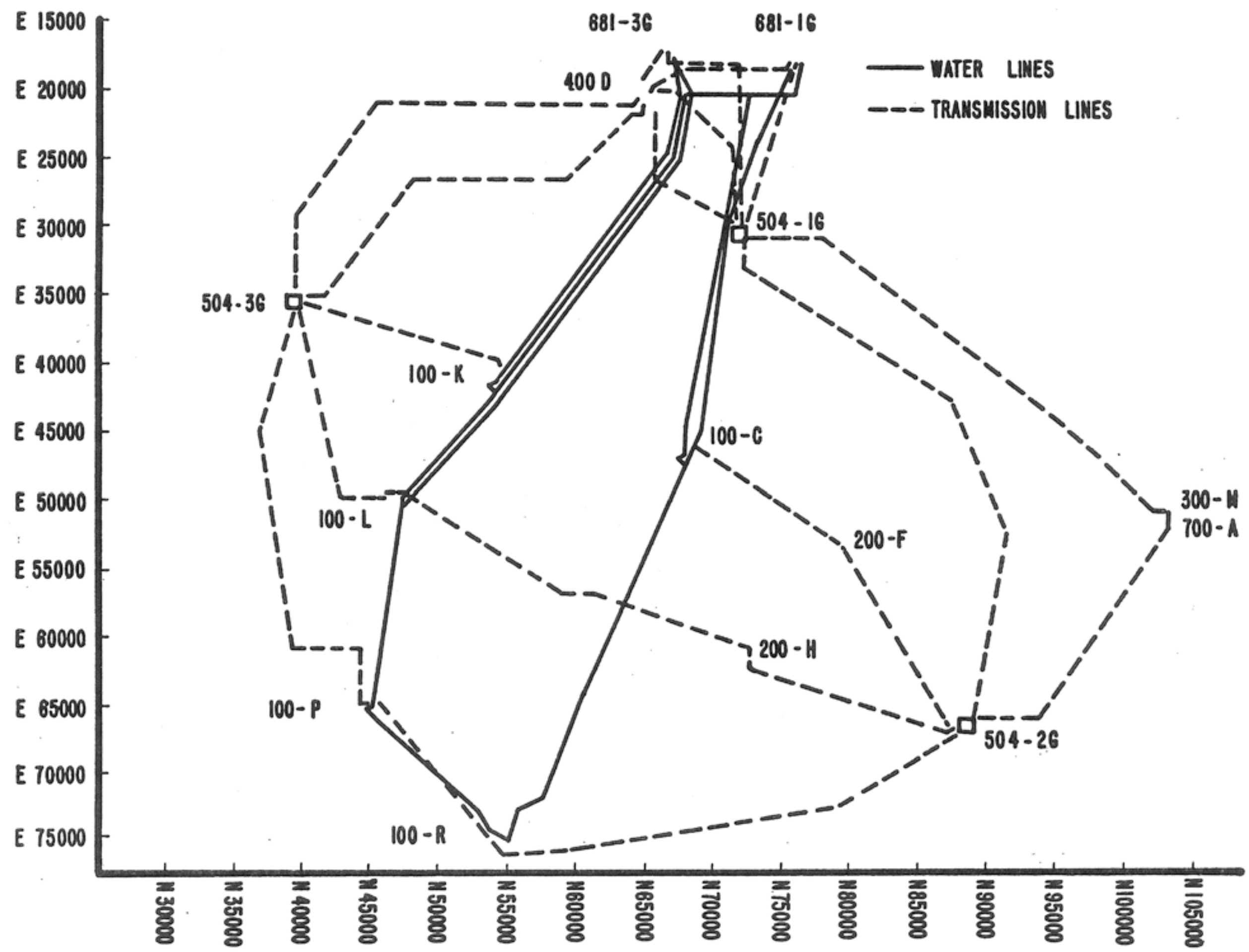
After Joint Venture won the contract, in June of 1951, consideration was given to creating a pipe manufacturing plant right on the site. In the end, this was not done, but pipeline orders, which began to go out in late June, kept the Joint Venture plant in Orangeburg, South Carolina, busy for over a year. As an example of some of the difficulties posed by this work, the Joint Venture contract had to be modified over 40 times during the course of the project.[48]

901 Pipelines, 1954, Gibbs and Hill, Volume 4




SOOTH CAROLINA
ELECTRIC & GAS CO LINES
115 KV.
504-26
N
FUTURE AREA.
WATER SUPPLIED
BY WELLS.
200 F.
WATER SUPPLIED
BY WELLS
200 H.
FUTURE AREA.
FUTURE AREA.
100 R
LEGEND.
115 KV TRANSMISSION LINES.
WATER LINES.
NATURAL RIVERS & STREAMS.
EFFLUENTS.
TO SUB-STATION 616G
IN CLASSIFICATION YARDS.
100 L
100 P
PROJECT 8980
SAVANNAH RIVER PLANT
STEAM-WATER-ELECTRIC
POWER FACILITIES
PRIME CONTRACTOR
E. I. DU PONT DE NEMOURS & CO, INC.
DESIGN SUBCONTRACTOR
GIBBS & HILL, INC.
ENGINEERS — CONSTRUCTORS
NEW YORK, N.Y. — LOS ANGELES, CAL.

River Water Pipelines and SRP Electrical Transmission System, 1957, Du Pont, Volume 4



The Joint Venture pipes ranged in size from 84 inches in diameter to 48 inches. There were many pipe lengths, but the standard, certainly for the largest pipes, was 16 feet. Du Pont had a representative at the Orangeburg plant to ensure that the specifications were met correctly.[49] The pipe was shipped to the Ellenton area by rail, after which Joint Venture loaded the pipe on trucks and transported them directly to the work site as part of their contract.[50] Plant production was affected by the national steel strike in the summer of 1952, but by that time, there were enough pipes on hand that the work schedule was barely affected.[51]

84" Pipeline Segment, April 3, 1952, SRS Negative DPESF-712-09

The construction of the pipeline required excavation of the trench, assembly of the pipeline in the trench, making sure the pipe joints were sealed, and finally covering the pipeline with earth. According to one source, explosives were tested as an early means of excavating the trenches, but this failed to produce adequate results.[52] In the end, heavy earth-moving equipment was employed, and cranes were used to place the pipe segments in line. This work began in 1952 and continued into the following year. According to a brief article in the SRP News and Views from June of 1952, it was reported that in one recent week, work crews were able to lay 3,380 feet of pipe. In just one single day, June 13, 1952, a record was set for 896 feet. The work involved people from almost every Construction department: Layout, Earthworks, Concrete, Rigging, Heavy Equipment, Pipefitting, Transportation, and Labor.[53] Another construction record was set on January 17, 1953, when 70 joints of "giant reinforced concrete pipe" was laid on what was being called the "Big Inch Pipeline." It was teamwork that was credited for the achievement.[54]


Pipe Laying Crew, January 15, 1953, SRS Negative M-1830-02

There were problems that had to be surmounted all along the way. Some areas had to be drained by special "well points" before construction could go through. In some of those wet areas, concrete pads were required to support the pipelines. In other areas, the well points worked so well that it was not necessary to even shore up the excavation walls. Since the Lock-Joint pipe groove often got coated in mud and was difficult to clean, a special devise was invented to clean the grooves with compressed air.[55] Sealing and inspecting the pipelines required human access. An average man could easily stand inside the large 84-inch pipelines, but that was not true of the 48-inch pipes. Many of those inside the reactor areas were smaller than that, and the smaller pipes were all metal and required welding. Small people were found to be the best solution for the smaller pipes, and the David Brothers were the most famous of these. The brothers, who appeared in the 1939 film, "Wizard of Oz," later worked as welders at the Charleston Navy Yard during World War II. They moved over to SRP in 1951, working as pipe welders for B. F. Shaw Company. In 1954, they were with the Pipe Department, working in C area.[56]

Even before the pipeline was completed in 1953, a range of specialists from Design, Construction and Operations tested it. Foremost among the issues examined was water hammer, which was tested by creating water pressure irregularities and checking the line's response.[57] The tests revealed that water hammer was not likely to be much of the problem on the SRP pipelines, and much of that success was due to the features that were added to the pipelines at various intervals. These included air release valves at pipeline high points to release air pockets, and blow-offs for draining at the low points. Control was further provided by sectionalizing valves and butterfly control valves spaced a intervals along the line.[58]. There were also "cooling water surge tanks," cylindrical structures with water level gauges, to provide an outlet for pipeline surges.

There are not many detailed maps of the pipeline routes that show these in relation to other land features, but there is one that shows all of the SRP secondary roads around 1954, at the end of the Construction Era and the beginning of Operations. At that time, all of the pipelines would have been in the ground, even if they were not all in use. Because these pipeline rights-of-way would have been kept clear and made accessible by road, the pattern of secondary roads clearly shows the routes of the pipelines, even though the pipelines are not labeled on the map [See page 94 for Secondary Road Map, Archer 1954].

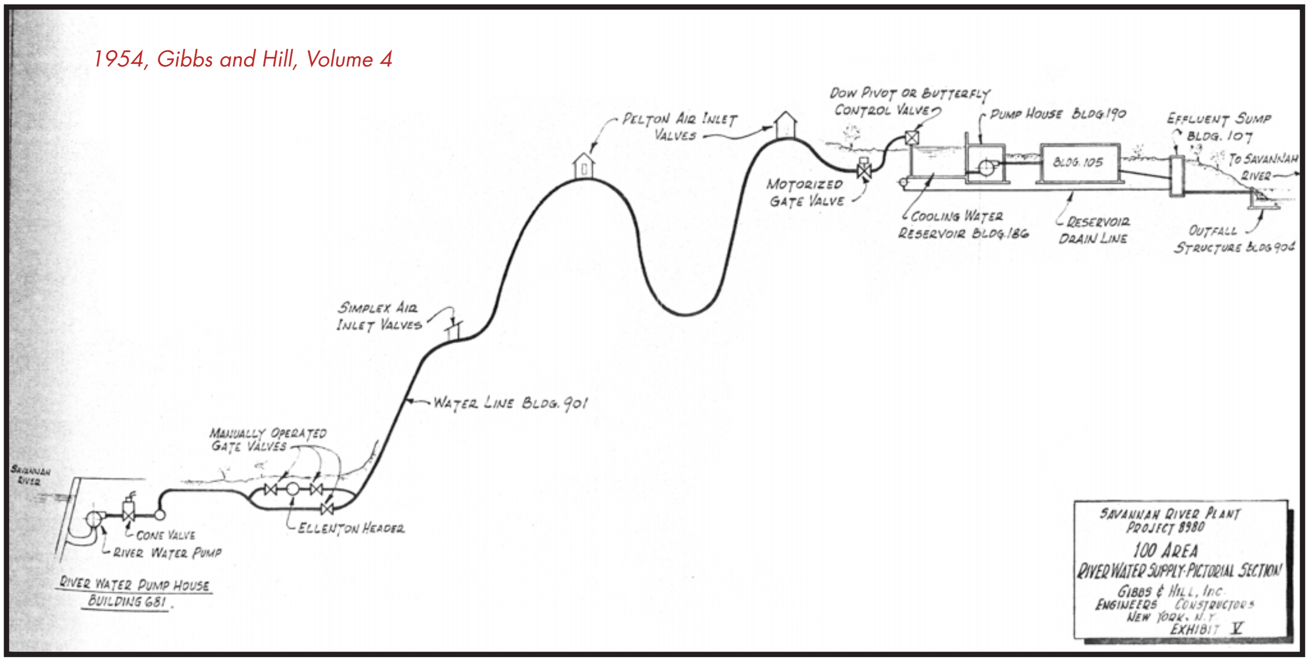
RIVER WATER EFFLUENT FLOW

Once the pipelines brought water to the reactor area, and once that water went through the cooling system inside the reactor building, it went to the effluent sump outside the building (Building 107), before being released through an effluent channel and finally an outlet located several hundred feet from the reactor building. From that point on, at least in the early days of operation, the effluent water, now very hot, was left to make its way to the closest stream.[59] In most cases, it was pretty clear which stream would be used to drain the effluent from

(TOP) Testing for Water Hammer on the 901 Large River Water Pipelines (Underground Water Pipes), December 1953, SRS Negative M-3193-10

(MIDDLE) Surge Tank on 901 River Water Pipeline (Underground Water Pipes), January 23, 1957, SRS Negative M-4489-01

(BOTTOM) Surge Tank Repair on 901 River Water Pipeline (Underground Water Pipes), January 23, 1957, SRS Negative M-4489-02



1954, Gibbs and Hill, Volume 4

each reactor: C would use Four Mile Creek; K, Pen Branch; and L and P, Steel Creek. R Area, however, was different. Sited in a relatively swampy location, it was plagued by poor drainage. It was not apparent where gravity would take a large volume of effluent flow.

In June of 1951, it was assumed that an open ditch, excavated in the direction of Four Mile Creek, would be the best solution. This would have R reactor effluent flowing westward to reach the stream, after which it would flow past the two separations areas, H and F, the C reactor, and Central Shops (N Area), on its way back to the Savannah River. It would also require a special culvert under the main railroad line between R and F, the railroad "Main Line," which had already been constructed. It would also cause trouble for the local road system, also in place by this time.[60]

Cooling Water Surge Tank, July 2009, SRS Negative 0901178087

By September of 1951, there were a number of meetings in Wilmington about the best route for the R Reactor effluent flow, with Lower Three Runs Creek figuring as a possible alternate. By mid-month, Du Pont's AED was making the case to the Atomic Energy Commission that Lower Three Runs was the better solution.[61] This route would not require alterations to existing roads and railroads, and effluent flow would go south, away from the other production areas. The big drawback was that Lower Three Runs Creek eventually flowed outside the area slated for purchase for the Savannah River Plant. If this route were chosen, then both banks of the stream would have to be purchased along its lower course, all the way to the Savannah River.

By the time the decision had been made to go with Lower Three Runs, some time in November 1951, there had been meetings among representatives from the Army Corps, the USGS, Gibbs and Hill, as well as the Du Pont departments of the AED, ESD, the Engineering Soils Laboratory, and Design.[62] Ironically, by the time of this decision, the culverts were already in place under the Main Line railroad and Road 4A.

The decision to use Lower Three Runs has already been discussed in the initial survey portion of the report, since it had ramifications for the surveys. Even so, it had some remarkable implications for the future of SRP. Not only was the project area expanded by the addition of Lower Three Runs Creek, the decision planted the seed for the development of Par Pond dam and reservoir on the upper reaches of the creek. As will be seen, the development of Par Pond, a few years after the beginning of reactor operations, was the single greatest change to the original SRP hydraulic system.

Effluent Flow from R-Reactor, April 1, 1953, SRS Negative M-2173-09

IX. COMMUNICATION, FIRE, AND WASTE

The communications system at Savannah River Plant was one of the most up-to-date available at the time it was installed, and this too had to be in place early in the Construction Era. Like many other things associated with the plant's infrastructure, some things associated with communications were basic and required little design work, while others were novel, or were combined in novel ways, and had to be worked out in detail. And even then there had to be adjustments once the system was put together.

Communication is a broad topic, and there are many different types of communication. At Savannah River, communication could range from weather announcements to fire alarms. Telephones were absolutely essential to the working of the plant, and safety alarm systems ensured the work force that emergency announcements would reach them in time to take all reasonable precautions. There was even an ESD Weather Group established for SRP in March of 1951.[1]

Much of the control for the plant-wide communication system was to be provided by facilities located in 703-A, the administrative building and headquarters for all of the Savannah River Plant, with offices for both the Du Pont and the AEC staffs. Located in the basement level of the A Wing of this building, the Savannah River Emergency Operations Center was the source for plant-wide announcements and essential weather forecasts and the like.

Gibbs and Hill, based on requirements provided by Du Pont's Design Division, designed the basic communication system for SRP. Even so, Du Pont's other subcontractors, namely Lummus, Voorhees Walker Foley and Smith, and Blaw-Knox, had input into the system, especially as that system applied to the areas of the plant for which they were responsible. Where communication had to go outside individual buildings and even individual areas, this was where Gibbs and Hill had the biggest impact.

As noted in the Gibbs and Hill design history, the SRP communications system operated on a number of different levels. There was the project-wide administrative telephone system that would have to be set up by a commercial entity like Southern Bell. There were also area-wide systems that would be set up in each area, such as the fire alarm system and the safety alarm system. There would also have to be intra-communications systems– basically specialized telephones to help coordinate the steam and electrical production and control the main process and its service facilities.[2] The discussion of these different communication functions will be presented in the order that Du Pont used: the fire alarm system (505); the telephone system (506); and the safety alarm system (507). Much of the intra-communications system was subsumed under Number 507, since it was actually built into the same system. Following this will be a discussion of radio communication, which did not have a number, but was important all the same.

FIRE ALARM SYSTEM (505)

The basic premise of the fire alarm system was pretty simple: provide a fire alarm signal when an alarm box was tripped.[3] This system was designed to function within individual areas and in all headquarters buildings. Special horns were situated on wooden poles outside, while gongs were set up inside the buildings. Both would be triggered by signals that would have to be delivered manually from outdoor fire alarm boxes. One of the VWFS contributions was to have fire alarm boxes placed at 600 feet intervals near building entrances, with electricity provided through the blackout panels to ensure continuous operation.[4]

Fire Fighters and Equipment, September 21, 1962

SRS Negative DPSPF-8543-5

SRS Negative DPSPF-8543-6

Much of the general design and procurement of the necessary materials for the fire alarm system was done by VWFS and then sent out to the other subcontractors for implementation or improvement. Gibbs and Hill was responsible for the fire alarm circuits between the buildings and within the fence lines of the 100, 400, and 300/700 areas. Blaw-Knox was responsible for the 200 areas. Three circuits were required in each of these areas, and they were to function in the following manner. The fire alarm circuit (FA) within each area, consisted of a fire alarm box, gong, and recorder loop or series circuit. The fire alarm horn circuit (FAH) provided power to the outdoor fire alarm horns; this was connected to the area fire alarm box, gong, and recorder loop. Finally, there was the fire alarm master circuit (FAM), which connected the various areas in a project-wide loop. There were connections here with the fire alarm master box at Patrol Headquarters (Building 701-1A) and the local fire alarm control panel.[5]

To ensure a better operation of the system, the fire alarm circuits were not fused, since it was thought that fuses would be ineffective or even damaging at the low current level used by the series loops. The horn circuits were fused individually at their source, but not at any other location within the system.[6]

TELEPHONE SYSTEM (506)

Beginning in December of 1950, local Construction personnel needed phone service as soon as possible, and for that Du Pont turned to the local provider, Cassels Telephone Company, based in Ellenton. Cassels provided the earliest service for the project area. They installed the first telephone in the Bush House, on December 22, 1950, and installed phone service in other local buildings as requested by Du Pont. Despite this work, both Du Pont and Cassels understood that the arrangement was only temporary. Cassels could not handle the massive telephone system that would be required by the Savannah River Plant. That work would have to go to the Southern Bell Telephone and Telegraph Company.[7]

The overall telephone system to serve the administrative needs of the plant, would be done by Southern Bell, the regional telephone conglomerate, with oversight provided by Du Pont. It was considered essential to have the regional telephone company set up basic service, since it would have to be connected to the outside world. From the beginning it was planned to have an automatic dialing system within each production area, with inter-area circuits and outside circuits for connections outside of each area. Gibbs and Hill was commissioned to provide space on their poles for the Southern Bell telephone lines.[8]

Du Pont met with Southern Bell as early as December 1950 to provide estimates of what would be needed for the phone system. At that time, plans were made to use Augusta as the hub, since it had connections to the main New York-Miami coaxial cable. The initial work of running a 200 pair, 19 gauge low capacity cable from Augusta to the site began as early as February 1951.[9] In the meantime, a direct teletype line was established from Wilmington to SRP as early as February 7, 1951, followed by a direct phone line on February 16.[10]

In April 1951, work began on the TC telephones needed by Construction. By late May 1951, switchboard installation began in T-1 of the TC administration area, to provide service for over 500 units. By early August of 1951, there were telephone tie lines between Wilmington and the plant.[11]

Knowing that the main Operations switchboard would be located in the 300/700 area, Du Pont had the foresight to route the coaxial cable through that area before continuing the line to the TC area.[12] The telephone system grew by basing new Bell South lines off this main line, using that connection until each area had enough phones to warrant its own manual switchboard. These were first set up in the TC area, then 300/700 area, followed by 200-F and 400-D, and so on. When the manual switchboards became too crowded, then the areas were united via tie trunks with permanent dial exchanges, which eliminated the need for manual switchboards. In this manner the system grew to over 3,200 phones and more than 1,200 extensions.[13]

By the beginning of Operations, the main switchboard for the site was located in Building 702-A. All internal connections were provided by automatic dialing; all external connections between the plant and the outside world went through the 702-A switchboard. The design of these facilities was based on the Du Pont directive, "Telephone Installation Standards, Savannah River Plant."[14] Building 702-A, the nerve-center for the on-site telephone system, was the subject of a previous thematic report dealing with the administration area of Savannah River Plant.

The teletype communication system was also installed by Southern Bell, since such signals would have to use the same basic telephone lines. By late May 1951, there was a direct teletype line from the plant to both Wilmington and to Augusta.[15] By 1953, there was a teletype network of 29 machines, with information sent out from a central teletype center to at least 10 different locations via relay wire connections. This saved an enormous amount of time that would otherwise be spent in hand delivery. During the Construction Era, it is recorded that the greatest teletype traffic occurred in December of 1952, with a total of 38,877 messages processed.[16]

There were other telephone systems in use as well, much smaller and more localized, and totally isolated for security reasons. There was a security telephone system, wholly isolated to the site, and often isolated to single lines. One such line appears to have gone from 221-F to the control lab in 772-F.[17] As we will see, there were other phone systems like this at SRP, and some of these were piggybacked onto the plant-wide safety alarm system, discussed below.

SAFETY ALARM SYSTEM (507)

The fire alarm system and the plant-wide phone system were relatively straight forward compared to the problems encountered in the creation of the safety alarm system. Like the others, this system was set up to cover all of the major areas of the site, but it was more complicated since there were a number of other features in addition to an alarm signal. Sound powered telephones were also a part of this system, as will be seen below.

Both Voorhees Walker Foley and Smith and Gibbs and Hill had a hand in creating the safety alarm system, based as usual on Du Pont instructions, which were established as early as May 10, 1951.[18] These instructions specified the equipment and wiring needed for area-wide signals to identify a safety alarm. The sounds had to be those for "evacuation," "air raid," and "all-clear." In addition, there had to be the capability for verbal messages and instructions to be broadcast inside individual buildings and other areas. Most of this work appears to have been the responsibility of Gibbs and Hill, the main electrical design subcontractor.

Du Pont's instructions called for a single, remote-controlled alarm system for each of the 100, 200, 300/700, and 400 areas. There were at least three sounds that had to be covered: "evacuation," which was a rapid warble; "air raid," which was a slow rise and fall, like a conventional air raid warning used widely in World War II; finally there was the "all-clear," a steady high-pitched tone that was also common during the war. All of these signals would have to be loud enough to overcome the ambient noise in areas where the noise would already be high and bothersome. To add to the difficulties, the system would have to be capable of delivering verbal messages in such an environment.[19]

It was understood that this would require a relatively new type of announcement system, one that had never before been put together quite this way. The basic requirements of the system were worked up in the summer and fall of 1951, and included the following components. There would have to be signal sources, such as microphones and electronic oscillator tone generators; low level distribution and control circuits (SA); audio-power amplifiers; high level distribution circuits (SAS) connecting the power amplifiers to the loud speakers; and finally enough loud speakers throughout the area to guarantee adequate coverage.[20]

Experiments in 400 Area

Because of the experimental nature of this work, it was decided to use 400 area as the plant guinea pig, with a single system to be developed for 484-D. Towards that end, Gibbs and Hill issued Specification GH-199-A-2, which was issued August 13, 1951. This was to be a balanced, all-metallic, low-level, nominally 600-ohm circuit, which would use master relays to perform all control and switching functions. The safety alarm signals were to have priority over all verbal communications; all plant paging and announcements were to be secondary, capable of being overridden by the safety alarm system.[21]

The low bid for the safety alarm system went to the House of Interphones, in Brooklyn, New York, a distributor for the Du Kane Corporation. The purchase order, AXC-2214-1/2, was worked up on September 20, 1951. Later, after the 400 area work, Du Pont decided that all safety alarm equipment would be provided by the House of Interphones to ensure standardization within the system.

After the safety alarm system was installed in the 400 area in early 1952, it was initially found to work well. This changed after Boiler 1 of 484-D commenced operation in July 1952. At that point, it was discovered that the loudspeaker sound was not sufficient to override the ambient noise of the powerhouse. After additional tests, it was determined that the loudspeakers could not overcome sound levels greater than 100 decibels. In the months that followed, Lummus discovered that they had the same difficulty in the 200 areas.[22]

This led to another round of tests and replacement programs in late 1952, as loudspeaker parts and components were changed out in hopes of obtaining better results. Loudspeaker drivers were changed, as were horns. Even the transformers had to be altered, with new lines to the loudspeakers. This was all done through vendors operating through the House of Interphones contract. When the new system was tested in January 1953, the replacement drivers were found to work well.

At that time, another problem arose with the 50-watt booster amplifier (Du Kane Model 1A360). There were six of these within the 400 area, and they were found to exhibit sound instability "caused by low frequency regeneration." After making adjustments to the amplifiers, more tests were conducted by Gibbs and Hill. The best solution to the problem was worked up as Specification No. 3255, dated April 9, 1953. For the next year or so, a system similar to that created for the 400 area was installed in the other SRP areas. The system at 484-D was a 300-watt system, while those at the 184's were rated 200 watts, but otherwise they were almost exactly the same. The systems required for the buildings that were not powerhouses were considerably simpler; the sound did not have to be as loud and there were no other secondary functions that had to be carried by the system, such as voice messages.[23]

Intra-Communication System

The greatest of these secondary functions were the plant intra-communications system that was originally considered part of the safety alarm system. These were to be provided for each powerhouse and water treatment facility within the site. Within this specialized communication system, there would be two types. The first, for the powerhouses, involved using the plant safety alarm system as a paging system for voice signaling. The second was for process steam and the water treatment facilities. As before, this system was first developed in the 400 area, specifically in 484-D and 483-D.[24]

The first consideration for this system was a series of microphones and loudspeakers for duplex communication between the control room and the other powerhouse locations, such as the turbine control panels, the valve locations switchgear, coal handling facilities, and the maintenance shops. This was basically an extension of the safety alarm and paging system discussed above. This arrangement was worked up in Specification GH-199, dated to July 21, 1951. Unfortunately, it was found to not work well with the safety alarm signals.

This led to another possibility: splitting the functions into different systems. This would entail having a general safety alarm and paging system as discussed above, and a totally separate system for communication within the powerhouse. After some study, this was approved, and it was further decided to use telephone headsets. They were found to be considerably cheaper than a microphone system; messages over headsets were easier to understand than over microphones. There was even added security in using sound-powered units, rather than conventional telephones.[25]

Sound-powered telephones use headsets just like a regular telephone, but without an external power source. A relatively new innovation, sound-powered telephones were commonly used on ships, where regular electrical power might be endangered by storms or enemy attack. Based on closed circuits, these telephone lines were not connected to any other telephone lines, since they operated according to a different system. With sound-powered telephones, the lines were always live, and were activated by merely talking into them. Elements in the phone then convert the speaker's voice to a weak electrical current, which travels down the line and is turned back into sound at the other end by a transducer.

In September 1951, the idea of a separate system for the safety alarm/paging system and the intra-communication system was okayed for use in 484-D and in the other 184's, with the exception of the C powerhouse. As finally designed and constructed, this intra-communication system allowed someone to call the control room directly, and allowed the control room to call the outlying stations, by first paging someone on the microphone and getting them to call the control room. It also allowed calls between outlying stations, so long as they were routed through the control room.

Even though the intra-communication system for the powerhouses was separate from the safety alarm system, there was still a connection between them for emergencies. In early 1951, when the whole communication system was being designed, consideration was given to allowing the intra-communication network to interrupt any safety signals or messages. This idea was rejected in 1951 as both too complicated and simply against the whole purpose of the safety alarm system. With construction of the powerhouses either complete or well-underway in 1953, this issue was re-visited. After some study, it was decided that local intra-communication might be necessary even after the safety alarm was activated. An emergency button was installed that allowed the intra-communication network to over-ride the safety alarm.

This more elaborate system was implemented for the powerhouses that produced electricity. For the powerhouses that just produced steam, and for the water treatment plants, the intra-communication system associated with the safety alarm system was not as complicated. In those instances, use was made of regular ringing, sound-powered telephone systems, with around six or seven stations per installation. Even so, the ringing had to be louder than that usually found with other magneto phone devices, and was also accompanied by howlers and loud-ringing bells. This system was first worked up for 483-D, and was then incorporated into the standard Gibbs and Hill design. Another feature incorporated into the system was the use of noise-reducing telephone booths, installed in those areas where the ambient noise levels were higher than 90 decibels.[26]

When the safety alarm system was finally installed as planned, they provided adequate coverage for each of the major production areas of the site. D area was the first to be established. Power amplifiers in 484-D worked the loudspeakers for 484, 483, and 451. Safety alarm signals also come out of Buildings 401, 411, 412, 413,and 701-1. In the 100 areas, the safety alarm system could only be triggered in the reactor building or in 701-1. The power amplifier equipment in 184 powered the loudspeakers in 184 and 151-2. To activate personnel paging, removing the mikes from their hang-up positions in the powerhouse control room put the system into service, if the system was not being used by the safety alarm. The red emergency button located on each of the two control cabinets allowed a temporary override of the safety alarm master relays. The safety alarm would still go through, but at a lower level to a loudspeaker in the control room and in the supervisor's office. This ensured that important announcements would not be missed during the override.

In the 200 areas, the two control points for the safety alarm system were in Buildings 221 and 701-1. These buildings were equipped with tone generators and microphones. To ensure area-wide coverage, Buildings 284, 280-1, and 282 had safety alarm loudspeakers, with a 100-watt power-amplifier in 284.

The 300/700 area, which had the greatest number of workers, had the most elaborate safety alarm arrangement. Here, the safety alarm could be triggered from 305-M, 313, 720-A, and 777-M (later designated 777-10A). The 784-A powerhouse had 100-watt power amplifier equipment to broadcast the safety alarm. Building 751-A had two loudspeakers, connected to the SAS circuit originating in 709-A. Building 789-A had two loudspeakers connected to an SAS circuit out of 735-A. Cooling tower 785-A had no loudspeakers, but was close enough to other facilities to be generally covered.[27]

RADIO

The use of radio-telephones was absolutely essential to the construction and later the operation of Savannah River Plant. This was particularly true during the Construction Era, when most of the communications infrastructure had not yet been completed. Even when the regular phone system was operational, the system of radio-telephones could reach workers in the field, far beyond the range of telephones. At the peak of Construction, there were over 450 mobile radio-telephones in use throughout the site, along with dozens of portable units and fixed units.[28] It was estimated that the use of radio telephones cut at least 20 percent of the work of handling the materials and vehicles required to build the plant.[29]

The use of radio-telephones, or mobile radios, was basically planned as early as April of 1951, when lists of equipment were drawn up for project management, patrol, fire, medical, railroad, and loading and unloading. That same month, permits were obtained for the use of a number of different channels from the Federal Communication Commission (FCC). The first radio equipment arrived in May, and by the summer of 1951, it was decided to use Bendix radio equipment as the standard.

During Construction, there were 10 main stations, some 44 area auxiliary stations, 458 mobile units, and 60 portable units, referred to as "handi-talkies." There were two main radio stations, each broadcasting at 60 watts: one from the TC administration area, and the other from Central Shops. In addition, there were 65 patrolling vehicles with radios, 10 fire units, and six ambulances.[30]

The FCC granted licenses for eight VHF channels for the construction of SRP. These were labeled Channels 1 through 8. In addition, there was a special industrial frequency channel allotted for use by pipeline and power line crews, and another off-site channel on a frequency used by the SC Forestry Commission for fire work.[31] Some of these channels simply provided one-way communication, but others were two-way systems. Voorhees Walker Foley and Smith helped design the buildings with radio receivers, transmitters, relay stations, and antennas, with power provided from the regular lighting system or from an emergency source.[32]

During Construction and certainly during Operations, the Du Pont Patrol provided over-all supervision of the SRP radio system. During the Construction Era, when SRP had eight regular channels, channels 1 and 3 were allotted to Patrol, Fire, and Medical personnel. Channel 2 was used by management and supervision, broadcasting from a station at Central Shops. This channel also covered the recreation parks. Channels 4, 5, and 8 were assigned to roads and transportation. With 275 mobile units and 12 small fixed stations, these three channels were controlled from the dispatching building in Central Shops. The railroad was assigned Channel 6. This system was run from a 60-watt transmitter set up in the Dunbarton Fire Tower and was remotely controlled from 618-G in the Railroad Classification Yard. Each of the eight SRP locomotives was equipped with mobile radios, as were the Traffic Superintendent's vehicle and the railroad maintenance unit. Channel 7 was assigned to Operations to help coordinate the work of the river water pump houses, the trucks of the water control system, and the river water facilities of the 100 areas. Construction used this channel briefly for the 400 area, before reverting back to Operations.

There was also a special industrial channel, KB8630, which was used for the testing of the large pipelines and for the installation of the 115 kv transmission lines. The main station for transmission on this line was at Central Shops. There were some 40 handi-talkies and portable pack units that were attuned to this frequency.[33]

DU PONT PATROL AND BUILDING 623-G

Much of the work of managing this radio-telephone system fell to the Du Pont Patrol, which also policed the SRP roads throughout the Construction Era and during the Operations period that followed. Patrol had the authority to keep out and arrest would-be trespassers on government land. According to South Carolina Law, Article 57516, Patrol officers had the same powers as a duly authorized police officer elsewhere in the state. When the first Du Pont Patrol Division units were organized in 1952, their chief supervisor was Roy Case, who remained in the position for 23 years. This provided the sort of stability that was characteristic of SRP's main security arm until the early 1980s.[34]

One of the structures important to this security arm was Building 623-G, also sometimes designated 623-1G, known as the "radio transmission building."[35] This small building, designed to stand near the center of the site, was to help relay radio signals to all parts of Savannah River. Specifically, its function was to house a radio transmitter for the control of plant patrol cars. The transmitter was to be operated through a central console in Building 720, Patrol Headquarters, located in A area. It could also be controlled via the 701-1 buildings in the 200 area. The building was not designed to be occupied. It was small, 12 by 14 feet, and single story. Despite its size, it was to be a blast-proof Class I construction.[36]

Du Pont Patrol, date unknown, SRS Negative M-665


Patrol Radio Operator, date unknown, SRS Negative M-999

The initial data report for this building was done in the summer of 1951. In August of that year, some changes were made to distinguish it from the railroad transmitter that was to be located elsewhere on site. The working drawing of this facility was approved in December of 1951. In August of 1952, an additional concrete blast protection baffle was requested for the emergency generator portion of the building, and this was added to the building drawings. The foundation was also concrete with spread wall footings. The walls and the roof were also concrete. The building itself was quite small, with a hollow metal door. Inside were a 60-watt transmitter and other equipment, as well as an antenna. The building also had an emergency power generator capable of 3.5 kw. A 55-gallon oil tank was buried nearby. There was also an exhaust fan with a capacity of 270 cubic feet per minute.[37]

Radio Pole Erection, March 28, 1957, SRS Negative 4334-09

Public Address Layout at 623-G, November 5, 1952, SRS Negative M-1567

In April of 1957, the plant newspaper noted that a new antenna was installed for SRP Patrol radio station KEB1. The total height of this new structure was 121 feet, and consisted of an aerial set onto a 100-foot tall pole. Although the location of this new antenna was not given, it seems likely that it was adjacent to Building 623-G.[38]

FIRE PROTECTION AND BUILDING 627-G

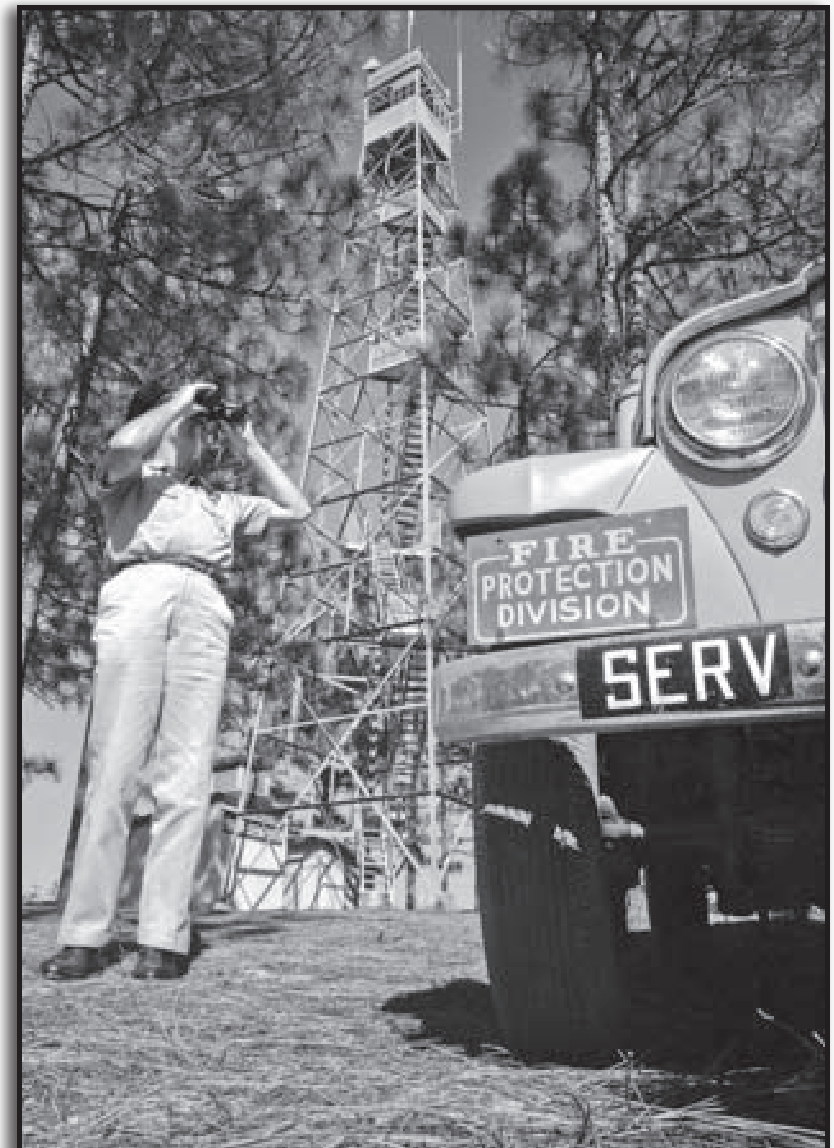
From the beginning, it was understood that fire protection would be a major concern of plant officials. In early February 1951, Du Pont established a Fire Section, which was part of the Service Department, and by November of that year the Fire Section had a force of 327 people. The first fire station was at the Bush House, and the fire headquarters for Construction was initially located in a farmhouse on Highway 28. In June of 1951, the headquarters was relocated to Central Shops. In the next two years, fire stations were established throughout the site, with the exception of C area, which was adjacent to Central Shops. In 1953, towards the end of the Construction Era, many of these stations were closed, and the rest were transferred to Operations for permanent use.

As time went on, and Operations was left with permanent buildings, many of which were concrete and could not burn, forest fires became a greater concern. The Savannah River Plant was a huge installation that covered more than 315 square miles. Despite the presence of 10 production areas, most of this land was purposefully left as a buffer to protect against accidents and to serve as a security hedge. Much of this buffer was wooded even in 1951.

In October of 1951, the Forest Service was first called in to assess fire risk at SRP. By this time, the plant had acquired the "Dunbarton Fire Tower" from the South Carolina Forestry Commission, which is believed to have built it sometime in the 1940s. In 1951, it was the only fire tower within the boundaries of the SRP, and was given the designation "Building 627-G," Fire Observation Tower. It was then placed under the management of the SRP Fire Section. Two radios were put in, one for the SC Forestry Commission, and the other for Project Fire and Patrol.[39]

On December 19, 1951, the AEC announced that the Forest Service would begin a program of reforestation at SRP. The first contract called for the planting of at least 10 million seedlings on 10,471 acres. This program was completed by March 6, 1953,[40] and was soon followed by others.

Soon, the Forest Service planted most of the local agricultural fields and cut-over lands in pines. After a decade or so, these could be harvested, netting the government a profit from land that would otherwise be unused. By the mid-1950s, it was estimated that around 70 percent of the site's surface was covered by forests or planted pines.[41] This made the job of the fire tower all the more urgent.



Fire Observation Tower, October 9, 1956, SRS Negative 3757-09

The McCullin diary suggests that at some point during the Construction Era, the tower was taken over for radio transmission service that would later be assumed by Building 623-G. According to the Du Pont construction history, this was indeed the case, since the fire tower was used to broadcast the signal for Channel 6, used by the SRP railroad during Construction.[42] Other channels may have used this tower too. In April of 1954, Operations wanted the tower back as a permanent fire observation post.[43]

A year later, in April of 1955, when almost everything was managed by Operations, the plant newspaper did an article on the fire tower, located near the juncture of roads B and 9. It was noted that the 85-foot tower was part of the Fire Protection Division and had been built "long before the coming of SRP." In addition to radios, the most important piece of equipment in the tower cab was the large alidade used to measure the angle of a forest fire from true north. When another tower also provided an angle from its location, it would then be possible to pin-point the location of any fire.[44] What the article failed to say was that any other tower would be a long way off; in 1955, the Dunbarton Fire Tower, 627-G, was the only one on site.

WASTE TREATMENT

Waste treatment was taken just as seriously as any of the other processes at SRP, and this is certainly reflected in the McCullin diary. At Savannah River, this topic covers a number of processes that might not be normally associated with waste treatment. The term preferred by Du Pont was "sewer," and there were three main categories: sanitary sewers, storm sewers, and process sewers. Sanitary sewers dealt with human waste; storm sewers dealt with rainwater run-off; and process sewers dealt with process effluent and water-borne industrial residue. River water used to cool the reactors, after exiting the reactor buildings, could be considered process effluent, but since it was such a special case, associated with the river water piping system, it was deemed better to include that discussion with the part of the report dealing with water. Nuclear residue holds a special niche position, and that topic will be discussed at the end of this section, especially as concerns the 643-G burial ground.

Most of the specifications for sanitary, storm, and process sewers were borrowed directly from those that had already been worked up for the Dana Plant, and these had been compiled for Du Pont by both Voorhees Walker Foley and Smith and by the Girdler Corporation. These plans called for sanitary sewer pipes of vitrified clay, with bituminous jointing. Storm sewers required reinforced concrete or cast iron pipes. Process sewers required vitrified clay pipes, with sulfur-base acid-proof joints. All of these pipes met Du Pont's Standard Engineering Specifications, and those of the American Society for Testing Materials, the American Water Works Association, the American Institute of Steel Construction, and the American Welding Society.[45]

In many areas, of course, the sewer system used at SRP had its own special engineering needs, and these were met for the most part by Voorhees Walker Foley and Smith and their subcontractors. VWFS designed underground sewer and drainage lines in the 400, 100, and 300/700 areas, as well as for the power blocks in the 200 areas. Blaw-Knox handled most of the other sewer work in the 200 areas.[46]

To deal with special problems, VWFS secured the consulting services of Elson T. Killam. Killam worked up some of the specifics for sanitary and storm sewer systems, and for the sewage treatment plants. He also worked with Du Pont on the largest of the sanitary sewage treatment plants, 607-1A, located at the south end of the 300/700 area.[47] According to McCullin's diary, Killam completed his work by June of 1953. There was at least one other consultant who helped with this work: S. W. Crossan.[48]

Much of this work was too specific to each area to cover in great detail, but it would be good to mention some of the highlights and general trends. Whenever possible, it was preferred to use septic tanks or septic lines to deal with sanitary sewer issues at each individual area. This was certainly done at the Railroad Classification Yard, where the worker population was small and there was plenty of surrounding land. At the other extreme, there was 607-1A, the sewage treatment plant for the 300/700 Area. This facility appeared in the McCullin diary often enough to say, categorically, that the construction of this facility was the biggest problem of the entire sewer system. In late February of 1951, McCullin noted that the treatment plant for the 300 area should resemble that used at the Camden plant, and that most other areas could use septic tanks and tile fields acceptable to the South Carolina Board of Health. By March, it was clear that septic tanks would not be acceptable for areas with a population greater than 500, and the 300/700 area would have an estimated working population of at least 2,500. This area would require a sludge digester tank, with a primary settling tank.[49] By February 1953, the 607-1A sewage treatment plant was designed to handle 3,000 people, with a digester tank that could accommodate 6,000.[50] Even as late as early 1954, there were still problems with 607-1A, which required more additions and modifications.[51]

Storm sewers do not appear to have posed much of a problem, but that was not the case with process sewers in separation and reactor areas. In December 1952, it was noted that process waste from 232-F should be directed south toward Four Mile Creek, and that there should be no connections with the local storm sewers and no man-hole covers, to prevent contamination.[52] In other parts of the 200 areas, process sewer lines went north to Upper Three Runs Creek. In December 1953, a decision was made to re-direct all process sewer lines in F and H areas to the south and Four Mile Creek, owing to concerns about dumping process waste into the Savannah River upstream of the river water pump houses.[53]

In R area, acid leaching of the 72-inch process sewer lines (904-R) was found to be a problem in late 1953. Placing a smaller steel pipe into the line and grouting the difference solved this problem. This work began at R and it was continued in the other reactor areas.[54] A later document provided more information on the status of the R area sewer lines. All waste from the worker buildings was removed to septic tanks and field drains. Even the storm sewers (907) sent their water to adjacent fields or to the process water effluent canal.[55]

BURIAL GROUND, 643-G

The 643-G burial ground, often referred to as a burying ground, was situated adjacent to the F and H areas to be accessible for the burial of solid radioactive waste and other materials from the 200 areas. The fenced-in burial ground was set aside for the disposal of contaminated solid waste, and other materials that could not be re-processed. Among the solid waste products were items such as irradiated quatrefoils and septifoils that could not be processed, and irradiated lithium-aluminum alloy products. As the name implies, these materials were to be buried.

Since this feature was not essential in the first year of construction, the report or scope of work on this burial ground was not issued until July of 1952. No drawings were made of this facility, and its location was merely marked on area grid maps. The burial ground "office" was a wooden skid-like movable shelter provided by Construction that measured 10 by 15 feet.[56]

Trial Recovery at Burial Ground, November 4, 1960, SRS Negative DPSPF-7106-2

Trial Recovery at Burial Ground, November 4, 1960, SRS Negative DPSPF-7106-3

Basically, the burial ground was a cleared field measuring 800 by 3,000 feet, accessed by both a dirt road and a railroad spur. The field was identified with concrete markers set at 200-foot intervals along the short axis, and at 500-foot intervals along the long. These were almost surely the same "I.D. monuments" that McCullin mentioned for the burial ground that were to be located 5 feet inside the fence line, and between 6 and 12 feet above ground. Materials were deposited into the field by 10-ton and 50-ton cranes.[57]

Even as early as May 1953, there were problems with the burial ground. McCullin mentioned that the surface drainage was not satisfactory, which led to a possible solution of using a series of ditches.[58]

X. DEFENSE SYSTEM – MILITARY SITES

Despite the huge amount of effort that went into the construction of SRP, there was remarkably little provision for the military protection of the site, at least in the early days. In Du Pont's Construction history, it specifies that the original Military Defense Plan called for:

> The protection and defending of the plant against attack or threat of attack by a foreign power, in conjunction with local subversive elements, and the protection and defending of the plant in event of a strike by plant guards and operation of the plant fire fighting system in an emergency.[1]

In case of the threat of such an emergency, the plant was to contact AEC offices both at the site and in Washington. Clearly, plant officials during the Construction Era did not have the time to give any serious consideration to a broader military threat. This was to change dramatically beginning in 1955.

Welder and Machine Gunner, June 29, 1954, SRS Negative M-3550-03

At that point, it was announced that the Savannah River Plant would be receiving the first military units that would take up positions around the periphery of the plant. These would occupy and support anti-aircraft batteries, designed to protect against Soviet bombers that might attack with either nuclear or conventional bombs.

MILITARY AT SRP

In late 1954, Du Pont, the AEC, and the Army began discussions on the creation of a series of anti-aircraft installations at Savannah River Plant. These would be 75mm and 90mm gun sites, with all the required support facilities. Du Pont agreed to design and construct these facilities as part of its original contract with the AEC, with funds provided by the Army and routed through the Army Corps of Engineers. Du Pont received the first scope of work in late December of 1954.

According to this scope, Du Pont would renovate the TC-2 building so that it could house 650 men and various offices. The cafeteria would be upgraded to handle 1,500 diners. Other buildings would either be constructed or taken over in this same area. Refurbished facilities would also be provided in the Central Shops area. Brand new construction included eight sites to house the 90mm guns. Each of these was to contain concrete block barracks that could house 120 men, as well as a mess hall, and the full range of support facilities. Four of these eight sites were to be completed by July 1955. As for the 75mm gun sites, there were to be 30 of these, all to be completed by July of 1955. Each 75mm site was to house between 3 and 11 men, with gun emplacements, a prefabricated bathroom building, and other facilities.[2] As will be seen below, this agreement was obviously modified at a later date, since it is certain that not all of the specified 8 barrack sites and 30 smaller gun sites were constructed at Savannah River.

The first announcement that military units would be stationed at the plant was made on January 28, 1955. At that time, it was said that a 2,150-man anti-aircraft detachment would arrive in April, and that their new headquarters would be the old TC facilities, that had just been vacated by Construction. The military group, which was not named, would have its overall headquarters with Central Army Anti-Aircraft Command, Grandview AFB, Missouri, but would be coordinated with Third Army Headquarters at Fort McPherson, Georgia. The unit, which was to be up to full strength by early 1956, would have 2,000 enlisted men and 150 officers. The single enlisted men would occupy barracks on the grounds of Savannah River Plant, while the officers and married enlisted men would live off-site.[3]

AAA Staff Officers: Colonel Greelee, Jr. (center), Lieutenant Colonel McElroy (right), and F. Greco, Executive Officer, November 10, 1955, SRS Negative 2959-05

This article was followed up by another dated to late April. At that time, it was announced that the first military unit, identified as the 33rd Anti-Aircraft Artillery (AAA) Battalion, would arrive in early May. The 33rd would set up its advance headquarters in the TC-2 building, which would also serve as the first barracks. The battalion was listed as having 500 enlisted men and 27 officers, with other units scheduled to follow.[4]

Building TC-2, the building that would serve as military headquarters, had been erected in early 1951. When it was first occupied, in late May of 1951, it was the headquarters of Du Pont Construction, as well as the local AEC office.[5] It was one of two distinctive starburst-looking buildings, TC-1 and TC-2. Each had six wings that radiated out from a central rotunda. The rotunda had a diameter of 60 feet, while each wing measured 50 by 300 feet. When the 33rd AAA Battalion moved in, in early May 1955, they claimed TC-2 (but not TC-1) and Building 720-G.[6] The unit had been flown from Fort Bliss, Texas, and then convoyed to the site from Bush Field outside Augusta.[7]

The 33rd AAA battalion was the first and best known of the military units at SRP. Their motto was "Vigilia Triumphamus" (in vigilance, we triumph).[8] One of our interviewees for this project, Patrick Harris, was with the 33rd's Battery Able during his two-year stint in the Army in the late 1950s. The three other batteries were Baker, Charlie, and Dog. The 33rd were in charge of the 90mm guns at SRP. Harris's basic experience with the 33rd was that the food was acceptable, but there was little to do.[9]

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1. Military Units Moving into T-2 Building, May 4, 1955, SRS Negative DPSPF-2214-8
2. AA Battalion, B Battery, July 1, 1955, SRS Negative 2718-09
3. Military Personnel at T-2 Building Mess Hall, May 4, 1955, SRS Negative M-3954-08
4. T-2 Area, June 5, 1956, SRS Negative AA-19-04

4

1. T-2 Administration Area, Military Barracks Site 95, February 26, 1959, SRS Negartive DPESP-25-6
2. Military Barracks Site 95, June 5, 1956, SRS Negative AA-19-08
3. 90 MM Gunsite at Barracks Site 72, circa 1956, SRS Negative DPESP-25-4
4. Gunsite 92, D Battery, 33rd AAA Battalion, 90MM Gunsite, February 11, 1956, SRS Negative M-4085-06A


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More than a year later, there was mention of the 425th AAA Battalion, listed as a 75mm Skysweeper battalion. It was mentioned because it was being re-designated the 4th Gun Battalion (Skysweeper) of the 7th Artillery Regiment. This unit had 500 officers and men, and it was mentioned that there had been no change in its mission.[10] Another battalion that saw service at SRP was the 478th. So far as is known right now, there were only three battalions that served on site: the 33rd, the 425th, and the 478th (Reed et al. 2002:83-84). The 425th and the 478th were both 75mm gun units.[11]

All three battalions were part of the 11th AAA Group. The 11th had been around since the days of World War II, when they were active in Britain and France. In late March of 1957, it was noted that a Col. James D. Shearouse was slated to take command of the 11th AAA Group at SRP.[12]

One of the more interesting military features left behind at SRS is a large anti-aircraft emblem set into a concrete pad beside what used to be TC-2, now in B Area. In addition to the letters "AA," there is also a central rocket symbol that resembles a Hercules missile. This has led some to suggest that Hercules missiles might have been stationed on site, in addition to the 75mm and 90mm guns.[13] While this is certainly a possibility, there is no other indication that missiles were ever kept on site. In all likelihood, this was a purely symbolic emblem employed by one of the anti-aircraft units.

After the military's arrival, a number of articles appeared in the plant newspaper about their activities. In late September 1955, there was an extensive air defense exercise conducted by the 33rd AAA battalion, and bombers and fighter jets from the 35th Air Division based in Marietta, Georgia. The goal of the exercise was to track potential enemy aircraft with the battalion's radar units.[14] The following month, radar training continued with the announcement by the 11th Anti-Aircraft Group that aluminum decoys would be dropped over the site, to help train radar crews.[15]

On a lighter note, the military was responsible for the first baby, and possibly the only baby, to be born on site since the creation of the plant. On August 19, 1955, the wife of Sgt. Joseph W. Moseley of Baker Battery, 33rd AAA battalion, was en route to the military hospital at Camp Gordon. From their home in Barnwell, the Moseleys picked up an ambulance at the TC-2 medical station, and were on the way to Augusta, when the baby was delivered in the ambulance near the barricade outside Jackson.[16]

In the years after 1955, there were far fewer mentions of military activities or events at the site. Senator Albert Gore, Senior, of Tennessee, a member of the Joint Congressional Committee on Atomic Energy, visited Aiken and SRP for two days in mid-June 1956, and that is the only mention of the military installations in the plant newspaper for that year.[17] The following year, the only article mentioned that there would be a military "open house" on May 19, 1957, for Armed Forces Day. For this event, a 90mm gun site on the Williston side would be open to the public.[18]

By the time of the open house, the 33rd had already left the site, or was in the process of leaving. The 33rd was the first military unit to leave SRP, in March of 1957. The unit itself was disbanded in December of that year. After the departure of the 33rd, all 90mm guns were removed. Ironically, the 75mm gun units were left for another two years, even though their range was less than those of the 90mm guns.[19]

Most military units left SRP in 1959. The very last military personnel left on January 20, 1960, a date that officially marked the end of the liaison between the Army and the Du Pont Patrol.[20] After the last Army units left, the TC-2 building (Military Site 95) remained vacant for a year, before it was finally torn down in January of 1961.[21] The other military installations were abandoned as well, and these too began to be demolished one by one.

In the rapidly changing environment of military technology, the SRP anti-aircraft units were almost obsolete as soon as they were installed. Anti-aircraft guns, whether 75mm or 90mm, were probably only marginally effective against high-flying jet bombers. They were totally useless against inter-continental ballistic missiles, which had become the standard by the late 1950s. In the years that followed, the Air Force would assume the work of protecting the site, and this was done by means of jet fighters and "Scramble" radar positioned at surrounding military bases throughout South Carolina and Georgia.

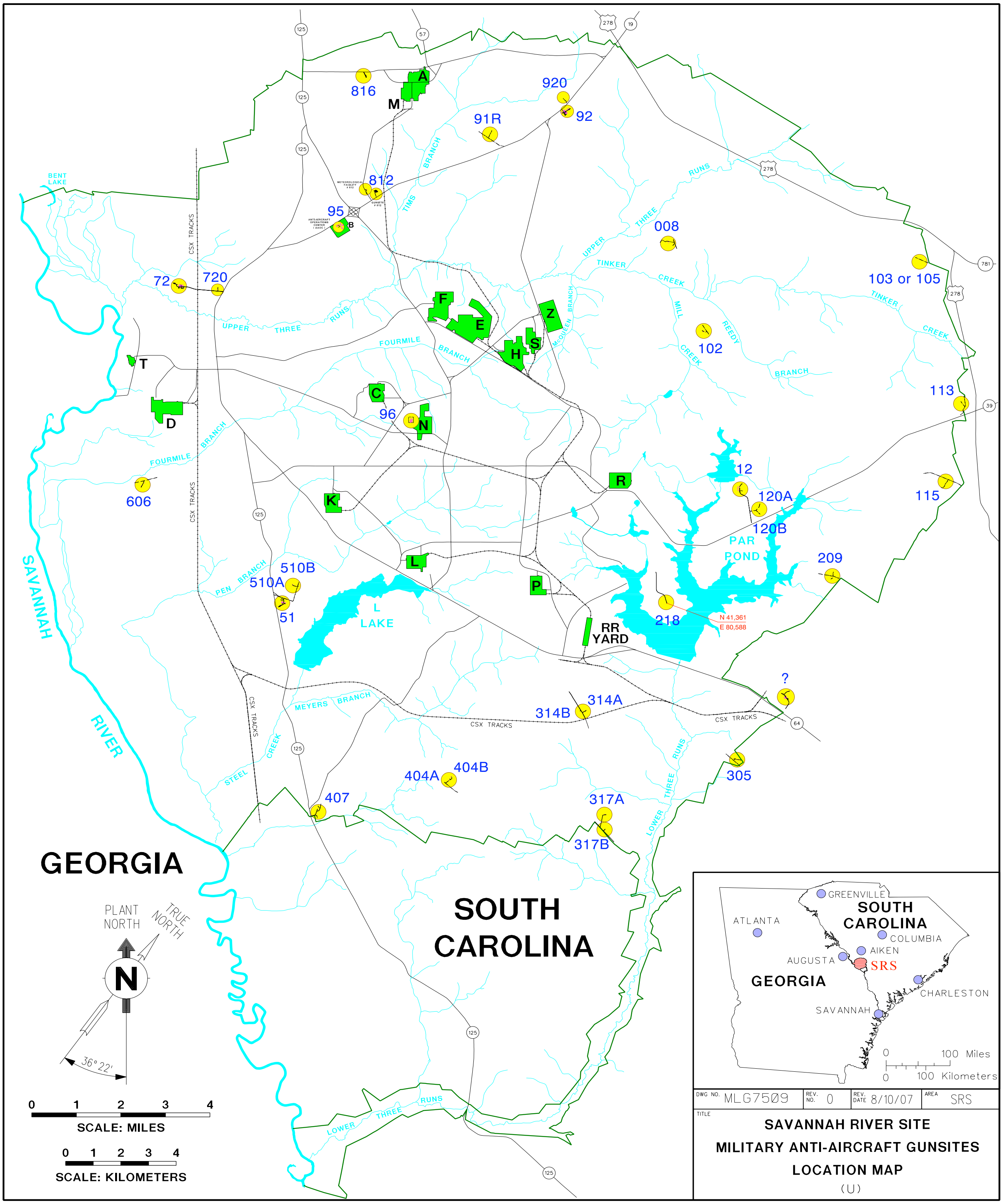
Patrick Harris, who served his two years in the military at SRP, recalled that anti-aircraft duty was tedious, made worse by a sense of futility. As he would say many years later, in an email dated May 14, 2009:

> Although I personally felt our mission at the S.R.P. was utterly useless, I do feel that our "story" in relation to the history of the SRP, needs to be told. A goodly number of officers and enlisted men spent almost two years fighting the battle of gnats, sand spurs, mosquitoes, and boredom. Our time at the SRP has always reminded me of Kipling's poem about the mythical British soldier, Tommy Atkins.
>
> > For it's Tommy this, and Tommy that, an' "Chuck him out, the brute."
> > But it's "savior of 'is country" when the guns begin to shoot.
> > And it's Tommy this, an' Tommy that, an' anything you please:
> > An' Tommy ain't a blooming fool—you bet that Tommy sees!

MILITARY SITES

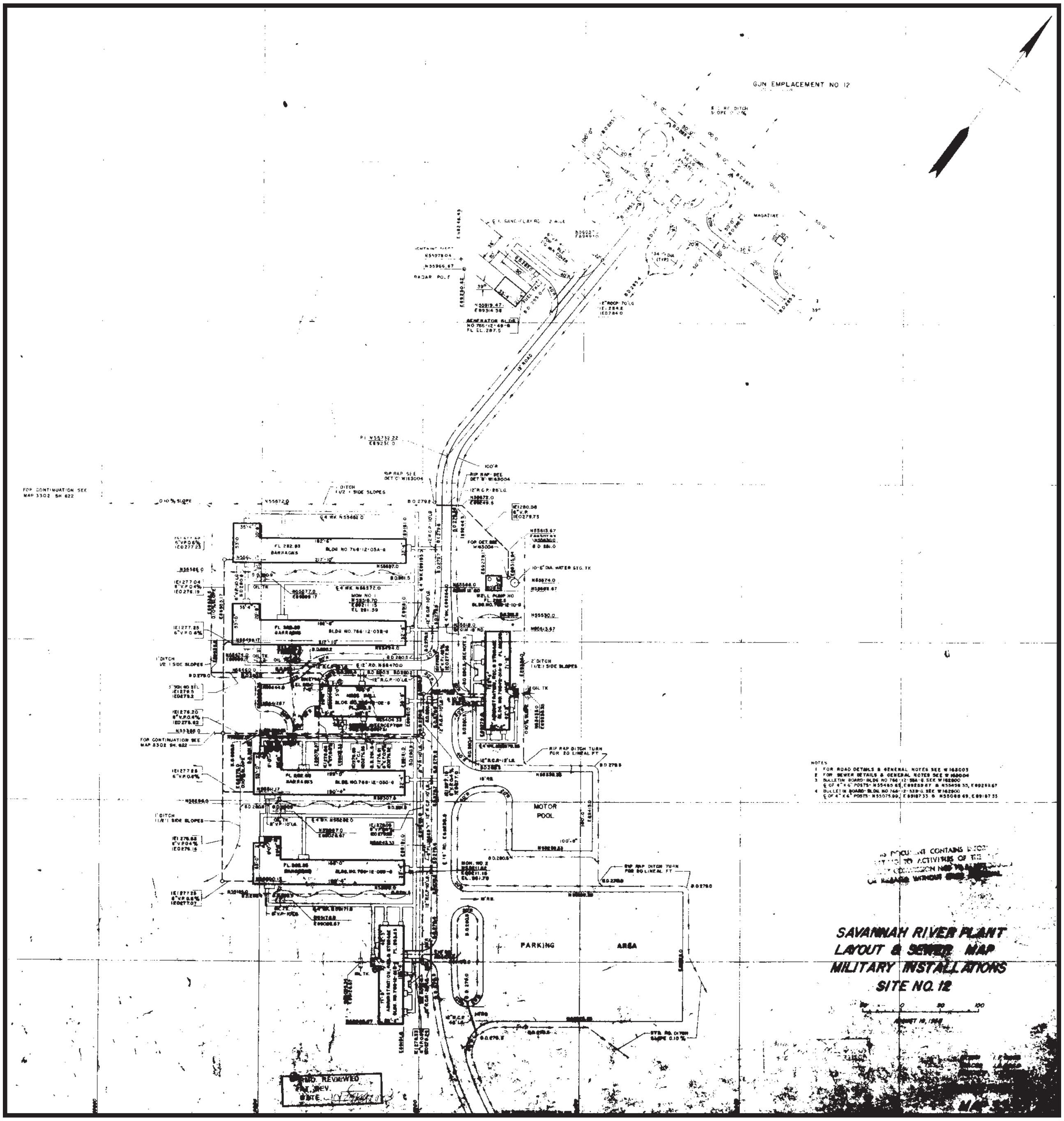
The military left a number of sites scattered around the peripheries of Savannah River Plant. In addition to TC-2, which served as a general headquarters, there were a number of other facilities, and these can be divided into two types: the larger barracks sites and smaller gun sites. It should be noted, though that all sites had gun emplacements. The barracks sites, referred to as "central sites" by one modern source, had 90mm guns, while the smaller gun sites, sometimes referred to as "satellite sites," contained 75mm's.[22] Even now, it is not certain exactly how many smaller sites were constructed, since the plug was pulled on the military program while construction was still underway. As we will see, there were probably 6 barracks sites (four of these built from scratch), and more than 20 satellite sites.

There are a number of maps that show the locations of these sites. The earliest maps are incomplete, either for security reasons or because the facilities themselves were still under construction (Map 3349 and its variants). The most accurate map of the various locations appears to be a modern map.[23] This map shows a total of 32 military sites, not all of which have been securely identified by number. It does appear, however, that all of these sites have been located in the field, and were actually constructed.



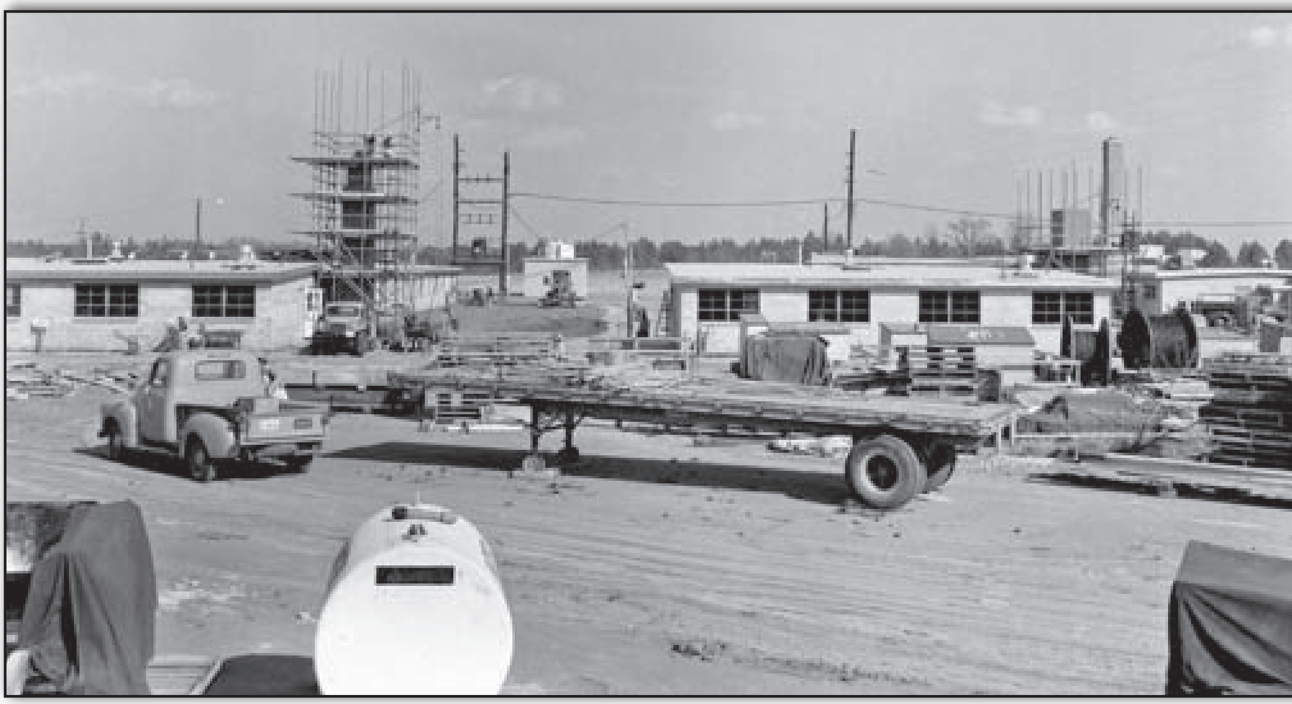
SRS Military and Anti-Aircraft Gunsites, 2007, SRS Archives

There appear to have been at least four barracks sites, and these were: Site Nos. 92, 72, 51, and 12.[24] These were the four barracks sites built from scratch. If, as appears to be the case, barracks sites were identified with two-digit numbers and the smaller gun sites with three-digit numbers, then there were two other barracks sites as well: No. 95 in B Area (almost surely TC-2) and No. 96, on the west side of N Area (Central Shops). If this assumption is correct, there would have been a total of six barracks sites within the boundaries of SRS. Three of these barracks sites (Nos. 92, 72, and 51) are situated close to the three 504 switching stations.



Gunsite 12, date unknown, SRS Archives

According to a modern source, each of these barracks or central sites contained three 90mm AA guns, barracks structures capable of holding 200 occupants, a cafeteria, office buildings, a motor pool and parking lot facilities, a well for water, an electrical generator, and an ECODS trench. This arrangement was certainly true for the four barracks sites located away from the other developed areas: Nos. 92, 72, 51, and 12. There is even an aerial photograph of the construction site for No. 12.[25]



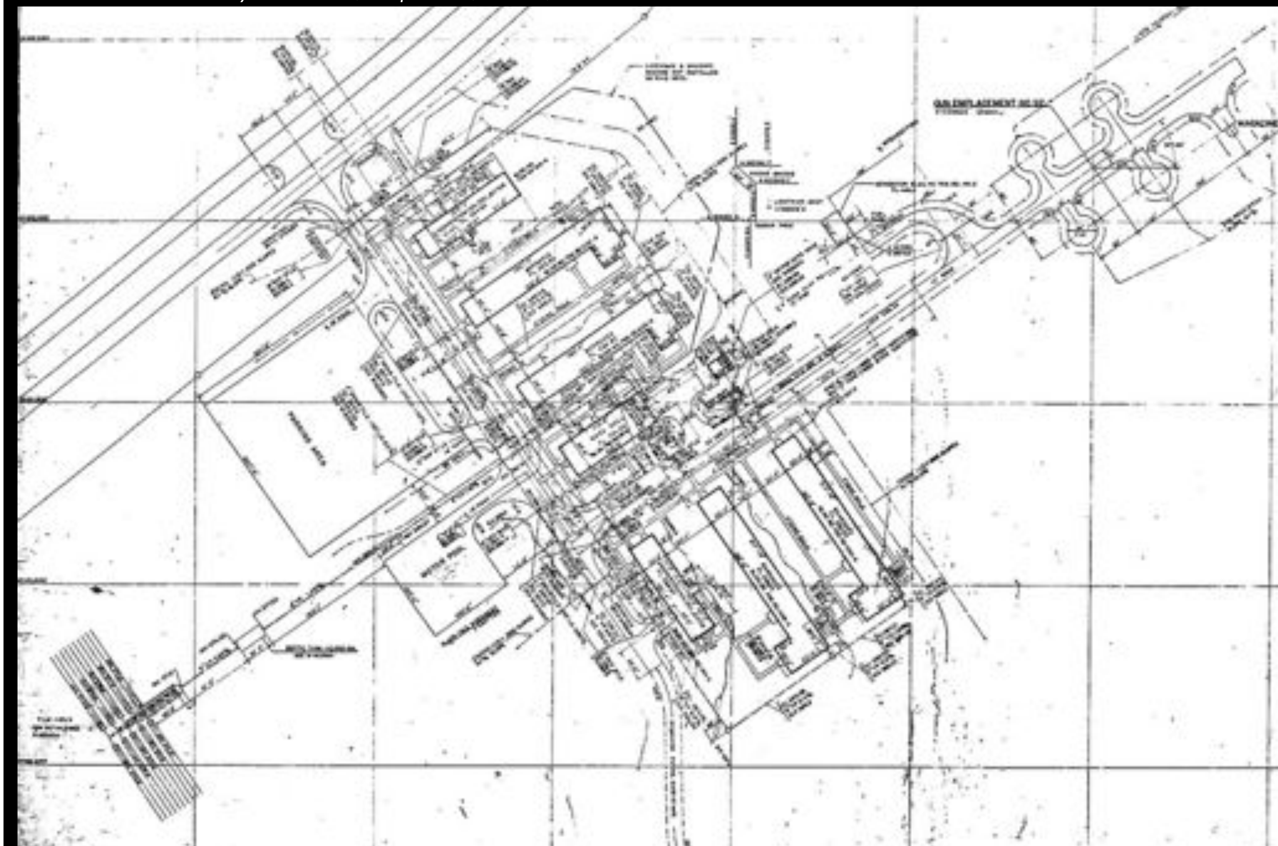
Military Barracks Site 12, January 1, 1954, SRS Negative S12-AA-11-08

The smaller satellite gun sites, of which there appear to have been around 26, had far fewer facilities. There were either one or two 75mm AA guns, a small administration building, and an electrical generator. The locations of these facilities are identified by the three-digit numbers on the Savannah River Site Anti-Aircraft Gunsites Location Map.[26]

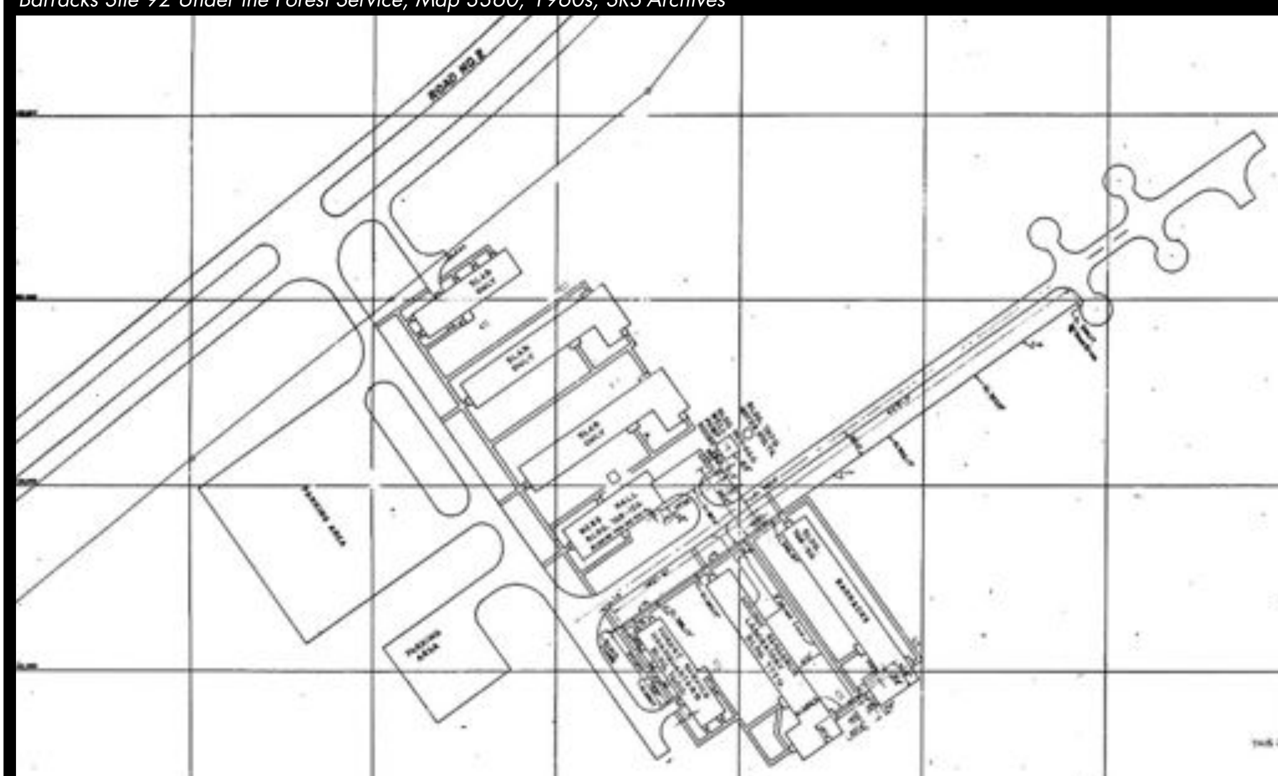
There is a series of small installation maps of SRP military facilities currently housed in Document Control (Maps 3372 through 3401). There are 30 of these maps and almost all are dated to September 20, 1955. While some of the site numbers correspond with the numbers shown on the 2007 map, most do not. In addition, 10 of these 30 maps are blank except for the identifying number, showing nothing at all inside the map frame. It is presumed that this was an early effort to lay out the military facilities, one that was not completed as conceived in September of 1955.

When the military left in 1959-60, the smaller gun sites were reduced to foundation pads almost immediately. The barracks sites, with many more buildings and facilities, lingered on for much longer. The best-preserved barracks site, by far, is No. 92, off Road 2 near the Aiken barricade. Constructed in July 1955, and augmented until 1957, it was turned over to the Forest Service in 1962 to serve as their local headquarters.[27] Some of the original barracks buildings are still used by the Forest Service to this day. Site No. 51, which was used as a storage area for many years, had its buildings taken down a few years ago. Like all of the military sites except No. 92, it has been reduced to concrete pads.

Barracks Site 92 Military Installation, Map 3353, 1950s, SRS Archives



Barracks Site 92 Under the Forest Service, Map 3360, 1960s, SRS Archives



XI. OPERATIONS HISTORY

The infrastructure at Savannah River Plant was basically in place during the Construction Era, and was turned over to Operations in the years that followed. Aside from basic maintenance, fundamental changes to the plant's infrastructure were relatively rare. This is reflected in the issues of the plant newspaper; by the mid to late 1960s, infrastructure issues are rarely mentioned in the pages of the SRP News over the hubbub of toy drives, fund drives, recreational organization matters, and personnel changes. Of course, many highlights of SRP history failed to find mention in those pages, largely for security reasons, but that was why infrastructure topics were so common in the 1950s—it was one of the few topics that could be mentioned, at least in a general way. In all likelihood, the dearth of articles dealing with infrastructure in the later 1960s was basically because there was little to report.

In the meantime, SRP went from one success to another. Throughout the late 1950s and 1960s, power was gradually increased in all of the reactor areas, pushing the reactors, power houses, and pump houses to the edge of their full capability. This was of course the main purpose of the plant, to produce nuclear materials for the nation's arsenal-- and this was the main function of the plant from the mid-1950s until the last reactors closed in 1988. This was a huge task, and SRP shared that work with Hanford. It was work that could never have taken place without the foundation established by the infrastructure, namely the roads, the railroads, and the power provided by the electrical and water works.

Throughout this period, and right up to the present day, the site infrastructure has been repaired or improved in every decade since the opening of SRP. How that infrastructure was altered over the decades is the main theme of this chapter. In the section below, that information has been presented together with the main events or achievements of the plant itself. During most of this period, infrastructure took a definite back seat to the other goings-on at Savannah River, and this too was as it should have been. Roads, railroads, electrical systems, and the river water flow, were all created so that SRS Operations could do its job. Even so, there were changes to the infrastructure during this long period of Operation, and some of them were not just maintenance. Many were substantial. The greatest of these, and the one that occurred first, virtually right after Operations began, were changes to the river water system. This is the story of Par Pond.

CHANGES TO THE RIVER WATER SYSTEM: PAR POND

The biggest change to the cooling water pumping system came with the development of Par Pond, located on the upper reaches of Lower Three Runs Creek, just east of the R and P reactors. With the rise of reactor power levels, there was an increasing need for cooling water. If extra water could be drawn from a reservoir just east of R and P, which were farthest from the river, this would be an improvement to the entire system. Plans for this reservoir, named "Par" for "P and R," were quickly approved. It was one of the first and the certainly the biggest of the early modifications to the original SRP set-up.

Most of the design work on the dam and the road realignment was done in 1957.[1] Construction of the Par Pond dam and reservoir basin began in late 1957. At that time, the first timber was cleared along the upper tributaries of Lower Three Runs, sufficient for the creation of a 2,800-acre lake. The earthen dam, which would be 50 feet tall and 4,400 feet long, was scheduled for completion by January 1959. The Army Corps of Engineers did the design work, and a Du Pont subcontractor, Green Construction Company, handled the construction. The field supervisor was Harvey Hutto.[2]

The lake behind Par Pond began filling on August 22, 1958, and the first pumping out of the lake occurred on October 8. The pond was almost full by the end of 1958. Par Pond was officially declared finished on January 15, 1959, right on schedule. In September of that same year, water damage from Hurricane Gracie left some damage to the dam face, but this was repaired by the end of the year.[3]

The construction of Par Pond was only the beginning of the new hydraulic system. Extra pipelines were added so that river water from SRP cooling system could be fed into the new reservoir. The effluent outtake for P reactor was re-oriented so that the water would flow into Par Pond, rather than Steel Creek. Also constructed were a series of canals and diversion basins just above the elevation of the Par Pond pool. The canals were eight feet deep and 10 feet wide at the bottom, and they passed through five reservoirs, the largest of which covered 30 acres.

These canals and small reservoirs, referred to as the Four-Mile Canal System, were designed to help moderate the heat from the P and R effluent water, before that water entered Par Pond. Lastly, there was the construction of a new pump house, designated 681-6G, located on Par Pond. This new pump house would provide water to both R and P, as needed by the cooling water system.[4] The 681-6G pump house was constructed about the same time as Par Pond. It had a 78-inch pipeline that connected to the original pipeline between R and P.[5]

One of the last problems to be worked out concerned the new R and P effluent canals, which were finished and approved in the summer of 1961. By October of that year, these concrete structures were found to be inadequate, and work began replacements for the inlet structures in December of 1961. In 1962, they were completely replaced by stone structures, in addition to other improvements.[6]

Today, with the reactors shut down, there has been no industrial use for Par Pond or the Par Pond pump house, which has been closed for a number of years. Even the river pump houses have seen their use diminish over the years. Currently, the 681-3G pump house sends water to the 186 basins in K and L areas to serve on-going missions there, and uses a smaller pump to maintain the water level at Par Pond.[7]

OTHER CHANGES IN THE 1950S

The big change in the operation of the plant in the mid to late 1950s would have to be the power ascension in the reactors, designed to maximize the production of nuclear materials. Power ascension was the reason for the construction of the Par Pond system, and it was the reason for most of the other changes to the infrastructure system in the 1950s. Railroad cars brought in more coal, with loaded in-bound cars, 18,057 in fiscal year 1955, rising to 22,804 the very next year.[8]

Another big increase was the amount of purchased power acquired from South Carolina Electric and Gas. On July 1, 1956, a contract was drawn up with SCE&G for 50 MW of power. One year later, another transmission line was added from the Urquhart Station.[9] This second "purchased power line" went to the "No. 2 terminal" (504-2G). The line itself was described as a 1-1/8-inch diameter line with a voltage of 115 kv. To receive this extra power, new GE transformers rated 160,00 kva were purchased for the 504-2G switch yard. Each held over 12,000 gallons of oil and weighed 228,000 pounds. They were shipped on special railroad cars from Pittsfield, Massachusetts.[10]

As of June 1, 1957, purchased power was increased from 50 to 70 MW. The following year, the amount increased to 82.5 MW, and went up again to 95 MW.[11] The level of purchased power would remain at 95 MW until the first reactors were shut down in the 1960s.

As for the work force, the big transition was from Construction to Operations. That transition occurred between 1953 and 1956. From the Construction Era, when there were at one point over 30,000 workers at the site, the Operations staff was reduced to around six thousand. During that period, the various Operations departments hired personnel to fill their needs. As an example, the Electrical Department for Operations had just 57 percent of full staff required in 1953, but was up to 92 percent in 1954.[12] One group that certainly lost out in the transition was African Americans. Comprising at least 20 percent of the Construction work force in 1951-52, usually as common laborers, they also comprised at least nine percent of the truck drivers, cement finishers, and carpenters.[13] Very few made the transition to Operations. None, for example, were in the Electrical Department and departments like that until many years later.

Another change was in the status of unions. Construction workers were highly unionized. An estimated 90 percent of the building trades represented at SRP were affiliated with the AFL unions. This was understandable since most of these workers were not local but were pulled in from more distant areas. This was done on purpose, to prevent disruption to local industry and commerce.[14]

This was not the case with Operations, where over 60 percent of the work force resided locally, with only a minority pulled in from other areas.[15] This local work force had to be trained, and was not previously exposed to the idea of a union. This agreed with general Du Pont policy in this regard, which was to treat its employees so well that few would want to unionize.

In the long run, this worked for Du Pont. In 1957, the International Brotherhood of Electrical Workers, AFL-CIO Local 1909, filed a petition for representation at SRP with the National Labor Relations Board. The plant opposed this move and eventually the petition was dismissed. Union activity remained high in the Augusta area, with a move toward breaking into the SRP labor force. In 1960, after a move by the Savannah River Atomic Metal Trades Council, AFL-CIO, for representation with the Labor Board, the move to unionize was defeated in a plant-wide vote by 67 percent.[16] This was the last and most serious move to unionize the SRP work force. In the years that followed, there was less and less of this sort of activity.

Transportation Changes, 1950s-Early 1960s

With the close of the Construction Era and beginning of Operations, the road and railroad system at SRP was turned over to Traffic and Transportation, better known as T&T. In 1954, superintendent Bob Cooke and his assistant, Bill Wills, headed up the T&T Department. At that time, the department was split into five divisions: Traffic; Railroad; Automotive; Equipment Maintenance; Labor and Heavy Equipment. The Traffic Division, headed by Charlie Watts, was headquartered in Building 703-A. Railroad, under Bob Snapp, was headquartered at the Railroad Classification Yard. Automotive, under Walter Freed, and Equipment Maintenance, under Ed Harmstad, were both in 716-A. Labor and Heavy Equipment, under Art Burkhardt, was in 724-A.[17]

In 1955, it was noted that T&T vehicles traveled 835,000 miles per month, which was the equivalent of 33 trips around the world. To do this, they used 800,000 gallons of gasoline and 50,000 quarts of oil. Conscious of the expense, T&T had various cost-saving measures, such as a tire re-capping program that was estimated to save the government $17,000 per year.[18]

One of the first changes to the transportation system at SRP was the purchase of new vehicles. In 1957, a Hough prime car mover was bought that could operate over both roads and railroads to move coal cars. It was purchased by Traffic and Transportation primarily for use in D Area, and could handle 10 loaded coal cars at a time, the equivalent of one thousand tons. It had a 106 horse-power engine, huge tires, and air brakes like a locomotive.[19]

That same year, a 75-ton crane, "the largest motor crane made in the USA," was purchased by T&T to replace the older, slower crawler-type cranes. This machine arrived at the site aboard three railroad cars, and was capable of 20 mph on the road.[20]

Other vehicles soon followed. In 1961, T&T bought a new truck-tractor capable of pulling 180 tons, with a top speed of 35 mph. Made by the Hendrickson Company of Lyon, Illinois, it was considered one of the largest gasoline truck-tractors in the country.[21] Two years later, they bought at least 12 three-wheeled "tricksters" to replace pick-up trucks at certain areas of the site. Found to be difficult to repair because they would not fit on a standard hydraulic lift, workman Rupert L. Denny invented a lift attachment that rectified the matter.[22]

CHANGES IN THE 1960S

The 1960s saw the continuation of nuclear weapons materials production that had begun in the 1950s, but it was also a decade filled with other achievements, and these should be re-capped here. The Transplutonium program was a remarkable achievement in its own right, and in 1965 this lead to a world-record high neutron flux in C Reactor. Heat and power isotopes were produced for the space program during this same period. "Hector," the Heavy Water Components Test Reactor (HWCTR) was an attempt to test the possibility of heavy water reactors for the U.S. commercial nuclear community. It was in operation from March of 1962 to December of 1964.[23] The first large computers were also installed to help with reactor calculations, in addition to other administrative functions.[24]

During this period, the plant work force remained relatively small, fluctuating between 5,500 and 6,700, depending on the level of work required. This period had one of the lowest levels in number of workers in the history of the plant. African American employment figures began to tick upwards, beginning in the mid-1960s with the rise of affirmative action programs and a decline in the old racial paradigms.[25]

It was also during this period that the first of the five SRP reactors was shut down. R reactor was closed in 1964. L reactor followed in 1968. For many years afterwards, SRP ran on just three reactors, with C often down due to leaks.

Power

After the decision to close R reactor in 1964, a great deal of study was put to the idea of producing electricity at R reactor. At one point, 12 power companies across the Southeast meet with Du Pont and AEC officials to hash out the terms for a possible conversion of the reactor to the production of commercial power. Eleven of these companies, including the local South Carolina Electric and Gas, signed on for the study, styling themselves the Savannah River Nuclear Study Group.[26] For a number of reasons, most of which had to do with economy, nothing ever came of this proposal. So far as is known, none of the other reactors, when they were closed in later years, ever went even this far.

The amount of purchased electrical power reflected the decline in the number of active reactors. In 1960, the purchase amount was 95 MW. That year, a new price agreement with SCE&G allowed SRP to buy power cheaper than they could make it, leading to minimum loads at the 100-area powerhouses. This led to a relaxation on the earlier policy of "spinning reserve" of electricity produced at the powerhouses.[27] By 1968, the level of purchased power was reduced to 75 and finally to 70 MW.[28] It would remain at the level of 70 MW for many years to come.

The 1960s was the beginning of a long era of inspection and repair to the equipment at SRP, as transformers, boilers, and other devices wore out or were damaged in the course of regular use. This may have been part of the reason why the Electrical and Instrument departments were merged into the single department (E & I) in 1961.[29] The following year, more than 22 miles of old 13.8 kv wire from the now abandoned military sites were cannibalized to replace damaged wire elsewhere, particularly at HWCTR and CMX-TNX. A few years later, there was a program to replace the damaged or deteriorated wooden poles that supported electrical lines and steam lines.[30]

Transportation

By the early 1960s, after more than 10 years of punishing traffic, the SRP road system was in need of re-surfacing. This program began with the primary roads in 1963, in a contract that went to the Claussen-Lawrence Construction Company. This work began with Roads C, A, D, 3, 5, and 6, but was extended to other roads in the next several years. It was noted at the time that most of these roads had been in service since the early days of the Construction Era, and conformed to South Carolina road standards for vehicles up to 100 tons.[31]

By far the biggest change to the SRP road system came with the decision to open the Jackson-Allendale highway to public traffic, announced on August 11, 1967. Known as Road A within the plant, this road contained parts of the old South Carolina highways 28 and 125, highways that had been closed to the general public since December 14, 1952. Scheduled to open in October 1967, this route would be made available to limited public use, with passes issued at the first point of entry, and then redeemed at the other side of the plant.[32]

Other changes came about more slowly and less dramatically. The numbering of road intersections, common during the Construction Era, was dropped in the years that followed.[33] After the shut down of the reactors, many of the secondary roads laid on top of the big river water pipelines were abandoned. The secondary road network, quite elaborate in 1954, became more simplified in the 1960s.

The railroad saw changes too. Here the main issue was maintenance. In 1960, the SRP rail system got its first check-up, done by the Sperry Rail Service. They inspected 63 miles of rail line, using physical inspection and the electronic detection of defects not visible to the eye. Robert Snapp, who was still chief supervisor of the SRP railroad, coordinated this work.[34]

While things remained basically the same for the SRP rail system during the 1950s and 1960s, the commercial lines that provided the outside links went through a number of transitions. In 1960, the Charleston and Western Carolina Railroad was incorporated into the Atlantic Coast Line.[35] Much later, the ACL itself would become the Seaboard Railroad, which in turn became part of CSX. In the years to come, with the interstate highway system and the development of commercial aviation, passenger rail travel would go into terminal decline, and freight transportation declined as well. Over the years, fewer and fewer types of materials were brought onto the site by rail. Today, despite a direct rail connection, coal is brought to the D area powerhouse by truck.

Pine Planting Equipment, March 30, 1955, SRS Negative DPSPF-2154-4

Planting Trees and Fire Protection

One of the biggest changes to the local landscape began with the planting of millions of pine trees in the years after 1953. Orchestrated by the USDA Forest Service, thousands of one-foot high seedlings were planted throughout the open fields left by the departed residents. When this planting program began, it was estimated that the first pines would be ready for the pulp mills in just 12 years.[36]

Eleven years later, in 1964, the plant newspaper reported that the first pulpwood harvest had been made on SRP property by a Newberry, South Carolina, firm. The company had thinned a stand of 11-year old pines, netting some two thousand cords of pulpwood. This was loaded onto railroad cars near what had been Ellenton.[37]

By this time, in recognition of the investment that the plant had made in the pine crop, two new fire towers were built to supplement the work of the Dunbarton Fire Observation Tower (627-G). Built in the late spring and early summer of 1963 by Steel Erectors, Inc., of Savannah, each of these two towers stood 100 feet and cost $24,480. The first of these two, the Cassels Tower, was located around one mile northeast of the old Ellenton site, and was named for the Cassels family that had been so prominent in that town. The second was the Hawthorne Tower, located in the northern part of the plant.[38] This tower was just a few miles southeast of Forest Service headquarters, now located in the old Military Barracks Site No. 92. With three fire towers, it was now possible to provide adequate fire protection to the vast forests that now covered most of the site.[39]

This same period also saw the final end to the remaining pre-plant structures that dotted the landscape up until the early 1960s. At the end of 1961, there were at least three of these structures within the SRP boundaries: the Bush House, the Old Stage Coach House, and the Ashley Place. The Bush House, which had been part of the Union Hill Plantation, began as a log cabin around 1773, before the American Revolution. It was briefly used as the headquarters of Du Pont Construction, before it had a longer stint as headquarters for the Forest Service. With the military gone and the Forest Service re-located to Site 92, the Bush House was now abandoned. This was already the situation at the Coach House and the Ashley Place. The latter, located near old Ellenton, had once been the site of a plantation of over 100,000 acres. It was announced that all three, the last of their kind, would be demolished in 1962 due to maintenance costs.[40]

CHANGES IN THE 1970S

The 1970s was a decade of mission consolidation and change. By the early 1970s, years of nuclear weapons materials production had led to the determination of the best methods and best fuels and targets for use in the reactors. It was also the decade of the first oil crises, beginning in 1973. These led to a greater interest in both conservation and an interest in the environment. Energy conservation became an important mission at the plant; between 1974 and 1977, SRP reduced its energy consumption by 21 percent.[41] During that same period, the Atomic Energy Commission was transformed into first the Energy Research and Development Administration (ERDA) and finally the Department of Energy (DOE). It has remained the DOE in all the years since.

The total SRP work force, which dropped to around 5,000 in 1973, was up to just over 8,000 by the end of the decade. The breakdown of that number was: 4,911 for the plant itself; 215 at DOE; 980 at the SRP Laboratory; 1,900 with the Construction Division; 60 with the UGA Ecology Laboratory; and finally 30 with the Forest Service. It was during this decade that the first African Americans broke into higher positions. In 1973, the first blacks were hired in such departments as Power, Patrol, E & I, and Warehousing. By 1976 black employment had risen dramatically to around 15 percent of the total work force. In subsequent years, the ratio would stabilize at around 25 percent.[42]

The Barnwell Nuclear Fuel Plant was established in the 1970s in order to reprocess nuclear materials for use by the commercial nuclear industry. Located on the eastern periphery of SRP, adjacent to the Barnwell exit, the Barnwell Plant had been conceived in the late 1960s, with construction beginning in the 1970s. In 1977, President Carter halted the reprocessing of commercial spent fuel in the drive to prevent nuclear proliferation.[43] Now commonly referred to as the Barnwell Industrial Park, it remains a separate entity to this day to.

With the collapse of the re-processing effort, a greater interest was paid to the issue of nuclear waste. By the 1970s and 1980s, SRP and the nuclear community were growing concerned about the permanent burial of nuclear waste. By this point, after years of reactor operation, the waste tanks in F and H areas were reaching capacity, and a means had to be found to reduce and stabilize those materials for permanent and safe storage. This was the origin of Savannah River's Defense Waste Processing Facility (DWPF), which was conceived in the late 1970s, with construction beginning in the early 1980s.

Power

Throughout the 1970s and into the 1980s, the level of purchased electrical power was 70 MW of firm power, with another 30 MW of standby power. During this period, the increasing cost of electrical generation caused the plant to continue favoring purchased power over generated power. In addition to the slow-down at the 184 buildings, electrical production at 484-D began to decline as well.[44]

During this period, in 1975-78, various upgrades were made to 484-D, which included the installation of electrostatic precipitators on all four boilers to prevent air pollution, and the overhaul of eight 115/13.8 kv transformers at 484-D and another transformer at 681-1G.[45] Computers were also introduced into the electrical system to help save energy. On a more mundane level, but just as important, work began on cleaning the ash basins, which were becoming full by the mid-1970s. This cleaning program continued through the rest of the decade, and led to the design and construction of new ash basins.[46]

In 1974, the supervisory control cable was tested for deterioration, and certain short sections were replaced, possibly the first replacements made to the line since the 1950s. A much more serious problem occurred in 1979. On July 25, an electrical fire at Building 751-A damaged the Visicode supervisory system and cable, and other controls associated with the control system. The reactors had to be shut down during these repairs. As a result, 10,000 feet of original wax-impregnated, cotton-insulated wires were replaced by flame-retardant PVC-insulated wire.[47]

One of the first major upgrades to the pump houses occurred at the very first one, 681-5G. In 1977, the support structure had to be repaired. These repairs were extensive, and were not complete until 1981.[48]

Communication

The 1970s saw the first major upgrades to the communication systems around the plant. The plant radio system was upgraded, particularly VHF channel 1. A central repeater base station was added at Building 221-F to increase coverage.[49] Around this time, the Nuclear Incident Monitors, or NIMs, originally installed around 1964, were found to not work as well as needed. In 1979, the original NIMs were replaced by 162 solid-state NIMs provided by the Victoreen Corporation.[50]

Transportation

The road system at SRP continued to shrink as many roads were found to be redundant. In 1971, some 20 miles of primary roads were demoted to secondary roads, with reduced maintenance costs. Much of this reduction was done on Road C, where one side of the dual-lane highway south of the reactor areas was simply removed from service as unnecessary, without maintenance of any sort.[51]

In 1974, there was a road re-surfacing program that saw the first switch from the older and heavier asphaltic concrete, to a more general sand and asphalt mixture. Two years later, road re-surfacing was carried out on 78 miles of road within G area.[52]

In 1977, work was also carried out on SC Highway 125, the road between Jackson and Allendale, which had been open to the public for 10 years. This road was widened and resurfaced, and all SRP lines under the road were excavated and left exposed during this work, to help prevent any construction accidents.[53]

In 1976, the trestles had to be replaced on the railroad bridge over Upper Three Runs Creek, and this work was done by the Seaboard Coast Line. This led to a study two years later of seven other pile supported bridges on site that might have suffered deterioration after over 24 years of service. Later, many of these supports were replaced.[54] In 1979, there was a general survey of the major SRP roads and railroads, DPSP 79-1-1.[55]

As for the railroads, there were upgrades to the 618-G building at the Railroad Classification Yard. Beginning in 1976, the building's heating and ventilation was overhauled with a new infrared heat system. A women's change room was also added. This work was completed by 1978.[56] In 1978, the two original above-ground diesel oil tanks were removed due to leaks. These were replaced by two underground 20,000-gallon diesel oil storage tanks. The following year, in 1979, 618-G served as a headquarters for law enforcement during a series of anti-nuclear demonstrations, presumably after the Three Mile Island incident.[57]

Waste

In 1970 or shortly before, the small dam that formed Steeds Pond failed, allowing water to flow unimpeded down Tims Branch, a small tributary east and south of the 300/700 area that eventually flowed into Upper Three Runs Creek. Since Steeds Pond held back many of the chemical wastes that would otherwise flow downstream, it was decided to repair this dam, and this was done in 1970.[58]

Several years later, in 1977, construction began on the sanitary waste water containment building, 607-7A, designed to solve the area's sanitary waste problem. A component of this new system was to have waste water from the 300/700 area sewage treatment plant sprayed into the adjacent woods.[59]

By this time, problems were found at the 643-G burial ground. In 1979, ground water surveys found that tritium deposited in the burying ground was migrating out of the southwest corner of the field. This situation and the solution were worked up in report DPSP 79-1-3. The following year, the burying ground received from the Navy a cache of reactor components that filled nine railroad cars.[60]

CHANGES IN THE 1980S

The decade of the 1980s was one of great swings in the fortune of Savannah River. Despite an increase in anti-nuclear sentiment, the decade began with a huge program for the re-start of L reactor, which had been closed down since 1968. This effort, which proved successful, dominated the first half of the decade. The second half saw the increasing disenchantment of Du Pont with its situation vis-à-vis the Department of Energy. When it appeared that the government was no longer willing to shield the company from litigation, which had been the case since the 1950s, then Du Pont announced that it would not renew its contract. The reactors themselves were all closed down in 1988, a move that proved to be more or less permanent. The decade also saw an influx of new workers, in addition to the introduction of the new contractor, Westinghouse, in 1989.[61]

Threats to the nuclear community were also changing during this period, and none was taken more seriously than terrorism. The rise of the Islamic republic in Iran in 1979, and the general up-tick in fundamentalist violence in the years that followed, led to security concerns that were different from those of the past. The threat of terrorism became just as great, if not greater than that of old-fashioned spy-rings and sabotage. Du Pont was not willing to militarize the site with its own people, and this led to the advent of Wackenhut, brought in by DOE to guard the site in the early 1980s. This led to the demise of the Du Pont Patrol in 1984.

Soon after, it became clear that Du Pont was no longer interested in operating the plant for the DOE. In 1987, Du Pont announced that it would not seek a renewal of the contract, set to expire in 1989. The reactors were then shut down in 1988, to await the new contractor, Westinghouse. When Westinghouse took over in 1989, they changed the name of the facility from Savannah River Plant to Savannah River Site. This would usher in a new era for Savannah River, one dedicated to clean-up and stabilization of the nuclear materials that had been produced since the 1950s.

L Reactor Restart

The re-starting of L reactor was one of the last hurrahs of the Du Pont era. The task force for the re-start was organized in October of 1980. At that time, the goal was to have the reactor up and running within three years, at an estimated cost of $180 million. Steam for heating would be provided by a temporary oil-fired boiler. Since it was decided not to re-start the 184-L powerhouse, it was determined to run a steam line from K area to provide a more permanent source for steam.[62]

L restart coincided with a general five-year program to upgrade the plant facilities, for a total cost put at $326 million.[63] Part of this new program required new steam lines extended from the 484-D powerhouse, to the 200 areas and to C area.[64] New steam lines were also done from 484-D to TMX, which allowed for the retirement of the old CMX oil-fired boiler. In 1984, the steam lines from D area to F area were damaged by water hammer during the start up tests and had to be repaired.[65]

Due to new environmental regulations posed by the state of South Carolina, the L reactor restart program was required to construct L Lake to help moderate the release of heated effluent water from the reactor. The L Lake dam construction began in 1984 and was completed by October of the following year. L reactor actually began operation again on October 31, 1985, the first time it had been run since 1968.[66] The whole L reactor re-start project, from the reactor and the lake to the new steam lines, was the largest SRP construction program since Par Pond.

Transportation

In 1981, an Intel microprocessor-based traffic monitor was installed along Highway 125 to help regulate traffic.[67] Otherwise, the annual plant histories had little to say about major changes to the SRP road system. This was not the case with the railroads.

In fact, the railroads were mentioned a number of times, despite the fact that the lines were contracting, which was certainly the case after the closure of the reactors. During this era, it was noted that many new hires into the plant were first brought to work on the railroad section crews until other openings became available in their preferred departments. "It was at the railroad where most of them learned their first lesson in safety and job discipline."[68]

In 1981, a decision was made not to replace the old SRP railroad locomotives, after it was determined that they could be upgraded instead. Chattahoochee Locomotive Works, based in Cornelia, Georgia, conducted the overhaul program, which did not really begin until the mid-1980s. The price for each locomotive upgrade was an estimated $273,000.[69]

One instance of the shrinking railroad system was the closure of the Robbins station by the Seaboard Railroad in December of 1983. The Seaboard's business with the plant, previously handled by the Robbins agent, was now done through railroad connections in Augusta.[70]

Locomotive Painted with "Savannah River Site", date unknown, Photograph Courtesy William Hinson

By 1986, the SRP rail system had some 64 miles of track, only 50 of which were regularly used. It was noted at the time that the system still had four 120-ton and one 80-ton "Alco" (American Locomotive Company) locomotives, with a roster of regular personnel of only around 25 people. Their main task, as before, was to move radioactive materials between the reactor areas and separations in cask cars that weighed up to 70 tons.[71]

By the late 1980s, changes finally had to be made to some of the locomotives and rolling stock. In June 1989, one of the four original American Locomotive Company engines was replaced with a new No. 107 GE locomotive, which had a horsepower rating of 4,000 and was also computerized. It was about this time that the locomotives were repainted red, white and blue, with the "SRS" label to reflect the new name of the plant. By this time, Railroad Supervisor Robert Snapp had long retired from the railroad service; the main siding at the Central Junction, located between R and L areas, was named in his honor.[72] Another new feature, added a few years earlier, were the solar chargers that were put on each of the railroad crossing signals, to replace the older battery system.[73]

Power

A number of powerhouse features were overhauled or replaced during the SRP five-year plan. This included an overhaul of the second generating unit of 184-K, done in 1980, followed by new boiler controls and instruments in the other active powerhouses. Almost simultaneously was the first overhaul of the 115/13.8 kv transformers at all the 100 areas.[74] The 784-A boiler house underwent major repairs when both boilers were overhauled in 1985 (SRP History, All Areas 1986:518). The river water pump houses also underwent repairs; in 1981, all 20 of the pumps and motors in 681-1G and 681-3G, plus the traveling screens, were overhauled.[75] In 1984, a third purchased power line was run to the plant from SCE&G, this time to the 504-3G switchyard.[76]

Despite all of the upgrades that occurred in the early 1980s, many of the power facilities that were being improved would not last the decade. With the close of the last reactors in 1988, most of the powerhouses were also closed. The big exception was 484-D. Ironically, most of the powerhouses that endured were the smaller ones that only produced steam, particularly the steam generation plant in A Area.

Communication

The communication system at SRP really began to change in the 1980s, with modern upgrades to the systems already in place, and the introduction of new technologies. One of the first to change was the original fire alarm system, which was replaced in 1980 by a new computerized system that met the provisions of the new National Fire Code. This was followed by replacement of the NIMs, Nuclear Incident Monitors, by new solid-state models that were better able to document radiation exposure. Other alarm and security upgrades occurred in the 300/700 area a few years later. This included a "Plantwide Alternate Alarm Center" established as a back up facility.[77] There was also a 12-station radiation monitoring system placed around the plant perimeter to check for gamma ray flux. This information was sent back to a central receiver in F area via radio telemetry.[78]

By this time, the Emergency Operation Communication (EOC) was set up to ensure that communications throughout the site would be safer and more secure than before. By 1983, there was a plant-wide cable television system, or CATV. There was also a digital voice privacy radio system, or DVP, set up as a radio network for the Security Department. It was encrypted so that listeners outside of the site could not eavesdrop on plant radio transmissions. This program included 184 radios for Operations and another 25 for DOE.[79]

By the mid 1980s, SRP had a plant-wide broadband communication network that could handle video, voice, and general data transmission. There were even the beginnings of a SRP-Wilmington stop-motion video conferencing arrangement, set up in Building 703-A. A new paging system was introduced.[80]

Probably just as important was the expansion of the computer age into the office workspace. By the mid-1980s, office computers had become the norm at Savannah River, and systems were required to ensure inter-connectivity within the plant. The Central Computer Facility, or CCF, grew by 42 percent in just 1986 alone, to reach 1,114 terminals and printers throughout the site.[81] This trend of working with computers and computer networks would continue at the site without interruption right up to the present day.

CHANGES IN THE 1990S AND 2000S

It just so happened that the departure of Du Pont in 1989 coincided with the end of the Cold War that same year, followed by the collapse of the Soviet Union two years later. As a result, the new contractor, Westinghouse, inherited a very different national and international situation than that which marked the Du Pont years. The end of the Cold War meant that nuclear weapons material production could take a definite back seat to other issues, and it even led to the general decline in the nuclear stockpile. Even so, there was a brief attempt to restart K reactor in the early 1990s, which led to the hiring of thousands of new employees, who would later be let go. From a high of 23,700 in 1993, the number of employees dropped to 13,854 by the end of the 1990s.[82]

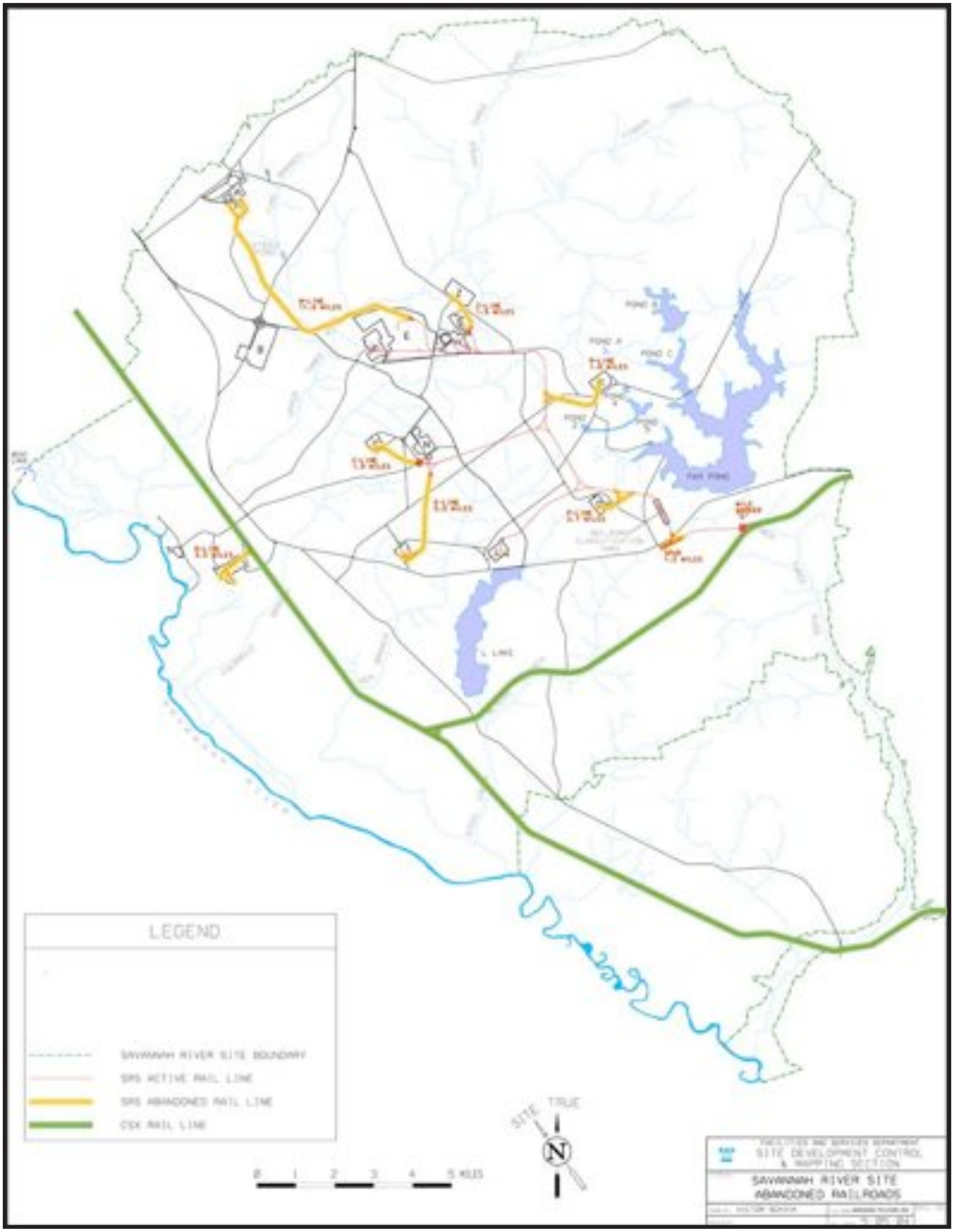
Despite a brief start-up at K reactor in the early 1990s, the reactors have all remained shut down. The emphasis at the site since the 1990s has not been on production, but on waste management, and this is as it should be. There has been much to clean up. Since that time, a number of firms have partnered with Westinghouse and the companies that followed, to ensure the smooth operation of the Savannah River Site.

This change in emphasis led to the new major mission of the 1990s, which was Environmental Management, or EM. This program began in 1989 as a means of dealing with the old burial grounds and seepage basins, and has dove-tailed well with the older and complementary mission of the Defense Waste Processing Facility (DWPF), which is still on-going at SRS. The EM program encompassed environmental quality, an interest in nuclear non-proliferation, and a general clean-up of "legacy wastes."[83]

As the mission changed, so did the infrastructure. With the final closing of K reactor in the early 1990s, there was no longer a need for the elaborate transmission loop system that had guaranteed the safe and uninterrupted operation of the reactors. The 504 switching stations are still in place, but much of the control equipment in the Load Dispatcher's Office in Building 751-A (Control House and Primary Substation) was dismantled around 1993.

The railroads have also continued to shrink. By 2004, many of the peripheral rail lines had been formally abandoned. As a map of the abandoned rail lines shows, the lines to D Area, to C and K, to P and R, and the M Line to 300/700, had all been decommissioned.[84] The main line out of the classification yard was still intact, as were the connections to L and to the separations areas.

SRS Abandoned Railroads, May 5, 2004, SRS Archives



THE PEOPLE AND SOCIAL LIFE

The people who worked in infrastructure, the people who did the everyday work in the T&T and Power departments, were the not the same as the engineers, physicists, and chemists who came to run the reactors, the separations areas, and the laboratory. The people who ran the nuclear side of the whole operation were Du Ponters with prior experience in Wilmington, Delaware, and at other Du Pont operations. While this was true for many of those in charge of T&T and Power, this was not true of most workers. Most of those folks were pulled from the surrounding predominantly rural communities around Savannah River Plant.

This can be seen in the different residence patterns between the two groups. In 1954, there was a survey done to determine where most Operations employees lived. While no social distinction was made within this group, it is clear that Aiken was the hands-down favorite. Some 46 percent of respondents lived there. If you included Augusta, the percentage rose to 73. The other towns listed had far fewer residents: North Augusta, Williston, Barnwell, and Allendale.[85]

By contrast, a more rural residence pattern was definitely perceived with infrastructure workers, even at the supervisory level. A listing of the residences of the T&T supervisors, compiled in 1986, clearly shows that most lived in smaller towns, not in Aiken or Augusta, or even North Augusta. Out of 44 supervisors, only 20 lived in Aiken, Augusta, or North Augusta. The other 24 lived in communities like Williston, Barnwell, New Ellenton, Edgefield, Jackson, Allendale, and even smaller South Carolina communities like Ridge Spring, Neeses, Denmark, Trenton, Sycamore, Appling, Warrenville, Salley, and Georgia communities like Hephzibah and Sylvania.[86] Among those in the department who were not supervisors, it is just as likely, if not more so, that they too lived in smaller communities.

Unlike many of the engineers, chemists, and physicists who ran the plant, many of the infrastructure folks were less buttoned-down in appearance. And this was certainly true in the 1950s. An interesting 1956 article in the plant newspaper mentioned an SRP "fraternal organization" of sorts that was called the "Brothers of the Brush." This referred to facial hair: beards, moustaches, or sideburns. Many of these employees worked in the Power or Electrical departments.[87] In the 1950s, this was not normal attire, and certainly not for those in a white-collar job. This seems to have created something of a trend in the Power and Electrical departments, and to this day, many employees in those areas continue that tradition.

"Brothers of the Brush", Electrical Department in A-Area, August 7, 1956

Mr. W.A. Poston, SRS Negative DPSPF-3649-5

Mr. Rock Harn, SRS Negative DPSPF-3650-7E

Electrical Crew in C-Area, June 6, 1958, SRS Negative DPSPF-5230-1

Another trend in these departments, particularly pronounced at the powerhouses, has been the tradition of outdoor grilling. When the reactors were still running and the power houses were occupied, grilling was an everyday event. It was even common for a worker to be designated the "official" cook. This was a serious task, and it was said that co-workers often relived the cook of his other responsibilities so that he could better fulfill this task.[88] Even today, one can see elaborate home-made grills tucked away in the exterior portions of almost every SRS powerhouse.

Electrical Department Supervisory Crew, September 20, 1952, SRS Negative M-1396-02

Traffic and Transportation, or T&T, also had its specialties. T&T employees often won the annual fish rodeo held by the plant's recreational organization at Clark Hill Reservoir.[89] This department was also one of the first to which African Americans were allowed to work. This was especially true after the Construction Era. In Operations, during the 1950s, most African Americans were only hired for janitorial and cafeteria work. By the 1970s, however, some African Americans, like Sheppard Archie, rose to prominent positions in T&T. This was trend was soon extended to the other departments as well.

By the early 1960s, the first wave of SRP retirees were regularly announced in the plant newspaper, and many of these were long-time Du Ponters who had worked for the company in other arenas before coming to Savannah River. Many worked in T&T or in Power. John P. Draughon, one of the supervisors in Power, retired in 1964 after 37 years with Du Pont.[90] Another Power supervisor who retired at about this time was Harry F. Ross. Born in 1899 in an Alaskan mining camp, Ross had previously served at Hanford.[91] Jack L. Allen, a chief supervisor in the Power Department, died in 1963.[92] William A. Wills, assistant supervisor of the T&T Department, retired in 1966 after 31 years with Du Pont.[94] Robert J. Snapp who had headed up the railroad division since its inception, celebrated 30 years with Du Pont in 1961.[95] He too would retire before the decade was out.

Construction Era Transportation Department Personel, January 8, 1953, SRS Negative M-1805-01

All of the people mentioned in the paragraph above are now deceased, but a few of the people who were much younger and held more subordinate positions in those early days, are still alive. Some of these people were interviewed for this project, and the highlights of those interviews are presented in Chapter 13.

XII. THE CURRENT STATE OF INFRASTRUCTURE

The various types of structures and resources that make up the infrastructure at SRS are represented in the current report. With the exception of the military barracks and gun sites, and the diesel oil storage tanks, each resource type is still extant. However, this situation may soon change.

The end of the Cold War in the late 1980s created a shift in the SRS mission from nuclear proliferation to waste management and the clean up of burial grounds and seepage basins. With the change in mission came a change in infrastructure needs. The shut down of reactors ended the need for the sophisticated transmission loop that guaranteed uninterrupted operation. While the 504 switching substation remains in place, most of the control equipment once located in the 751-A primary substation has been decommissioned and dismantled. In addition, the 184-K powerhouse and the 784-A boiler house have both been decommissioned and abandoned in place. The 681-3G river water pump house, as well as the Par Pond pump house (681-6G) and equipment building (681-7G) have also been decommissioned.

Many of the original rail lines have been decommissioned and abandoned, along with much of the rolling stock, the track scale house, and the locomotive shops (601-G, 602-G, 608-G, and 618-G). Although most of the decommissioned and abandoned facilities are currently extant, several are scheduled for demolition.

Infrastructure services that remain in use include fence and road lighting (501-G); roads, walkways, and parking areas (603-G, 604-G, and 613-G); the truck scale house (616-G); pipe supports and overhead steam lines (801-F and 802-F) and undergound water pipes and steamlines (901-G and 905-G); the fire alarm system, and telephone and cable (505-G and 506-G); and sewers and sewage treatment (607, 903-G, 904-G, and 907-G). Although these systems have remained in use, standard maintenance and upgrades have changed the original configurations of these facilities over time.

The infrastructure of SRS will continue to change over time. As the mission of the plant changes with future shifts in social, political, and economic conditions, infrastructure facilities will be abandoned, replaced, and modified to meet the changing operation and needs of SRS, the surrounding community, and the nation.

XIII. INSIDE PERSPECTIVES

This chapter contains excerpts from oral history interviews that provide historic perspectives on the Site's infrastructure, its creation and change over time. They are ordered topically dealing with site layout and survey, followed by transportation and power systems. The interviews are presented in their entirety in Appendix A.

RAY BLACK

When I worked at Savannah River Plant in the beginning there wasn't any buildings out there so we used a farmhouse and things of that nature. And where I was located at was called the Bush House, which was right out of the 700 Area. And we worked out of that area the whole project, from one side of the project from the other side, surveying it out, getting the baseline set up, getting everything coordinated in order to get the areas located and all of the systems of that nature. Also worked on the survey and laying out of the Savannah River Plant in the beginning. That's over 300 square miles down around Savannah River, the river itself. In other words, we laid out the boundary line.

We also did survey that out again in—I believe it was in 1957, 1958. We went through there one more time. Why they did that was because there was people that was moving in on the Savannah River Plant property. And as we surveyed the place we ran into several places that people had buildings over on the Savannah River Site and things of that nature and all that had to be moved out. That was the purpose of the survey the second time. And they also put fences up around those areas that people was living close by and I think that probably eliminated most of that problem.

They did have a fence around part of [the plant]. In the beginning [it] didn't have the barbed wire fence up. But they entered the project from Barnwell, Williston, and the Aiken side and also the North Augusta side. We did have perimeter fences up, but they only went for a few hundred feet.

Green Construction. They had a big contract out there in 1951 and they had a slew of people working for them. Green Construction Company built most of the main roads, I'm going to put it that way, you know, short roads around the areas and things like that, DuPont did it. Green Construction Company out of Greenville, South Carolina, had the big contract out there putting the railroad lines, doing the work for them and also the main roads.

I [also worked on the pipelines]. That's the pipelines that goes—the pipeline that went to 100-R, 100-P, 100-K, 100-K, 100-L, and 100-C all come from the river from the pump house. And we pumped it from the pump house off the river. I had some experience on that too.

Some [of the pipelines were] probably about eight foot [in diameter] because I'm 6'4". I'm 6'3" and I could stand up in the pipe. Yeah, I could stand up in it. And the pipes were something like ten, twelve foot in sections. All concrete pipes. Well we really never did run into a big problem. Everything was well co-ordinate, everybody knew what they was doing. You didn't have a lot of this paperwork back in those days. Your crew will line up on safety the first thing in the mornings and what they expected during the day, and everything was pretty well coordinated and putting those pipelines in almost worked perfect. No problem whatsoever.

Back in those days most of it [pipeline trench excavation] was cranes with a bucket. They didn't have these nice backhoes and things they have today. But most of it was done with a crane, a bucket.

Put those pipelines in, it was fast. 100-R was the first one that went into operation out there. I believe that was in '53, 1953 and then I think 100-P and so forth. The complete job— The whole job was complete in 1955, everything, all the reactors were in operation in 1955. That's hard to believe, from '51 to '55 all of them operating.

The people there were—there's plenty of them. Just my department, layout department alone, we probably had 1500 people scattered around the whole project, and they had a lot of crews. It would be hard for me to say exactly how many, but I would say there'd be at least a hundred working on those pipelines at the time in different sections. And really they could work anyplace on that pipeline. In other words, it was not starting here and go all the way through with it. One crew would be maybe a mile apart. But then we'd tie into each other and things of that nature. Some of it started at the hundred area itself and go back towards the river. It tied in. That's the way we put it in.

This here is hard to believe, but it's a fact, they put those pipelines in and never, ever did one ever bust. There are ones that never had to be replaced. Now the pump houses, the metal pipes in the pump houses, I'm not sure which one it was but they had a pipe down there that bust, it flooded that pump house. Put them in and forgot about it. Now they maintained those pipelines. Operations, they maintained those pipelines.

There was very few building contractors out there because back in those days they had a strong union, and there's some contractors were to come out there but the union kept them out. The first union contractor came out there to put up buildings that I know about was in about 1970, and he started off at Central Shops and they've been there ever since.

Well each department had a union. The carpenters had their union, pipefitters had their union, electrical had their union, sheet metal had their union, millwrights had their union. Every craft had their separate union. And B. F. Shaw was a pipe— They're the one that had the contract for putting all the pipe in was B.F. Shaw.

In the beginning it wasn't all that hard. But a lot of them— As a bunch of us finishing up it was hard to get on out there. You had to have experience—whatever craft needed that men you had to have experience, things that nature. And every craft hired their own people. It didn't go through the administration and things of that nature. If the pipefitters needed so many men in the Pipe Department, they hired Electric [folks], so forth, and things of that nature. But it was up and down. It was a yo-yo out there for a long time, hiring and laying off.

I worked in the engineering department all the years I was out there. We started off with something like—I think at the time it was probably about 1500 men. And as it progressed, we'd have layoffs, things of that nature. And the other crafts, pipe, electrical, millwrights, everything else, everything the same way. And the people they all started about 1953, 1954, 1955. And like my department, I said, our number it started going down real fast and I was looking anytime to get laid off myself. But there was only two of us left in my department that stayed from the beginning to the end of it, and that was myself and George Shealy. And it was sort of—construction was up and down. If you didn't have a lot of work to do they'd lay off. Another job would come up, they'd hire. They was hiring and layoff. It was just a steady thing going on. I don't know how it is out there now. Sometimes I wonder how I survived, but I know how I survived from hard work and I did my job.

GEORGE SHEALY

I worked with the survey crew, better known as Layout, Layout Department, or they called us the layout engineer was one name for us. I went there March 19, 1951 is when I started. I stayed there until the first day of April, when Du Pont left, 1989.

Because of the nature of our work, we were in every area and we had folks—our engineers covered every area, every aspect. But even before I got into management I was involved almost in every area of work, some way or another. I remember what they look like, a lot of them right now, before. For example, 200-F was built right in the middle of a cotton field. And it's cotton still there in— The diversion box I was telling you about was built right in the middle of—prettiest peach orchard you ever saw. Had peaches—I'd say the biggest peaches I ever saw. [When] we was in there laying they'd have them old Albertas in there.

I worked in all areas from the very beginning. We ran what is known as control, running the (unintelligible) system for all the areas, and I was involved in a lot of that. Our party did that. We also ran the power lines and that was our first work I did.

Yeah, [I worked on] establishing what we call control. That Geodetic Survey did a lot of that but then we had to take off of their control and establish that throughout the plant. You had a system. It was not difficult at all. It was something you had to work at to do it. I mean, not everybody—not every crew was really suited to do the work that precise and we were picked, our crew was picked. [You worked] with the instruments and chains. Your chain is primarily the way we did that. Nothing electronic in those days. Wheelbarrow and shovel was the main thing from a mechanical [standpoint].

…we cleared our own right-of-way and everything through those swamps. I know this one sticks out in my memory because Three Run swamp was so tough to get through. And we did that big power line through. I forget the voltage line on that.

Yeah, we cleared it out. We had a—so that we finished it and tied it down and made sure that it was correct according to the drawings and where they want them. And of course things was happening so fast then you might look up and see a bulldozer behind you when you're doing these things a lot of times.

We ran through Three Run Creek…, we crossed that rascal twice. It's about a mile wide, the swamp area of that. That was a tough go and you couldn't get anybody to do that now, they'd have to have a bulldozer or something. We did it with bush axes and crosscut saws, whatever we needed. If we got to a big tree we didn't bypass it. We cut it by hand. No power saws, nothing power. You know power saws then wasn't [available]. In 1951 you really didn't have the power saws you'd have now… A lot of these companies have these two big large ones, but we never had any power saws. There's cross-cut saws, axes and bush axes, machetes.

We had to cut those—always our right-of-way but where people could walk them and inspect them, look at them. Our supervisors and engineers and power line people could walk them. We had to cut everything down where they could walk without a tripping hazard. (laugh) Every power line location, every road location or pipeline location, everything was did by hand same way that I described what we did there. — Let me make this clear, our right-of-way was just three foot wide or so. This was just to get our job done, not—and where people could [walk] —well-defined—a well-defined line and where people could go, walk it, do whatever they needed to do.

And then part of my same layout crew we started working on installing the pipeline, laying the pipe. All right. Well let me tell you a little bit about how they were constructed. There was a company that we called Lock Joint Pipe. They built a plant in Orangeburg just for this project, this large project, probably the largest they ever had. And they constructed these reinforced pipe, had a steel cylinder in and reinforced concrete. There was a steel cylinder inside. And these—And where you made your connection, you really was connecting steel because you know you could never—concrete itself you could never make it tight enough to hold that pressure. Of course you had your rubber gasket went around there. We had a representative from Lock Joint that stayed with the laying crew all the time. And one that stayed with our crew was— I still remember his name. His name was—last name was Short.

They started out at pump house 96 and they went a ways and they—exactly how far away I don't remember now, it come to 84. But when you got down to the— Of course it went into the diversion boxes. You know about— You have your three—three pump houses, three diversion boxes where you can divert this water to—you can cut off any pipe, but all your systems still work, any pump. If any pump shut down you can still divert that water around to wherever you need it to go to any area. Right, and that is really a complex thing, installation of the pipe.

You didn't really have a master control. You had to go to the— You had big large valves and most of them you could— The way I remember I think you had—they was electronic but you could control them manually. I don't know if a man could really [physically deal] with all that pressure. I don't know how that worked, but I remember the manual thing—handle on it, wheel-like. You had it—had these lines all interconnected when you put them there. Put it to the right place. Man that area where all your lines intersected here at these control junction boxes it was—this one, it was elaborate!

The whole time we were constructing this pipeline you—they had special trucks and trailers [that] was larger—largest—about the largest thing was built in that day and time. We had to have that— We had to have them a road—kept a road built up parallel to this pipeline right there and close to where those pipes could be delivered right to the site. And it had to be a good road for them. Even though it was dirt, it had to be a solid foundation all there because that heavy weight coming over those trucks.

And what we did is our crew would … lay those pipe exactly the way they went in the holes, the way they were to be laid in the line. So they had to be laid up there so that crane was on track. See it was slow. You couldn't have something stored somewhere way off. It had to be in the right location there. And it could be laid in the ditch. Of course it's our responsibility too, because you had different pipes. You have these outlets, vents and things, different—through that pipe. They had to be laid at the proper place and it was our responsibility to lay them. And then once they was laid everything was documented, exact location of that pipe, the number of that pipe and everything was documented. And we did that.

Your standard pipe on the straight line was a 20-foot pipe. All these other pipes had to be special made around all these interchanges, diversion boxes, so forth. They had to be special made. And a lot of times we'd come in there and we would have to give them—our layout crew would have to give them the specific measurements, how to make this one last fitting joint in there. And it would be curved. [The way the pipeline was constructed], it'd probably last hundreds of years. On the final inspection, yeah, they had a car that run through [the pipeline].

WILLIAM HINSON

I hired in on September 10th of 1951. I was with the railroad system from September 10th of 1951 to August 30th of 1993, forty-two years. Well, the railroad system at the Savannah River Site was a main part of building the Savannah River Site. It had to be built first. That was the first permanent thing that was built on the site was the railroad system. Because we had to have the rail system to move the railcars in and out with the heavy steel, rock, concrete, cement, whatever we had to have to build the plant with, and there's no other way you could get it in and out except by rail. So during the construction phase of it we had a hundred and twenty mile of track. Of course this included the tracks that were inside of the areas and the tracks in the classification yard, and the ones at the 400-Area and the ones at the interchange yard where we received the cars from the Atlantic Coastline Railroad.

This was the first thing they had to build, to start with. And of course they were working on the road system too. And the day that I was hired in, they took me down to where I would be working and the 618-G building which was—had the classification yard was—they were just pouring the concrete foundations for the building, the 618-G. And the railroad operations was being (unintelligible) was being (unintelligible) in skid shacks. These were little old temporary shed buildings, and this is where we all met, this is where we had our meetings, and this was our lunchrooms and whatever. And there's no permanent facilities down there. So 618-G was the first permanent building that was completed. And this was what we called the railroad shop. And we had eight locomotives, and there was four of them that were 1000 horsepower engines and four of them that were 500 horsepower engines, the smaller type, and we handled a lot of cars.

Once we got the powerhouses built, coal had to come in, then the reactor areas, and then the separation areas had to be built. And had something like about 35,000 to 40,000 construction workers working on the site at that time, during the peak of the construction, which was a period of—the latter part of '51, '52, and '53. And people came here from all over the country to work.

Well there was only the 618-G building, which was the big enclosed shop. And of course it contained the dispatcher's office and several little office rooms in the building. That and the scale house were the only two permanent buildings that were down there—other than just the—what we call the track crew building which housed the mobile cars that we—what the track crews worked out of. We had three full time track crews to maintain the tracks. And they consisted of one foreman and about eight employees. And another item of interest that might be, during the construction of this building, 618-G, the state law of the State of South Carolina and Georgia were that the buildings had to be—have separate sections for the white and the black. So we had separate washrooms, separate water fountains, and separate dining areas where we could eat. That changed a little later on in the later fifties—it was just a change of times and everybody accepted it and it was—there was no big deal.

We had 72 wage-roll employees—that was engineers, conductors, switchmen, and like that. And then the section crews probably consisted of three or four section foremen and maybe about thirty to forty section men. And they maintained the tracks and done the real heavy work of keeping the tracks up. Now the railroad itself was built by a construction company out of Texas, and they brought their own employees with them. And all of these employees were Mexicans. And of course they brought their equipment too, machinery and everything, to lay the track, the ties. This was a big job for a 120-mile track.

Smith's Construction. Smith's Construction, right out of Texas. Our superintendent on the railroad at that time was Mr. Bob Snapp. He was a transferee from Hanford. And he headed up the railroad division out at Hanford, and then they sent him down here. And he was DuPont and he was originally from West Virginia. He had started working with DuPont in West Virginia and then he went to Hanford, and then from Hanford he moved back to Savannah River Site when it started. And he had an assistant by the name of Mr. C.N. Cowlings, and he was known mostly as Charlie Cowlings, that's what everybody called him. And he was a superintendent from one of the southern divisions of the Atlantic Coastline Railroad. And they just had him on loan to help Mr. Snapp with the railroad. And of course later on he gave up his seniority with the Atlantic Coastline Railroad and continued with DuPont. And that was the same thing that I done. I had worked three years with the Atlantic Coastline Railroad, on the western division.

We had an interchange yard at a little place called Donora, down between—just below Dunbarton, South Carolina. And that was right on the main line that run through from Augusta to way across and down through that way in the southern part of the state. And that was called the eastern division of the Atlantic Coastline Railroad. And of course they had interchanges with other big railroads like the southern and all these other tracks down in Aiken County and on down. But we had a interchange yard in Donora with eight tracks that were one mile long each, and they weren't allowed inside of the main part of the plant. So they set the loaded cars off at the Donora interchange yard and they—then we at 618-G were only about a half a mile away. And then we would take the locomotives and go down and pick up the loads and bring them back to the classification yard, which was 618-G. And this way, we had our train crews that classified the cars. They would be all mixed up, say fifty cars, it'd be tanks, concrete, and sand, all this stuff had to be classified. And from 618-G after they were classified, then our train crews took these cars to places like central shops where there was a huge area that was built with tracks going to huge warehouses. And then we would place these cars where they could be unloaded. And then we done the placing at night, picked up the empties, so when the crews come to work on the morning part of the day, well they could unload the cars during the day. Then at night the railroad crews would go back in there, pick up the empties, and then leave the new cars, the loaded cars, for them to unload.

And I was a locomotive engineer at that time. And we were picking up cars there one night and they said that I had about right at a hundred cars behind me with a locomotive. And so that was a big train for us. Normally we didn't handle that many cars, but that particular night we had a huge load. And we had to get a car to follow us to pick up and throw the switches and stuff. As soon as the construction was over, that area was eliminated and the tracks were removed, and used elsewhere in the plant.

Well in 1954, first day of January, the entire railroad went into the operation phase out of construction, see. And at this time we had been working nine hours a day and we were reduced down to eight hours a day in the operations part. But we also got a 22-cents-an-hour increase in pay from $2.25 an hour at that time—this was for the locomotive engineers and conductors. And the switchmen, they were a $1.75 an hour, and then they got an increase too. But, like I say, it was nothing but work, work, work, and lots of it.

But we were all proud to have jobs and proud to be earning a living for our families, and we were proud of the company we were working with. But now as time went along, they reduced the crews when we went into operations, from seventy-two people down to thirty-six people, and the rest of them were excessed or let go. And another little thing I might mention, out of the thirty-six that was in my group, which was in the operations phase, there's only three of us still living, out of the thirty-six. The other two is Clyde Hammock, he lives in Barnwell, South Carolina, and Tommy McPherson, he lives over in Beach Island. Tommy is ninety years old and Clyde is eighty-three.

Now during those first years of operation, we had five reactors running—R, P, C, K, and L. And R-Reactor was the first one that went on line. And then of course you had your two separation areas which was H and L. And during those years we hauled thousands of cars, cask cars from your production areas to the separation area. And that was where I was involved in mostly, hauling cask cars.

Well, it was mostly hand operated. (laugh) Back then you didn't have a whole lot of communications, but you had enough to get by. What we would have to do is we'd take a cask car in. The H and F Canyons were separations areas altogether, and you had an extra gate you had to unlock to get into that separations area. And we had to call the patrol ahead of time to tell him to come unlock the gates, the entrance gate and then to the area, 200-F area, and then he'd have to lock that gate back when we would get through. Then we'd go to the next area and he would have to unlock that gate to let us in. And then he would stay there with us until we ran around the car. And then what we had to do was get it in front of us instead of behind us, the car, and then we could shove the car into the canyon. We always had flatcars that we had to put in between us and the cask car, see. That give us some leverage and some distance between us and the contamination material.

And we would have to change— The switchmen and the trainmen would have to change clothes, put on protective clothing and everything because they had to go inside the canyon and—whereas me on the engine, as the locomotive engineer, I was still outside the canyon. But I was close enough to see everything that was going on. But then when they came out then they would have to take the protective clothing off, check their selves out and make sure they didn't have any contamination on them.

Well just like the year of 1973 when we had the huge snowstorm here that covered the plant. Seventeen— I think it was maybe about fourteen officially inches of snow, extremely cold weather in 700-Area. Their coal fired plant was—all the coal was frozen in the bottom of the cars, and so they got up there with water hoses and stuff and tried to wash it down when it would fall into the hopper so the conveyor would pick the coal up and move it inside the plant. Well all this stuff got frozen up. And so they couldn't use no—none of the coal they had there because they had no way of moving it. So they thought if they could get some new cars in, then they could maybe open them and they wouldn't be frozen in the bottom see, and it would fall out and get in there. But anyway, they—there was no traffic being moved on the plant to amount to anything, but this snowstorm started on a Friday and continued all through Friday night and Saturday, the following day Saturday. Well, we got a call—or I got a call somebody was going to come pick me up. And so they came and got me about nine o'clock one morning on a Saturday morning, I lived out in South Augusta. And he was in an old Ford station wagon and he had chains on his wheels. And by the time he got to the house to pick me up, just one person driving it, those chains was already beating the whole side of that station wagon out, where they had come a loose. So we still had to go to South Augusta to pick up two other fellows to make up a railroad crew, see. So what we had to do was to go out to the plant and see if we could get nine cars of coal from 618-G to 3-700-Area which was roughly ten or twelve miles, and most of it was uphill. I mean, the last three or four miles was up hill.

And so we got out to South Augusta to pick up the other two fellows so that made a total of three of us, a regular train crew. And then the dispatcher, the supervisor, we picked him up on the way back so that was five of us in there. And it took us 'til six o'clock that night to get to 703-Area.

This time—the rest of the time was spent on the road pushing, sliding, trying to get there, but we—that afternoon about six o'clock we finally got to 3-700-Area. And when we got there, this old station wagon you was in with the chains (laughter) it was all to pieces. But they had another vehicle to transport us, a four-wheel drive vehicle on down to the classification yard, which was another ten miles. And it didn't take us too long to get down there. We got to the classification yard and the snow was about three foot deep up against the doors of 618-G where the locomotives had been stored. So we shoveled snow about thirty minutes to get the door opened, and then you couldn't even see a switch stand anywhere in the area, the snow was so deep. But anyway, we finally got the locomotive out, got up to the north end of the classification yard, hooked onto these nine cars of coal. And we got out of the classification yard and headed north to 703-Area where they were in dire need of coal because it was about to run out of steam. So we made it okay after we left the yard. We couldn't see any sign of a track or switch or anything, but we know that all the switches are supposed to been lined. The track is supposed to be open. The only place that we had stop to change the switch was at Fox Junction they called it. That's where the track branched off and went to 3-700-Area and we always kept it lined to F-Area.

That's the one we used the most. So we did have to stop there and line the switch to go to 3-700. And by this time I had used all the sand that I had on the locomotive for traction. We had a sandbox we (unintelligible) and we left there with (unintelligible). By the time we got this far well we done used up most of the sand so— We left Fox Junction with those nine cars of coal and crossed Three Runs Creek and we got up to the 3-700 run-around track and I applied the brakes but I didn't have any. And so I just kept braking it down a little bit at a time and finally rolled into (unintelligible) where I had to stop so they could throw the switch where we could run around the cars and me get behind them instead of in front of them to shove them on in. And all the brakes on the cars were frozen, on the locomotive was frozen. I didn't have any sand to get traction. So the locomotive and the cars started rolling backwards and I was helpless. So we all got on the locomotive—I mean the other two had gotten off to do some things they had to do. Of course they were knee deep in snow. And so we rolled down to Three Runs Creek and probably about a half a mile beyond Three Runs Creek before it came to a halt.

And we had already broken the ice on the rail, see going up and coming back the second time. And I didn't have any way to stop but I just held on the horns and the whistles when I'd come close to a crossing, because couldn't stop, nothing else I could do and there's nobody out there anyway. And so— But anyway, when the locomotive came to a halt due to no traction or nothing, I just put it back in gear and started up—back up again and had a little bit of momentum because I was going back downhill rolling. So I just opened it up and we made it right on up real good then. And got up there this time, still didn't have any brakes but I was going at a speed to where I stopped. And when I did stop, well there was a man out there and he threw chains under the wheels on the locomotive.

Of course we put chains under the cars of coal until I could run around them. And then when I got around them then we pushed them on back in, into 3-700-Area up there where they could get some coal. I had started that morning at nine o'clock from my house and I didn't get back home until six o'clock Sunday afternoon, the next day.

ROBERT SMITH

I interviewed Easter week of '51, went to work in June of '51 from Wilmington, Delaware and stayed there for three months prior to being called into the service, and then I returned to Savannah River in 1953 after being discharged from the service and stayed there through 1957. I worked in the Cost Department in the category of senior cost clerk at the time.

My first assignment was to the D-Area, I think that was the heavy water area. And this was early in the game, June of '51. And they were working from the D-Area in the close proximity to 400-Area, the pump stations and the lines to the various 100-Areas. What I recall at the time I worked on a cost study, or a unit cost study, to determine the feasibility of blasting the holes versus the conventional digging with backhoes and so forth. I don't know what the outcome of it was. I only recall being to one of those that blew up and my goodness the dirt all went up, came back down in the same hole and they still had to excavate with machinery, so I'm not sure that it was very feasible. That would have been June-July timeframe, 1951, yes. And (laugh) I do recall it was a long area. Golly, it must have been a half a mile that they planted explosives and set the charge off and the dirt went flying (laugh) in the air and as I say, it didn't excavate as well as they anticipated.

As I remember the D-Area, the traffic—(laugh) This was before the four-lane highway was constructed. And I guess it was I talked to you about the name of the road, some Ferry Road, the old road from Augusta out, and it was just trucker-blocked. An awful lot of the emphasis was on the 400-Area at that time. And we had the old prefab buildings, two-story office buildings where the staff and so forth used. And they were digging the holes. And I just remember a massive effort of men and, it was just an unbelievable effort. I don't know that we could ever do that again, to pare that away like they did.

As I recall there were about 12,000 people on the roll in June, and when I left and went in the service it went up to what sixty-some thousand and when I came back it was on the downside there.

The infrastructure was there, the Central Shops were there, the Central Office facilities, those web-shaped buildings, the two of them that were sitting in the middle, were already there and all the highways. And that was the biggest thing, the four-lane highway from North Augusta out to the plant that allowed all that traffic to flow much more freely.

I'm thinking [it took me] an hour, hour or so from Augusta. I lived in Augusta. When we first went down we lived in the Green Street Apartments, new building, high rise. In the morning and the evening it was just a steady flow out of Augusta, and it all funneled (laugh) into this one little old road. And the cars weren't air conditioned. I remember the dusty roads and the—well they were just terrible roads. And it's a wonder we didn't kill people and maybe we did, I don't know, but I wasn't involved in any other than the fact that it was just— You'd just go to sleep and hope you made it out there. And the parking lots there again too, at the job sites. These were big parking lots and they emptied clean, and I don't recall a lot of fighting and anything like that about somebody cutting somebody off or something like that.

Well everybody carpooled and it was—you just rode out that (laugh) little old narrow road. Every car was full. And the people were charging reasonable rates to pick you up and take you out there, but that was a fair buck to pick up six people or five people and carry them back and forth to the job. And I think the other thing that I would remember is payday and going through the lines and so forth. Everything was orderly. There wasn't a lot of pushing and shoving. People just did their job.

And I was just amazed at the ironworker craft, for example. These guys out there in that hot sun climbing that iron…There was so much professionalism that it made you proud, I'll tell you.

The old tin buildings were— I recall— I guess this was in— No, this would have been in '53 when I went back. I was working for a while in the T1, T2—yeah, T1, T2 the two spider-type buildings. And I remember they didn't even have air conditioning because I can remember sitting at my desk and the gnats would just come flying through the window, land on your arm. So I think air conditioning followed shortly or as quickly as they could. But it was a pretty hot place.

And of course you're aware of the way they poured all that concrete. They had these Pumpcrete machines centrally located at the end of the 100-Area building, the reactor building and they just ran these lines all over. And that was another interesting thing. You'd wake up in the morning and here's a pile of pipe the next morning and they've got it strung out, climbing up a wall. It was all over the place. I'd never seen anything like that before. This would have been at the 100-Area. I picture in my mind of the pouring of that bottom slab in the 100-C Area, the laborers that were down there. It must have been 130 degrees down there and they're moving the vibrators to get the concrete down between the re-bar rod and so forth.

I think I mentioned to you that when I came back in '53 I was assigned in the same capacity in the 100-C area. And it was the last of the 100-Areas to be constructed and as such all the men—maybe that's why the craftsmen were so good—all of the craftsmen had gone through and there was a weeding process going because the force was going down and they were keeping the better people. And to see the carpenters put the formwork up and the ironworkers put the steel in those forms and then to see the laborers pour the concrete in that, it was just remarkable.

HENRY MAIN

They needed the powerhouse, one thing, for back-up, electrical on-plant backup for the reactors. And each area had their own electrical system and they also generated steam for production, which was used in the reactor buildings. But not only did they have electrical generators, they had emergency generators also to back up. And inside the reactors there was backup for your pumps to circulate the heavy water through the reactors, they was also backup. They continually ran inside the building itself.

We bought power from South Carolina Electric & Gas, and they have a plant just outside of Augusta that was built at the time the plant was built for backup power in Savannah River Plant, but it's run by South Carolina Electric & Gas. We had a dispatcher's office that was in constant contact with South Carolina Electric & Gas. We bought a great amount of power from South Carolina Electric & Gas on a continuous basis.

There is a plant-wide system, yes - that looped the whole plant together. All the generators were connected and they were also synchronized with South Carolina Electric & Gas. You have to be synchronized. If you bring a generator online you have to synchronize it with the system before it's connected into the loop. But we were in the loop. It was also South Carolina Electric & Gas. We all tied together.

Well the 13,800 volt large cables were buried underground from the powerhouses to the reactor buildings rather than being exposed overhead. Some of it, I would assume, was probably for security reasons they were buried. Not only they were buried, they were enclosed in concrete, the lines themselves. And any line that you dig in the ground, your concrete's always red, it has a red dye, and it alerts you that it's electrical.

[The load dispatcher] they could remotely open and close switches, out in the system. And we had two primary sources of power coming from South Carolina Electric and Gas, coming two directions. And if you lost power from one direction, you could feed from another direction. It was a back-up system. Also in that building if there was—you might already know, but you could remotely control those reactors.

I was at one time—I was a boiler operator, and so I fired boilers. And sometimes it was fairly easy and sometimes it was very difficult. Sometimes we had wet coal, almost mud, and it would just work you to death, try to keep steam pressure up, and other times things would go well. But it depended on what my position was. I started out at the very bottom and I ended up as a manager of a—which I thought for me I did well. I didn't have a lot of education. I had common sense and sometimes that goes a long way…

[In] The power department, we took care of all the cooling waters, whatever it happened to be, and that's water for your reactors and any other place that they needed water. We were in charge of pumping the water from the river into the reactors, and so if it was heat, air conditioning, we took care of all that, the wastewaters which is sewage and drinking water, anything to do with utilities we would—we handled all that. And even in the production building, all the ventilation and electrical supplies and everything inside those buildings we were in charge of that.

Well, the power department for the reactors themselves, we had a—we pumped the water from the river to basins in the area. Then from those basins, it was pumped to the reactor through the heat exchangers. The power department ran the pumps going to the reactor heat exchanger. Inside the reactor building itself there is the pumps that pump the heavy water through the reactors, comes through a heat exchange and (unintelligible) there's a AC motor pulling those pumps, on the opposite end there's a DC motor. And that DC motor, the power department operated. If that AC motor fails, we're sitting there with the generators inside the building that ran twenty-four hours a day seven days a week on the end of that shaft, and it would just keep on going. So that was one of the power department's responsibilities, even though it's inside the reactor building. The emergency generators inside the buildings, we maintained all those also.

[Steamline] for instance, 400-Area, it starts out— In the 200-Areas the steam pressure was 350 pounds, and the pressure is going to be related to temperature, okay. So it leaves 400-Area at 385 pounds, and by the time you get there you have condensate as it cools. The pipes are insulated but there are steam traps all along the way, and you have to do that to get rid of the excess water as it cools and condenses. You either had a trap, it could be an inverted bucket and the bucket will fill up and it'll dump the water, or it can be thermal. And as the trap cools it will open up and it'll blow until it heats back up.

So it has to continually get rid of that moisture. What it's trying to do, get rid of the condensate. Okay and when they built that line, originally built it, the pipe was bought from South Korea. And it was built for certain temperature. You couldn't exceed a certain temperature. And so as they put it in service the first time, the—each trap which you see it blow off, there's also a free blower. You can open a valve and just blow the steam out. As you go down the line you start putting steam in the line and you blow it out and you start getting steam, no more water. You close the valve off and the trap's supposed to maintain from then on, get rid of the moisture, and you go down the line. And when it got down to where you go over the 125 highway, they had accumulated too much water in the line. And it made a slug. And you can get a water hammer from steam. If you let condensate build up you can get a (unintelligible) terrible, even in the building you had to be careful. This slug of water came along and hit that pipe and knocked it off the stands. Those pipes, they [are] in loops, expansion loops, and they on a graphite slide. And as—when it heat up it'll expand and contract. And it knocked that thing off those stands and they had to go back all the way through and put in bigger traps. The traps were too small to take care of them, so it was sort of a disaster the first time they put it in service.

Well I worked there forty years and my experience—I went away feeling good. I don't think that the company ever tried to take advantage of me. Some people went away bitter. I didn't do that. I felt good about my job and what I did and my contribution.

CHARLES HOBER

I was with the engineering department in Wilmington. I worked on the design of the—part of the design in the electrical and instrument areas from 1951 to '53, and I was transferred to the site from '53 to 1956 as design liaison to the construction operating divisions for both electrical and instrument work. I did some on the grid. Most of my work was primarily inside of the reactor buildings, but I did do— Being design liaison to the site, I got involved in questions concerning any areas that were electrical or instruments on the entire site, not just on those specific areas.

The original grid system primarily supported some of the small town areas. First off, it essentially had to be abandoned since an overall system was going to be provided for the support of the facility. So one of the first things you had to do was decide which areas were going to remain, how they were going to be supported though the transition period, and then how they were to be abandoned.

That was probably the biggest challenge. The other area, of course, was when you got down below the 115 kv system was the generation of power directly on the area itself, the powerhouses that we built. Well, the major reason [they were built] was security of individual areas themselves. They had to be self-sustaining,

The first and primary concern was continuity of power to the site. We recognized that particularly in the reactor areas that shutdown after startup of operation was going to cause long delays in restarting and significant difficulties so that multidirectional feeds had to be provided into each area. The 115 kv system was the primary feed that circled the plant, but it was supported also in step-down areas and to each area by powerhouses that supported the facilities from both a steam as well as from an electric backup. The electric backup was minimal. It was— The powerhouses were primarily for steam in the individual areas. The electrical backup in each area was primarily by the circle of supply of 115 kv system and then the support in each area of individual parallel-fed transformer breaker systems that provided the electrical supply to each of the areas. But from an electrical standpoint, the primary source was power-generated offsite feeding the 115 kv system. and that came from multiple sources.

Electric power was never really a problem on the site. Electric distribution was a concern. That's a fairly high lightning area so we had problems with that. Well there's a ground grid that runs underneath the entire 115 kv system and so that had to be maintained. The soil down there was not exactly conducive to this…[However] the entire grounding system which took care of a lot of the protection to protective relaying on the 115 kv system was a wire system underground and that was very well protected.

Basically what they were doing was taking standard transformers that were available. If you realize, we're looking at trying to get a plant up and running in truly a ridiculous timeframe. The 400-Areas were up and running in less than a year. The first 100-Area, the design of it started in late '51 and the plant went online Christmas of '53. And by any standard that's an unbelievable amount of work in a very short period of time.

DuPont limited itself primarily to the design of a few of the areas, primarily the 105-Buildings, and in fact the electrical control system was not designed by Dupont, it was designed by Blaw-Knox. And that is true, the entire 200-Area was designed by outside contractors with DuPont overseeing and participating basically in the overseeing of the design. It was— When you realize the amount of work that was being turned out, you wouldn't get one engineering department that was big enough to handle all of that.

We set the rules, we said what we wanted. We wrote the specs for what the system had—basically had to do and then we gave those to an outfit like Gibbs & Hill and put one or two people in their organization to monitor the design as it went along. That's all you really could do. You couldn't— If you wanted to operate at the speeds we were running, you had to take suppliers that you thought were capable of doing the job and let them do it.

Well my most memorable was of course in the 100-Areas where I personally was responsible for a lot of the control system. And that was a memorable experience. As a 23-year-old kid I wrote all of the checkout procedures for the control system for the reactors, and practically nobody knew what the hell I was doing. I wrote them, ran them, and when I dealt with the operating people they said, You tell us when it's ready and we'll believe you. We'll have people working with you, but you're going to take the lead. And I guess one of my most memorable experiences was when I had a manager that was umpty ump levels above me at the time and I said I didn't want to proceed on this checkout until this, this, and this were done. And he went to my boss and he said, Don't you think you can proceed? And my boss said, Yeah I think we can but— He came back to me and he said, I think you ought to proceed. And I said, Well that's fine. If you're trying to take over and run this test, I'll do it any way you suggest. But if you want me to run it, we're going to run it the way I'm going to do it. And as a 23-year-old kid how I didn't get fired God only knows.

But I remember that manager went back to the head of the 100-Areas at the time and said, I think that kid's being a smart aleck. I want him— Either he gets off the site or I do. And I remember the words of the manager of construction, What time's your plane leaving? He's doing me good, you're not. So those are the kind of things that, for me personally, were the case, but there wasn't a lot of that.

Oh I think [my experience at Savannah River] it was great. We used to laugh—Reader's Digest would write an article about all the things that were going on on the site when they were never allowed anywhere near it, and we all would laugh at how erroneous the articles were.

PATRICK HARRIS

I was born in 1933. I grew up there in the northwestern section of the state. I arrived there [Savannah River] in August, 1955 - August '55 until March of 1957, Able Battery, 33rd Anti-Aircraft Battalion.

Well that was part of the cold war situation. We had not quite gone to missiles. They were in the process of perfecting them. And I think they needed a stopgap measure plus being able to use all these soldiers and equipment (laugh) get their dollars worth out of them I guess. And it was— I referred to it— Some people may not like my reference but I refer to that as my time in internal exile because I was (laugh) out in the middle of nowhere, to tell you the truth about it. And I know the South Carolinians would love that terminology. But when you turned the lights out there on Site 12 it was—if there wasn't any moon it was just like the inside of a cave. No city lights, nothing. (laugh)

We didn't have to have a badge. And let's put it this way, the "searches" were usually cursory. They just— They'd look in the back seat. Sometimes they'd get you to open the trunk but that was a very rare occurrence. I guess when they saw that we had the military tag there they considered we were not security risks.

I really don't know exactly [how many military personnel were there] because each of our batteries, the four batteries of 33rd, were about a hundred-and-some-odd men. I couldn't give you a closer figure than that, just being a dog soldier I never actually looked it up. And then we had two other batteries—pardon me, two other battalions. One was the 425th Automatic Weapons. Now they used what's called the Skysweeper. It was a 75-mm self-contained unit with radar directing all in one unit. And the 478th— And they were scattered all over the place out there. They would be in— And I got the impression that they had what I would call hasty fortification, sandbags, nothing permanent. But they were scattered all over the place. And the men would go out there and they would stay three, four days at a time, then come back in, stay a few days at the barracks.

Well it [living at Site 12] wasn't bad, to tell you the truth about it. The coffee was horrible but that's sort of par for the course for army. But no I guess the food wasn't too bad. It had its moments. I know that one time I think I insulted the—pardon the expression—living hell out of one of the cooks there. He put this piece of cornbread on there. And I said, Sergeant, I said, when you going put some icing on that thing? He said, What do you mean, put some icing on the cornbread? I said, Well that's Yankee cornbread. I said, it tastes like cake.

[Early on] We were in tents. We had not moved into our permanent barracks out at Site 12 and we were in those huge tents. I don't know what size. I guess it would be—God's sakes, I'm trying to remember how many men. But anyway, he had been out on the town (unintelligible). And coming in—coming back, he ran over a wildcat, killed the son-of-a-gun. And it was a pretty good sized one. And when he came in out there, the—he had to show all—everybody that was out at the barracks, or out at the tent at that time. And he put it in the trunk. And so we had to go over there and admire his kill. And he was still just tight enough and said, Why don't we have some fun? And there was always a rotating card game going on there in the middle of the tent. And so a couple of us guys pulled the tent flap back and he threw that dead wildcat and it landed right in the middle of the poker game. And there were men going out the back, climbing under the side of the tent and everything else like that. (laugh)

They [the permanent barracks] were concrete block buildings, and ours were in a slight L-shape. In other words, facing the road, it'd be the long-axis and then right at the very back there was a little jog out. It didn't look like it was more than about twenty or thirty feet out from there. We didn't have any air conditioning. But what we did have were two or three huge attic fans to pull air through there. It wasn't cool in that sense of the word but the moving air made it at least tolerable, even in that part of South Carolina. (laugh)

The weapons that we had, the 90 mm, it was a radar-directed gun. We— Actually we had two radars. One was what was called the acquisition, which reached out, oh gosh, I think it was a hundred-and-some-odd miles out. And we would—you could see the targets coming in way out there. Then when they got in a little bit closer, the radar that was on the radar van, which had a much narrower beam, would—and that's what they called the tracking radar. And we would lock onto that and the radar would stay on the target and it would direct the guns, just following along like that.

It was very accurate, extremely accurate as a matter of fact. Each 90 mm, I think it had something like about a 50-yard bursting radius. In other words, if your target was within 50 yards of the burst, some steel would get into the target. How much, that'd be something else again. And we were put into a box formation, in other words, two and two. Really, if you're centered on the target, that would be an overlapping bursting radius of—well, your math may be better than mine.

And of course the 90 was a very—just like with the German 88, it was a very accurate rifle (unintelligible) as far as that's concerned. Yes, it was—they were quite accurate. No those were the only two types. Now at other sites around the country they had—and I think it's something like 120 mm. I think that was some of those out in the extreme northwest. I don't remember. Seem like it was Hartford [Hanford] or something like that. And those were actual permanent structures. I think they were casemated in concrete or something like,

Let's see, well [at Savannah River] you had the orderly room. And then you had two barracks, the mess hall, and then the two barracks for 425th and 478th. And then across the street you had the orderly room and so forth for those other two batteries. So—that'd be what, one, two, three, four, five, six, at least seven buildings out there.

They were just gun sites. Now I will say one thing. On one end of the orderly room for the 425th, the army built a small, what I'd have to call as a Beer-X, where you could buy some beer and cigarettes and everything else. And I think it had a couple of tables in it. But that's about the size of any (laugh) entertainment we had.

The [bars] that we usually hit were [in] Williston, Barnwell, Aiken, because it was— It was pretty close to an hour's drive from 12 over to Augusta, and most of the time we didn't really care to drive that far to get us a beer. It was kind of a boring duty there so that was one way to relieve that.

[Our leaves?] Well it would depend. Some of the guys would wait until they built up enough leave to— Because some of our—a lot of our guys were—their homes were out in Kansas, Texas, up in Pennsylvania, and New Jersey—"Joisey," pardon me. But I found out that you were allotted, I think it was something like two-and-a-half days leave per month. And I found out that if you applied for a five-day leave, you had very little trouble getting it. If you try for a three-day pass, they didn't like those but I said five days, three days, plus one other thing. You had what was called, I think it was a day of grace. And so I figured out that if I applied for a five-day leave about every two, three months that I was able to spend five days at home and one using that one day as travel to and from the site itself. I was working the system, is what I was doing. As a matter of fact, I was going to apply for a five-day leave once. Our sergeant said, Harris, I wouldn't do that. Said, Why don't you apply for a three-day pass? I said, Sarg, first of all a three-day pass only extends out so many miles and my home is well beyond that. And he said, Well you're using up your leave time. And I said, Well what am I going to do with it? So I applied for leave. And I had just barely gotten home when the first Suez crisis broke out between Egypt and Israel. And they were all—my mess mates were on 24-hour alert and I was fishing in the Tennessee River. So I had to rub it in when I got back!

SHEPHERD ARCHIE

When I first come in, why I got hired so fast, the first thing, when they opened up a plant, they need what? Janitors. So I applied for a janitor. I wanted to get in there. So they applied me for a janitor. I worked as a janitor eleven months, then I went to T and T, transportation. I was in the old schoolhouse in Ellenton. That was my first job, down in the schoolhouse down there. I was a janitor down there. They had an office down there, in Ellenton, South Carolina. So that was my first job.

What happened, you cannot force no one to do the right thing. You've got to let them do it on their own. You've got to carry yourself in the way they will give it to you, and not you go try to take it. See, I could ask you for something, you will give it to me, but I try to take it, you're going to rebel. You're going to take longer giving it to me. So we decided we wouldn't do that. Most of them came up through the segregation world, and we know how, and we were trying to make it better for our kids by going along whatever they do.

We knew we couldn't go in the cafeteria and eat like other people; we had to go in the corner. We'd bring our lunch. We sat in a group and eat. We know we didn't have bathrooms to go to, wash our hands. When we'd go in the field to do jobs, we would carry fifty-five gallon drums with water on it to wash our hands. So we didn't rebel. As it come, and when it did come—they integrated all the bathrooms—we didn't just run in there, and say, "I'm going to take this locker, I'm going to take that locker." We eased into what locker was available, easing in. So, trying to make it better for the next generation to come. So that is how we worked it.

Now these things here, the supervision didn't know nothing about. We talked that among ourselves, and we tried to be a part of the plant. Just like I'd tell them, said, "Now we may not run the reactors, we might not run the powerhouse, we might not run the administration building, but we repair the roads for them to get there. We're making a big contribution toward the plant. We repair the roads to get here, we repair the waterlines, we do that. We're making a great part of it for these people who are running the reactor, because they couldn't run the reactor if they couldn't get to it. They couldn't run the reactor if they didn't have water. So we're doing the greater part. Your job ain't low. Your job is just as big as the man pushing the buttons in the reactors.

I associated a lot with the minority of black. Their lives changed tremendous from poor to middle class. They got a better life out of that, by this plant coming, because just like I was trying to tell some of the guys that were working. I said, "You ought to be thankful the plant come here, because this land you was farming was just something to keep the earth together, the land was so poor." I said, but now most of them own homes, nice homes and all, so they benefit.

So I learned a lot from out there, and I hope that we continues to keep the plant. I worked the whole plant. I worked the whole plant. If somebody wanted something did, after I came to be a supervisor, I was over all the heavy equipment in roads and grounds. If they wanted something did, I'd try to get it did. Regardless of how it was, I tried to get it done. And then nine times out of ten, I got it did, because I had good peoples, and the onliest way to work with good peoples is to be good to them, and let them be a part of what's going on, make them feel a part of what you do. So we'd get in the line-up meeting in the morning. "We done got this job and we've got this going on there, so we're going to do so and so today. How do you want to do it?" And they've got some good ideas. So we get together, we go do it, and we can do it the easiest way and the safest way.

We had some of the dangerous work out there. We didn't have no accidents. We turned one motor-grader over since I was there, one of the motor-graders turned over, but nobody didn't get hurt. But we relied on each other. And something they're doing right now in T and T that I started when I was there, I did not work two blacks together, I did not work two whites together; I mixed them. You get a better line of work safety-wise and production when you do that. The two men, they compete. They didn't have nothing in common last night. Their wives didn't go out to eat together last night. They ain't got nothing to hide from each other, to share with each other. The only thing they got in common is their safety and their job, and they did a tremendous job together by working like that. I left that—they are still doing it now. In the CSWE [Central Services Works Engineering], it's working like that, and that's working out fine.

Most everybody benefit by this plant coming here, and by that Savannah River Plant coming here, it not only helped that people that moved out of the area, the people that worked out there, but the industries inside Augusta and in the surrounding area. [They] had to go up and match the salary, or come close to matching the salary at the Savannah River Plant, the people at Babcock and Wilcox, Miriam Brothers and everybody, they had to go up and match the salary, or come close to matching the salary at the Savannah River Plant to keep their employees.

So that being that Savannah River Plant over there, it helped the whole area. Helped everybody. It didn't just help the people that worked out at the Savannah River Plant. The people at Babcock and Wilcox, Miriam Brothers and everybody, they had to bring their salaries up to keep their employees, because they were leaving here and going out there. Even the police department. They were going, leaving the police department, going to work for Du Pont security department and different places.

[The area has] changed. Some of the peoples left and some—the guy next door there, he worked over there, but he died in '81. But it's been the same. Kind of changes everywhere—you don't have no hard feelings about the plant out there. Everybody really cared for the Savannah River Plant, because why, they felt like they were kind of safe with the Savannah up there, but they don't trust these chemical companies here now. But Savannah River Plant, they trusted Savannah River Plant. Savannah River Plant tried to practice what they preached.

And another thing that made Savannah River Plant great, they hired inside the families. See, I have a son working out there now. My wife and I raised her sister's boy, a nephew. He's out there. And I have a niece out there. See, a big part of the safety record was to—see, I brought safety home with me. I'd tell my kids about house safety and what to do, what to don't do, how to drive a car, what they don't do, and Savannah River Plant helped a lot of families. You hardly ever hear kids, that their family was employed at the Savannah River Plant, get in trouble, because of the family, the peoples, the family that took care of them.

That man out there, he have five kids. He have two sons, three daughters, and they're always doing well. And nine times out of ten, everybody that had families worked at the Savannah River Plant, they did good. I sent all three of my kids to college, from working at the Savannah River Plant. My son, he's out there now, in the fire department. The one on the end out there, she's a doctor in Morehouse College, Atlanta. And this one right there in the middle (points to photograph), she went to Paine College.

So the Savannah River Plant really upgraded this section of the Southeast, not only here, all around Beaufort and all of those places down there. I worked with a lot of peoples from down there. So I think that it did us a good thing by moving in here. That's why I hope they keep it there.

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CHAPTER II

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GLOSSARY

A

Alpha Particle
A positively-charged particle from the nucleus of an atom, emitted during radioactive decay.

Atom
A particle of matter which cannot be broken up by chemical means. Atoms have a nucleus consisting of positively-charged protons and uncharged neutrons of the same mass. The positive charges on the protons are balanced by a number of negatively-charged electrons in motion around the nucleus.

Atomic Bomb
An explosive device whose energy comes from the fission of heavy elements such as uranium or plutonium.

B

Becquerel (Bq)
A unit of radiation equal to one disintegration per second.

Beta Particle
A particle emitted from an atom during radioactive decay.

Biological Shield
A mass of absorbing material (e.g., thick concrete walls) placed around a reactor or radioactive material to reduce the radiation (especially neutrons and gamma rays respectively) to a level safe for humans.

Breed
To form fissile nuclei, usually as a result of neutron capture, possibly followed by radioactive decay.

C

Chain Reaction
A reaction that stimulates its own repetition, in particular where the neutrons originating from nuclear fission cause an ongoing series of fission reactions.

Containment Building
A containment building houses the reactor, pressurizer, reactor coolant pumps, steam generator and other equipment or piping containing reactor coolant. The containment building is an airtight structure made of steel-reinforced concrete. The base slab is approximately 9 feet thick; the vertical walls are 3 3/4 feet thick; and the dome is 3 feet thick.

Control Rods
Devices to absorb neutrons so that the chain reaction in a reactor core may be slowed or stopped.

Coolant
This is a fluid, usually water, circulated through the core of a nuclear power reactor to remove and transfer heat energy.

Core
The central part of a nuclear reactor containing the fuel elements and any moderator.

Critical Mass
The smallest mass of fissile material that will support a self-sustaining chain reaction under specified conditions.

Curie (Ci)
A unit of radiation measurement, equal to 3.7x1010 disintegrations per second.

D

Decay
Decrease in activity of a radioactive substance due to the disintegration of an atomic nucleus resulting in the release of alpha or beta particles or gamma radiation.

Decommissioning
Removal of a facility (e.g., reactor) from service, also the subsequent actions of safe storage, dismantling and and making the site available for unrestricted use.

Depleted Uranium
Uranium having less than the natural 0.7% U-235. As a by-product of enrichment in the fuel cycle it generally has 0.25-0.30% U-235, the rest being U-238. Can be blended with highly-enriched uranium (e.g., from weapons) to make reactor fuel.

Deuterium
"Heavy Hydrogen", an isotope having one proton and one neutron in the nucleus. It occurs in nature as 1 atom to 6,500 atoms of normal hydrogen, (Hydrogen atoms contain one proton and no neutrons).

Dose Equivalent
The absolute measurement of exposure to a dose of ionising radiation depends upon the type of particle and the body tissue with which it interacts - hence the conversion to dose equivalent, which has units of rem. Rads are converted to rems by multiplying by a factor that depends upon the type of ionising radiation and it's biological effect. For example, with gamma radiation the factor is 1 and a rad is equal to a rem.

E

Element
A chemical substance that cannot be divided into simple substances by chemical means; atomic species with same number of protons.

Enriched Uranium
Uranium in which the proportion of U-235 (to U-238) has been increased above the natural 0.7%. Reactor-grade uranium is usually enriched to about 3.5% U-235, weapons-grade uranium is more than 90% U-235.

Enrichment
Physical process of increasing the proportion of U-235 to U-238.

F

Fast Breeder Reactor (FBR)
A fast neutron reactor (qv) configured to produce more fissile material than it consumes, using fertile material such as depleted uranium.

Fast Neutron Reactor (FNR)
A reactor with little or no moderator and hence utilising fast neutrons and able to utilise fertile material such as depleted uranium.

Fertile (of an isotope)
Capable of becoming fissile, by capturing one or more neutrons, possibly followed by radioactive decay. U-238 is an example.

Fissile (of an isotope)
Capable of capturing a neutron and undergoing nuclear fission, e.g., U-235, Pu-239.

Fission
The splitting of a heavy nucleus into two, accompanied by the release of a relatively large amount of heat and generally one or more neutrons. It may be spontaneous but usually is due to a nucleus absorbing a neutron.

Fission Products
Daughter nuclei resulting either from the fission of heavy elements such as uranium, or the radioactive decay of those primary daughters. Usually highly radioactive.

Fuel Assemblies
These are a group of fuel rods.

Fuel Fabrication
Making reactor fuel elements.

G

Gamma Rays
High energy electro-magnetic radiation.

Graphite
A form of carbon used in a very pure form as a reactor moderator.

H

Half-Life
The period required for half of the atoms of a particular radioactive isotope to decay and become an isotope of another element.

Heavy Water
Water containing an elevated concentration of molecules with deuterium ("heavy hydrogen") atoms.

Heavy Water Reactor (HWR)
A reactor which uses heavy water as its moderator.

High-Level Wastes
Extremely radioactive fission products and transuranic elements (usually other than plutonium) separated as a result of reprocessing spent nuclear fuel.

Highly (or High)-Enriched Uranium (HEU)
Uranium enriched to at least 20% U-235. Uranium in weapons is about 90% U-235.

I

Isotope
An atomic form of an element having a particular number of neutrons. Different isotopes of an element have the same number of protons but different numbers of neutrons and hence different atomic masses, e.g., U-235, U-238.

J

Joule
A unit of energy.

K

KeV
One thousand electron-volts. An electronvolt (symbol: eV) is the amount of energy gained by a single unbound electron when it falls through an electrostatic potential difference of one volt. This is a very small amount of energy.

Kilowatt
A Kilowatt is a unit of electric energy equal to 1,000 watts.

Kilowatt-Hour
This is a unit of energy consumption that equals 1,000 watts used for one hour. For example, ten 100-watt light bulbs burned for one hour use one kilowatt-hour of electricity.

L

Lattice
Structural configuration in a reactor organizing positioning of fuel rods, control rods, and safety rods.

Light Water
Ordinary water (H20) as distinct from heavy water.

Light Water Reactor (LWR)
A common nuclear reactor cooled and usually moderated by ordinary water.

Low-Enriched Uranium (LEU)
Uranium enriched to less than 20% U-235. Uranium in power reactors is about 3.5% U-235.

M

Megawatt (MW)
A unit of power, = 106 Watts. MWe refers to electric output from a generator, MWt to thermal output from a reactor or heat source (e.g., the gross heat output of a reactor itself, typically three times the MWe figure).

Metal Fuels
Natural uranium metal as used in a gas-cooled reactor.

Micro
One millionth of a unit (e.g., microsievert is one millionth of a Sv).

Millirem
This is a measurement of the biological effects of different types of radiation equaling 1/1000th of a REM.

Mixed Oxide Fuel (MOX)
Reactor fuel which consists of both uranium and plutonium oxides, usually with about 5% Pu.

Moderator
A material such as light or heavy water or graphite used in a reactor to slow down fast neutrons so as to expedite further fission.

N

Natural Uranium
Uranium with an isotopic composition as found in nature, containing 99.3% U-238, 0.7% U-235 and a trace of U-234.

Neutron
An uncharged elementary particle found in the nucleus of every atom except hydrogen. Solitary mobile neutrons travelling at various speeds originate from fission reactions. Slow neutrons can in turn readily cause fission in atoms of some isotopes, e.g., U-235, and fast neutrons can readily cause fission in atoms of others, e.g., Pu-239. Sometimes atomic nuclei simply capture neutrons.

Nuclear Reactor
A device in which a nuclear fission chain reaction occurs under controlled conditions so that the heat yield can be harnessed or the neutron beams utilised. All commercial reactors are thermal reactors, using a moderator to slow down the neutrons.

O

Oxide Fuels
Enriched or natural uranium in the form of the oxide U02, used in many types of reactor.

P

Plutonium
A transuranic element, formed in a nuclear reactor by neutron capture. It has several isotopes, some of which are fissile and some of which undergo spontaneous fission, releasing neutrons. Weapons-grade plutonium is produced with >90% Pu-239, reactor-grade plutonium contains about 30% non-fissile isotopes.

Pressurised Water Reactor (PWR)
The most common type of light water reactor (LWR).

R

Radiation
The emission and propagation of energy by means of electromagnetic waves or sub-atomic particles.

Radioactivity
The spontaneous decay of an unstable atomic nucleus, giving rise to the emission of radiation.

Radionuclide
A radioactive isotope of an element.

Radiotoxicity
The adverse health effect of a radionuclide due to its radioactivity.

Rads
A unit to measure the absorption of radiation by the body. A rad is equivalent to 100 ergs of energy from ionising radiation absorbed per gram of soft tissue.

Reactor Vessel
It is the steel pressure vessel that holds the fuel elements in a reactor.

rem (Roentgen Equivalent Man)
REM is the common unit for measuring human radiation doses, usually in millirems (1,000 millirems = 1 rem).

Reprocessing
Chemical treatment of spent reactor fuel to separate uranium and plutonium from the small quantitiy of fission products (and from each other), leaving a much reduced quantity of high-level waste.

S

Shielding
Material, such as lead or concrete, that is used around a nuclear reactor to prevent the escape of radiation and to protect workers and equipment.

Spent Fuel
This is used nuclear fuel awaiting disposal.

Stable
Incapable of spontaneous radioactive decay.

T

Thermal Reactor
A reactor in which the fission chain reaction is sustained primarily by slow neutrons (as distinct from Fast Neutron Reactor).

Transuranic Element
A very heavy element formed artificially by neutron capture and subsequent beta decay(s). Has a higher atomic number than uranium (92). All are radioactive. Neptunium, plutonium and americium are the best-known.

U

Uranium
A mildly radioactive element with two isotopes which are fissile (U-235 and U-233) and two which are fertile (U-238 and U-234). Uranium is the basic raw material of nuclear energy.

Uranium Oxide Concentrate (U308)
The mixture of uranium oxides produced after milling uranium ore from a mine. Sometimes loosely called yellowcake. It is khaki in colour and is usually represented by the empirical formula U308. Uranium is exported from Australia in this form.

V

Vitrification
The incorporation of high-level wastes into borosilicate glass, to make up about 14% of the product by mass.

W

Waste
High-level waste (HLW) is highly radioactive material arising from nuclear fission. It is recovered from reprocessing spent fuel, though some countries regard spent fuel itself as HLW and plan to dispose of it in that form. It requires very careful handling, storage and disposal.

Waste
Low-level waste is mildly radioactive material usually disposed of by incineration and burial.

Y

Yellowcake
Ammonium diuranate, the penultimate uranium compound in U308 production, but the form in which mine product was sold until about 1970.

Sources Used:
www.gnep.energy.gov/gnepGlossaryOfTerms.html;
http://www.sea-us.org.au/glossary.html