HYDRAULIC LABORATORY

SUMMARY REPORT

FISCAL YEAR 1957

BUREAU OF RECLAMATION
ENGINEERING LABORATORIES
DENVER, COLORADO

FOREWORD

"It is a proper function for industry to do basic research--a proper function but not a responsibility. The responsibility lies with the universities and government laboratories. * * * Industry should support basic science as its normal contribution to society, but its obligation is to produce better products and step up the efficiency of production," Iron Age, by Dr. Lawrence R. Halfstad, Vice President and Director of Research, General Motors Company, and former Director of Reactor Development, Atomic Energy Commission.

CONTENTS

HYDRAULIC LABORATORY
Division of Engineering Laboratories
Commissioner's Office
Denver, Colorado
July 1, 1957

SECTION I - INTRODUCTION

This is the seventh annual summary report on the operations of the Hydraulic Laboratory. Several aspects of this year's experience in the Hydraulic Laboratory are especially striking. The first is a number of complex design and rehabilitation problems which were referred to the laboratory. The Colorado River Storage Project will continue to develop numerous hydraulic problems which can be solved in the laboratory.

The second most striking aspect of this year's work was the part the Hydraulic Laboratory had in training engineers on the Rotation Program. Fifteen engineers had a 3-month training experience in the Hydraulic Laboratory during the year. This, of course, came at a time when the heavy workload developed. The addition of inexperienced staff contributed to increased costs of the various laboratory design studies, making it impossible to stay within the original estimates for several laboratory projects. Three student engineer trainees were taken on during the 3-summer month period of 1956, three were employed for the Summer of 1957.

Some assistance was rendered by this branch in the College Contact program. Two trips to engineering colleges were made by the chief of the branch with a representative of the Personnel Branch. Seven schools were visited, one of them twice.

Considerable assistance was rendered the Small Business Administration in arranging a 2-day exhibit in Building 56, Denver Federal Center, in October 1956.

The Hydraulic Laboratory cooperated with Region 7 representatives in making arrangements for the Four-State Irrigation Conference which was held January 10 and 11, 1957.

Employee interest in professional advancement has shown a continued increase in the past year. Of the 15 hydraulic engineers on the staff, 14 are now members of a professional engineering society. A number of papers have been prepared and presented at various engineering meetings. Details are found in Section VII. Ten of the staff have acquired M.S. degrees in engineering. Two others are studying toward advanced degrees.

The Hydraulic Laboratory staff organization structure was filled in by promotion in the higher grades; two additions were made to the staff at grade GS-7.

The scope of investigations, design studies, and research in the Hydraulic Laboratory has widened considerably in the past 5 to 10 years. Our laboratory practice had not been discussed with a qualified outside consultant during this time. Accordingly, Dr. Arthur T. Ippen was employed as a consultant with broad experience in hydraulics and fluid mechanics to review and advise upon our present practices. The general feeling of the members of the Hydraulic Laboratory staff is that much benefit was derived from Dr. Ippen's visit. He made several suggestions for the improvement of certain techniques of obtaining and applying data from model studies, but in general indicated that our procedures are in line with those used by other well-known organizations and authorities.

Costs. A cursory study of model study costs was made to determine the relation of estimated costs to the actual costs incurred. Twenty laboratory studies for which finance data are available indicated that, in general, the actual costs for Hydraulic Laboratory staff and shop work exceeded the estimated cost approximately 1-1/2 percent. Hydraulic Laboratory staff costs varied from a minimum of 50 percent of the estimated costs to a maximum of 225 percent. Shop costs varied from a minimum of 51 percent to a maximum of 295 percent of the estimated costs. Hydraulic Laboratory staff costs exceeded the estimated costs in 10 of the 20 projects analyzed. Shop costs exceeded the estimated costs in 12 of the 20 projects. Reasons for deviation from the estimated costs vary from job to job. Suffice it to say that it is very difficult to visualize the type and scope of all of the problems likely to be encountered before tests are started.

The study indicates that continuing vigilance is required to insure that accumulated costs on laboratory projects reflect only those costs that are directly chargeable to those projects.

"Time to Think." In his annual address presented at the Buffalo Convention of the American Society of Civil Engineers President Mason G. Lockwood speaking on the topic "Time to Think" made the following comment: "One notorious thief of time strikes at all engineering levels--on-the-job social visiting with associates and, to a lesser extent, with outsiders. The twice-daily recreational breaks, which have come to be an accepted and wholesome part of American business, industrial, and professional life, are proper times for such visiting; but sbuses are reported everywhere. Probably the only effective remedy against excessive visiting is personal discipline. A thinking engineer who longs for more time for thought while at work might well examine and improve his personal habits in this regard."

SECTION II - STUDIES FOR BUREAU PROJECTS DESIGN, OPERATION, MAINTENANCE AND REHABILITATION

The problems referred to the laboratory continued to be of increasingly complex nature and an interesting variety this year. Some of the more difficult problems included the investigation of high pressure turnouts, the Trinity Dam morning-glory spillway, and sediment problems of a varied nature. There was an increase in the requests from other divisions and branches for analyzing difficult hydraulic problems.

The following studies constitute the major laboratory studies conducted in this category of work:

Boysen Dam Outlet Works and Spillway

Tests were performed on the outlet works at Boysen Dam to verify predictions of performance made during the hydraulic model studies. The outlet works utilizes two 48-inch hollow-jet valves tilted downward to discharge between pairs of wedges which compress the hollow jet. The stilling basin is short compared to conventional designs and is the first of its kind. It was predicted during the model studies to develop the new type stilling basin, which is constructed as part of the powerplant structure, that performance would be better than for previous basins constructed.

Field tests with the valves open 100 percent and reservoir only 1.5 feet below normal operating pool level showed that performance was excellent and exceeded the expectations.

Tests included (1) left valve open 100 percent with and without the adjacent turbine operating and the right valve closed and (2) both valves open 100 percent with and without both turbines operating. There is no dividing wall in the tailrace between the draft tube outflows and the outlet works outflows.

For all combinations of discharges the structure performed in an excellent manner. Turbulence and water surface disturbances downstream from the outlet works were only slightly more intense than downstream from the turbine. Flow conditions in the tailrace were exceptionally good and no noticeable effect on power production was observed when the outlet works was in operation.

The knowledge obtained by testing the Boysen Dam outlet works was particularly valuable since two similar basins have been

constructed on the Falcon Dam (not yet operated), and a similar basin is to be built into the proposed Yellowtail Dam Powerplant. The test results provide additional assurance that the Falcon and Yellowtail basins will operate as intended and that the general principles of the basin design may be included in future projects.

The spillway alone was also operated for discharges of 2,000 and 4,000 cfs and the performance of the hydraulic jump stilling basin was evaluated. The spillway performance was excellent and it was estimated that the basin will safely handle the design discharge of 20,000 cfs.

Glen Canyon Diversion Tunnels

A 1:88 scale model of the Glen Canyon diversion tunnels was constructed in the Hydraulic Laboratory to check the alinement and elevation of the tunnels with respect to the river channel. During construction of the dam the normal river flow will be diverted through two tunnels--one on either side of the river channel. Each tunnel will be 50 feet in diameter and approximately 2,800 feet in length. Upon completion of the dam, the upstream portion of each diversion tunnel will be plugged and the downstream 1,000 feet of the tunnels will be lined and used to carry the spillway flows. The two tunnels are designed for a maximum diversion discharge of 130,000 second-feet and 284,000 second-feet for spillway flows.

In addition to checking the alinement and elevation of the tunnels for both diversion and spillway flows, the model was used to make preliminary studies of the size and shape of the flip buckets at the downstream portals of the tunnels and to obtain data on the water level drawdown in the powerhouse tailrace for various spillway flows.

Anchor Dam Spillway

Hydraulic model studies were made on a spillway for Anchor Dam. The dam is an earth structure having a concrete-lined horseshoe tunnel spillway designed to discharge 7,340 second-feet. The tunnel is approximately 900 feet long and is 12 feet in nominal diameter. The upstream portion of the tunnel is tapered and inclined 50° from the horizontal. The drop is about 159 feet in elevation from the spillway crest to the tunnel invert at the downstream end of the vertical bend. The downstream portion is nearly horizontal and contains a 200-foot-radius, 25° horizontal bend. It was necessary to revise the spillway entrance topography to obtain satisfactory flow in the spillway approach area and upper end of the spillway tunnel transition.

At the downstream end of the tunnel it was necessary to add a directional vane to the crown of the tunnel to prevent flow in the horizontal bend from spinning over the crown of the tunnel. The vane also helped to maintain a clear ventilation passage through the tunnel. The junction section was found to perform in an excellent manner for all combinations of spillway and outlet works flow. The joining of the spillway discharge, 4,000 cfs, with the outlet works discharge, 640 cfs, is accomplished very smoothly. Pressures throughout the junction section were satisfactory, the minimum pressure being 5 feet of water below atmospheric pressure.

The combination hydraulic-jump-stilling-basin and flip bucket performed well for all anticipated flows. The stilling basin will retain the hydraulic jump in the basin for flows up to about 1,300 cfs. For greater flows the jump sweeps out and the basin becomes a flip bucket. Thus, the basin will provide smooth flow in the downstream channel for flows well above the irrigation water requirement, 640 cfs.

Glen Canyon Erosion Studies

Erosion studies were made on samples of the Navajo sandstone through which the 50-foot-diameter diversion tunnels of Glen Canyon Dam will pass to determine if a tunnel lining will be required for the diversion period. Two tunnels about 2,800 feet long are to be drilled, and their combined diversion capacity will be 130,000 cfs. After completion of the diversion period the upstream two-thirds of both tunnels will be plugged and abandoned. The downstream portions will then be utilized as part of the spillway tunnels.

The first tests were made by passing a stream of clear water straight across the flat test surface at velocities from 20 to 72 fps. Practically no erosion was produced by 53 hours of operation.

The second tests were made by directing a stream of clear water downward onto the test surface at a 25° angle at velocities from 40 to 110 fps. Very little erosion was produced by 42 hours of operation.

In a third series of tests fine sand was added to the flowing water to represent sediment in the river. The stream impinged on the test surface at a 15° angle, and produced considerable erosion after 4 hours at 20 fps. Four hours of operation at 30 fps produced a much greater degree of erosion.

Glen Canyon Dam Spillway Models

A hydraulic model (1:63.48) contains the features of the arch dam and includes the excavated approach channels to the spillways, the crest section, the tunnel portals and tunnels, outlet works, powerhouse and approximately 1 mile of downstream river channel. The model is 27 feet wide and 90 feet long.

The preliminary tests were concerned with the adequacy of the excavated approach channels, the appearance of the flow entering the tunnels, the capacity of the spillways, and the pressures on the spillway crest.

In the preliminary layout the approach channel to the left spillway was 400 feet wide at the canyon edge and converged to 100 feet at the spillway crest. The right side approach channel was 500 feet wide at the canyon edge and converged to 100 feet at the spillway crest. The model investigations determined that the entrance to each channel could be reduced to about 210 feet at the canyon edge. The 100-foot widths at the spillway crests were not changed. The narrower channels reduced the amount of rock excavation by approximately 440,000 cubic yards.

The flow velocity was increased from an average of about 4 feet per second in the preliminary channels to about 15 feet per second in the modified channels. However, the flow became more stable in the modified channels resulting in more uniform water surfaces in the tunnels.

The model tests indicated that pressures as low as 20 feet of water below atmospheric were possible on the sidewalls of the transitions at the tunnel portals. This pressure was considered near the cavitation range and it was recommended that the transition be redesigned. A revised 100-foot-long transition was installed in the left tunnel to replace the preliminary 70-foot-long transition. The flow appearance in the new transition was satisfactory and pressure measurements indicated that there were no subatmospheric pressures on the invert or sidewalls.

Tests were also made with the circular invert of the tunnel continuing downstream through the transition and rectangular section to the flip trajectory. By eliminating the transition and rectangular section the amount of excavation and complex concrete form work would be reduced. The flow appearance with this approach to the flip bucket was satisfactory. After leaving the bucket the flow was spread

over a wider impact area in the river channel producing good energy dissipation with few eddy currents in the vicinity of the powerplant.

The downstream section of the model is being rebuilt to incorporate a revised outline and location for the powerplant. The modified model powerhouse will be constructed so that the proper flow quantities can be discharged through simulated penstock outlets. This will make it possible to observe the effect of flow through the powerplant, river outlets, and spillways, and to determine whether they are in the correct relative positions. It will also provide proper flow conditions in determining the difference in water surface elevations between the powerplant and a point approximately 3,000 feet downstream from the powerplant. In the preliminary model, without flow through the powerplant and with the spillways discharging 276,000 cfs, the water level at the powerplant is approximately 15 feet lower than the water level 3,000 feet downstream.

Surge Tank, Clear Creek Power Conduit, Trinity River Division, Central Valley Project

The surge tank on the 56,000-foot-long, 18-foot-diameter Clear Creek power conduit will contain and gradually reduce the normal turbine flow of 3,200 cfs when simultaneous load rejection occurs at both generators. A model study was required since the surge tank installation is unique, consisting of a 16-foot-diameter standpipe 210 feet high opening directly into the conduit; a tank 44 feet in diameter concentric to the standpipe and 195 feet high; and a catch basin or retaining pond extending out from the top of the tank capable of holding 800,000 cubic feet of water. Four rectangular ports located in the walls of the standpipe 9 feet above the top of the conduit connect the standpipe to the tank. Two model studies were made, one to determine the discharge coefficients of the ports, and the other to study the action of the water as it spills from the top of the standpipe into the tank.

The port coefficient was determined by calibration of a model utilizing air as the test fluid. Charts were prepared showing the coefficients of discharge for flows from the standpipe to the tank and from the tank to the standpipe. These charts enable the determination of the cross sectional area of the ports such that the total flow of 3,200 cfs will pass from the standpipe through the ports and into the tank when the water surface in the standpipe is 40 feet above that in the tank (a design requirement).

The flow of water spilling from the top of the standpipe into the tank was studied in a 1:18 scale hydraulic model. The design recommended for the top of the standpipe included 4 piers triangular in cross section and 2 feet high to split and aerate the jet, and an overhanging lip on the outside rim of the pipe to prevent flow from clinging to the outside of the pipe and to reduce the tendency for the water nappe to flutter.

Angostura Diversion Works

Model studies were completed on the investigation of the sediment problem at the Angostura Diversion Works, Middle Rio Grande Project. The recommended modifications evolved from the model study are: (1) Placing parallel curved walls so that they form a 30-foot wide approach channel to the headworks; (2) install an overhanging sill or corbel in front of each bay of the headworks; (3) extend the right approach wall downstream so that it bisects the river sluiceway and make provisions for opening either half of the sluiceway independently; and (4) optionally, to place a vortex tube in the overhanging sill of the last bay. A sand pump capable of pumping approximately 20 cfs against 15 feet of head would be necessary to draw water and sand from the vortex tube.

In the unmodified diversion works, the ratio of sediment concentration in the headworks to sediment concentration in the sluiceway was about 8:1. For the recommended modification the sediment concentration ratio was 0.02:1 when the vortex tube was operating and 0.18:1 without a vortex tube. During all tests the ratio of flow through the headworks to flow through the sluiceway was 3.33:1.

Trinity Dam Morning-glory Spillway

When construction of the 1:30 scale model of the spillway had proceeded to the stage at which hydraulic tests of the structure could be made, seven piers were used on the crest and a 90° segment of the crest was blocked off to provide an opening for ventilation at high spillway discharges. The purpose in blocking off part of the crest was to determine the feasibility of eliminating an air vent system in the structure itself. Since only a short vertical section of tunnel below the morning-glory throat was in place, and no topography surrounding the crest had been constructed, the tests were only exploratory in nature.

Tests at five different discharges up to the maximum of 23,800 cfs were conducted. Thirty-six piezometers, in three rows of twelve

each, were used to measure the pressures on the crest and in the throat regions of the spillway. Maximum negative pressures occurred at a point just downstream of the crest in each piezometer row and amounted to minus 14.5 feet of water for 20,000 and 23,800 cfs. The severity of the negative pressures was due to blocking off part of the spillway crest. Tests were then conducted with flow straightening vanes and crest piers made of light sheet metal. Operation with the features scaled to dimension was not nearly as satisfactory as with the thin sheet metal vanes. Flow patterns in the tunnel below the vanes were erratic and there was a tendency for spiral flow. The principal objection, however, lay in the resistance offered to the passage of debris. Above a flow of 20,000 cfs about 80 percent of 4-foot-diameter by 40-foot-long logs became jammed on the pier or straightening vanes. This scheme was thus abandoned.

Another series of tests was made using a single diametrical straightening vane extending between elevations 2325 and 2350, placed for the best tunnel flow pattern, and a small unaerated deflector in the shaft just above the upper bend. Crest pressures were unsatisfactory, approaching a negative 14 feet of water at 20,000 cfs. Flow patterns in the tunnel were excellent for all discharges. The straightening vane, however, offered objectionable resistance to the passage of logs.

Changes in the topography were made to improve the approaches to the morning glory. The berm was lowered another 6 feet to elevation 2358, and the natural hillside behind and to the left of the morning glory was excavated to the same 2:1 slope. The left approach area became larger, allowing a greater proportion of water to flow along that side, thus increasing the crest discharge coefficient.

Tests were made on an aerated deflector placed near the point of curvature at the inside of the upper bend and three rib vanes placed in the entrance as the flow straighteners. Flow patterns in the tunnel were satisfactory, even though the separation of air and water masses was not as clear cut as it had been with other schemes.

Tests to define the spillway head-discharge relationships for various deflector and rib vane sizes and arrangements in the tunnel shaft have been concluded. It was apparent from these tests that major changes in adjacent topography and in the crest profile produce only minor effects on tunnel flow patterns; therefore, the placement and sizes of deflector and rib vanes could be tentatively selected. Efforts have since been concentrated on developing a spillway crest profile with acceptable pressures. Four profiles have been tested; the best showing a maximum negative pressure of

6.3 feet of water. This is a substantial improvement from the minus 14.5 feet of water measured in the preliminary design. The diameter of the latest spillway crest is 60.25 feet; that of the preliminary shape was 53 feet.

The size of the deflector in the shaft above the upper vertical bend has been increased. The deflector is now 25 feet high and projects 6.85 feet toward the axis of the spillway shaft. It is placed on the tunnel centerline 5 feet above the point of curvature of the bend. A duct will be provided for supplying air below this deflector to provide a free water surface in the tunnel below.

The elevation of the berm adjacent to the spillway morning-glory entrance has been fixed at 2,358. The model tests indicated that this berm should have a minimum width of 6 feet.

Considerable reshaping of the topography on the left approach to the spillway entrance proved necessary to secure an acceptable balance of flow around the crest.

Future tests will be concerned with positioning the pier, varying its length and height, and measuring pressures at critical points on the aerated deflector and rib vanes in the shaft.

Trinity Dam Outlet Works

Extensive tests have been conducted on the 1:28 scale model of the hollow-jet valve stilling basin and flow channel downstream from the basin. These tests show that the basin length should be reduced from 135 to 123 feet and that the length of the center training wall should be reduced from 70 to 35 feet. The shorter basin improves the performance in that the flow currents for the design flow travel the full length of the basin floor before they rise to the surface; therefore, upstream undercurrents cannot develop to move bed material into the basin which might scour the concrete surfaces. With the basin length reduced, it was necessary to shorten the center dividing wall to prevent flow sweepout when one valve was discharging at maximum head.

Further testing is being conducted to make sure that the basin will operate properly over a wide range of tail water elevations. The tail water might be very low when the outlet valves are initially opened to discharge the design flow. It may be necessary to lower the basin floor to prevent flow sweepout for this initial condition.

Water surface profile data are being obtained in the stilling basin for various combinations of discharge, head, and tail water elevation. The water surface profile data will aid in the design of the basin walls.

Paonia Dam Spillway and Outlet Works

A 1:36 scale model is being tested in connection with the design of this hydraulic structure.

The spillway is the side channel type and consists of a crest structure, a rectangular chute having a drop of 179 feet in a distance of 537 feet, and a stilling basin. The side channel structure is approximately 200 feet long, has a floor 20 feet wide and varies in depth from 23.5 feet at the upstream end to 35.5 feet at the downstream end. The floor of the chute which conveys the flow from the side channel structure to the stilling basin is 30 feet wide at the upstream end and 42 feet wide at the downstream end. The stilling basin is 42 feet wide by 120 feet long. Its floor is 23.6 feet below the expected maximum tail water elevation.

The outlet works consists of two 2-foot-9-inch square slide gates discharging into a 10-foot-6-inch-wide tunnel that intersects the floor of the spillway chute 67 feet upstream from the upper end of the stilling basin floor. The complete spillway and only that portion of the outlet works tunnel adjoining is being model tested. Initial tests have shown the general concept of the preliminary design to be satisfactory. Modifications of a minor nature will be developed to improve performance where deemed necessary. Spillway capacity is 12,600 second-feet and outlet works discharge is 700 second-feet.

Relief Map of the Colorado River Storage Project

At the request of the Regional Director, Salt Lake City, Utah, the laboratory shop completed 10 rubber casts of a 47- by 60-inch model of the Upper Colorado River Basin. Distribution of the maps is to be as follows: Regional Office, Salt Lake City; Washington Office; Glen Canyon Dam; Flaming Gorge Dam; Governors of the Upper Basin States; Denver Office.

The model is built to a horizontal scale of 1:633,600 and a vertical scale of 1:120,000. Its borders extend beyond the basin to encompass Idaho Falls, Denver, Pueblo, Albuquerque, Flagstaff, and Cedar City. Emphasis is given to the basin area and the features of the Colorado River Storage Project and participating projects. Orientation is aided by inclusion of the principal rivers, streams, cities, towns, railroads, and highways.

Geophysical Velocity Measurements, Flaming Gorge, Utah

Laboratory technical assistance was furnished to the Engineering Geology Branch to measure the speed of travel of seismic waves in foundation rock at Flaming Gorge Dam site to ascertain the value of Young's modulus of elasticity for the rock in place. This is the second time this particular type of geophysical investigation has been applied by the Bureau, the first being for Monticello Dam. Portable equipment was used in the second investigation because of the difficult terrain. Three cored drill holes and ten different surveyed surface lines were used to obtain data. Core drilling data were available with which to correlate the seismic results. Computations indicate that valuable information was obtained for design purposes.

Woodston Diversion Dam, Kansas

A 1:8 scale model of the headworks and sluiceway of Woodston Diversion Dam was studied in the Hydraulic Laboratory. This structure will be built on the South Fork of the Solomon River in Kansas on the Missouri River Basin Project.

The purpose of the study was to establish the best possible arrangement of curved guide walls to reduce to a minimum the sediment inflow into Osborn Canal headworks. An 8-foot-wide sluiceway and a 7-foot-wide headworks were studied. The essential features of the design consist of the curved guide walls, the canal headworks with its curtain wall and overhanging sharp-edged sill, and the sluice gate. This arrangement improved the sediment handling performance compared to designs without the sediment excluding device.

Cavitation with High Velocity Jets in Sudden Enlargements (Davis Aqueduct)

Some recently designed closed conduit irrigation distribution systems make flow releases at high heads through partly opened gate valves. Cavitation can occur in many of these control structures, and these cavitation forces can destroy the valves and downstream conduits under certain conditions. Much work has been done in recent years at heads up to 150 feet to evaluate methods of preventing damage in those structures where cavitation will be inevitable. One of the most effective methods is to provide an oversize conduit downstream from the control valve so that the conduit boundaries are outside of the area of cavitation collapse and therefore not subjected to destructive forces. Tests made in the Hydraulic Laboratory thus far indicate that this oversize conduit should have a diameter about 1.4 times the valve diameter.

Distribution systems are now being planned with operating heads of about 400 feet. These heads are much above the heads for which the control structure operating characteristics and design requirements are known. The phenomenon of cavitation is perverse in that its nature does not allow its detailed study under reduced heads, as in the case of the usual scaled model. Therefore, to study the conditions to be encountered at high heads, laboratory tests must be made at high heads.

The first studies were made with a 6-inch-diameter transparent pipe placed immediately downstream of a 3-inch gate valve. The clouds of cavitation bubbles produced when flows up to 1.1 cfs were passed through the partly closed valve with differential heads of 230 to 630 feet were readily visible through the pipe walls. Cavitation index values, K, of 0.050 and 0.292 were produced. In this case, K equals the drop in head from the pressure measured some distance downstream of the valve, to vapor pressure, divided by the drop in head from the total pipeline pressure upstream of the valve to the pressure head measured some distance downstream. Severe vibration and noise were present during runs with the lower K values, and as the higher values were set, the vibration and noise decreased.

Tests made previously with heads up to 150 feet, valve openings to 25 percent, back pressures of about 15 feet (K = 0.31), and a downstream pipe diameter 1.75 times the valve diameter showed that no cavitation erosion would occur on the interior of the pipe downstream from the control valve. To determine if erosion would occur in a similar installation with a 400-foot upstream head and a 1- to 25-foot downstream head, a 24-inch long concrete pipe, 5.25 inches inside diameter, was installed just downstream of the 3-inch valve. A 6-hour test with the 1-foot downstream head produced considerable erosion on the top of the pipe about 6 inches from the inlet. A similar test with the 25-foot downstream head produced no erosion at all. The K values during these tests were 0.07 and 0.14, respectively. Other tests are being made on other pipe sizes and on impact type stilling basins.

Other Project Work

The foregoing paragraphs of this section describe the major laboratory studies. In addition the staff was required to assist in the analysis and solution of numerous minor problems covering a wide scope in the hydraulics field.

These minor studies may be identified in the Division of Engineering Laboratories Time Distribution Record found in Section X of this report. Accounts of these studies may be found in the Daily Record of the Branch.

SECTION III - STUDIES FOR OUTSIDE AGENCIES

Valve Tests for GSA

Hydrostatic tests on a number of valves ranging in size from 3/8 inch to 2 inches were made for the local office of the General Services Administration. The tests concerned mainly leakage through castings, leakage through the leaves, and leakage which would prevent packing of the valves under pressure.

Cooperation with Corps of Engineers--Strain Gage

The Engineer Procurement office of the San Francisco District requested the laboratory to assist in the inspection of their new Brush strain gage and recording equipment to be used in measurement of stresses in dynamic loading of Quickway truck and shovel units. The new test equipment was inspected, put into operable condition, and several trial tests were conducted to acquaint the Corps of Engineers inspector with the use of the instruments.

Glenn L. Martin Company

Fluid measurement problems attendant to the production of missiles were discussed with the Production Control department engineers of the Martin Company. An inspection was made of the laboratory facilities to determine whether our facilities were adequate to calibrate liquid flow meters and gas meters. It was agreed that the liquid meters could be calibrated in the Bureau laboratories until the Martin Company had finished its laboratory facilities. No further inquiry has been made by the company.

General Inquiries from Public Agencies and Private Institutions

Numerous inquiries are made of the laboratory staff. Some are by telephone; some are by visits to the laboratory. Many are consulting engineers in the vicinity or those crossing the country stopping over in Denver to visit the laboratory.

Bureau of Land Management--Lectures on Hydraulics

The Bureau of Land Management requested a half-day lecture on the general topic of energy dissipation in connection with the construction of small earth dams and low head structures of the most simple and inexpensive type. A half-day lecture and demonstration was given to a group of approximately 25 field men of the Bureau on the afternoon of February 12, 1957.

Cooperative Study With Geological Survey

A preliminary planning meeting was held with representatives of the Quality of Water Branch and the Surface Water Branch of the Geological Survey which is considering a research project to develop and study a bedload sampler suitable for use on transported material the size of pea gravel and larger. The Survey is seeking suitable hydraulic laboratory facilities and the Bureau of Reclamation was approached because of mutual interest in the problem and the possibility that facilities now in the Hydraulic Laboratory might be suitable at least for preliminary testing of the developed sampler. Further negotiations may follow if the Survey determines that the Bureau facilities and their availability are suitable for the requirements.

SECTION IV - DESIGN STUDIES FOR FOREIGN GOVERNMENTS

Tooma-Tumut and Tooma-Eucumbene Control Structures, Australia

The hydraulic model studies on these structures have been completed and a final report, Hydraulic Laboratory Report No. Hyd-429, entitled "Hydraulic Model Studies of the Control Structures for the Tooma-Tumut and Eucumbene-Tumut Tunnels--Snowy Mountain Hydro-Electric Authority, Australia," prepared and issued.

Tooma-Tumut control structure. Studies made to improve the downstream transition design resulted in a simpler and less costly transition downstream of the gate frame. The tests showed that the 18-foot-long, constant width conduit section was unnecessary between the control gate and the start of the transition to the round tunnel. The section was omitted and the transition was moved upstream to the gate frame.

Studies directed at relieving the negative pressures that occur on the lower walls of the control gate at small gate openings with submerged flow at low back pressures were not completely successful. Actually a design was developed that eliminated the negative pressures and that produced exceptionally smooth, spray-free releases. However, it involved a seal problem that was new and somewhat complex, and it was not felt advisable to pioneer the design on these gates. The Palisades-type slide gates will therefore be used without major change and gate settings between 0° and 5° must be avoided during submerged operation with low back pressures. The above studies are discussed in Hydraulic Laboratory Report No. Hyd-432, entitled "Hydraulic Model Studies of the Effect of Moving the Slots Upstream in a Slide Gate, and of Reducing the Slot Size Near the Floor."

Tooma-Eucumbene control structure. Additional piezometers were placed in the tunnel section downstream from the control gate, but no objectionable pressures were found. Tests were made with a square conduit downstream from the gate and with the circular tunnel extended up to the gate. The performance and the tunnel wall pressures were about the same in both cases. The simpler design with the circular tunnel extending to the gate will therefore be used.

Yanhee Spillway

Hydraulic model studies were completed on Yanhee Dam spillway for the country of Thailand and a final report, Hydraulic Laboratory Report No. Hyd-428 "Hydraulic Model Studies of Yanhee Dam Spillway, Yanhee Project, Thailand" prepared and published. The dam is a concrete arch with a crest length of approximately 1,540 feet and rises 505 feet above the riverbed. The maximum capacity of the reservoir impounded by the dam will be 9,890,000 acre-feet.

The spillway, designed for a maximum discharge of 212,000 second-feet, has a concrete overflow crest 144 feet in length which spills into two concrete lined tunnels, each about 1,300 feet in length and 37 feet in diameter. The spillway tunnels discharge into the river channel where the erosive energy of the floodwater is minimized by flip buckets at the downstream ends of the tunnels. Flow over the spillway is controlled by 4 radial gates, each 36 feet wide by 57 feet high.

The studies were conducted on a 1:77.37 scale model to investigate the spillway approach conditions, the flow characteristics of the spillway overflow crest and tunnels, and the effect of the spillway flow on the downstream river channel.

The model indicated that the preliminary spillway approach was satisfactory except for a flow disturbance at the left pier. This condition was corrected by extending the left pier about 14 feet into the reservoir and by increasing the width of the pier nose.

Changes were made in the length and curvature of the transitions from the rectangular tunnel portals to the circular tunnels. Flow at the downstream end of the transitions tended to separate from the sides of the tunnel boundary. The curvature and length of the transitions were increased to provide satisfactory flow conditions in this portion of the tunnel.

To spread the spillway flow over a larger area of the river channel, the right flip bucket was moved about 80 feet downstream from its preliminary location. The radius of the buckets was also increased and the bucket lips were raised about 6 feet in elevation to steepen the trajectory of the jets leaving the buckets and to reduce the drawdown of the river surface at the powerplant tailrace.

Additional data obtained from the model included head discharge curves, water surface profiles in the spillway tunnels, piezometric pressures on the crest and transitions, river surface drawdown curves, and proper procedure for operating the gates. A motion picture of more than 800 feet of film, in color, was prepared with titles to describe the spillway model studies.

Wu-Sheh Dam Spillway

Hydraulic Laboratory Report No. Hyd-430, "Hydraulic Model Studies--Wu-Sheh Dam Tunnel Spillway--Wu-Sheh Dam Project--Taiwan, China." February 7, 1957, was prepared and published during the year.

Murrumbidgee-Eucumbene Tunnel--Fixed-wheel Gate and Stilling Basin

One of the transmountain diversion tunnels in the Snowy Mountains Project, Australia, will transport water from the Murrumbidgee watershed to the Eucumbene River basin. A 7- by 8-foot fixed-wheel gate near the tunnel entrance will control the flow to a maximum of 600 cfs; the head at this gate may be as great as 145 feet. Ten feet downstream from the gate the high velocity flow will enter an underground stilling basin 180 feet long, then a concrete lined horseshoe tunnel 50 feet long, and continue to Adaminiby Reservoir on the Eucumbene River through approximately 10 miles of unlined tunnel.

The fixed-wheel gate is 25-3/4 inches thick and the gate slots are 2-1/2 feet wide by 2-1/2 feet deep. These proportions have not been previously used by the Bureau. The stilling basin is unique: it is quite narrow, has a 4-foot stepdown between the gate frame invert and the basin floor, and the elevation of the bottom of the horseshoe tunnel is 16 feet higher than the basin floor. The design possessed so many hydraulic indeterminates that model studies were deemed necessary to assure a cavitation and vibration free gate installation and an adequate stilling basin. Construction work has been completed in the laboratory on a 1:10 scale model of the gate and gate chamber, the stilling basin, and the horseshoe tunnel downstream. Testing will follow.

SECTION V - SPECIAL RESEARCH STUDIES

Lower-cost Canal Lining Program

Tractive force and erosion studies. This work is being carried on cooperatively with the Earth Laboratory Branch and the accomplishments may be considered the results of the joint effort.

During FY57, field data have been collected from 11 reaches of canals in a range of variation of earth materials and size of cross section. In one reach data on the hydraulics and the characteristics of the earth materials were taken on two curved sections. The canal reaches which have been studied are in Regions 2, 4, and 7.

The field data procured from the above test reaches have been partially processed in the laboratory offices. Further processing will be required as additional data are gathered. This processing will include studies regarding the pattern or trend of the data and determining the trends with a view of definitely establishing a relationship or relationships between the hydraulics and earth properties.

Two field trip reports covering the details of securing the hydraulic data in the field have been prepared and distributed to members of the Lower-cost Canal Lining Committee. The two reports are:

1. Obtaining hydraulic data for erosion and tractive force study of unlined and earthlined canals, Region 7, Lower-cost Canal Lining Program, by Phillip F. Enger, dated September 6, 1956.

2. Obtaining hydraulic data for erosion and tractive force study of unlined and earthlined canals, Region 2, Lower-cost Canal Lining Program, by Phillip F. Enger, dated September 10, 1956.

The report on the tests in Region 4 is being prepared.

During the current fiscal year, personnel of the Hydraulic Laboratory have designed, constructed, and calibrated a "Vane Shear Tester" to aid in determining physical properties of the earth materials in the canal sections. This apparatus was used in the field studies accomplished during the past season in Regions 2, 4, and 7. The equipment worked quite well and should prove to be a valuable aid in the study.

A draft of a report covering the construction, calibration, and use of the "Vane Shear Tester" has been completed.

During the current fiscal year, 29 test reaches of canals have been selected for study. These reaches are excavated in various soil types and have a range of hydraulic conditions including considerable spread in discharges. The cross sections vary from small to large. Soil samples have been procured and are being analyzed in the Earth Laboratory. Hydraulic data and additional observations on soil properties will be made during the irrigation season in FY58. These selected study reaches are in Regions 1, 4, and 5.

The following field trip reports, covering selection of the above test reaches, have been prepared:

1. Selection of field sites and obtaining soil samples for canal erosion and tractive force studies, Eden Project, Region 4, Lower-cost Canal Lining Program, dated October 17, 1956, by E. J. Carlson and John Merriman.

2. Selection of field sites and obtaining soil samples on canal erosion and tractive force study, Paonia Project, Region 4, and Minidoka, Yakima, and Columbia Basin Projects, Region 1, Lower-cost Canal Lining Program, dated January 21, 1957, by E. J. Carlson and J. Merriman.

3. Selection of field sites for canal erosion and tractive force study, Tucumcari and W. C. Austin Projects, Region 5, dated February 12, 1957, by W. G. Holtz and E. J. Carlson.

The results of the studies completed so far are covered in a progress report, Hydraulic Laboratory Report No. Hyd-435.

Considerable evaluation of the program as a whole has been made from time to time. The findings of a recent conference of Hydraulic and Earth Laboratories personnel were definitely positive. No revisions in techniques or program were recommended. The procedures being followed were found adequate and proper and continuation of the program was recommended.

Tractive force flume studies. The studies being made in the large laboratory flume to determine the distribution of tractive forces and establish a correlation with size of material remaining in place for various tractive forces was continued. Manpower was not available to make additional runs in the flume. However, analysis of the data and preparation of a report of the studies made using pit-run gravel from the South Platte River were continued.

Erosion studies. This study was continued in FY57 to establish better design criteria. Information on the frequency and magnitude of wind-generated waves in canal was obtained from two sites in the field. One site was in the Delta-Mendota Canal and the other was in a canal on the Imperial Irrigation District. These data have been processed and additional data are being awaited.

Equipment and instructions were sent to other locations but conditions were not conducive to obtaining the desired information during the fiscal year. Personal contacts with field personnel made during the year will help to alleviate this circumstance in the future. Arrangements have been completed for obtaining some of the needed information during the approaching irrigation season on the Tucumcari and Eden Projects. Similar arrangements have been made with personnel on the North Platte Project and will be carried out if the needed equipment is available.

Adequate information was not obtained to design the model proposed for installation in the hydraulic laboratory to further these studies with a view of determining the optimum protective measures to be taken to insure against beaching of earth canal banks as a result of wave action. Search of the literature available has been continued and some helpful information has been obtained.

Although progress on this study has been slow, the positive information gathered to date indicates that the height of wind-generated waves in canals may not be of the magnitude envisioned at the outset. However, numerous instances were observed where beaching is a costly maintenance problem. Continuation of the study is recommended to yield the data necessary for design and operation of the hydraulic model and furtherance of the general study.

Seepage Studies

Ponding method. During the year no field evaluations of trial linings with respect to their ability to prevent seepage were made by this method either before or after lining. Two exceptions to this statement are to be noted under the sediment lining program. No requests for assistance were received from the regions.

Papers on the subject of Canal Linings presented to the Third Congress of the International Commission for Irrigation and Drainage were reviewed for comments on this method of determining

seepage losses from canals. Although some criticism, which is known to exist, is apparent in the papers, the ponding method of determining seepage is generally accepted on an international basis as being the most positive procedure. Review of the literature was kept current during the year.

Electrical detection studies. A new "Millivac" voltmeter was purchased during the year with non-LCCL funds and primarily for uses other than LCCL work. This instrument is specified to be more than 100,000 times more sensitive than conventional vacuum tube voltmeters and will measure potentials of one one-millionth of a volt. Therefore, it appears that this instrument will aid in the solution of the problem of locating seepage paths from canals by tracing the electrical field generated by seepage. The instrument will be available for this use.

Some work has been accomplished toward designing and building equipment to adapt the instrument to use in seepage detection. Ancillary apparatus will be developed and constructed. Preliminary laboratory tests were started near the close of the fiscal year. Field trials are contemplated at a site in Region 7 to explore the potential value of this equipment.

Other means of determining seepage losses. Parts for seepage meters in use on projects and other assistance in the use of and interpreting results from these devices were provided from time to time throughout the year.

Development of devices and techniques for determining seepage losses from canals as reported by others throughout the world were studied with a view of improving the methods we now use. It was noted that the technique used by Lancaster some years ago to treat a representative area of canal perimeter with bentonite by use of the seepage meter is now being used by others.

It appears that adequate data are now available to make some comparisons of the different techniques being used. A study of this information might permit establishment of transfer factors for use in comparing data derived by use of one technique to those derived from other methods.

Evaluation of Sediment Linings

Lateral 1, Interstate Canal, North Platte Project. Ponding tests were made at the close of the 1956 irrigation season in the reach

of Lateral 1, Interstate Canal, North Platte Project, which was sediment lined with bentonite in the Spring of 1956. The results of these studies are included in the field trip report of November 26, 1956, from Warren B. McBirney to the Assistant Commissioner and Chief Engineer. These results, when compared with the data obtained from similar studies made at the close of the 1955 irrigation season, permitted an evaluation of the bentonite lining. The results of the ponding tests show no benefit from the lining since little of the bentonite remained on the canal surface and an insignificant amount penetrated into subgrade materials.

A study of the data gathered before and after lining from ground water observation wells, inflow-outflow records and other sources was made. This study also led to the conclusion that no benefit was derived from the lining insofar as seepage losses were concerned.

A comparison of the data derived from the ponding tests is contained in the field trip report referred to above.

Lateral 7.2, Angostura Unit, Missouri River Basin Project. Ponding tests were made at the close of the 1956 irrigation season in two reaches of Lateral 7.2, Angostura Unit, Missouri River Basin Project, which were sediment lined with bentonite in the Spring of 1956. The results of these studies are included in the field trip report of November 5, 1956, from Phillip F. Enger to the Assistant Commissioner and Chief Engineer. The results of these tests, when compared with those obtained at the close of the 1956 irrigation season, show that the lining was effective in reducing seepage losses in one ponded reach of the lateral while in the other ponded reach no apparent reduction was effected by the lining.

The report recommends that the reach of lateral which showed positive results from the ponding tests be studied in the Fall of 1957 to ascertain whether or not the lining retains its effectiveness in the reduction of seepage after two seasons of operation with a winter period of no flow between the two operating seasons.

Flume studies. A report, "Hydraulic Flume Tests Using Bentonite to Reduce Seepage" covering the hydraulic flume studies made during FY56, was prepared during FY57. The study included tests using a fine uniform laboratory sand and material from Horse Creek Lateral, North Platte Project. The bentonite used was "Volclay," a sodium base material.

Sedimentation

Channel stabilization. A hydraulic model study is being continued to determine the most economical Kellner jack and jetty arrangements for protection of levees and inducing channelization. Two models are being utilized. A 1:16 undistorted model is being used to study various jetty spacings. The second model was built to a scale of 1:140 horizontal and 1:22 vertical. A light plastic is being used in the model to simulate suspended sediment, and fine sand is used to simulate movable bed material. Field data have been taken of the prototype installation and will be used to verify the model and to adjust its roughness so that flood flow predictions can be made. The progress of the study up to August 1956 was presented in the paper "Use of Steel Jetties for Bank Protection and Channelization in Rivers," by E. J. Carlson and P. F. Enger. The paper was presented at a Hydraulic Division meeting, ASCE, Madison, Wisconsin, August 22-24, 1956. A Hydraulic Laboratory report giving the results of the studies to the present time is now being prepared.

Sediment removal. Several types of sediment removal devices have been tried in connection with design of specific diversions from streams carrying large amounts of sediment. Advancement in the study of such devices this year consisted in the extension of recent model data. Two such studies were made this year: (1) Sediment Control Arrangement for Angostura Diversion; (2) Woodston Diversion Dam.

Hydraulic Laboratory Report No. Hyd-419, "Hydraulic Model Studies to Develop a Sediment Control Arrangement for Angostura Diversion, Middle Rio Grande Project, New Mexico," has been prepared. The study was made with a 1:10 scale model. The sediment excluding devices studied and recommended as modifications were an overhanging sharp-edged headworks sill, curved guide walls, and vortex tubes powered by pumps. Operational recommendations were also made in the report.

An analytical and economic study was made to determine the effectiveness of a curved guide wall sediment excluding device to be incorporated in the design of Woodston Diversion Dam. The study was made by comparing characteristics of Woodston Diversion Dam with other diversion dams which were modeled by the Hydraulic Laboratory. The preliminary design was based on this study, and the Hydraulic Laboratory has since been authorized to perform a model study.

Tractive force studies. In addition to the extensive investigations being conducted in the LCCL program the Hydraulic Laboratory has been running tests on noncohesive material in an 8-foot laboratory flume. Data taken on a pit-run gravel canal section were processed this year and a report is being prepared. The data will be used to determine a correlation between velocity distribution and tractive force distribution. Sieve analyses of bed material transported as well as that remaining on the bed have also been obtained. The data will be valuable in improving design criteria for unlined canals to be built in noncohesive materials.

A tractive force testing apparatus was designed by the combined efforts of the Hydraulic and Soils Laboratories. Shear is induced on standard 8-inch-diameter soil samples by rotating vanes immersed in water. The apparatus is being calibrated using Pitot tubes to determine tractive forces produced by each speed of rotation of the vanes. The tractive force that the soil is capable of withstanding can then be read from calibration curves and used as a basis for canal design.

Flocculating agents. Tests were continued to determine the effectiveness of flocculating agents of three different companies in settling out suspended sediment. Tests were also made to determine what minimum and maximum size is affected by flocculating agents. "Hydraulic Laboratory Report No. Hyd-420, Progress Report No. II, Preliminary Investigations in Hydraulic Laboratory of Flocculating Agents" describing the above tests is now being reviewed.

Canal wave studies. Data on surface waves caused by winds are still being collected. Equipment and instructions have been sent to field locations. The data are being analyzed to determine a correlation between wind velocity and wave heights for various canal conditions. The ultimate goal of the study is to develop design criteria for protective blankets for preventing the beaching action caused by waves.

Water Measurement

Numerous requests have been received during the past years for information relative to the deflection meter used by the International Boundary and Water Commission. Considerable information was gathered on this device by correspondence and field inspections several years ago, but the material had not been consolidated. During FY57 the available data were organized and assembled into a memorandum. This memorandum makes our store of knowledge on the device readily available to our own organization and others.

A paper "Common Errors in Measurement of Irrigation Water," by Charles W. Thomas, was completed during the year. This paper was submitted to ASCE in January 1957 for consideration regarding publication. Advice was received in late April 1957 that the paper had been approved for printing. It should appear in printed form at an early date.

A paper "Structures and Methods for Measuring Irrigation Water," by Charles W. Thomas, was prepared during the year and submitted to the Third Congress of the International Commission on Irrigation and Drainage held in San Francisco in May 1957. This paper is printed in the transaction of the meeting under Question 9.

A third paper, "Water Measurement and Control at the Farm Turnout," by Charles W. Thomas, has been completed and proposed for presentation at an ASCE meeting and later publication by that society. This paper discusses devices and methods in use in various parts of the world.

Some modification work was accomplished on the battery operated mechanical counter for use with the pygmy-type current meter previously developed in the laboratory. This counter has been used throughout the year on various studies and the changes mentioned above were indicated by the use.

A review was made of the information currently available on discharge coefficients for radial gates. Data gathered on the 1956 flood releases from Canyon Ferry Dam were processed and Report No. Hyd-433 was prepared covering the results of the study. A project to be conducted under the hydraulic research program for future study of radial gate coefficients was formalized and proposed for inclusion in the FY58 program.

A study was made in the laboratory of a 2-inch magnetic-type flow meter manufactured by Foxboro Company. This study showed the meter to be quite consistent and accurate when used in clear water. Processing of the data will be completed and a report issued in FY58.

Revisions were made in the pendulum-type low velocity meter built during FY56. This meter has not yet been calibrated because of lack of adequate facilities.

A limited study was made of a Clausen-Pierce weir rule which was borrowed from the Yuma Project. The results showed that

the order of accuracy was not good and was essentially as found in previous studies. The data are being processed and a memorandum report will be prepared.

Because of repeated requests from the Design Division relative to the constant-head orifice-turnout design and calibration, a program of study of this device was formulated for execution in FY58. Arrangements were made for Professor Marvin Bogema of Cornell University to work on this project during the Summer of 1957.

Additional work was done during the year on the data derived from the limited study made on an 18-inch Cippoletti weir relative to location of the head gage. A memorandum report on the study is in process but has not been completed.

During the year considerable discussion was carried on with the Design Division and the Division of Irrigation Operations regarding the standardization of water measurement devices. Slides and notes were prepared for the latter division for use at O&M meetings. Information was also furnished for use in the O&M releases.

Work was carried on throughout the year on the hydraulics of square-leaf turnout gates. Particular attention was given to flow conditions in the turnout entrance. The results of these studies are covered in Hydraulic Laboratory Report No. Hyd-422. These results combined with those from previous studies on square-leaf turnout gates will provide information for improving the calibration tables for this type of gate. The studies made during previous years were primarily concerned with the Denver screw-lift gate and a draft of a report is available.

Throughout the year information was gathered for revision and correction of the Water Measurement Manual. It is not proposed that this manual will be republished in the immediate future.

Reviews of proposed designs for measuring installations have been furnished the Design Division from time to time throughout the year. Consultation has been provided the Division of Irrigation Operations concerning the solution of operational problems of measuring devices on the same basis.

Periodicals, reports and correspondence were utilized as a means of keeping abreast of national and international developments in the general subject area of water measurement. A limited amount of translations of foreign articles was accomplished. A file of these reports is maintained as a part of the program.

SECTION VI - GENERAL HYDRAULIC LABORATORY INVESTIGATIONS

The Hydraulic Laboratory General Investigations program for FY57 consisted of 14 projects, the designations of which were published in August 1957, and transmitted to the Assistant Commissioner and Chief Engineer by memorandum dated August 23, 1956, from the Chief, Division of Engineering Laboratories.

Reference is made herein to the brief descriptions of the 14 hydraulic projects for FY57. The project numbers retain the same identity as in FY57. Descriptions of new projects, Nos. 15 to 19, contemplated for FY58 are given in paragraphs following.

Accomplishments attained so far on the program projected for FY57 are noted on the tabular summary. Narrative description of the status of the projects follows the summary.

TABULAR SUMMARY OF HYDRAULIC
LABORATORY GENERAL INVESTIGATIONS
BY CATEGORY

1. FY57 projects accomplishments	2. FY57 projects to be continued in FY58	3. FY57 projects to be discontinued	4. New projects for FY58
2. Third Progress Report--Hyd-415	2. Hydraulic jump and energy dissipators	1. Hydraulic characteristics of vertical stilling wells	15. Specification finishes and tolerances for irregularities and misalignments in concrete surfaces subjected to high velocities
4. Progress Report--Hyd-422	3. Operation and design characteristics of siphon spillways	6. Cavitation and head loss in conduit and penstock branches	
5. Progress Report--Hyd-337	4. Standardization of design of small canal structures	7. Cavitation-erosion of roughened surfaces	
7. Summarized in ASCE paper, "Cavitation Damage of Roughened Concrete Surfaces," October 1956	5. Hydraulic characteristics of pipeline distribution system and related structures	9. Air demand of gates and valves in conduits	16. Side spillways
8. Progress Report--Hyd-421	8. Downpull forces on coaster, cylinder and fixed wheel gates	13. Determination of minimum size riprap for channels	17. Air requirements for tunnels, control devices, siphons, and outlets
13. Progress Report--Hyd-409	10. Development of cavitation-free gate slots		18. Discharge coefficient for radial gates
	11. Instrumentation for acquiring and recording hydraulic data		19. Crest and transition section for morning-glory spillways
	12. Outlet works stilling basins		
	14. Friction loss tests in large conduits		

CATEGORY 1 (Projects completed)

7. Cavitation-erosion of Roughened Surfaces

This project was summarized by the paper "Cavitation Damage of Roughened Concrete Surfaces" by Donald Colgate, prepared for presentation at the 1956 annual convention, ASCE, October 15-19, 1956, Pittsburgh, Pennsylvania. This exploratory study demonstrated that a simple laboratory test can be made to determine and evaluate the cavitation potential of any surface. Having reached this limited objective, work will be discontinued. However, further laboratory studies must be made at some future date to permit establishment of criteria which will enable the designer or field engineer to state with confidence that a given surface texture will or will not induce cavitation.

CATEGORY 2 (Projects to be continued)

2. Hydraulic Jump and Energy Dissipators

This project has proceeded through the second Progress Report Hyd-399 dated June 1955. Several hundred copies have been distributed for comments, criticism, and suggestions. Additional data for this topic have been obtained during FY57 and the report has been revised accordingly.

The third Progress Report Hyd-415, "Slotted and Solid Buckets for High, Medium and Low Dam Spillways," was issued July 1956.

Work toward revision and improvement of published reports will continue. Additional data will be added as deemed necessary in the light of experience.

Further testing will be conducted on the overchute-type of dissipator where baffle blocks distributed over the entire length and width of the chute dissipate the energy in the water as it falls.

3. Operation and Design Characteristics of Siphon Spillways

Observation of prototype siphon spillways reveals that a considerable number of the structures operate improperly, either not priming fully or even partially, or discharging at a rate far removed from that upon which the design was based. This indicates

a need for revision of design criteria. Limited testing of the new design of an emergency siphon spillway was carried on during the year. The siphon is of the fixed-crest type with a conventional siphon breaker pipe. Intake, crest section, and siphon breaker are proportioned as in our standard design; the flow, however, is directed down a 60° slope to a lower basin in which a water seal is obtained, removing from the influence of atmospheric pressure the entire siphon barrel, forebay to outlet. On the slope two adjustable-angle lips are in place to deflect the water to the roof of the barrel at or near the seal point in the lower basin. These lips have been placed at two arbitrary elevations and are used separately for determination of the optimum location.

A comparison of the effects of the lips on priming time and crest heads required for full prime shows the lower lip most effective in reducing priming times and heads. It is located about one-third of the distance up the slope above the basin. As the angle of projection of either lip is decreased from 45° the time to prime and crest head increase for a given discharge. The new design primes at a discharge less than 25 percent of that required for the standard design, and it does so at a crest head about 15 percent of that formerly needed.

The measured coefficient of discharge for the new design is 0.62, while the coefficient for the standard design is 0.86. This decrease means that for similar barrel sizes the new design has a lower discharge capacity; however, the lower capacity can be easily offset by increasing the barrel size.

A technical paper covering the general operating characteristics of both the presently used design and the proposed design is being prepared for presentation at the October 1957 annual meeting of the American Society of Civil Engineers. Sufficient data on the new siphon will be taken to insure a sound basis for comparison of the two structures. During FY57 time did not permit investigation of auxiliary means for air control in achieving partialized operation. This will be accomplished in FY58.

4. Standardization of Design of Small Canal Structures

Canal systems contain numerous small structures such as drops, turnouts, overchutes, wasteways, culverts, and bifurcation works. Many of these incorporate energy dissipating devices which are quite different from the conventional types. Efficient energy dissipators and transitions are essential to prevent undercutting of the structures and damage to the earth canal sections downstream.

Because of the large number of structures involved, a poorly operating or uneconomical design will be repeated many times before the deficiency is discovered. Although a number of designs have been tested individually by models, standardization has not been established as the structures operate under such a wide range of conditions.

Research studies will be made to standardize designs, and will include an orderly program to observe and check prototype installations designed in accordance with findings in the laboratory.

During FY57, a study was made to establish limitations for turnout entrance structures; a report on this topic (Hydraulic Laboratory Report No. Hyd-422) has been completed.

Studies for the design of transitions from culverts or inverted siphons to canals will be resumed during FY58. The designers have asked several questions concerning outlet transitions during the past year and more data are needed to answer their questions. The idea of using a "closed" transition to decrease losses has been proposed. As a result, several shapes have been built and will be tested using air as the test fluid. It seems desirable that work on this project be continued at an accelerated pace. A report will be prepared during FY58 on the results of the air tests.

5. Hydraulic Characteristics of Pipeline Distribution Systems and Related Structures

In localities where losses by seepage and evaporation from open, lined, and unlined ditches make irrigation costly or unfeasible, it is becoming common Bureau practice to use pipeline distribution systems operating under heads up to about 125 feet. The regulation of flow from such systems introduces many problems, including: (1) the dissipation of energy from high-velocity jets before releasing the flow onto the land; (2) protecting parts of the system from damage by cavitation, vibration, and water-hammer; (3) controlling surges induced by auto-oscillation or sudden changes in flow requirements; (4) regulating pressures to give constant turnout quantities; (5) developing simple automatic regulators; and (6) determining hydraulic losses for various parts of the system. The information now available is widely scattered and not adequate for resolution of these problems.

A comprehensive report, Hydraulic Laboratory Report No. Hyd-337, on means of eliminating or minimizing the cavitation and damage to valves and pipeline walls has been issued. Demand for general design data on high head turnouts has accelerated during the past year. Testing of high head turnouts will continue with particular attention to expansions and baffles downstream from the control.

8. Downpull Forces on Control Gates

When gates are used for control or emergency closure of penstocks and outlet conduits, large downpull forces (forces tending to pull the gate closed) are often encountered. To design the hoist and gate support properly, knowledge of the hydraulic downpull forces is necessary.

Improvement in methods of study indicated by previous investigations has led to more comprehensive data and a direct approach to determining downpull forces. Needed information includes (1) pressure distribution on the gate bottom for different ratios of gate thickness to lip extension, (2) effect of recess above the gate in the face of the dam, (3) effect of gate slots, (4) effect of aeration on pressure distribution, and (5) gate seal shape and location.

Some special studies performed on this subject are reported in Hydraulic Laboratory Report No. Hyd-421, February 1957. Only a limited number of laboratory tests will be possible during FY58.

Prototype studies on the fixed-wheel gate at Glendo Dam supplementing the laboratory tests have been planned. The laboratory studies differed from previous downpull investigations in that air as the flowing fluid in place of water was used to compute the anticipated downpull force. Since downpull forces computed from hydraulic model tests have compared favorably with subsequent prototype measurements, it is highly desirable to further our knowledge of gate downpull forces by comparing the air study results with measurements made on the Glendo gate. Further preparation for prototype tests will be made during FY58.

10. Development of Cavitation-free Gate Slots

Experience has proved that expensive and troublesome maintenance is required on the surface downstream from conventional, high head gate slots due to damage incurred by cavitation erosion. Because slide gates of various designs are used extensively by the Bureau, this problem is of considerable importance.

Studies so far have indicated that practical slot shapes can be provided for gates discharging at partial opening under high heads. Continued research is needed to better establish the effect of various design elements on cavitation formation, and ultimately to yield a practical cavitation-free slot. The study should be extended in a general way to permit the use of slide gates in high head installations where cavitation would otherwise make them prohibitive. Recent studies were performed for the design of the control gate structures of the Tooma-Tumut and Tooma-Eucumbene tunnels in Australia. A progress report will be prepared during FY58 to summarize numerous tests made in the past and make the data available for design.

11. Instrumentation for Acquiring and Recording Hydraulic Data

Good instrumentation is essential to making accurate and efficient hydraulic studies. It is important that we keep abreast of latest developments and investigate improved techniques so that the instrumentation used in both laboratory and field studies will be the most competent available. Work by others will be kept under review and instruments designed and modified as opportunities for improvement are presented.

Specifications were written for the procurement for a limited amount of equipment and instruments last year. Application of the highly developed instrumentation including the hot wire anemometer, turbulence meter and pressure cells will be advanced during FY58.

12. Outlet Works Stilling Basins

Considerable time is devoted to model studies of outlet works stilling basins for individual dams. Often there is insufficient background experience even to approximate a first design closely enough to make a good estimate of the ultimate cost of the structure. The objective of this research is to develop several types of stilling basins for general use so that extensive laboratory development work for each individual case will be unnecessary.

The complete program may require developing as many as six different types of basins including those for (a) discharges from hollow-jet valves, (b) discharges from pipes or conduits flowing partially full at low velocity and low discharge, (c) discharges from sluices or tunnels flowing partially full at high velocities and/or high discharges, (d) discharges where energy must be dissipated in a tunnel, (e) discharges into spillway stilling pools, and (f) discharges into vertical stilling wells.

An example of type (a), known as the "Boysen" type, was developed by the laboratory for use on Boysen, Falcon, and Yellowtail Dams. This type is especially notable for its relatively low cost. Further research will provide data so that the basin can be quickly adapted to structures having greatly different head and discharge requirements than those already tested. Some general data were obtained in FY57 from tests on models previously used for specific projects. Tests of a general nature are being performed on such a model; a progress report will be prepared during FY58.

A basin known as the "Franklin Canal" type has been developed for use on some 35 canal drops on the Franklin Canal. This type (b) is primarily for low heads and small quantities of water. This study has been concluded and reported in Hydraulic Laboratory Report No. Hyd-399. During FY57, studies were extended to a modified design (c) combining a basin and well for valve-controlled high head pipe turnouts. This study will be continued in FY58.

14. Friction Loss Tests in Large Conduits

Head losses in pipes for the purpose of computing head loss coefficients have been measured in laboratory and field investigations from time to time. Many equations have been derived from the results but there is uncertainty in their application to the design of large conduits because the majority of the tests were made on relatively small pipe. Closer evaluation of friction losses could save considerable in construction costs through reduction in size of conduits. The current need for additional information in this subject area is in connection with the planning and design of the Gulf Basin Project in Texas. The economic feasibility of this entire development may be dependent upon reducing the size of the very large primary conveyances which include a large proportion of closed conduit. These closed conduit reaches are necessary because the general alinement is across the natural drainage system. During the year assistance was tendered the Design Division toward an improvement in practical application of friction loss coefficients. A letter was drafted for dispatch by the Canals Branch to designing agencies throughout the world. Inquiry was made regarding current design practice regarding friction loss coefficients. The information acquired, which was considerable, has not been completely analyzed. These data will be combined with those obtained from a search of the literature. This search, including some translation, has yielded additional knowledge on the subject during the past year and will be continued.

The data obtained from the field tests of the large siphons on Columbia Basin Project have been analyzed and a report is being prepared. The report will be completed in FY58.

At the time field performance tests were made on the turbines in Eklutna Powerplant sufficient observations were made of flow conditions through the pressure tunnel to permit calculation of friction factors. The derived data will be processed during FY58. It is hoped that this information may further the knowledge on the subject.

CATEGORY 3 (Projects to be discontinued)

1. Hydraulic Characteristics of Vertical Stilling Wells

A study of vertical stilling wells originated from the problem of converting water flow of high energy content to one of low content, such as unwatering certain structures which contain water under high pressure, and supplying irrigation water from high pressure conduits to earth ditches. The investigation of three stilling well structures of square cross section and the operation of two field structures have established the feasibility of the stilling well. Development of the project to this point permits use of the principle in design considerations and the project will be discontinued.

No work is contemplated on this project during FY58. However, vertical stilling wells from which some information has already been obtained are available for a laboratory study. Area, depth, and shape of well for various discharges and entrance velocities may be obtained to establish design criteria. Tests at some future date should consist mainly of obtaining data for the circular-type well.

6. Cavitation and Head Loss in Conduit and Penstock Branches

This problem is an important one but it will have to be postponed until some immediate need arises and time and personnel are available to pursue it.

9. Air Demand of Gates and Valves in Conduits

This project has been deferred because of more urgent work.

13. Determination of Minimum Size Riprap for Channels

A progress report, Hyd-409, has been published covering most of the work performed on this project. Although further data are needed this project has been discontinued because of more urgent work.

CATEGORY 4 (New projects)

15. Specification Finishes and Tolerances for Irregularities and Misalinements in Concrete Surfaces Subjected to High Velocity Flow

Many Bureau spillway and outlet works structures have concrete surfaces over which water flows at high velocities. Certain irregularities and misalinements, if permitted in these surfaces, cause regions of low pressure which will cause cavitation and cavitation-erosion when vapor pressure is reached. It is, therefore, important that offsets, bulges, grooves, joints, misalinements and other surface irregularities be eliminated or reduced sufficiently to prevent the occurrence of vapor pressure.

The lack of information concerning the cavitation tendencies of these various surface irregularities and the uncertainties regarding the application of test data to predict the point of incipient cavitation for the prototype structures have resulted in the adoption of rather stringent specifications regarding the construction finishes and tolerances for these flow surfaces.

The treatment of these surfaces to make them comply with these stringent specifications often proves quite costly. Much of this extra cost could be eliminated by a relaxation of the specifications. A thorough knowledge of the cavitation tendencies of the various irregularities is needed to ascertain whether or not a relaxation is possible. This knowledge can be obtained through hydraulic tests using facilities similar to those employed in a recent study concerning cavitation of roughened concrete surfaces. Representative joints, humps, offsets, depressions, etc., would be placed in the test apparatus where they would be subjected to high velocities and low pressures. Pressure and velocity conditions for incipient cavitation would be determined and the critical cavitation index obtained for each of several sizes of the various irregularities.

The project will extend over a period of possibly 3 years depending upon the time available to pursue it. During FY58 it is proposed to select for study one or two of the shapes most commonly encountered in the field. These exploratory studies will serve to guide the remainder of the program.

16. Side Spillways

Requests for information necessary in the design of side spillways have been received in the laboratory from the design division periodically for a number of years. Although there is considerable information available on the subject, correlation is lacking. The usual procedure has been to make the best use of the material available and complete a design or to rely on hydraulic models to resolve the immediate questions pertinent to the specific structure.

The purpose of the study would be to develop basic design data utilizing an analytical approach and hydraulic models.

This study should be considered in two very closely associated parts: (a) a study of the parameters involved in the flow characteristics in the channel upstream from the side spillway and in the spillway proper (this type of structure is generally termed a side spillway and serves as an emergency structure to release excess flows from canals); and (b) a similar study of the hydraulics of a channel downstream from the spillway with relation to the overflow weir (this type of structure is generally termed a side channel spillway and is normally used in connection with reservoirs. The flow may enter the channel from one or both sides, or from one or both sides and one end).

In regard to Part (a), available information will be extended and reduced to a form readily usable by designing engineers as follows: (1) an analysis would be made of all available technical literature on the subject; (2) correlation of data previously obtained in the laboratory would be attempted; and (3) studies would be made on existing hydraulic models to obtain additional necessary information.

During FY58, it is proposed to make an inventory of the available information on the subject and translate pertinent foreign articles. Some correlation of the assembled technical information will also be made. It is contemplated that a project study will be made during FY58 of a proposed side weir. If this model becomes available it could be used as a facility to start the laboratory studies.

In Part (b), a procedure similar to that outlined for Part (a) will be followed. Hydraulic model studies directed toward developing a crest-channel relationship will be made, utilizing existing models. During FY58 initial tests could be started utilizing a model of a side channel spillway now in operation in the laboratory.

17. Air Requirements for Tunnels, Control Devices, Siphons and Outlets

There is a need for the determination of the mechanics of the escape of air absorbed in water when the ambient pressure is changed and for criteria to determine the quantity of air required by ejector action to prevent the formation of pressures conducive to cavitation or vibration.

In the case of siphons, for instance, the release of air entrained in the water by natural means together with the larger volume resulting from agitation by pumps or energy-dissipating devices will collect at a high point in the conduit preventing continued operation of the siphon or decreasing its capacity. Should the accumulation of the air be sufficient to adversely affect the capacity of the hydraulic carrier, the obstruction in the form of an air pocket can only be removed by mechanical means such as an air pump. With existing knowledge, the designer is forced to estimate the quantity of air to be released from the flow, and if it is assumed that a vent or mechanical means of removing the air is required, a second estimate must be made to determine the size needed. Obviously, these estimates must be on the side of safety resulting in a costly structure.

The other phase of the problem stemming from those designs necessarily introducing air to prevent the formulation of excessively low pressures requires a knowledge presently insufficient to evaluate the quantity of rarefied air in terms of the size of duct connecting to the atmosphere. A determination of the data from a hydraulic model does not permit transference with certainty to the prototype structures because of the introduction of unknown factors, such as the effect of the increased velocity of the water jet involved or the action of the rough contour of the water stream compared to a smooth surface obtained in the laboratory.

The program includes the laboratory investigation to determine the basic principles governing the rate of separation of air from solution and the flow of air in the rarefied state, the selection of instrumentation for laboratory and field measurements; and prototype observations to simplify and confirm laboratory studies permitting an analysis usable by the design engineer. It is proposed that in FY58 an inventory of all information available on both phases of the project will be prepared. Prototype installations will be reviewed for possible sites for field study. This assembled information will serve as a basis to better define the problem and firm up a future program.

18. Discharge Coefficients for Radial Gates

Radial gates are used extensively in irrigation systems for rate of flow and water surface level control. Normal and flood releases from storage dams, and at diversion dams and regulation and control in the conveyance systems, are effected by the use of these gates. Intelligent and orderly operation of the systems normally requires that the rate of flow passing the gated structures be known. The need for accuracy of measurement is dependent upon conditions existing at the site.

The radial gate is used to close an opening in a structure. Hence, the boundaries of the flow orifice are formed in part by the structure and in part by the gate. The wide variety of shapes which the structure may assume, together with the extensive choice of physical dimensions, shapes, and settings of the gate itself, combine to create an almost infinite number of combinations which affect the rate of flow. Therefore, determination of discharge coefficients through a structure utilizing radial gates for control is not readily solvable by analytical means. An empirical solution is thus indicated.

Needed information includes the effect on the discharge coefficient of: (1) the radius of curvature of the gate leaf; (2) the ratio of breadth to height; (3) the relative position of the hinge pins; (4) the submergence both upstream and downstream; (5) the profile of the bottom of the structure adjacent to the gate; (6) the alinement of the sides of the structure (assuming that the structure has only one gate or that the gates are separated by piers. If there are no separating piers between gates other questions arise); and (7) orientation of the structure with respect to the approaching flow.

A program including library and hydraulic model research will develop adequate data to determine discharge coefficients for radial gates for use in design and initial operation.

Tests on selected types of gates and structures could be conducted in the 4-foot-wide laboratory flume. The permissible size of model which may be used in this facility is considered adequate to alleviate such criticism as has been directed toward some previous work on very small models. Unless the results of the laboratory flume studies so indicate, prototype observations are not considered necessary to an initial solution.

In FY58, a review of the information available in the laboratory would be completed. The January 22, 1951 memorandum on discharge capacities of radial gates would be revised. Preparatory work such as design and fabrication of a large model would be started.

19. Crest and Transition Section for Morning-glory Spillway

It is known that adjacent topography or structures exert a decided influence on the hydraulic action in the morning-glory spillway and transition which follows. One way in which adjacent land masses affect the spillway is to cause unequal operating heads on different segments of the crest.

The height of the crest above the surrounding berm is a factor which enters into selection of a design coefficient of discharge, and the width of the berm may well be important, too.

It is proposed, that a program be developed for the evaluation of the factors known to be important in design of morning-glory spillways. More particularly, it is desired to arrive at empirical coefficients which will enable the designer to allow for unsymmetrical approach and to adjust profiles to operate at or above atmospheric pressures. The existing Trinity spillway model can probably be used during FY58 for investigation of the effect of unsymmetrical approaches. It is anticipated that as the work progresses additional separate facilities will be required.

The work done on the Trinity model during FY58 will assist in determining the extent of a program, and a more accurate estimate can then be made for future work.

SECTION VII - NONDESIGN WORK

General Description and Identification

At the beginning of FY57, the various overhead jobs were regrouped and redefined in order that all changes not directly chargeable to project work can be collected under definite accounts. To assist the reader in visualizing the types of work covered in the nondesign budget, brief descriptions of the various budget items are given.

ADMINISTRATION (Direct labor--Reporting Branches only)

0-3000-0-0-1 Administration, miscellaneous, including former Clerical and Stenographic

** For General Administration, the number is primarily for use of supervisors. Supervisors, however, should distribute their charges to the various jobs in their unit and use this number only on assignments entirely unrelated to project and research work, such as preparation of job sheets, efficiency ratings, budgets, and estimates for outside work for which funds have not yet been advanced. This number is also for use of the secretaries when their work is so general that there is not enough time spent (1 hour or more) on any one phase to justify a charge to a specific activity. When an hour or more is spent on a specific activity, the charge should be to that activity. Others may use this number when substituting for the secretary or when doing clerical work of a very general nature (for example, filing accumulations of bulletins, technical journals, miscellaneous correspondence, etc.) that can not properly be charged against other work in the unit.

FIELD TRAINING, CONFERENCES, AND REVIEW OF FIELD ACTIVITIES (Formerly Administrative Services)

0-5000-0-0-1 Field Engineers Laboratory Training

The preparation for and conducting of laboratory training programs for field engineers when such a program has been authorized.

0-5000-0-0-2 Construction Engineers Conference

Planning of or participation in such conferences when authorized.

0-5000-0-0-3 Conferences with Bureau Personnel

Time spent in discussing general problems, not chargeable to specific project or research numbers, with personnel from other branches, divisions, or offices of the Bureau. Most conferences are chargeable to project or research activity.

0-5000-0-0-4 Safety Engineering

Safety inspection and construction of safety devices.

MEETINGS, CONFERENCES, AND PANELS

0-3002-0-0-1 Meetings--Civic, Professional, and Scientific

** To this number shall be charged the time of an employee while attending, including travel to and from, a civic, professional or technical society meeting, such as ASTM, ASCE, etc., when the attendance is authorized by the Commissioner. (Preparation of papers to be presented at these meetings shall be charged to Preparation of Articles and Papers, 0-3003-0-0-6.)

0-3002-0-0-2 Meetings--Public and Private Groups

Official attendance at a public meeting, such as Chamber of Commerce, League of Women Voters, study groups, etc. Usually, the deciding factor between this and the previous number is whether Commissioner's approval must be obtained for travel involved.

PUBLIC RELATIONS

0-3003-0-0-1 Preparation and Display of Exhibits

For use in preparation of displays for exhibit here in the Bureau for public information purposes; at colleges and universities for Engineers' Day; or at technical conferences and conventions.

0-3003-0-0-2 Domestic Visitors

** Time spent with visitors to the Laboratories, including representatives of industry, seeking information or for discussion of special subjects not related to a specific project or research activity. (Tours should be charged to 0-4000-0-0-24.)

0-3003-0-0-3 Cooperation with Technical Societies

General society correspondence, committee correspondence, review and comments on technical papers prepared by other society members. In general, cooperative test programs will be a logical part of our research activity.

0-3003-0-0-4 Foreign Visitors

Conducting foreign visitors through the laboratories and time spent in discussions with foreign visitors when no funds have been provided by the country represented. In most instances, foreign trainees and foreign observers have funds provided by the country represented and an appropriate job number in the "6195" series will be made available.

0-3003-0-0-5 Technical Information Services

** Answering requests from the general public, foreign or local, for technical information when the exchange of correspondence is not directly related to an active foreign or Bureau project or research program. (This type of work was charged to "Cooperation with the Public" number last year.)

0-3003-0-0-6 Preparation of Articles and Papers

** For use in preparation of all articles and papers for publication in magazines and technical journals, and for presentation at society meetings and conventions.

0-4000-0-0-24 Laboratory and Office Tours

Conducting visitors on tours of the office and laboratory facilities, open houses, inspections, etc.

DATA AND DATA ANALYSIS

0-3004-0-0-1 Preparation, Maintenance, and Collection of Data

Preparation of monthly and annual reports on laboratory activities, review of technical literature or otherwise gathering statistical or technical data for general purposes and future reference. Completing laboratory reports of tests or model studies of project work when production order for the specific project is closed and cannot be reopened should be referred to Dudgeon for proper charging.

STANDARD DESIGNS AND PROCEDURES

0-3005-0-0-14 Preparation and Review of Standard Specifications

For preparation of standard guide paragraphs for Bureau use in future specifications, and review of Federal specifications.

BUILDING ALTERATIONS

0-4003-0-0-

A specific job number will be issued for each authorized alteration.

MANUALS AND PUBLICATIONS

0-3006-0-0-1 Concrete Manual

0-3006-0-0-2 Engineering Monographs

0-3006-0-0-3 Earth Manual

0-3006-0-0-4 Paint Manual

0-3006-0-0-5 Manual on Measurement of Irrigation Water

0-5001-0-0-1 Reclamation Instructions

0-5001-0-0-5 Low Dams

LABORATORY INVESTIGATIONS

0-3007-0-0-1 Concrete

0-3007-0-0-2 Cement and Pozzolan

0-3007-0-0-3 Earth

0-3007-0-0-4 Hydraulic

0-3007-0-0-5 Structural

0-3007-0-0-6 Bituminous

0-3007-0-0-7 Chemical and Radioisotopes (Special Techniques)

0-3007-0-0-8 Paint and Corrosion

0-3007-0-0-9 Rock Foundations

0-3007-0-0-10 Riprap

0-3007-0-0-11 Evaporation Control

0-3007-0-0-12 Hungry Horse Test Cores

0-3007-0-0-13 Weed Control (Expanded cooperative program)

REPAIRS, MAINTENANCE, AND INSTALLATION

0-4002-0-0-1 Engineering Laboratories

Repair, maintenance, and installation of Laboratory equipment. This number is primarily for the use of shop personnel. It may be used by other branches, within the allocations provided, in the maintenance of laboratory equipment which requires specialized techniques.

0-4002-0-0-2 Electric Load Analyzer

0-4002-0-0-3 Photoelastic Laboratory

0-4002-0-0-4 Office Equipment

0-4002-0-0-5 Auditorium Operation and Maintenance

The three numbers ending in 2, 3, and 4 are for use by the laboratory shops. The last number, Auditorium Operation

and Maintenance, is to be used only when the operation or maintenance has been requested by the Property Branch.

EQUIPMENT FABRICATION

0-8900-

The "8900" series is used for fabrication orders which are required for fabrication of all nonexpendable property regardless of its purpose or disposition, and all expendable supplies except those for immediate use by the laboratories on existing, authorized jobs. Fabrication orders may be initiated by forwarding a request on Form ASD-810 to the Laboratory Services Branch, where a fabrication order will be prepared and routed through the proper channels for approval and assignment of a job number.

SPECIAL STUDIES

0-8001-0-0-1 Sedimentation Studies

0-8008-0-0-1 Weed Control Studies

0-8009-0-0-1 Water Measurement Devices, Development and Standardization

0-8030-0-0-1 Lower-cost Canal Lining Program

All special studies are charged as a direct charge in the same manner as project work.

LEAVE

0-4100-0-0-1 Annual Leave

0-4100-0-0-2 Sick Leave

0-4100-0-0-3 Holiday Leave

0-4100-0-0-4 Military Leave (not military furlough)

0-4100-0-0-5 Court Leave, Jury Duty

0-4100-0-0-6 Administrative Leave

0-4100-0-0-7 Civil Defense Leave

OUTSIDE AGENCIES

Job numbers in the "6000" series except "6195" and "6300" are used for work performed for other Government agencies, and private industry or individuals, on a contract basis; in case of other Government agencies by transfer of funds on SF-1080. There is a different job number for each contract or agreement.

FOREIGN ACTIVITIES

The "6195" and "6300" series are the project numbers assigned to work for foreign countries, whether it is an engineering assignment, in-service trainee, or foreign observer. There are different account numbers for each category as well as for each country.

PROJECT WORK

Any work performed in the laboratory which is related to current Bureau projects should be charged to project job numbers. The direct labor charge may be divided among several projects in 1 day. Minimum charge is 1 hour. Timekeeping, cleanup, supervision and administration (except as noted under General Administration) are logically chargeable to the project and research activities in progress within the unit.

Special Activities

1. Staff Committee Activity

H. M. Martin	Member, Incentive Awards Committee, Commissioner's Office, Denver
H. M. Martin	Member, Chief Engineer's Committee on Professional Activities
J. W. Ball	President, Denver Interior Credit Union
C. W. Thomas	Chairman, Water Measurement Committee

2. Professional Activities of Hydraulic Laboratory Staff Members

Name	Membership in Founder Society	Membership in Other Technical Organizations	Registered Professional Engineer-State	Other
Martin	Member, ASCE	Member, International Association for Hyd Research	Colorado	Member, Exe Comm, Hyd Div, ASCE, for 5-yr term ending Oct '59 Reviewed one paper proposed for publication in ASCE in past year
Ball	Associate member ASCE	United States Committee on large dams Reclamation Technical Club		Reviewed one paper for ASCE and comment on several others
Wagner	Member, ASCE	Reclamation Technical Club	Colorado	
Peterka	Member, ASCE	Reclamation Technical Club	Colorado	ASCE Hydraulics Division: a. Member, Committe on Design b. Member, Task Force on Cavitation in Hyd Structures c. Chairman, "Task Force on Spillway and Crest Gates"

Name	Membership in Founder Society	Membership in Other Technical Organizations	Registered Professional Engineer-State	Other
Rhone	Associate Member, ASCE			Member, Hyd Division, ASCE Task Force "Friction Factors in Large Conduits"
Beichley	Associate Member, ASCE	Reclamation Technical Club	Colorado	Member, Civil Engineering Corps, Naval Reserve
Simmons	Associate Member, ASCE			
Colgate	Associate Member, ASCE			Member of Hyd Division ASCE Task Force on "Aerated Flow in Open Channels"
Thomas	Member, ASCE International Association for Hyd Research United States Committee on Irrigation and Drainage United States Committee on Large Dams of the International Commission on Large Dams		Colorado	Member, ASCE Committee on the J. C. Stevens award Reviewed one paper proposed for publication by ASCE in past year

Name	Membership in Founder Society	Membership in Other Technical Organizations	Registered Professional Engineer-State	Other
	Reclamation Technical Club Four States Irrigation Council			
Carlson	Member, ASCE	5002 Res and Dev Unit United States Army	Colorado (also registered land surveyor)	Member, Committee on Sedimentation, Hydraulic Division ASCE
Schuster	Member, ASME	Reclamation Technical Club		Chairman, Membership Development Committee, Rocky Mountain Section, ASME
McBirney	Associate Member, ASCE	Reclamation Technical Club		
Dexter		5002 Res and Dev Unit United States Army Reclamation Technical Club		Classwork for M.S. degree completed; now working on thesis
Enger	Junior Member, ASCE	Reclamation Technical Club		Vice Chairman; Hyd Div, Colorado Section, ASCE for past year; elected chairman for coming year. Classwork for advanced degree complete; now working on thesi
Dodge		Reclamation Technical Club National Society of Professional Engineers	Engineer in training, Michigan	Taking night courses at University of Colorado

Name	Membership in Founder Society	Membership in Other Technical Organizations	Registered Professional Engineer-State	Other
Kuenmich		Instrument of America Reclamation Technical Club		

3. Professional Papers--Presented During FY57 and in Preparation for Coming Year--Hydraulic Laboratory

Author	Title of Paper	Meeting	Place	Date	Paper Published
Martin	"Glen Canyon Dam"	Student Chapter ASCE, University of Alabama	Tuscaloosa, Alabama	February 14, 1957	Field Trip Report attachment
Ball	"Cavitation Characteristics of Gate Valves and Globe Valves Used as Flow Regulators Under Heads Up to About 125 Feet"	Fall Meeting, ASME	Denver	September 10-12, 1956	To be published in ASME Transactions, 1957
(Co-Authored with J. C Schuster)	"Hydraulic Studies of a Vertical Shaft Intake to a Pressure Tunnel"	IAHR	Lisbon, Portugal	July 31, 1957	To be published later Proceedings of the Congress
Ball	"Hydraulic Design Studies for a Cylinder Gate at Bottom of Vertical Shaft"	ASCE			To be prepared for future meeting
Peterka (Co-Authored with Bradley)	"The Hydraulic Design of Stilling Basins and Associated Appurtenances"				Scheduled for publication in the ASCE Journal of Hydraulics Division
Peterka	"Preparation of Hydraulic Laboratory Reports"	ASEE	Ithaca, New York	June 20, 1957	

Author	Title of Paper	Meeting	Place	Date	Paper Published
Beichley and Peterka	"Hydraulic Design of Solid and Slotted Spillway Buckets"				To be presented at a future ASCE meeting and for publication in Hyd Div Journal
Peterka and Beichley	"The Hydraulic Design of Hollow-Jet Valve Stilling Basins"				To be presented at a future ASCE meeting for publication in Hyd Div Journal
Simmons	"Hydraulic Downpull on Gates"				To be prepared for presentation at a future ASCE meeting for publication in Hyd Div Journal
Colgate	"Cavitation Damage of Roughened Concrete Surfaces"	ASCE	Pittsburgh, Pennsylvania	October 19, 1956	Paper will be published in Hyd Div Journal
Beichley	"Overflow Weirs"				To be prepared for presentation at a future ASCE meeting for publication in Hyd Div Journal

Author	Title of Paper	Meeting	Place	Date	Paper Published
Thomas	Structures and Methods for Measuring Irrigation Water	Third Congress, International Commission on Irrigation and Drainage	San Francisco, California	May 1957	Bound Preprints Will be printed in published Transactions of Third Congress
	Common Errors in Measurement of Irrigation Water	Presented in part Irrigation and Drainage Conference, Irrigation and Drainage Div, ASCE	Denver, Colorado	September 1955	Accepted for publication as ASCE separate April 1957
	Velocity, Scour and and Pressure Measurements from Three Models of the Same Structure	Seventh Congress of the International Association for Hydraulic Research	Lisbon, Portugal	July 1957	Becomes part of Proceedings of Seventh Congress July 1957
	Water Measurement and Control at the Farm Turnout	Joint meeting of the Hydraulics and Irrigation and Drainage Divisions, Colorado Section ASCE	Denver, Colorado	September 1956	Paper completed Publication pending final program for Portland meeting
		Tentatively scheduled for ASCE Convention	Portland, Oregon	June 1958	

Author	Title of Paper	Meeting	Place	Date	Paper Published
Carlson (Co-Author Enger)	"Use of Steel Jetties for Bank Protection and Channelization in Rivers"	Hydraulics Division Meeting ASCE	Madison, Wisconsin	August 1956	
Schuster	Penetration of a Jet into a Counterflow	Course in Experimental Techniques State University of Iowa	Iowa City, Iowa		Seven Exploratory Studies in Hydraulics Paper 1038. Journal of the Hydraulics Division of ASCE HY4 August 1956
Co-Author J. W. Ball	Hydraulics Studies of a Vertical Shaft Intake to a Pressure Tunnel	Seventh Congress of the International Association for Hydraulic Research	Lisbon, Portugal	July 1957	Becomes part of Proceedings of Seventh Congress July 1957
McBirney	Some Experiments with Emergency Siphon Spillways	ASCE, Annual Meeting Hydraulics Division	New York	October 1957	
Glover, Thomas, and Dexter	Analytical Developments and Applied Practices of the Salt Velocity Method (Title Tentative Only)				USGS has suggested submission to ASCE for publication

4. Special Publications

a. Films completed and available for showing:

Title	Comments
Yanhee Dam Spillway Model Study 900 feet of film; color; silent	This film shows the hydraulic tests to develop the spillway for prototype construction. About 200 feet of the film illustrates the method of constructing hydraulic models, including the placing of topography in the model and the fabrication of transparent plastic transitions
Yellowtail Dam Spillway and Outlet Works Model Study 1,050 feet of film; color and black and white; silent	This film includes construction of the model; development of the spillway beginning with preliminary design; and the development of the outlet works
Lovewell Dam Outlet Works and Stilling Basin 270 feet; color; 16 frames per second; silent	Shows an unusual outlet structure controlled by a high head radial gate. After leaving the jump type stilling basin provided with a cover the flow enters a bifurcation with one leg leading to a wasteway and the other leading to a measuring structure and canal
Casitas Dam Spillway and Outlet Works 310 feet; color; 16 frames per second; silent	The film shows an unusually long and narrow earth dam spillway that narrows from 50 feet to 25 feet near the crest. The spillway flow and outlet works both enter a jump type stilling basin. Of particular interest are studies showing slug-like flow on the spillway at small discharges and its effect on the stilling basin

b. Films in progress

(1) Vaquero Dam Outlet Works. Flow in approach conduit and action in stilling basin

(2) Trinity Dam Spillway. Approach and morning-glory spillway

(3) Anchor Dam Spillway. General study of entire structure

(4) Hollow-Jet Valve Stilling Basin. Illustrates typical limiting design conditions which can be applied to any generalized stilling basin design of this type

(5) Palo Verde Dam Spillway and Canal Headworks

(6) Boysen Dam Spillway and Outlet Works. Prototype film to study prototype performance and model conformance

(7) Paonia Dam Spillway and Outlet Works. Approach, chute, and stilling basin. Outlet tunnel junction with spillway chute

(8) Wu-Sheh Dam Spillway. Entrance, tunnel, flip bucket and river channel

(9) Glen Canyon Dam Spillway. General overall study with particular emphasis on the entrances

(10) Wave Studies. Prototype waves in canals

(11) General Sedimentation. Containing Woodston Diversion Dam model, Casa Colorada Channel model and prototype, and tractive force field measurements

(12) Cavitation. Mostly high speed color photographs

5. Training Foreign Engineers

Quite a sizeable number of engineers from other countries has been assigned to the Hydraulic Laboratory for training in hydraulic laboratory practice. The engineers assigned to the laboratory this year were especially capable and persevering. It was again demonstrated that generally speaking trainees, who stay longer than 3 months, pay for the cost of supervision and training through productive work.

Name of Engineer	Country	Duration of Training
Tweechai Maksaman	Thailand	December 16, 1955 to November 1, 1956
Wladimiro W. Kestenbaum	Honduras	1 week
Philip T. A. Griffiths	Australia	6 weeks
Chareuk Nonthathum	Thailand	5 months
Dr. Ahmed M. Yassim	Egypt	14 weeks
Christopher Donabedian	Lebanon	2 weeks
Zeev Vered	Israel	2 days
Monowar Ali	Pakistan	2 days
Beswaswar Martra	India	1 month
Wan Hai Cheng	Formosa	September 11, 1956 to June 1957
John R. Ewers	Australia	10 weeks
M. G. Hiranandani	India	3 weeks
Jose C. Regalado	Phillipines	1 month
Peter Brown	Australia	8 weeks
K. Y. Hseuh	Formosa	3 months

6. Exhibits

(1) Upper Colorado River Basin Model.--Planned during last fiscal year; layout and construction of this model was started July 16, 1956, as authorized by the Director of Region 4. This 1:633,600 scale model comprises all the Upper Colorado River Basin and surrounding territory within a 47- by 60-inch rectangular frame. On it are shown features of the Colorado River Storage Project and the participating projects that are under construction and those that have been authorized.
Status and disposition of the original request for 10 copies are as follows: Copy 1, complete and shipped to the Commissioner's office; Copy 2, complete and shipped to Region 4 Director's office; Copy 3, complete and shipped

to Region 4 Director's office for presentation to the State of Utah; Copies 4, 5, and 6, complete and being held in Denver pending formal presentation to the States of Wyoming, Colorado, and New Mexico; Copies 7, 8, and 9 almost complete, to be displayed at Glen Canyon and Flaming Gorge Dam sites and in the Denver office; Copy 10 yet to be cast and painted will be used as a traveling exhibit by Region 4.
In addition to the above one other copy has been completed and one more has been authorized. The first of these is now in use by the Technical Information Branch in Denver as part of a portable display. The last is to be made at the request of the Division of Administrative Services in Denver.

(2) "Small Business Procurement Clinic" exhibit in Building 56, October 17-18, 1956. Cooperated with the Small Business Administration in space allocation, planning, programing and installations for the displays and meetings.

(3) Weir Demonstration Model.--This working model was conditioned and shipped to Albuquerque for display at the New Mexico State Fair, September 29 through October 7, 1956. The request for this use of the model was made by the Project Manager at Albuquerque, New Mexico.

(4) Display Model at Hoover Dam.--At the request of the Director of Region 3, the laboratory model maker was sent to Boulder City on a 4-week detail (March 11 through April 5, 1957) to revise the model in the exhibits building at Hoover Dam. Palo Verde Diversion Dam and the principal features of the Colorado River Storage Project were added. As the model is distorted and these features were not anticipated in the original construction numerous, modifications were necessary to make the additions possible.

(5) Colorado-Big Thompson Project Model.--Under the direction of Region 7 this model was crated and shipped, on April 4, 1957, to Loveland, Colorado, where it is now on display in the Loveland Museum.

(6) California Relief Map.--As authorized by letter of April 16, 1957, from the Director of Region 2, four rubber casts of the small California map were made and shipped to Sacramento. A plaster cast of this model from the 1893 Columbia Exposition was donated to and restored by this office some years ago. A mold made at the time of restoration was used in complying with the above request.

(7) Architectural Models in Building 53.--A requisition has been received from the Property Branch of this office to rehabilitate and paint 11 of the models now on display on the southwest mezzanine of Building 53. Due to the workload of previous commitments a start on this request is not anticipated much before the end of the calendar year of 1957.

(8) Model Estimates.--In addition to the above work cost estimates were requested and furnished for the following:

(a) A model of Region 1 for the Regional Project Development Engineer in Boise, Idaho, through the Director of Region 7 in Denver, August 1956

(b) A large model of Colorado showing streams, canals, ditches, and irrigation districts for the State Game and Fish Department, August 1956

(c) A typical Reclamation multipurpose project model for the Department of Commerce through the Technical Information Branch of this office, November 1956

(d) Models of the Garrison Diversion Unit and the State of North Dakota for the Garrison Diversion Conservancy District through the Director of Region 6, January 1957

(e) A finished copy of the Upper Colorado River Basin model for the Utah Water and Power Board, January 1957

(f) Architectural Model of Glen Canyon Dam. The model would include the following features by phases: initial--powerhouse, adjacent parking and outlet valve house; second--dam, spillway entrances and exits and surrounding topography; future--bridge and switchyard area. The model without switchyard would be roughly 8 by 14 feet at a scale of 1":20'

SECTION VIII - LABORATORY REPORTS, PAPERS, PUBLICATIONS AND FIELD TRIP REPORTS ISSUED DURING FY57

Hyd-408	Hydraulic Model Studies of Palo Verde Diversion Dam
Hyd-415	Progress Report III--Research Study on Stilling Basins, Energy Dissipators, and Associated Appurtenances Section 7, Slotted and Solid Buckets for High, Medium, and Low Dam Spillways
Hyd-416	Hydraulic Model Studies--Service Spillway--Alamogordo Dam Enlargement
Hyd-417	Hydraulic Flume Tests Using Bentonite to Reduce Seepage
Hyd-418	Hydraulic Model Studies of Vega Dam Outlet Works--Collbran Project, Colorado
Hyd-419	Hydraulic Model Studies to Develop a Sediment Control Arrangement for Angostura Diversion, Middle Rio Grande Project, New Mexico
Hyd-421	Model Studies of Hydraulic Downpull Forces that Act on the Palisades-type Regulating Slide Gate, and on the Glendo Fixed-wheel Gate
Hyd-422	Flow Characteristics in a Pipeline Downstream from a Square-cornered Entrance
Hyd-423	Erosion Studies on Sandstone Through Which the Glen Canyon Dam Diversion Tunnels Will Pass--Glen Canyon Dam--Colorado River Storage Project
Hyd-424	Measurement of Effects on the Gorge Powerhouse and its Equipment and Tunnels During Blasting in the Adjacent Rock for the Department of Lighting--City of Seattle, Washington (Issued as Structural Research Laboratory Report SP-24)
Hyd-425	Hydraulic Model Studies of Stratified Flow over a Weir
Hyd-426	Erosion Studies on the Earth Materials from the Site of the Proposed Unlined Emergency Spillway at Foss Dam, Washita Project, Oklahoma
Hyd-427	Hydraulic Model Studies of Robles Diversion Dam Spillway

Hyd-428	Hydraulic Model Studies of Yanbee Dam Spillway
Hyd-430	Hydraulic Model Studies--Wu-Sheh Dam Tunnel Spillway--Wu-Sheh Dam Project--Taiwan, China
Hyd-431	Hydraulic Model Studies of Nimbus Dam Spillways--Folsom Unit--American River Division--Central Valley Project, California
Hyd-433	Model-Prototype Conformance of Radial Gate Discharge Capacity--Canyon Ferry Dam
Hyd-434	Design, Assembly, and Use of a Portable Vane Shear Tester
Hyd-435	Progress Report of Canal Erosion and Tractive Force Study--Lower-cost Canal Lining Program (issued as General Report 21)
Hyd-436	Hydraulic Model Studies of Howard Prairie Dam Outlet Works--Rogue River Basin Project, Oregon
Hyd-437	Hydraulic Model Studies of Anchor Dam (Earthfill) Tunnel Spillway and Outlet Works
Hyd-438	Model Studies of Clear Creek Power Conduit Surge Tank--Trinity River Division--Central Valley Project
PAP-87	Use of Steel Jetties for Bank Protection and Channelization in Rivers
PAP-88	Cavitation Damage of Roughened Concrete Surfaces
PAP-89	Common Errors in Measurement of Irrigation Water
PAP-90	Model Studies--Clear Creek Power Conduit Surge Tank--Trinity River Division--Central Valley Project
PAP-91	Cavitation Characteristics of Gate Valves and Globe Valves Used as Flow Regulators Under Heads Up to About 125 Feet
PAP-92	Velocity Scour and Pressure Measurements from Three Models of the Same Structure
PAP-93	Hydraulic Studies of a Vertical Shaft Intake to a Pressure Tunnel

PAP-81	Results of Tests to Determine the Merits of Constructing Baffle Piers With the Upstream Face Vertical and Normal to the Sloping Floor of a Baffled Chute
PAP-94	The Preparation of Hydraulic Laboratory Reports
PAP-95	"Deflection Meter" International Boundary and Water Commission
FTR	Field Trip to South Platte Supply Canal to Obtain Data on Canal Erosion and Tractive Force Study--Lower-cost Canal Lining Program--July 30, 1956
FTR	Performance of Outlet Works and Spillway--Boysen Dam--Boysen Unit--Missouri River Basin Project--August 1, 1956
FTR	Trip to Colorado A&M College, Fort Collins, to Discuss With Dr. M. L. Albertson and Professor D. B. Simons Data and the Proposed Report on Tractive Force and Hydraulic Data Obtained on USBR and Other Canals--July 26, 1956
FTR	Obtaining Hydraulic Data for Erosion and Tractive Force Study of Unlined and Earthlined Canals--Region 7--Lower-cost Canal Lining Program--September 6, 1956
FTR	Obtaining Hydraulic Data for Erosion and Tractive Force Study of Unlined and Earthlined Canals--Region 2--Lower-cost Canal Lining Program--September 10, 1956
FTR	Attendance at Hydraulic Division Meeting--American Society of Civil Engineers in Madison, Wisconsin--August 22-24, 1956
FTR	Selection of Field Sites and Obtain Soil Samples for Canal Erosion and Tractive Force Study--Eden Project, Region 4--Lower-cost Canal Lining Program--October 17, 1956
FTR	Seepage Measurements for Bentonite Sediment Lining Evaluation--Lower-cost Canal Lining Program--Lateral 7.2--Angostura Unit--Missouri River Basin Project--November 5, 1956
FTR	College Contact Program--November 6, 1956
FTR	Friction Loss Tests--Weber Branch and Weber Coulee Siphons--East Low Canal--Columbia Basin Project--November 16, 1956

FTR	Seepage Tests--Lateral 1, Interstate Canal--North Platte Project--Lower-cost Canal Lining Program--November 26, 1956
FTR	Selection of Field Sites and Obtaining Soil Samples on Canal Erosion and Tractive Force Study--Paonia Project, Region 4, and Minidoka, Yakima, and Columbia Basin Projects, Region 1--Lower-cost Canal Lining Program--January 21, 1957
FTR	Attendance at the Annual Convention of the American Society of Civil Engineers in Pittsburgh, Pennsylvania--October 15-20, 1956
FTR	Selection of Field Sites for Canal Erosion and Tractive Force Study--Tucumcari and W. C. Austin Projects, Region 5--February 12, 1957
FTR	Attendance at the American Society of Civil Engineers Convention--Jackson, Mississippi--February 18-21, 1957
FTR	Trip to Hoover Dam Relative to Addition of the Upper Colorado River Basin Features and Palo Verde Dam to the Display Model--April 10, 1957
FTR	Seismic Field Studies to Determine the Modulus of Elasticity of Foundation Rock at the Glen Canyon Dam Site--Colorado River Storage Project--Glen Canyon Unit, Arizona--April 10, 1957

SECTION IX - PERSONNEL

Date	Permanent Employees	Total Annual Salaries	Temporary Employees	Military Furlough	Trainee	On Detail
1-1-51	47	$211,885	--	1	6	--
1-1-52	41	219,035	--	2	1	1
1-1-53	39	219,445	--	1	1	--
1-1-54	30	178,145	--	1	3	--
7-1-54	25	162,170	--	1	--	2
7-1-55	21	127,000	--	2	--	--
7-1-56	20	134,595	*1	2	3+	--
6-30-57	22	153,735	1	**0	3+	1

*90-day appointment of Henry A. Babcock.
**Reinhart resigned; Norman dropped from military furlough status.
+Engineering students working for the summer.

During the year, two additions were made to the staff: W. W. Sayre, Hydraulic Engineer GS-7 (promoted to GS-9) and Russell A. Dodge, Jr., Hydraulic Engineer GS-7 (promoted to GS-9). James A. Liggett GS-7 was transferred from Klamath Project but plans on returning to Stanford University in September to pursue a doctorate degree in civil engineering.

Summer Trainees

1956

Paul Marquardt	Engineering Aid	GS-4	(CU)
Glen Logan	Engineering Aid	GS-4	(CU)
T. E. Backstrom	Engineering Trainee	GS-3	(CSM)

1957

Michael B. West	Engineering Trainee	GS-4	(MIT)
Donald W. Hapke	Engineering Trainee	GS-4	(CU)
Richard W. Kramer	Engineering Trainee	GS-4	(Lehigh)

University Faculty

Henry Babcock	Hydraulic Engineer	GS-9	Summer of 1956
Donald G. Leitch	Hydraulic Engineer	GS-7	Summer of 1957
Marvin Bogema	Hydraulic Engineer	GS-11	Summer of 1957

Rotation Engineers

The following rotation engineers received 3 months experience and training in the Hydraulic Laboratory during FY57:

Lowell Hoy
N. E. Taylor
Phillip Tryon
W. W. Sayre
A. H. Mueller
Isao Kuge
W. R. Stoneman
William G. Allen
Richard Sager
William A. Lidster
Richard P. Kotelly
Herbert Weinfeld
Darrell W. Webber

SECTION X - TIME DISTRIBUTION BY CLASSIFICATION OF WORK - SUMMARY FOR FY57

This section consists of three parts, as follows:

a. Percentage of Labor Distribution for FY57 (July 1, 1956 to June 30, 1957)

b. Labor and Leave Expenditures--FY56--Hydraulic Laboratory Branch, by feature and job number

c. Engineering Laboratories Division Time Distribution Record for fiscal year With List of Accumulated Shelved Work Items

E1-1
(8-56)
Bureau of Reclamation

ENGINEERING LABORATORIES DIVISION

Percentage of labor distribution July 1, 1956 through June 30, 1957

Feature	Division Office	Conc.	Chem.	Hydr.	Earth	Services	Division Actual	Division Budget	Rate of Expend.
Admin. Engineering	38.6	1.9	3.4	6.0	4.9	3.0	5.6	5.4	1.06
Admin. Services	0.4	1.5	0.3	--	1.8	0.5	0.9	0.9	0.95
Mtgs., Conv. & Conf.	12.7	0.9	1.3	2.6	1.0	0.3	1.7	1.7	0.98
Public Relations	15.5	4.4	4.6	7.5	5.3	0.5	5.1	5.9	0.88
Data & Data Analysis	1.4	1.5	3.8	2.2	2.4	1.8	2.3	2.3	1.03
Std. Designs & Proced.	--	0.1	0.5	0.1	--	--	0.1	0.2	0.87
Manuals & Publications	--	--	--	0.1	--	--	--	0.6	0.05
General Studies	8.8	22.0	25.3	20.5	18.7	16.4	18.9	23.1	0.83
Repairs & Maintenance	--	2.4	1.5	1.7	2.1	28.5	5.2	5.8	0.91
Fabrication Orders	--	--	--	--	--	8.0	1.0	0.8	1.22
Special Studies	0.8	0.3	10.1	18.5	8.8	1.5	7.0	7.5	0.96
Projects	19.5	54.9	43.1	40.4	48.7	35.3	45.0	50.8	1.18
Outside Agencies	0.1	2.4	4.4	0.5	3.0	3.6	2.6	2.5	1.07
Foreign Activities	0.8	3.5	1.3	0.1	1.4	2.6	4.0	4.1	1.00
Office & Lab. Alteration	--	--	--	--	--	0.8	0.1	0.1	0.78
G. A. E.	1.3	0.1	0.2	0.8	--	--	0.3	0.3	0.90

Leave is distributed to all items.

EL-2 (Page 1)
Rev. 7-56

LABOR & LEAVE EXPENDITURES--FISCAL YEAR 1957

Hydraulic Laboratory Branch, Cost Center 830. Date of this report 6-30-57

Feature	Job Number	Labor & Leave Annual Budget	Labor & Leave Expended to date	% spent in 100 % of time Branch	% spent in 100 % of time Division	Rate of Expenditure
Administrative Engineering						
Gen. Admin., Clerical & Steno.	0-3000-0-0-1	7,000	6,817.49			
Student Engr Training	-2	1,500	1,813.18			
Rotatee Program	-3	1,300	1,316.90			
		9,800	9,947.57	101.5	105.8	1.02
Administrative Services						
Field Engr. Lab. Training	0-5000-0-0-1	50	--			
Safety	-4					
Mtgs., Conv., Conf., & Panels						
Mtgs.--Civic, Prof. & Scientific	0-3002-0-0-1	1,500	1,247.04			
Mtgs.--Public & Private Groups	-2	50	88.38			
Constr. Engineers Conference	0-5000-0-0-2					
Conf. Bureau Personnel	-3	3,000	2,920.60			
		4,550	4,255.82	93.5	97.9	0.94
Public Relations "By Their Deeds"	-1		440.51			
Prep. & Display of Exhibits	0-3003-0-0-1	900	906.61			
Domestic Visitors	-2	1,100	1,152.55			
Coop. with Tech. Societies	-3	4,000	3,350.15			
Foreign Visitors	-4	800	707.12			
Technical Information Service	-5	3,000	2,334.47			
Prep. of Articles & Papers	-6	2,500	2,512.84			
Laboratory & Office Tours	0-4000-0-0-24	1,000	1,013.03			
		13,300	12,575.28	94.6	88.3	0.95
Data and Data Analysis						
Prep. Maint. & Collect. Data	0-3004-0-0-1	3,500	3,720.43			
	-4	--	28.85			
		3,500	3,749.28	107.1	103.2	1.07
Standard Designs & Procedures						
Prep. & Review of Std. Specs.	0-3005-0-0-14	500	203.81	40.8	66.5	0.41
Repairs, Maintenance & Install.						
Engineering Laboratories	0-4002-0-0-1	2,500	2,513.10			
Elec. Load Analyzer	-2					
Photoelastic Laboratory	-3					
Office Equipment	-4					
Auditorium, Operation & Maint.	-5	650	319.03			
		3,150	2,832.13	89.9	90.7	0.90
Office & Laboratory Alterations	0-4003-0-0-					

El-2 (Page 2)
Rev. 7-56

Cost Center 830
Date of this report 6-30-57

Feature	Job Number	Labor & Leave Annual Budget	Labor & Leave Expended to date	% spent in 100 % of time Branch	% spent in 100 % of time Division	Rate of Expenditure
Manuals and Publications						
Concrete Manual	0-3006-0-0-1					
Engineering Monographs	-2		44.48			
Earth Manual	-3					
Paint Manual	-4					
Measurement of Irrigation Water	-5	200	111.19			
Reclamation Instructions	0-5001-0-0-1					
Low Dams	-5					
		800	155.67	77.8	4.7	3.78
General Investigations						
Concrete	0-3007-0-0-1					
Cement & Pozzolan	-2					
Earth	-3					
Hydraulic	-4	20,250	17,305.09			
Structural Materials	-5					
Bituminous	-6					
Chemical & Radioisotopes	-7		25.22			
Paint & Corrosion	-8					
Foundation	-9					
Riprap	-10					
Monomolecular--Surface Film	-11		54.34			
Hungry Horse Test Cores	-12					
Weed Control--Expanded Program	-13					
		20,250	17,473.05	86.3	83.3	1.86
Fabrication Orders	0-8900-	--	73.86			
Special Studies						
Sedimentation	0-8001-0-0-1	11,300	11,381.39			
Weed Control	0-8008-0-0-1		44.77			
Water Meas. Devices	0-8009-0-0-1	8,300	7,629.75			
L.C.C.L.	0-8030-0-0-1	10,350	11,573.20			
		29,950	30,029.11	102.9	95.8	1.03
Project Work		65,000	67,345.88	108.0	117.7	1.02
Outside Agencies		500	849.70	173.9	107.1	1.80
Foreign Activities		11,000	15,232.22	138.4	100.3	1.38
G. A. E.	0-9100-	1,250	1,257.83	100.6	82.9	1.01
		104,000	166,327.61	101.7	101.5	1.02

EL-4
(FEB 56)
BUREAU OF RECLAMATION

DIVISION OF ENGINEERING LABORATORIES
TIME DISTRIBUTION RECORD

BRANCH Hydraulic Laboratory
SECTION

Fiscal Year 1957
DATE c.o.b. June 30 1957
(MONTH / YEAR)

REF. NO.	JOB NUMBER	PROJECT / FEATURE SHOPS	TIME IN MAN DAYS → 00 ← AND HOURS: FISCAL YEAR 1957 BAL. FWD.	FISCAL YEAR 1957 THIS MONTH	FISCAL YEAR 1957 TOTAL	FISCAL YEAR 1957 ALLOCATION ORIG.	FISCAL YEAR 1957 ALLOCATION REV.	TOTAL JOB BAL. FWD.	TOTAL JOB TO DATE	TOTAL JOB ESTIMATE ORIG.	TOTAL JOB ESTIMATE REV.	DURATION MONTH / YEAR START	DURATION MONTH / YEAR ESTM. END	REMARKS
	0-3000-0-0-1	Administrative (labor only)			110		113							
	0-3000-0-0-1	Clerical & Stenographic			91 4		86							
	0-3000-0-0-2	Student engr train. prog			78 7		50							
	0-3000-0-0-3	Rotatee Training Program			47 1		10							
	0-3002-0-0-1	Mtgs, Civic, prof, sci, attendance			30 6	37								
	0-3002-0-0-2	Mtgs, Conf, Pub & Private groups			3		3							
	0-3003-0-0-1	Prep & disp of exhibits	3 0		36 5		32							
	0-3003-0-0-2	Domestic visitors--Inf Reqsts			36		36							
	0-3003-0-0-3	Coop with Tech Societies			88 1		105							
	0-3003-0-0-4	Foreign visitors (unassigned)			21 5		23							
	0-3003-0-0-5	Tech Inf Serv--Corres.			63 3		75							
	0-3003-0-0-6	Prep articles & papers			72 1		75							
	0-3003-0-0-9	The Reclamation Engineering Story			12 1									
	0-3004-0-0-1	Data & data analysis			123 5									
266	"	--Alamogordo enlargement			3									Hyd-416 issued
274	"	--O.W. Report			3 4									Hyd-402 in Duplicating
		Totals 0-3004			130 1		130							
	0-3005-0-0-1	Design Standardization			1									
	0-3005-0-0-14	Prep & Rev Stand. Specs			4		12							
	0-3006-0-0-2	Engineering Monographs			1	1								
	0-3006-0-0-5	Water measurement manual			2 4		4 4							
226	0-3007-0-0-4	Hydraulic research, gen	23 3		160 2									Hyd-425 issued
224	"	--Friction loss tests, large cond												Trans to Assign. No. 310
240	"	--Vertical stilling wells			3 4									
218	"	--Jump & energy dissipators			34 3									
292	"	--Riprap sizes			1									
256	"	--Outlet works stilling basins	4 4		28 2									
219	"	--Siphon spillways			23 3									
220	"	--Small canal structures	4 6		96 6									
310	"	--Friction factors, lge conduit	26 4 26		71 7	45						7/56		F.T.R. issued
221	"	--Pipeline dist sys, cavitation	17 10		19 3	71								
313	"	--High head turnouts	27 2		19 3									
309	"	--Conduit & penstock branches			0									
223	"	--Cavit-eros, rough surfaces			15 4									PAP-88 issued
191	"	--Downpull forces on gates			21									
222	"	--Air demand, gate & valv in cond			0									
255	"	--Cavit-free gate slots	10 4 } 48		50									
255	"	--Wide offset slots, flar frame	37 4 }		2									
225	"	--Instrument for Hyd data			5 6									

NOTES:

EL-4
(FEB 56)
BUREAU OF RECLAMATION

DIVISION OF ENGINEERING LABORATORIES
TIME DISTRIBUTION RECORD

BRANCH Hydraulic Laboratory
SECTION

Fiscal Year 1957
DATE c.o.b. June 30 1957 (MONTH / YEAR)

REF. NO.	JOB NUMBER	PROJECT / FEATURE	SHOPS USED	SHOPS ALLOWED	SHOPS ESTIMATED	TIME IN MAN DAYS → 00 ← AND HOURS — FISCAL YEAR 1957: BAL. FWD.	THIS MONTH	TOTAL	ALLOCATION ORIG.	ALLOCATION REV.	TOTAL JOB: BAL. FWD.	TOTAL JOB: TO DATE	TOTAL JOB ESTIMATE ORIG.	TOTAL JOB ESTIMATE REV.	DURATION MONTH / YEAR: START	DURATION MONTH / YEAR: ESTM. END	REMARKS
	0-3007-0-0-4	Hydraulic research, con't															
288	"	--Baffled apron, Energy Dis						13									
251	"	--Conc Pipe exit--Canal dis sys	13	3				12 4									
	HYDRAULIC RESEARCH	(0-3007-0-0-4) Totals						577 7		674							
	0-3007-0-0-7	Radioisotopes						1									
	0-3007-0-0-11	Evaporation Control	2 4					2									
Canceled	0-4000-0-0-23	Coop with public						2 4									
	0-4000-0-0-24	Office & Lab tours						30		29							
	0-4002-0-0-1	Repair & Maintenance	112 3		112 3			88 3		92							
	0-4002-0-0-5	Bldg 56, Auditorium expense						11 2	21								
	0-4100-0-0-1	Annual leave						543 7									
	0-4100-0-0-2	Sick leave						159 3									
	0-4100-0-0-4	Military leave						46									
	0-4100-0-0-5	Court leave						6									
	0-4100-0-0-6	Administrative leave						2 1									
	0-4100-0-0-7	Civil Defense						1									
	0-5000-0-0-3	Mtgs, Bureau personnel						79 2		83							
	0-6202-0-13-2	Materials Testing Services						17 3									
280	0-6207-0-2-1	Bureau of Federal Supply, GSA						8 4									
	0-6217-00-02-05	Bur of Land Management						4	3								
	OUTSIDE AGENCIES	(6200-6400) Totals						30 1		16							
	0-6195-0-22-1	Foreign trainees						67 2									
	0-6195-0-23-1	Foreign observers						28 5									
	0-6195-0-73-1	Foreign observers--India-Korea-Turk						10 2									
	0-6195-20-7-1	India--B. M. Johnson						1 4									
	0-6195-20-0-1	Gen Tech Services						1 3									
	0-6195-28-01-03	Rihand Dam (Review of criteria)						12		12							
	0-6301-0-1-3	Australian Trainees						14 3	2								
	0-6301-00-01-05	Gen Tech Serv--Snowy Mtns						8 1									
	0-6301-02-02-0	T-2 Div Dam						2	2								
	0-6301-05-03-00	T-2 Tunnel						2									
284	0-6301-05-06-01	Tooma-Tumut Div Wks--Aust			34			39 5	49		120 5	124 5			11/5		Hyd-429 being reviewed
295	"	Tooma-Tumut tapered gate slots	6 4	6	6 4			24 1		35					/		Hyd-432 being reviewed
	0-6301-05-07-01	Murrum-Eucumbene Div-Sny Mtn Conf						8									
317	"	Murrumbidgee-Euc Intake Control	103	106				29 4		34			143				
285	0-6305-01-01-02	Model Study YanHee spillway			139 3			109 5	105								Hyd-428 in Duplicating
	0-6305-0-2-2	YanHee trainees						3 4									
263	0-6397-01-01-02	Wu Sheh Model Study			248			80		80							Hyd-430 issued

NOTES:

EL-4
(FEB 56)
BUREAU OF RECLAMATION

DIVISION OF ENGINEERING LABORATORIES
TIME DISTRIBUTION RECORD

BRANCH Hydraulic Laboratory
SECTION

Fiscal Year 1957
DATE c.o.b. June 30, 1957 (MONTH / YEAR)

REF. NO.	JOB NUMBER	PROJECT / FEATURE	SHOPS			TIME IN MAN DAYS → 00 ← AND HOURS: FISCAL YEAR 1957 BAL. FWD.	FISCAL YEAR 1957 THIS MONTH	FISCAL YEAR 1957 TOTAL	FISCAL YEAR 1957 ALLOCATION ORIG.	FISCAL YEAR 1957 ALLOCATION REV.	TOTAL JOB BAL. FWD.	TOTAL JOB TO DATE	TOTAL JOB ESTIMATE ORIG.	TOTAL JOB ESTIMATE REV.	DURATION MONTH / YEAR START	DURATION MONTH / YEAR ESTM. END	REMARKS
	0-6397-01-01-01	Wu Sheh, general						8	25								
	FOREIGN ACTIVITIES (6195-6300) Totals							447		325							
177	0-8001-0-0-1	Sedimentation, gen	84	3				108									
36	"	--Stable Channel Shapes						52									
306	"	--Sediment removal studies						109 5									
87	"	--Tractive Force, non-cohes matl						78 6									
260	"	--Bentonite seepage control						28 1									Hyd-417 issued
	SEDIMENTATION	(0-8001-0-0-1) Totals						376 3		390							
	0-8008-0-0-1	Weed Control						1 4									
184	0-8009-0-0-1	Water measurement, gen	4					127 6									
189	"	--Silting of propeller meters						0									
296	"	--Cippoletti weir						3									
7	"	--Standarization of devices						12 6									
70	"	--Denver screw-lift & meter gate						14 5									
258	"	--Pipe ent w/wo gates						83 3									Hyd-422 issued
316	"	--Magnetic Flow Meter	86	5				39 4									
	WATER MEASUREMENT	(0-8009-0-0-1) Totals						278 3		294							
152	0-8030-0-0-1	LCCL, gen						47 1									
290	"	--Erosion & tractive force						176 3									Hyd-434 being reviewed
307	"	--Permeability & seepage						41 5									Hyd-435 ~~issued~~
305	"	--Evaluation of sediment linings						48 6									Hyd-417 being reviewed
308	"	--LCCL annual reports						22 2									
247	"	--Waves in canals						1									
279	"	--Sediment Flocculating agents						10 1									Hyd-420 being reviewed
	LOWER-COST CANAL	LINING (0-8030-0-0-1) Totals						357 1		329							
	0-9100-0-1-2	Insp Bureau structures						3 2									
	0-9100-01-01-01	College Contact						23									
		TOTALS (0-9100)						26 3		25							
	0-8900-0-3-82	Fab--Transistor Checker						3	3								Complete
	0-8900-0-3-95	Fab--Gal. Iron Tank	2	2													Complete
	1-222-05-12-05	Potholes East Can.--Ck station						2	2								Hyd-411 issued
	1-222-05-37-01	Wahluke siphon--Potholes East Can.						0	0								
	1-222-05-40-01	Bacon tun & siphon, 2d Branch						3 5		5							Complete
	1-222-06-40-04	Lat., Block 89-CRP						4									
	1-R222-22-08-02	Invest. OW Gates, Gr Coulee D						76		85							Complete
	1-3-05-03-03	Black Canyon Inspection						6		6							
	1-33-11-01-01	Roza PP--Yak Proj (Conf)						2		2							
	1-415-01-02-01	Keene Cr D, Rogue RBP, Oregon						2		2							

NOTES:

Interior - Reclamation - Denver, Colo.

EL-4
(FEB 56)
BUREAU OF RECLAMATION

EL-4
(FEB 56)
BUREAU OF RECLAMATION

DIVISION OF ENGINEERING LABORATORIES
TIME DISTRIBUTION RECORD

BRANCH Hydraulic Laboratory
SECTION

Fiscal Year 1957
DATE c.o.b. June 30, 1957 (MONTH / YEAR)

REF. NO.	JOB NUMBER	PROJECT / FEATURE	SHOPS THIS EX. MONTH	SHOPS EXPENDED	SHOPS ESTIMATED	TIME IN MAN DAYS → 00's ← AND HOURS: FISCAL YEAR 1957 BAL. FWD.	FISCAL YEAR 1957 THIS MONTH	FISCAL YEAR 1957 TOTAL	FISCAL YEAR 1957 ALLOCATION ORIG.	FISCAL YEAR 1957 ALLOCATION REV.	TOTAL JOB BAL. FWD.	TOTAL JOB TO DATE	TOTAL JOB ESTIMATE ORIG.	TOTAL JOB ESTIMATE REV.	DURATION MONTH / YEAR START	DURATION MONTH / YEAR ESTM. END	REMARKS
304	1-415-01-01-01	Howard Prairie outlet works	4	5	4			15		15					7/56		Hyd-436 in Duplicating
	1-415-11-01-01	Green Spring PP--Bald Mtn penstock						1		1							
	1-456-01-06-01	Palisades spillway						0									Hyd-350 issued
	1-456-11-01-01	Palisades Dam						0									
270	1-456-11-01-01	Palisades Penstocks, Hydro. Test			3			10 3/4		10	95	95					
	1-222-05-30-01	Esquatzel Channel (Coulee)						1 1/4									
	1-566-03-01-01	Chandler Pump & Powerplant						27 3/4		28 3/4							Canceled
	1-A845-73-61-01	Owyhee outlet works rehab						0 1/4									Complete
	2-0-31-07-01	Cast, Maywood, Calif map	4					1									Complete
	2-214-03-01-01	Tracy Pumping Plant						1 1/2	1 1/2								Letter sent to project
	2-413-01-02-01	Monticello Dam spwy Conf						3/4		2 1/4							
	2-416-00-02-01	Clear Cr conduit--CVP (Conf)	15	10				1 3/4	1 3/4								
	2-416-01-01-01	Trinity Dam Spill. & OW (Conf)						8 1/4		6 1/2							
299	"	Trinity spillway	18 9/2	23 5/2	24 3/4			307 3/4		147	322 1/2	333 1/2			4/56		
312	"	Trinity OW stilling basin	27	30	27			90 1/2		95 1/2					9/56		Also see 4-591-01-01-01
	2-416-02-01-01	Lewiston Div Dam--Trinity						2									
311	2-416-05-01-01	Clear Creek Surge Tank (Trinity)	27	27				56 1/2		57							Report in Duplicating
96	2-485-01-01-01	Nimbus Dam Spillway						9 3/4		20							Report in Duplicating
	2-485-11-01-01	Folsom Pumping Plant	4					7	7								Complete
	2-485-11-02-01	Nimbus Pumping Plant	1					9	9								Complete
286	2-575-01-01-01	Vaquero Dam O. W.			73 1/4			78 3/4		90 3/4	198 3/4	211 1/2		183	12/55		
295	"	Vaquero Tapered gate slots	7	6				25 1/4		25 1/2					3/56		Hyd-432 being reviewed
	2-767-01-01-04	Casitas Dam reservoir gage						13		18							
	2-767-02-02-01	Robles Div Dam--Ventura Proj						18 3/4		20							Hyd-427 issued
	2-767-05-03-01	Ventura RP--Ojai Pres Belt, Conf						6		6							
262	3-385-02-01-02	Palo Verde Model Study						31 1/2		30 1/2	146 3/4	147 3/4			9/54		Hyd-408 issued
	3-385-02-01-02	Palo Verde--dismantle model	9	10				1/4	0								Complete
	3-45-00-02-01	Hoover Dam Exhibit						24 3/4		25							Complete
291	4-482-01-01-01	Vega Dam						17 1/4	20								Hyd-418 issued
	4-526-05-05-01	Davis Aqueduct Conference						6		7 1/2							
313	4-526-05-05-01	Davis Aqueduct (Weber Basin Proj)	40 1/2	46 3/4				34 3/4	34 1/4								Trans to 0-4007-0-0-4
	4-551-01-01-01	Paonia Dam & Res, gen						3	3								
315	"	Paonia Spillway & OW Model	82 1/2	86				42 1/2		66							
303	4-557-00-01-01	Relief model Colo Riv Stor	19 3/4					161 3/4		200					7/56		
	4-557-01-01-01	Glen Canyon D & Spwy Conf						2	5								
	4-557-01-01-01	Glen Canyon Geophysical						42		42					2/57		Complete
302	4-557-01-01-01	Glen Canyon spillway						49 3/4		49 3/4							Canceled
	4-557-01-01-02	Glen Canyon Tunnel & ow Conf						5 1/2	5								
300	4-557-01-01-02	Erosion studies--sandstone						37 3/4	37 3/4						4/56		Hyd-423 issued
301	4-557-01-01-02	Glen Canyon Div Tunnel						72 1/2		75					6/56		
319	"	Glen Canyon Tunnel Plug OW		25				6	155								
302	4-557-01-01-03	Glen Canyon spillway	445 3/4	430				278 3/4		624							Trans from 4-557-01-01-01

NOTES:

EL-4
(FEB 56)
BUREAU OF RECLAMATION

DIVISION OF ENGINEERING LABORATORIES
TIME DISTRIBUTION RECORD

BRANCH Hydraulic Laboratory
SECTION

Fiscal Year 1957
DATE c.o.b. June 30, 1957 (MONTH / YEAR)

REF. NO.	JOB NUMBER	PROJECT FEATURE	SHOPS THIS JOB	SHOPS EX. TO	SHOPS TOTAL USED	TIME IN MAN DAYS → 00 ← AND HOURS — FISCAL YEAR 1957 BAL. FWD.	THIS MONTH	TOTAL	ALLOCATION ORIG.	ALLOCATION REV.	TOTAL JOB BAL. FWD.	TOTAL JOB TO DATE	ESTIMATE ORIG.	ESTIMATE REV.	DURATION MONTH / YEAR START	DURATION MONTH / YEAR ESTM. END	REMARKS
	4-557-11-01-03	Glen Canyon powerplant	8 2		8 2			7	6								Shipment of equip comp
312	4-591-01-01-01	Flaming Gorge OW stilling basin	25	25				23 2	95								See also 2-416-01-01-01
	"	Flaming Gorge OW (Conf)						2 2	2								
318	"	Flaming Gorge spillway	52	100				24 3		25							
	4-591-01-01-04	Flaming Gorge Seismic Studies						28 2	28								Complete
303	4-594-00-01-02	Relief model Colo River Stor Proj						5									Canc, chg to 4-557-01-01-01
	4-711-01-01-01	Navajo Dam (Correspondence)						4	4								
	5-0-31-18-01	Ship weir model to Albuquerque							4								Complete
293	5-163-02-01-01	Angostura Div Sediment control	3 4	6 4	65 3			100		100	194 3	200 1			3/56		Report issued
277	5-163-09-05-01	Casa Colorada channelization	98 3	98 4	196 1			209 6		228	384 4	399 5					Report being reviewed
	5-R253-22-02-01	Platoro Res Gages	3 2	5				1 4	12								Complete
	5-830-00-03-01	Washita Proj--Foss Dam Ero tests						3									Hyd-426 issued
	5-830-01-01-01	Fort Cobb Dam ow & spwy Conf						6	4								
	6-26-01-01-01	Buffalo Bill Dam Rehabilitation						7 2	7 2								
294	6-339-01-01-01	Anchor Dam spillway & outlet wks	162 3	168 4	330 4			125 3	145		162 3	166 3			3/56		Report in Duplicating
55	6-459-01-01-01	Yellowtail Dam & Res--MRBP						7	7								Shelved--Rpt draft compl
	6-466-00-31-01	Ultimate Sys--Mo-Oahe Div						86									
274	6-84-01-01-01	Tiber Dam OW Still. Basin						18 4		18 4							Report in Duplicating
	6-84-01-01-03	Tiber Dam						2	6								
	7-R144-22-02-01	Alcova Tunnel						0 2									Complete
	7-328-02-04-02	Red Willow Creek Dam (Conf)						1	1								
	7-245-11-08-01	Colorado-Big Thompson PP						2	2								
	7-328-05-12-01	Driftwood Canal-Frenchman-Cambridge						6	6								
	7-328-05-11-01	Upper Meeker Canal						4	4								
287	7-449-01-01-01	Glendo downpull studies	7 2		7 2			2 2	2 2		16 1	16 1			1/56		PAP-77 issued
239	7-449-01-01-01	Glendo outlet works						2 2									Hyd-413 issued
282	7-449-11-01-02	Glendo hydrostatic tests	19		19			53		53	152 6	152 6			3/55		
	7-449-11-02-01	Fremont Tunnel--Pathfinder Dam						3	6								
213	7-449-11-02-01	Boulder Cr Supply Canal						0									Hyd-407 issued
	7-468-01-01-01	Webster Dam						1	1								
314	7-468-02-01-01	Woodston Headworks & Sluiceway	64	64				102 1		148 5							Report in progress
	7-468-02-01-01	Woodston Div Dam Spill.															Complete
	8-738-11-01-01	Eklutna Powerplant	2	2				6	6								Complete
Canceled	9-800-0-0-1	Coop off. saline water						0									
	9-800-0-1-1	Office of saline water						18	15								
	9-F801-74-30-07	Equip repair for GI Resurvey						8 4									

NOTES:

Interior - Reclamation - Denver, Colo.

EL-4
(FEB 56)
BUREAU OF RECLAMATION

DIVISION OF ENGINEERING LABORATORIES
TIME DISTRIBUTION RECORD

BRANCH Hydraulic Laboratory

SECTION

SHEET 1 OF 1

DATE C.O.B. June 30, 1957 (MONTH / YEAR)

Shelved jobs

REF. NO.	JOB NUMBER	PROJECT / FEATURE	TIME IN MAN DAYS → 00 ← AND HOURS								DURATION MONTH / YEAR		REMARKS
			FISCAL YEAR 1957					TOTAL JOB					
			BAL. FWD.	THIS MONTH	TOTAL	ALLOCATION ORIG.	ALLOCATION REV.	BAL. FWD.	TO DATE	ESTIMATE ORIG.	ESTIMATE REV.	START	ESTM. END	
21		Spillway jet insufflation, Gr Coulee Dam, CBP							16	40		7-49	Indef	Hyd-368 to be written
22		Air demand studies, river outlets, Grand Coulee							35	60		7-49	"	
25		Spillway and diversion scheme, Davis Dam, DDP							17	107		8-49	"	Hyd-346 to be written
35		Calibration of 8-in. Sparling deflection meter							26	35		11-49	"	
40		Salinity meters report, Sac'to-San Joaquin Delta							8	15		3-50	"	
49		Spillway velocities, Shasta Dam, CVP							16	30		6-50	"	
52		Weir stands, Exeter & Saucelito Irr.Dists., CVP							223	285		11-50	"	(6)#
59		Spillway data, Falcon Dam, IB&WC							28	55		1-51	"	
63		Velocity distribution, Sparling deflection meter							67	80		2-51	"	
75		Stream-gaging devices (in coop. with USGS)							110	200		6-51	"	
76		Pump flow indicator, Tracy Pumping Plant, CVP							63	73		7-51	"	
77		Frequency response of pressure cells							23	40		7-51	"	Tests completed 3-53
86		Sparling meter, Mohawk Canal turnouts							370	362		9-51	"	(11)#
88		Calibration of 12-inch Sparling line meter							2	20		10-51	"	
89		Calibration of 8-inch Sparling line meter							2	20		10-51	"	
90		Calibration of 12-inch Spar. deflection meter							1	20		10-51	"	
110		Sediment sampling, Cambridge Diver. Dam, MRBP							156	185		12-51	"	(16)# Tests comp. 11-52
111		Compilation of data, desilting works							44	200		1949	"	
125		Negative-pressure crest studies							38	54		12-51	"	
139		Spillway, river outlets, & powerplant, Shasta Dam							0	100		1939	"	
140		Gila Pumping Plant flap gates, Gila Project							2	52		2-52	"	
141		Pump discharge siphon elbow, Grand Coulee, CBP							7	40		3-48	"	
143		Hyd characteristics, Shasta river outlets, lower							0	30		7-49	"	
151		Resloping tailraces & river channel, Gr Coulee							7	32		1945	"	
180		Flow characteristics, Sparling open-flow meter							21	66		7-52	"	
224		Chem & Pressure disch. meas. in large conduits							148	254		7-53	"	(2)*
241		Red Bluff spillway model studies, CVP							14	18		11-53	"	Memo rpt to be written

Bracketed Nos. in Remarks Col. show Shop time (This month--this FY--Total) or (FY and/or Total) if comp. Add to Hyd Lab time to get Charge against Hyd budget except where followed by (*) indicating separate budget.

NOTES:

		1957		1958
		Initial	Revised	
Administrative Engineering				
Gen Admin, Clerical and Steno	0-3000-0-0-1	$ 7,500	$ 7,000	$ 7,50
Student Engr Train	-2	720	1,150	1,15
Rotatee Training	-3		310	2,10
Administrative Services				
Field Engr Lab Training	0-5000-0-0-1		50	5
Safety	-4			
Mtgs, Conv, Conf and Panels				
Mtgs--Civic, Prof and Scientific	0-3002-0-0-1	1,300	1,500	1,50
Mtgs--Public and Private Groups	-2		50	5
Constr Engineers Conference	0-5000-0-0-2			
Conf Bureau Personnel	-3	4,300	3,000	3,00
Public Relations				
Prep and Display of Exhibits	0-3003-0-0-1	1,300	900	90
Domestic Visitors	-2	400	1,100	1,10
Coop with Tech Societies	-3	3,800	4,000	4,00
Foreign Visitors	-4	1,100	800	80
Technical Information Service	-5	1,850	3,000	3,00
Prep of Articles and Papers	-6	1,000	2,500	2,50
Collection and Dissemination of Data	-7	--	--	1,00
The Reclamation Engineering Story--Film	-9	--	500	40
Laboratory and Office Tours (Public inspections, open house)	0-4000-0-0-24	1,000	1,000	1,00
Data and Data Analysis				
Prep Maint and Collect Data	0-3004-0-0-1	3,000	3,500	3,50
Standard Designs and Procedures				
Prep and Review of Std Specs	0-3005-0-0-14	300	500	50
Design Standardizations	-1			
Repairs, Maintenance and Install				
Engineering Laboratories	0-4002-0-0-1	2,800	2,500	2,50
Elec Load Analyzer	-2			
Photoelastic Laboratory	-3			
Office Equipment	-4			
Auditorium, Operation and Maint	-5	650	650	65
Office and Laboratory Alterations	0-4003-0-0-			

BUDGET ESTIMATE

		1957		1958
Manuals and Publications		Initial	Revised	Initial
Concrete Manual	0-3006-0-0-1			
Engineering Monographs	-2			
Earth Manual	-3			
Paint Manual	-4			
Measurement of Irrigation Water	-5	$ 200	$ 200	$ 200
Reclamation Instructions	0-5001-0-0-1			
Low Dams	-5			
General Investigations				
Concrete	0-3007-0-0-1			
Cement and Pozzolan	-2			
Earth	-3			
Hydraulic	-4	16,800	20,250	20,000 (+3,000 for shop
Structural Materials	-5			
Bituminous	-6			
Chemical and Radioisotopes	-7			
Paint and Corrosion	-8			
Foundation	-9			
Riprap	-10			
Monomolecular--Surface Film	-11			
Hungry Horse Test Cores	-12			
Weed Control--Expanded Program	-13			
Fabrication Orders	0-8900-		200	200
Special Studies				
Sedimentation	0-8001-0-0-1	11,200	11,300	16,775
Weed Control	0-8008-0-0-1			
Water Meas Devices	0-8009-0-0-1	7,400	8,300	14,375
LCCL	0-8030-0-0-1	10,350	10,350	14,115
Project Work		58,900	66,000	60,000
Outside Agencies		2,000	500	500
Foreign Activities (Including Trainees)		9,000	11,000	6,000
	0-9100-0		1,200	
Regular Payroll, 22 employees	Total	$146,870	$162,810	$169,365