



**US Army Corps
of Engineers**

LOCK HYDRAULIC SYSTEM MODEL AND PROTOTYPE STUDY DATA

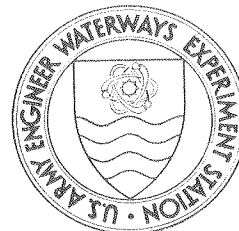
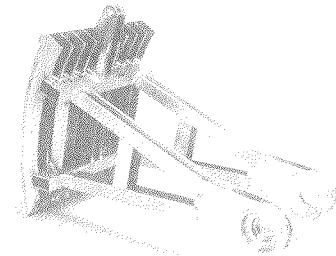
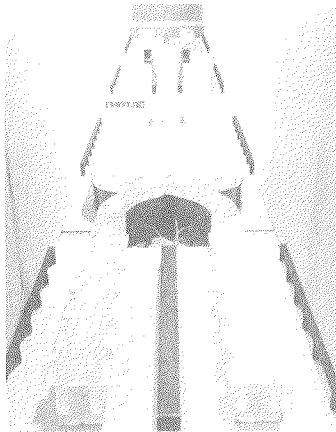
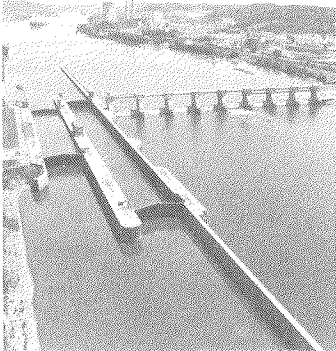
Corps of Engineers Projects
1937-1984

by

Ellis B. Pickett, Frank M. Neilson

Hydraulics Laboratory

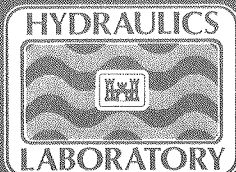
DEPARTMENT OF THE ARMY
Waterways Experiment Station, Corps of Engineers
PO Box 631, Vicksburg, Mississippi 39180-0631



March 1988

Final Report

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| 19. ABSTRACT (Continue on reverse if necessary and identify by block number) This report describes a data base which contains descriptions of navigation lock studies conducted by the Corps of Engineers during 1937-1984. The data base identifies measured quantities, lock features, and a complete bibliography of reports. Data base maintenance and management are automated by means of computer software. | | | |
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Preface

The model and prototype study data listings provided herein were prepared for use with a newly revised issue of EM 1110-2-1604, "Hydraulic Design of Navigation Locks." The text, Table 1, and References (Bibliography) will be included in the appendices of that manual. The effort was funded by the Headquarters, US Army Corps of Engineers, Publications Program during June - September 1984.

The work was accomplished under the general supervision of Messrs. H. B. Simmons and F. A. Herrmann, Jr., former and present Chiefs of the Hydraulics Laboratory (HL), US Army Engineer Waterways Experiment Station (WES); B. J. Brown, Chief of the Design Criteria Branch, Hydraulic Analysis Division, HL; and M. B. Boyd, Chief of the Hydraulic Analysis Division.

Review of the reports was accomplished by Mr. E. B. Pickett, under Purchase Order No. DACW39-84-M-3000 dated 13 June 1984. Coordination of the work with respect to its use in the manual was done by Dr. F. M. Neilson, Research Engineer, Design Criteria Branch. The computer program for sorting and listing the data was prepared by Mr. M. T. Hebler and the computer terminal work was done by Mrs. B. W. Gaskin, both of the Design Criteria Branch. This report was edited by Mrs. Beth F. Burris, Information Products Division, Information Technology Laboratory.

COL Dwayne G. Lee, CE, is the Commander and Director of WES.
Dr. Robert W. Whalin is Technical Director.

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LOCK HYDRAULIC SYSTEM MODEL AND PROTOTYPE STUDY DATA

Corps of Engineers Projects 1937-1984

Introduction

1. The availability of data from Corps of Engineers (CE) hydraulic model and prototype investigations of navigation lock filling/emptying systems is summarized in Table 1. This information was obtained from a detailed review of 81 reports on model and prototype studies (1937 to 1984) by the St. Paul District (STP), Bonneville Hydraulic Laboratory (BHL), and US Army Engineer Waterways Experiment Station (WES). Those reports are listed in the references. The organization and use of Table 1 are described in the following paragraphs.

Design and Operational Variables

2. A list of 251 hydraulic design and operational variables or significant features of navigation locks was derived from a review of such items in several kinds of filling/emptying systems used in CE locks. This list is organized in an upstream-to-downstream order and has a numbering sequence for easier manipulation in a digital computer. The major divisions of the list include:

- 11000 INTAKE SYSTEMS
- 12000 FILLING VALVE SYSTEM
- 13000 CULVERT-CHAMBER MANIFOLD
- 14000 LOCK CHAMBER
- 15000 EMPTYING VALVE SYSTEM
- 16000 OUTLET SYSTEM

A listing of operational variables is included with each major division in Table 1 rather than in a separate division in order to group more closely the aspects of the lock operation with their related design features. The 22 "NOTED ITEMS" lines include special items peculiar to the specific projects and are identified in the notes at the end of Table 1.

Test Reports

3. Each column heading in Table 1 includes a very brief identification

of the project and a brief notation of the report number (full title is given in the References). The reports are listed in chronological order by report date. The St. Paul District Report No. 46 contains six separate studies and is listed in six separate columns in Table 1. This gives an apparent total of 86 reports. All the reports are available on loan from the WES Technical Library.

Types of Data in Reports

4. The types of lock performance data available in each report and pertaining specifically or generally to the various design and operational features investigated are indicated by the following letter symbols in Table 1:

- T - time, curves, and/or tabulation of lock chamber filling and/or emptying, or actual valve motion in a few tests
- O - overflow or overempty in lock chamber
- Q - culvert system discharge, or lock chamber rate-of-rise or rate-of-fall
- H - hawser force on tow in lock chamber, or in approach in a few tests
- D - tow displacement, unrestrained by hawsers
- V - local velocities in ports, approach channel, etc.
- C - surface currents, including vortices at intakes
- B - boils, or surface turbulence
- W - waves, or water-surface profiles in a few tests
- S - surges or oscillations
- I - internal flow pattern or flow distribution
- Z - local average piezometric pressures
- P - local transient or fluctuating pressures
- L - pressure losses or differences
- F - mechanical forces or torque
- A - vibration
- X - other data, usually air vent discharge; see last line of "NOTED ITEMS" at end of Table 1

Comments

5. The following comments result from observations during the

compilation of Table 1 and may be of interest and/or assistance to users searching for available test data pertinent to their design problems.

- a. Consideration of both the design and operational variables of the feature under investigation, both more general and more specific identification of the variables, and related items or systems may aid in finding data in Table 1 that might otherwise be missed.
- b. The listing of operational variables by divisions in Table 1 and the compilation process may have resulted in some inappropriate entries of types of data relative to the design variables. This would most likely occur where a report table or illustration includes several kinds of design and operational variables.
- c. Culvert roof pressures just downstream from a valve were considered pertinent to, and listed under, 12230 (15230) FILLING (EMPTYING) VALVE SYSTEM, FLOW PASSAGE, ROOF EL, although a different variable may have been the primary consideration.
- d. Surface currents at the intakes are listed under 11150 INTAKE SYSTEM, APPROACH, VORTEX CONTROL, although the vortex control may have been by valve operation or other feature rather than modification of the intake system.
- e. Variable 14000 LOCK CHAMBER was given data references for nearly every citation involving lock chamber filling and emptying times and/or rates, hawser forces, surges, etc. Although there may not have been any design variations within the chamber, it is a location of primary interest for most aspects of lock operation.

Detailed Test Data Listings

6. The data locations within each report are listed in Table 2. The LINE NO.'s correspond to those 251 numbers assigned to the design and operation variables. The TYPE OF DATA symbols correspond to those given in paragraph 4. The following FORMAT symbols are used:

- T - numbered table
- P - numbered photograph
- D - numbered drawings (plates)
- F - numbered figures (covers all illustrations in St. Paul District reports)
- W - text paragraph (or page if unnumbered paragraphs) containing information not indicated by the tables, photographs, drawings, or figures

The LOCATION IN REPORT numbers and letters are those of the pertinent tables, photographs, drawings, figures, and/or paragraphs in that particular report.

7. In addition to the indicated tables, photographs, drawings, and/or figures having data pertinent to a specific design and/or operational variable, the user should refer to those parts of the text where these data items are discussed. The comment in subparagraph 5b also applies to the detailed data listings. Also, variations in design and/or operational variables from table to table, photograph to photograph, etc., rather than in individual tables, photographs, etc., are covered by listings of all the related data item location numbers. The user should compare variables from item to item as well as in a single item.

8. A total of 24,635 location citations was derived from a total of 2,816 single- or combined-item references (tables, photographs, drawings, figures, text) in the 86 reports (81 publications).

Project Data Listings

9. Listings of available dimensional and other descriptive data pertinent to the project designs investigated in the model tests are given in Table 3. Entries of "XXXXX" indicate subheadings; entries of "X" indicate confirmed nonapplicable items; and blanks indicate unavailable information. A definition list for the abbreviations is included in the introduction to Table 3.

References

| <u>Number</u> | <u>Laboratory Code and Report Number</u> | <u>Date</u> | <u>Description</u> |
|---------------|--|-------------|---|
| 01 | STP No. 19 | Apr 1937 | "Laboratory Tests on Hydraulic Model of Pickwick Lock Hydraulic System, Tennessee River, Pickwick Landing, Tennessee." |
| 02 | STP No. 21 | Jul 1937 | "Laboratory Tests on Hydraulic Model of Guntersville Lock Hydraulic System, Tennessee River, Guntersville, Alabama." |
| 03 | STP No. 27 | Dec 1937 | "Laboratory Tests on Hydraulic Model of Filling and Emptying System for Proposed Watts Bar Project Lock, Tennessee River, near Dayton, Tennessee." |
| 04 | STP No. 28 | Dec 1937 | "Hydraulic Model Tests of the Filling and Emptying System for the Chickamauga Project Lock, Tennessee River." |
| 05 | STP No. 34 | Jul 1939 | "Laboratory Tests on Hydraulic Model of Filling and Emptying System of the General Joe Wheeler Lock, Tennessee River, near Florence, Alabama." |
| 06 | STP No. 44 | Nov 1940 | "Laboratory Tests on Hydraulic Model to Determine Navigation Conditions in Approaches to St. Anthony Falls Locks, Mississippi River, Minneapolis, Minnesota." |
| 07 | BHL TR No. 8-1 | Jun 1941 | "Model Study of the Willamette Falls Locks, Oregon City, Oregon." |
| 08-13 | STP No. 46 | Oct 1941 | "Prototype Lock Hydraulic Tests to Verify Model Experiments." (This volume contains reports on studies of six separate lock systems.) |
| 14 | STP No. 48 | Feb 1944 | "Laboratory Tests on Hydraulic Model of Filling and Emptying System for the MacArthur Lock, St. Marys River, Sault Ste. Marie, Michigan." |
| 15 | STP No. 49 | Feb 1944 | "Laboratory Tests on Hydraulic Models of Filling and Emptying Systems for the New Lock No. 2, Mississippi River, Hastings, Minnesota." |
| 16 | STP No. 51 | Aug 1945 | "Laboratory Test on Hydraulic Models of a Submergible Tainter Lock Gate for St. Anthony Falls Lower Lock, Mississippi River, Minneapolis, Minnesota." |

| <u>Number</u> | <u>Laboratory Code and Report Number</u> | <u>Date</u> | <u>Description</u> |
|---------------|--|-------------|---|
| 17 | STP No. 52 | Jun 1946 | "Laboratory Tests on Models of Lock Hydraulic Systems." |
| 18 | WES TM 2-282 | Jun 1949 | "Vacuum Tank Tests of Model Tainter Valve for McNary Dam." |
| 19 | WES TM 2-309 | Apr 1951 | "Filling Characteristics, Algiers Lock, Intracoastal Waterway, Gulf Section, Louisiana; Model Investigation." |
| 20 | WES TM 2-313 | Jun 1950 | "Study of Butterfly Valves for Pearl River Locks; Model Investigation." |
| 21 | STP No. 56 | Aug 1952 | "Laboratory Tests on Hydraulic Models of Filling and Emptying Systems for the New Cumberland Locks, Ohio River." |
| 22 | WES TM 2-358 | Apr 1963 | "Upstream Emergency Dam, Cheatham Lock, Cumberland River, Tennessee; Hydraulic Model Investigation." |
| 23 | STP No. 59 | Jan 1955 | "Laboratory Tests on Hydraulic Models of Filling and Emptying Systems for Auxiliary Locks, Mississippi River." |
| 24 | BHL TR No. 26-1 | May 1955 | "Navigation Lock for McNary Dam, Columbia River, Oregon and Washington; Hydraulic Model Investigation." |
| 25 | WES MP 2-146 | Nov 1955 | "Prototype Tests of Filling and Emptying Systems, McNary Dam Lock, Washington, October 1955." |
| 26 | STP No. 565 | Mar 1957 | "Laboratory Tests on Hydraulic Model to Determine Hawser Pull on Short Tows near Cumberland Main Lock, Ohio River, Suppl. Report," by D. L. Preston and J. J. Hartigan. |
| 27 | WES TR 2-497 | Apr 1959 | "Filling and Emptying Characteristics of Calumet-SAG Project, Illinois; Hydraulic Model Investigation," by J. H. Ables. |
| 28 | WES TR 2-500 | May 1959 | "Filling and Emptying System, Port Allen Navigation Lock, Gulf Intracoastal Waterway, Louisiana; Hydraulic Model Investigation," by J. H. Ables. |
| 29 | WES TR 2-519 | Aug 1959 | "Walter F. George Lock and Dam, Chattahoochee River, Alabama and Georgia; Hydraulic Model Investigation," by E. S. Melsheimer. |
| 30 | WES TR 2-527 | Oct 1959 | "Emergency Gate, Greenup Locks, Ohio River, Kentucky; Hydraulic Model Investigation," by E. S. Melsheimer. |

| <u>Number</u> | <u>Laboratory Code and Report Number</u> | <u>Date</u> | <u>Description</u> |
|---------------|--|-------------|---|
| 31 | STP No. 64 | Oct 1959 | "Laboratory Tests on Hydraulic Models of Filling and Emptying Systems for Chain of Rocks Locks, Mississippi River." |
| 32 | STP No. 68 | Mar 1960 | "Laboratory Tests on Hydraulic Models of the Filling and Emptying Systems for Jackson Lock, Tombigbee River, Alabama." |
| 33 | STP No. 69 | May 1960 | "Lower Lock and Dam Tainter Gates, St. Anthony Falls Upper Harbor Project, Mississippi River, Minneapolis, Minnesota; Hydraulic Model Investigation." |
| 34 | WES TR 2-549 | Jun 1960 | "Filling and Emptying System, Old River Navigation Lock, Louisiana; Hydraulic Model Investigation," by J. H. Ables and F. R. Brown. |
| 35 | WES TR 2-552 | Jun 1960 | "Hydraulic Prototype Tests of Tainter Valve, McNary Lock, Columbia River, Washington," by E. B. Pickett. |
| 36 | WES TR 2-556 | Aug 1960 | "Filling and Emptying Characteristics of Barge Canal Lock, Sacramento River Deep-Water Ship Channel Project, California; Hydraulic Model Investigation," by J. H. Ables and T. E. Murphy. |
| 37 | WES TR 2-561 | Apr 1961 | "Filling and Emptying System, New Poe Lock, St. Marys River, Sault Ste. Marie, Michigan; Hydraulic Model Investigation," by J. H. Ables and T. Schmidtgall. |
| 38 | STP No. 70 | Apr 1961 | "Intake Manifolds for Demopolis and Warrior Locks, Tombigbee River, Alabama and Jim Woodruff Lock, Apalachicola River, Florida; Hydraulic Model Investigation," by F. T. Mertes and M. E. Nelson. |
| 39 | WES TR 2-537 | Jun 1961 | "Culvert Tainter Valves, New Lock No. 19, Mississippi River; Hydraulic Model Investigation." |
| 40 | STP No. 71 | Jun 1961 | "Filling and Emptying Systems for Dwight D. Eisenhower and Bertrand H. Snell Locks, St. Lawrence Seaway Project; Hydraulic Model Investigation," by S. Fidelman. |
| 41 | WES TR 2-573 | Jul 1961 | "Intake Studies, Dardanelle Lock, Arkansas River, Arkansas; Hydraulic Model Investigation," by J. H. Ables. |

| <u>Number</u> | <u>Laboratory Code and Report Number</u> | <u>Date</u> | <u>Description</u> |
|---------------|--|-------------|---|
| 42 | STP No. 73 | Sep 1961 | "Filling and Emptying Systems for Walter F. George Lock, Chattahoochee River, Alabama-Georgia; Hydraulic Model Investigation," by S. Fidelman and M. E. Nelson. |
| 43 | STP No. 74 | Jan 1962 | "Filling and Emptying Systems for Greenup and Markland Locks, Ohio River; Hydraulic Model Investigation," by J. J. Hartigan and F. J. Ryder. |
| 44 | STP No. 65 | Jun 1962 | "Laboratory Tests on Hydraulic Models of Filling and Emptying Systems for a Proposed 600-Ft Lock and Dam No. 19, Mississippi River, Keokuk, Iowa; Hydraulic Model Investigation." |
| 45 | BHL TR No. 111-1 | | "Miter Gate Bottom Seals, Panama Canal Locks; Laboratory Investigation." |
| 46 | STP No. 66 | Jun 1963 | "Filling and Emptying Systems for New 1200-Ft Lock No. 19, Mississippi River, Keokuk, Iowa; Hydraulic Model Investigation," by D. L. Preston and J. J. Hartigan. |
| 47 | STP No. 75 | Jun 1963 | "Filling and Emptying Systems for Barkley Lock, Cumberland River, Kentucky; Hydraulic Model Investigation," by S. Fidelman. |
| 48 | WES MP 2-622 | Feb 1964 | "Emergency Gate Performance, McAlpine Lock, Ohio River, Kentucky; Hydraulic Prototype Tests." |
| 49 | WES TR 2-651 | Jun 1964 | "Operating Forces on Miter-Type Lock Gates," by J. L. Grace, T. E. Murphy, and F. R. Brown. |
| 50 | STP No. 76 | Dec 1964 | "Filling and Emptying Systems for St. Anthony Falls Locks, Mississippi River, Minnesota; Hydraulic Model Investigation," by S. Fidelman and J. J. Hartigan. |
| 51 | WES TR 2-678 | Jun 1965 | "Filling and Emptying System, Jonesville Lock, Ouachita-Black Rivers, Louisiana; Hydraulic Model Investigation," by N. R. Oswalt, J. H. Ables, M. B. Boyd, and T. E. Murphy. |
| 52 | BHL TR No. 56-1 | May 1965 | "Navigation Lock, The Dalles Dam, Columbia River, Oregon and Washington; Hydraulic Model Investigation," by M. J. Webster and H. P. Theus. |

| <u>Number</u> | <u>Laboratory Code and Report Number</u> | <u>Date</u> | <u>Description</u> |
|---------------|--|-------------|--|
| 53 | WES TR 2-685 | Aug 1965 | "Prototype Hawser-Force Measurements, Jackson Lock, Tombigbee River, Alabama," by J. V. Dawsey, C. J. Huval, and W. C. Blanton. |
| 54 | WES TR 2-689 | Aug 1965 | "Tests of Structure Orientation, Spillway, and Lock Emergency Gate, Barkley Lock and Dam, Cumberland River, Kentucky; Hydraulic Model Investigation," by T. E. Murphy and R. S. Cummins. |
| 55 | WES TR 2-698 | Nov 1965 | "Lock Filling and Emptying System, Holt Lock and Dam, Warrior River, Alabama; Hydraulic Model Investigation," by T. E. Murphy and J. H. Ables. |
| 56 | WES MP 2-794 | Feb 1966 | "Lock Culvert Outlet Basins; Hydraulic Model Investigation," by J. H. Ables and M. B. Boyd. |
| 57 | WES TR 2-713 | Feb 1966 | "Filling and Emptying System, Cannelton Main Lock, Ohio River, and Generalized Tests of Sidewall Port Systems for 110-by 1200-Ft Locks; Hydraulic Model Investigation," by J. H. Ables and M. B. Boyd. |
| 58 | WES TR 2-718 | Mar 1966 | "Filling and Emptying Systems, Millers Ferry and Jones Bluff Locks, Alabama River, Alabama; Hydraulic Model Investigation," by J. H. Ables and M. B. Boyd. |
| 59 | WES TR 2-734 | Jul 1966 | "Culvert Pressures, Greenup Lock, Ohio River, Kentucky; Hydraulic Prototype Tests," by P. M. Smith and R. A. Yates. |
| 60 | WES TR 2-739 | Sep 1966 | "Filling and Emptying System, Cordell Hull Navigation Lock, Cumberland River, Tennessee; Hydraulic Model Investigation," by N. R. Oswalt and M. B. Boyd. |
| 61 | WES TR 2-743 | Nov 1966 | "Filling and Emptying Systems, Low-Lift Locks, Arkansas River Project; Hydraulic Model Investigation," by J. H. Ables and M. B. Boyd. |
| 62 | WES TR 2-778 | May 1967 | "Modernization of Filling and Emptying System, Existing McAlpine Lock (Old No. 41), Ohio River, Louisville, Kentucky; Hydraulic Model Investigation," by J. H. Ables and T. E. Murphy. |

| <u>Number</u> | <u>Laboratory Code and Report Number</u> | <u>Date</u> | <u>Description</u> |
|---------------|--|-------------|--|
| 63 | WES TR H-68-4 | Sep 1968 | "Effect of Valve Position in a Sidewall Port Filling System, Newburgh Lock, Ohio River; Hydraulic Model Investigation," by J. O. Farrell and J. H. Ables. |
| 64 | WES TR H-69-5 | Apr 1969 | "Filling and Emptying System, Dardanelle Lock, Arkansas River; Hydraulic Model Investigation," by J. H. Ables and M. B. Boyd. |
| 65 | WES TR H-70-2 | Mar 1970 | "Operating Forces on Sector Gates Under Reverse Heads; Hydraulic Model Investigation," by N. R. Oswalt. |
| | | Dec 1971 | "Appendix A: Results of Supplemental Tests; Hydraulic Model Investigation," by N. R. Oswalt and T. E. Murphy. |
| 66 | WES MP H-71-4 | Feb 1971 | "Calcasieu Saltwater Barrier Prototype Sector Gate Tests," by D. F. Bastian. |
| 67 | WES TR H-72-6 | Sep 1972 | "Navigation Conditions and Filling and Emptying System, New Bankhead Lock, Black Warrior River, Alabama; Hydraulic Model Investigation," by N. R. Oswalt, J. H. Ables, and T. E. Murphy. |
| 68 | BHL TR No. 32-1 | May 1973 | "Filling and Emptying System, Ice Harbor Lock, Snake River, Washington; Hydraulic Model Investigation," by L. Z. Perkins. |
| 69 | BHL TR No. 98-1 | Jul 1974 | "Filling and Emptying System, John Day Lock, Columbia River, Oregon and Washington; Hydraulic Model Investigation," by A. J. Chanda and L. Z. Perkins. |
| 70 | BHL TR No. 105-1 | May 1975 | "Intake Manifolds and Emptying Valves for Lower Monumental Lock, Snake River, Washington," by A. J. Chanda and L. Z. Perkins. |
| 71 | WES TR H-75-11 | Jun 1975 | "Barkley Lock Prototype Tests, Cumberland River, Kentucky," by F. M. Neilson. |
| 72 | WES HP H-75-7 | Jul 1975 | "Lock Design, Sidewall Port Filling and Emptying System," by T. E. Murphy. |
| 73 | BHL TR No. 115-1 | Sep 1975 | "Filling and Emptying System, Little Goose Lock, Snake River, Washington; Hydraulic Model Investigation," by A. J. Chanda and L. Z. Perkins. |
| 74 | WES TR H-77-7 | Apr 1977 | "Filling and Emptying System for Medium-Lift Locks, Trinity River, Texas; Hydraulic Model Investigation," by N. R. Oswalt. |

| <u>Number</u> | <u>Laboratory Code and Report Number</u> | <u>Date</u> | <u>Description</u> |
|---------------|--|-------------|---|
| 75 | WES TR H-78-9 | Jun 1978 | "Bay Springs Canal Surge Study, Tennessee-Tombigbee Waterway, Mississippi and Alabama; Hydraulic Model Investigation," by C. H. Tate, Jr. |
| 76 | WES MP H-78-10 | Sep 1978 | "Single-Valve Prototype Tests, Main Lock, Locks and Dam 26, Mississippi River, Alton, Illinois," by E. D. Hart. |
| 77 | WES TR H-78-16 | Sep 1978 | "Filling and Emptying System, New Ship Lock, Mississippi River-Gulf Outlet, Louisiana; Hydraulic Model Investigation," by J. H. Ables, Jr. |
| 78 | WES TR H-78-19 | Nov 1978 | "Filling and Emptying System for Bay Springs Lock, Tennessee-Tombigbee Waterway, Mississippi; Hydraulic Model Investigation," by J. H. Ables, Jr. |
| 79 | BHL TR No. 126-1 | Sep 1979 | "Navigation Lock for Lower Granite Dam, Snake River, Washington; Hydraulic Model Investigations, Bonneville, Oregon," by L. Z. Perkins. |
| 80 | WES TR HL-79-21 | Dec 1979 | "Modifications to Filling and Emptying System of Lock No. 1, Mississippi River, Minneapolis, Minnesota; Hydraulic Model Investigation," by J. H. Ables, Jr. |
| 81 | WES TR-80-13 | Aug 1980 | "Prototype Filling and Emptying System Measurements, New Bankhead Lock, Black Warrior River, Alabama," by A. R. Tool (includes Appendixes A-B). |
| 82 | WES TR HL-80-17 | Sep 1980 | "Lock Approach Canal Surge and Tow Squat at Lock and Dam 17, Arkansas River Project; Mathematical Model Investigation," by C. J. Huval (includes Appendix A). |
| 83 | WES TR HL-81-10 | Sep 1981 | "Lock Culvert Valve Loss Coefficients; Hydraulic Laboratory Investigation," by G. A. Pickering. |
| 84 | BHL TR No. 194-1 | Apr 1983 | "Emergency Closure System and Flood Control Regulation Gate for Hiram M. Chittenden Locks at Lake Washington Ship Canal; Hydraulic Model Investigation," by M. M. Kubo. |
| 85 | WES TR HL-84-8 | Sep 1984 | "Filling and Emptying System, Walter Bouldin Lock, and Lock Culvert Valve for Coosa River Waterway, Alabama; Hydraulic Model Investigation," by J. F. George. |

| <u>Number</u> | <u>Laboratory Code and Report Number</u> | <u>Date</u> | <u>Description</u> |
|---------------|--|-------------|--|
| 86 | WES Unassigned | Draft | "John Day Lock Hydraulic Prototype Tests, Columbia River, Washington," by E. B. Pickett and F. M. Neilson. |

TABLE 1
LOCK HYDRAULIC SYSTEM
MODEL AND PROTOTYPE STUDY DATA

PAGE SEQUENCE FOR TABLE 1

| DESIGN AND OPERATIONAL VARIABLES | TEST REPORT COLUMN NUMBERS | | | |
|--|----------------------------|----------|------------------|----------|
| | 01 TO 20 | 21 TO 45 | 46 TO 65 | 66 TO 90 |
| 11000 TO 11275 | ① | ② | ③ | ④ |
| 11300 TO 12290 | ⑤ | ⑥ | ⑦ | ⑧ |
| 12300 TO 13236 | ⑨ | ⑩ | ⑪ | ⑫ |
| 13240 TO 14180 | ⑬ | ⑭ | ⑮ | ⑯ |
| 14200 TO 15290 | ⑰ | ⑱ | ⑲ | ⑳ |
| 15300 TO 16260 | ㉑ | ㉒ | ㉓ | ㉔ |
| 16300 TO 16460 AND "NOTED ITEMS" | ㉕ | ㉖ | ㉗ | ㉘ |
| | ← FACING PAGES → | | ← FACING PAGES → | |

1. Select DESIGN and/or OPERATIONAL variable(s) of interest and note line number(s) (11000 to 16460).
2. Trace selected line(s) across appropriate tables and note which REPORTS (columns) contain TYPES OF DATA (T,O,Q, etc.) of interest.
3. See last four pages of TABLE 1 for descriptions of NOTED ITEMS and X's.

