Flood Protection for the Kansas City Bannister Federal Complex

Kansas City Division

James J. Nolan;
Robert H. Williams;
Gregory A. Betzen, KCMO; and
Raymond C. Meis, KCMO

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BANNISTER FEDERAL COMPLEX 

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FLOOD PROTECTION FOR THE KANSAS CITY BANNISTER FEDERAL COMPLEX

James J. Nolan and Robert H. Williams
Kansas City Division*
AlliedSignal Inc.
Kansas City, MO

Gregory A. Betzen and Raymond C. Meis
Kansas City Area Office
Department of Energy
Kansas City, MO

ABSTRACT

The Bannister Federal Complex is bordered on the east by the Blue River and on the south by Indian Creek. After a flood in 1961 and several near-miss floods, flood protection has been installed. The protection consists of 2,916 feet of concrete flood walls, 8,769 feet of levee, five rolling gates, four stoplog gaps, one hinged pedestrian gate, and one sandbag gap. The flood walls are over 14 feet tall. Construction was started on August 3, 1992 and was completed in early 1995. Architectural treatment was incorporated in the flood walls as well as landscaping to enhance the appearance of the flood protection.

INTRODUCTION

In April 1942, the Navy was seeking a site for a new factory to build aircraft engines for the nation's war effort. A 394-acre site 12 miles south of downtown Kansas City was selected. The reasons for the selection of this site include proximity to the geographic center of the United States, in World War II considered safe from enemy air attacks; land that was flat and easy to excavate; and location near a major metropolitan area with ready access to a large work force.

The site, now known as the Kansas City Bannister Federal Complex, now comprises 4.5 million square feet of buildings housing the Department of Energy - Kansas City Plant, General Services Administration, United States Marine Corps, Internal Revenue Service, Federal Aviation Administration, Department of Defense, Department of Commerce and National Archives and Records Administration. The Kansas City Plant occupies 70% of the floor space, manufacturing non-nuclear components for nuclear weapons. The Management and Operating Contractor for this facility is AlliedSignal Inc.

The Bannister Federal Complex is bordered on the east by the Blue River and on the south by Indian Creek. The Indian Creek and Blue River watersheds draining toward the plant comprise 188 square miles, 74 square miles from the Indian Creek watershed and 114 square miles from the Blue River watershed.

PREVIOUS FLOODS

In September 13, 1961, the site was inundated by a 30-year flood, with a total damage of approximately 1.1 million dollars and a significant disruption of activities. In response to the flood threat at this facility, a flood protection system was partially constructed in 1970-72. The flood protection was intended to protect the facility from a "standard project" flood event. However, due to funding problems, the flood protection was not completed. The system installed provided protection for a 60-70 year flood event. Since that time, there have been several near-miss floods.

JUSTIFICATION

It has been estimated that due to the unique and expensive machinery and computers currently in use, a 100-year flood would now cause damages in excess of $38 million, production curtailment of at least six months, and environmental damage which would be both difficult and expensive to clean up. A 200-500 year flood is estimated...
to cause damages in excess of $330 million, potential loss of life, plant production curtailment in excess of six months, and environmental contamination of the entire site and the flooded Indian Creek and Blue River ground surfaces.

The most immediate need for flood protection for the Federal Complex is to meet the requirements of Executive Order 11988, the Resource Conservation and Control Act, the Toxic Substances Control Act, and Federal Regulation 40CFR265. Each of these regulations requires that the Department of Energy-Kansas City Plant be protected from a 100-year flood event. The Comprehensive Environmental Response Compensation and Control Act (CERCLA) requires 500-year protection for hazardous wastes.

PROJECT APPROVAL

A letter from The Department of Energy (DOE) dated May 16, 1989, requested that the Corps of Engineers (COE) design and construct the uncompleted portion of the Federal Complex flood protection. An Intergency Agreement signed in September 1989 between DOE and the COE provided funding to the COE to produce a complete set of plans and specifications for construction. On September 17, 1990, DOE officially requested that Corps of Engineers Missouri River Division Kansas City District (CEMRK) design the flood protection project to provide the Federal Complex with 500-year plus freeboard and balanced overtopping, approximately three feet of additional protection.

PRELIMINARY ANALYSIS

In February 1990, an analysis of the discharge-frequency relationship for the Blue River basin disclosed that, due to urbanization in the watershed areas, an update was necessary. This COE study used data from 1956 through 1989 to establish a base condition for the period in which urbanization was occurring. The watershed model developed used basin data such as surface area, ground slope, roughness coefficients, infiltration rates, and percent of impervious surface. The outflow hydrographs for the Blue River basin were added to establish the peak discharges at the U.S.G.S. gauging station immediately east of the Federal Complex. The study included existing (1995) and future (2015) basin conditions which are based on upstream Planning Commission land use projections.

The resultant data was used to establish the elevations for the flood protection. Design was based on year 2015 discharges that yielded a minimum of three feet increase over the 500-year profile along the Blue River levee at the Federal Complex. The design river discharge at this profile is 89,600 cubic feet per second at the old 95th Street Blue River Bridge. The three feet of freeboard is provided to insure against overtopping due to factors not specifically accounted for in the design flood profile because they are too small or because they are too intractable to be quantified. Design was started in mid-1990 and total cost was estimated at $12.3 million.

A near-miss flood in May 1990 provided an opportunity for the COE to verify the accuracy of its' predicted flood elevations. River basin data were refined to match the elevations experienced in the flood situation.

DESIGN CONSIDERATIONS

Design Analysis disclosed that a foundation design supported by reinforced poured-in-place high strength grout auger cast piling would be more economical than a spread footing design. The design incorporates both tension and compression piling as well as sheet piling beneath the footings for water cutoff.

The flood protection system consists of 2,916 feet of concrete flood wall, 8,769 feet of levee, five rolling gates, four stop-log gaps, one hinged pedestrian gate, and one sandbag gap. The flood walls are over 14 feet tall. The flood wall design was configured to provide eleven openings in the system for vehicle, pedestrian, and railroad traffic. The designs for closure of those openings were based on a February 1992 Time Response Analysis to determine a workable manpower, equipment and time response combination to close these openings during a flood threat in a timely manner.

At five openings, rolling gates are used to assure fast response. The gates are constructed of steel with railroad tracks and wheels used for moving the gate. Precast concrete panels are attached to the face of the gates to enable them to blend with the flood walls. The gates vary from 20 to 88 feet in length and from 9.7 to 14.4 feet in height. A winch house has been installed on the inside face of the flood wall which houses the winch, cables, pulleys, clevises, chain come-alongs, etc. needed to close the gates. It has been found that manual closure of the flood wall using the winch is too slow to be practical. A power closer is provided by modified chain saws that have been geared down to operate the winch. A large truck may also be used to close the gates by pulling on the cable attached to the gates. Large hooks on the outside face of the flood gates engage receptacles in the top of the foundation to support the gates as a cantilever from the foundation. Rubber seals at the bottoms and sides of the flood gates seal against steel armor plates built into the top of the foundation and the ends of the flood wall. The flood gates are secured in the closed position with chain come-alongs which attach the gates to the adjacent flood walls.

Stop-log gaps are provided at four openings in the flood wall. The gaps vary from 22 to 80 feet in length and from 4.9 to 12.8 feet in height. The stop-logs are aluminum and weigh approximately 1000 lbs each. A jib crane has been built-in at two of the gaps where it would be very difficult to operate a self-propelled crane on wheels. At the other
two gaps, small self-propelled cranes on wheels will be used to move the stop-logs into position. Rubber seals built into the stop-logs provide the seal with adjacent stop-logs and with the flood wall stop-log channels. At the wide gaps, up to three intermediate steel support beams have been provided. The support beams are set into receptacles built into the top of the foundations. Holes are provided in the stop-logs on the river face to allow them to fill with water as the flood waters contact them. This prevents the stop-logs from floating out of position.

A hinged gate was used at one 10 foot wide opening in the flood wall that is used for pedestrian access to the plant. The gate is constructed of steel and is equipped with rubber seals all around and turnbuckles to hold the gate tightly closed during a flood event. A come-along will be used to close the gate to the point where the turnbuckles can be engaged.

The sand bag gap is three feet in height and 45 feet in length. It will be involved only if overtopping occurs and will be the last gap to be closed.

The alignment of the floodwalls was constrained by an underground 24-inch gas main that is on the south side of the plant, site distances for the entrances in front of the plant, bus stop location, and alignment of existing streets, parking lots and railroad tracks.

Sluice gates were installed for storm drainage systems at the west side of the complex, a flap gate was installed at the outfall at the northeast side of the complex, and existing sluice gates on the north, south and east sides of the complex were extended upward to match the increased height of the flood protection.

AESTHETICS

Architectural treatment was provided by designing the flood wall with a series of arched shapes in the face of the wall and using colored concrete that matches the color of the brick on the existing buildings. The wall appearance was further enhanced by designing offsets, alcoves, in the wall at intervals and planting landscape shrubs at these locations.

Since the new flood wall obscures the building, it became necessary to install signage on the flood wall to indicate the organizations accessed at each entrance. The signs are of bronze colored metal letters attached to the wall at each entrance and a logo for the General Services Administration (GSA) provided at their main entrance.

PUBLIC RELATIONS

A number of public meetings were held with neighbors and other interested parties invited. The meetings were for the purpose of informing the public of what was being planned, allowing input from concerned persons, and assuring the public that their interests were being considered in the plan preparation.

CONSTRUCTION

Construction was started on August 3, 1992, and was completed in early 1995. Di Carlo Construction Co. was the low bidder and oversight was provided by the COE. The project was monitored throughout by both DOE and AlliedSignal engineering personnel. Construction was planned to minimize conflicts with plant operations and traffic. Coordination was necessary to work with schedules for adjacent construction projects, notably the Abandoned Indian Creek Outfall cleanup project, and the GSA and DOE/AlliedSignal Parking Lot projects.