DEPARTMENT of the INTERIOR

news release

BUREAU OF RECLAMATION

Macfarlan - 343-4662

For Release April 12, 1973

FEATURE MATERIAL

HAVASU PUMPING PLANT, ARIZONA, IS TESTED IN MODEL FORM

Bureau of Reclamation engineers are studying in miniature the critical details of the future Havasu Pumping Plant, a major feature of the Central Arizona Project, the Department of the Interior said today.

The good-sized model, at Reclamation's Denver Engineering and Research Center, is small compared to the ultimate pumping plant which will lift 94 tons of water per second out of Lake Havasu on the Colorado River and force it 800 feet up and through a mountain barrier as it begins its 300-mile course across Arizona to augment water supplies in the Phoenix and Tucson area.

The pumping plant will draw water from an intake channel on the Bill Williams arm of Lake Havasu, through six suction tubes, each 9 feet in diameter. Six electric-motor-driven 500-cfs pumps will lift the water through two buried 3,000-foot-long pipelines to discharge into a 7-mile-long tunnel that will pierce the Buckskin Mountains. A complex system of tunnels, canals, and aqueducts will convey the water south and eastward to its destination.

Before construction can begin, however, Reclamation's research and design engineers are conducting hydraulic model studies that seek to isolate potential problem areas and to optimize the final design. Such studies have contributed millions of dollars in savings in the design, construction, and operation of water resource facilities and projects.

In the Denver laboratories of Reclamation's Division of General Research, a hydraulic model has been constructed of portions of the Havasu intake facility at a scale of 9.4:1. It consists of a "box" 36 by 26 feet, elevated 8 feet above the floor and simulating the forebay at the Lake Havasu site.

Along one wall of the elevated box are the rectangular mouths of six suction tubes through which water will be admitted in actual practice by wheel-mounted gates. A plexiglass tube with quarter-inch-thick walls replicates the suction tube in the test. Water moving at velocities up to 12 feet-per-second flows down the tube a vertical distance of 7 feet, encounters a 150-degree bend that abruptly returns it to a vertical course, and there finds a sharply reduced diameter of pipe.

In actual practice, the pipe's diameter will reduce from 9 feet to

4 feet 4 inches over a lateral distance of 20 feet as the water velocity increases to suit the intake of the pump.

There six pumps will receive the flow from the identical suction tubes and force it into two discharge lines that ascend the Buckskin Mountains along a buried path. Each of the discharge lines will be 11 feet in diameter.

There are three main purposes of the hydraulic model study in the Denver laboratories.

The intake works will be studied to assure that no vortex problems occur at the mouth of the system which could produce voids--or bubbles--that would disturb the smooth operation of the pumps.

Secondly, the study will develop the most efficient configuration for the suction tubes, one that will provide the least energy loss to the pumps.

And finally, it will help obtain a uniform flow of water at the pump eye, where the water first enters the pump. The pump's efficiency, in terms of its ability to impart energy to the flow, hinges in large part on the kind of "toehold" it gets on the water. An uneven flow into the pump's impeller would cause the pump to operate roughly and at reduced efficiency.

"Our objective is to get the best possible combination from each of these factors," says Perry L. Johnson, a hydraulic engineer who directs the testing and is coordinating results with members of the Division of Design. He estimates the hydraulic model study program will require perhaps 6 months to complete.

A visitor to the completed Havasu pumping plant will see none of these complexities. The intake works, suction tube, and pumps all will lie beneath the surface of the 306- by 138-foot structure. The bottom-most portion of the facility will be 110 feet beneath ground surface.

Where the water starts its journey, the top of the six concrete-framed inlet channels will be 8 feet below minimum (and 18 feet below maximum) water surface elevation. Trashracks will span the entire 218-foot lateral face of the inlet facility.

The efficiency of the six 10-foot 9-inch tall inlets is a function both of their configuration and that of the broad forebay that channels the water's flow to the suction tubes. With the hydraulic model, different designs are tested and flow conditions recorded on videotape, with confetti marking every surface eddy. The results then may be evaluated visually by split-screen videotape playback.

More demanding is the researchers' pursuit of a suction tube that minimizes energy loss.

To obtain flow information for comparison, Johnson inserts a ring of piezometers around the circumference of the suction tube slightly below the upper transition and at the pump eye. With suction tubes of differing profiles and with different rates of water-flow, the piezometers measure pressure to one-thousandth of a foot accuracy. Pilot tubes are used to measure the velocity of flow through the intake.

From these data, Johnson calculates the velocity distributions and total energy in the flow at various cross-sectional points within the tube. This in turn enables the design team to choose the tube with the greatest energy efficiency.

How critical is this research to the eventual design of the pumping plant?

"The critical factor," Johnson explains, "is a reduced cost of operation and maintenance. By satisfying the objectives of this study, we can design a smoother-running, more efficient plant. And that means a more trouble-free plant that uses less electric power to do its job. In the end, this all means huge long-term savings."

The 514-rpm pumps will be powered by motors rated at about 60,000 hp. They will be powered by electrical energy provided through the Parker Dam Switchyard from the Navajo Powerplant.

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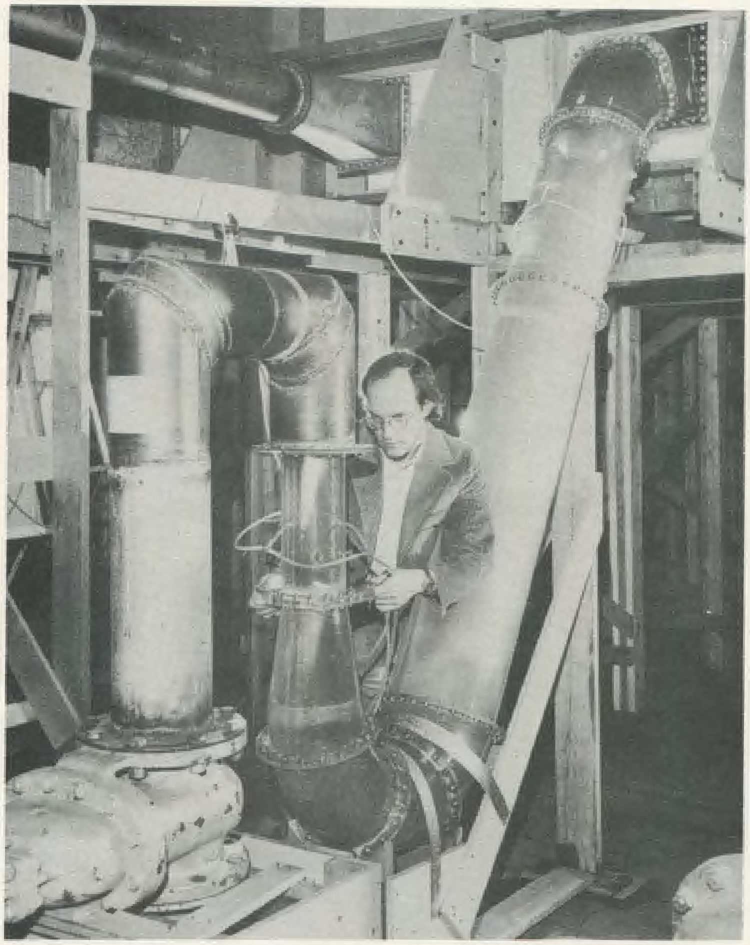
Note: Editors may obtain glossy photographs to illustrate this feature by writing Bureau of Reclamation, U.S. Department of the Interior, Washington, D.C. 20240.

PUMPING PLANT MODEL--To develop the most efficient design for the Lake Havasu Pumping Plant in Arizona, engineers for the Bureau of Reclamation Engineering and Research Center at Denver are conducting extensive tests with this hydraulic model. It seeks, in miniature, to replicate the removal of water from a forebay area (top) through suction tubes and into a pumping chamber. From there, pumps will lift the water over a mountain range to start its journey south and eastward to Phoenix and Tucson as part of the Central Arizona Project. At work are Steve C. Mallen, a National Science Foundation-sponsored physicist, and Perry L. Johnson (bottom), a hydraulic ingineer with the Bureau of Reclamation.

CONFETTI STUDY--Hydraulic engineer Perry L. Johnson of the Bureau of Reclamation's Division of General Research casts paper confetti into the forebay portion of a model of the Havasu Pumping Plant under study at the Bureau of Reclamation's Engineering and Research Center at Denver. The confetti, caught up in the gentle flow, enables engineers to observe the performance of different configurations of intakes. Five of the six intake mouths that will comprise the facility are in this view.

-- Bureau of Reclamation Photos



HYDRAULIC SURGE--Thrust along by the unseen pressure exerted by a difference in elevation, or "head," water surges through this plexiglass suction tube under the eyes of hydraulic engineer Perry L. Johnson at the Bureau of Reclamation's engineering laboratories in Denver. Johnson is directing research into the design and operation of the Lake Havasu Pumping Plant, a principal feature of the Central Arizona Project.

--Bureau of Reclamation Photo