Form DFC-11
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Bureau of Reclamation

INFORMATIONAL ROUTING

HYDRAULICS BRANCH
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MAR 5 1976

Mr. C. H. Whalin, Manager
Civil Engineering Department
Salt River Project
P.O. Box 1980
Phoenix, AZ 85001

Dear Mr. Whalin:

In accordance with your letter of November 24, we have completed stability analyses and hydraulic model tests of splitter piers for the Stewart Mountain Dam spillway.

A stability analysis for the splitter pier shown on the USBR drawing dated January 21, 1976, was performed prior to running the hydraulic model and was predicated on conservative assumptions for dynamic forces acting on the pier.

After the pier had been modeled hydraulically and the flow patterns better understood, the pier was analyzed again. The analysis was performed on a pier similar to the configuration shown on section A-A of the USBR drawing except the nose of the pier was not rounded. The projected width, normal to the flow, of section A-A is 3.48 ft. Assuming a velocity of 60 ft/s, flow lines normal to the spillway lip, and a depth of water of 15 ft (admittedly this is conservative since the depth from the model studies, refer to table 1, indicates 11.3 ft depth for a flow of 140,000 ft^3/s), the following design loads should be applied to the pier:

Loading condition	Magnitude of load	Location	Direction
Static	24,500 lb	5 ft above spwy lip	Downstream
Dynamic	12,400 lb	7.5 ft above spwy lip	Downstream

It is the Bureau's conclusion that a pier of fabricated steel or concrete could be adapted to Stewart Mountain spillway.

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Hydraulic model tests were run for your pier design (Salt River Project Drawing No. SK75-Y57) and the pier design developed in the Concrete Dams Section of the Engineering and Research Center (USBR drawing of January 21, 1976, which was sent to you). The model pier of your design was tested with a 3-inch radius rounding on the nose. This rounding was included because of our misconception that the proposed pier would be built from concrete. A sharp nose would not be feasible on a concrete pier. Although the nose was rounded, it is felt that the rounding had minimal effect on the hydraulic performance of the pier and, therefore, the data obtained would be representative of a sharp-nosed structure.

Figure 1 shows the two piers on the dry spillway lip.

When tested, both piers were found to adequately separate the flow. However, they both created fairly large fins which may be esthetically undesirable. The finning indicates that the piers are separating the flow more than is needed and that a thinner structure would suffice. This is not to say that the proposed designs are hydraulically unacceptable; but only that, if structurally possible, their size could be reduced.

Because of variation in the flow from one side of the spillway to the other, photographs were taken of the piers operating on both sides of the spillway. Figures 2 and 3 show the piers operating at discharges of 30,000 ft^3/s and 140,000 ft^3/s, respectively. The piers are identified on the photographs. It can be seen that the Salt River design creates somewhat smaller fins than the E&R Center design. This was found to be a result of the smaller projected area of the pier (normal to the flow) at the flow water surface. The smaller area, which results from the tapering of the pier, intercepts and deflects less of the flow and therefore, results in the reduced fin size.

In addition to observing the operating piers, flow velocity and direction data were collected at the pier positions on the spillway lip. These data are summarized in table 1. The left and right pier positions are again established by looking in the direction of flow.

The α angle is defined in the drawing below the table. An angle of 90° is normal to the lip while angles less than 90° indicate that the flows approach the lip from left of normal, and angles greater than 90° indicate that the flows approach the lip from the right of normal. In addition to the angle of approach, data on the velocity

of the flow and the depth of the flow are also presented in table 1. These data are generally self-explanatory. One point should be made. Although the flow depths shown at the maximum discharge are less than the 15-foot pier height now being considered, the 15-foot height is representative of what is required. The additional height is needed because of the finning. The flows tend to climb the piers (figure 3) and could conceivably climb completely over the piers and reseal if the pier heights are insufficient.

If we can be of any additional help, feel free to contact us. This letter has the concurrence of the Director of Design and Construction.

Sincerely yours,

HOWARD COHAN

Howard J. Cohen, Chief
Division of General Research

Copy to: Regional Director, Boulder City, Nevada
Projects Manager, Arizona Projects Office, Phoenix, Arizona

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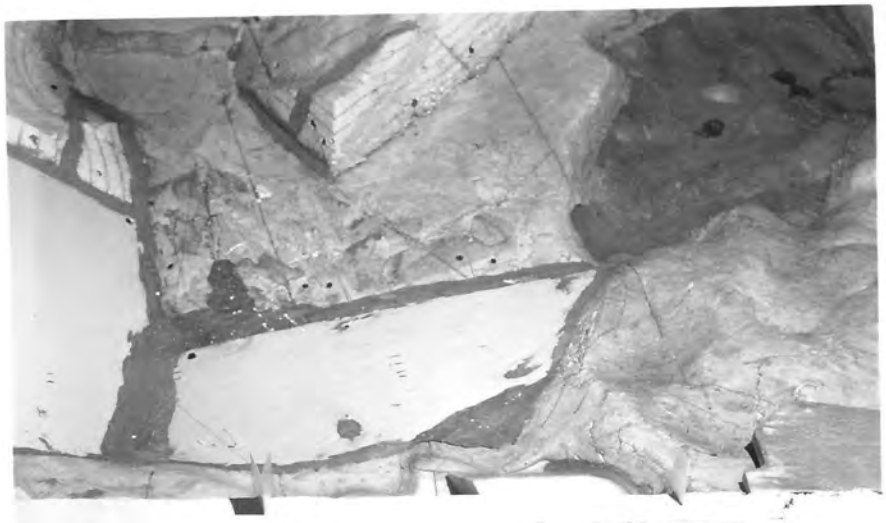
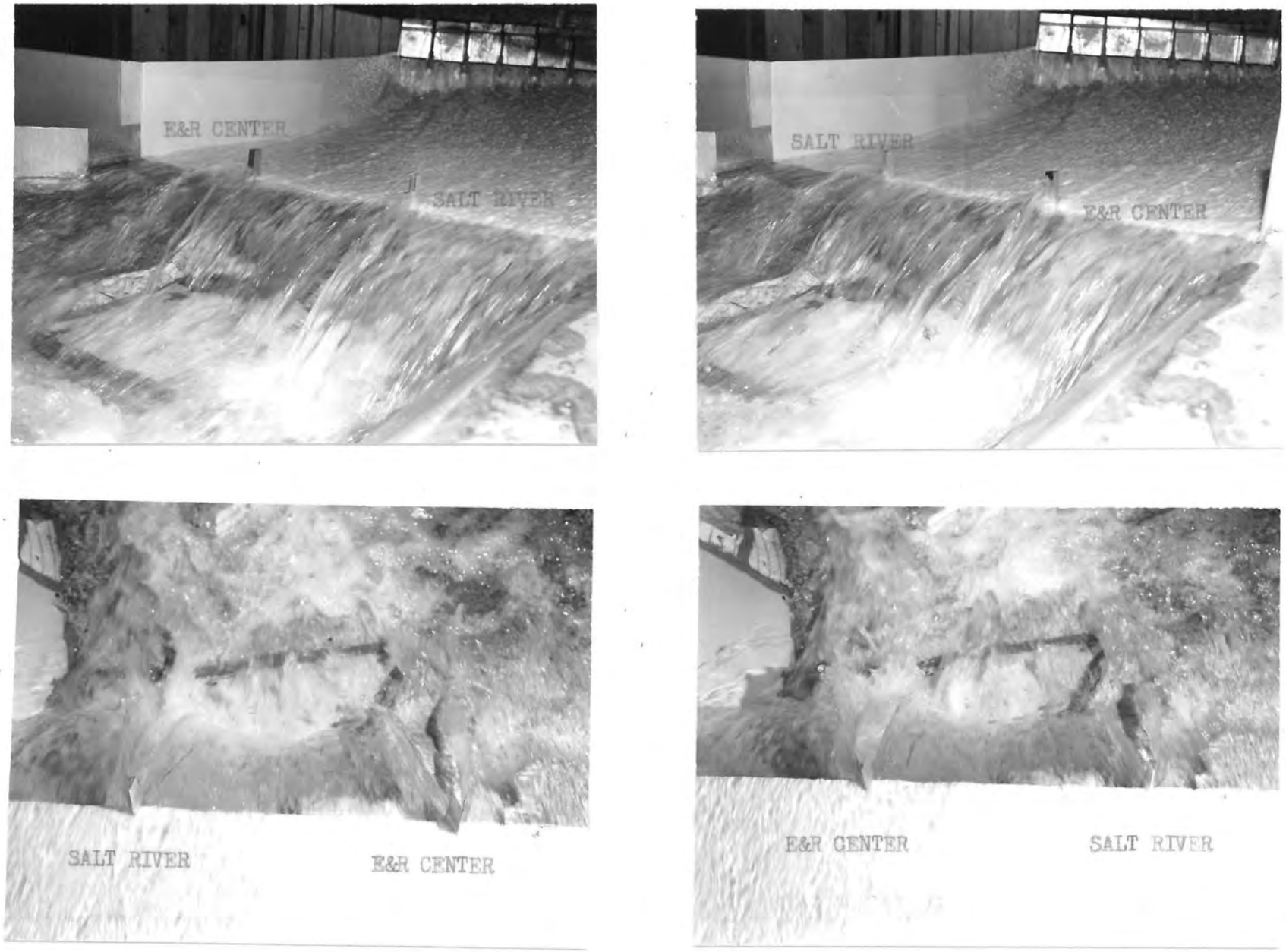


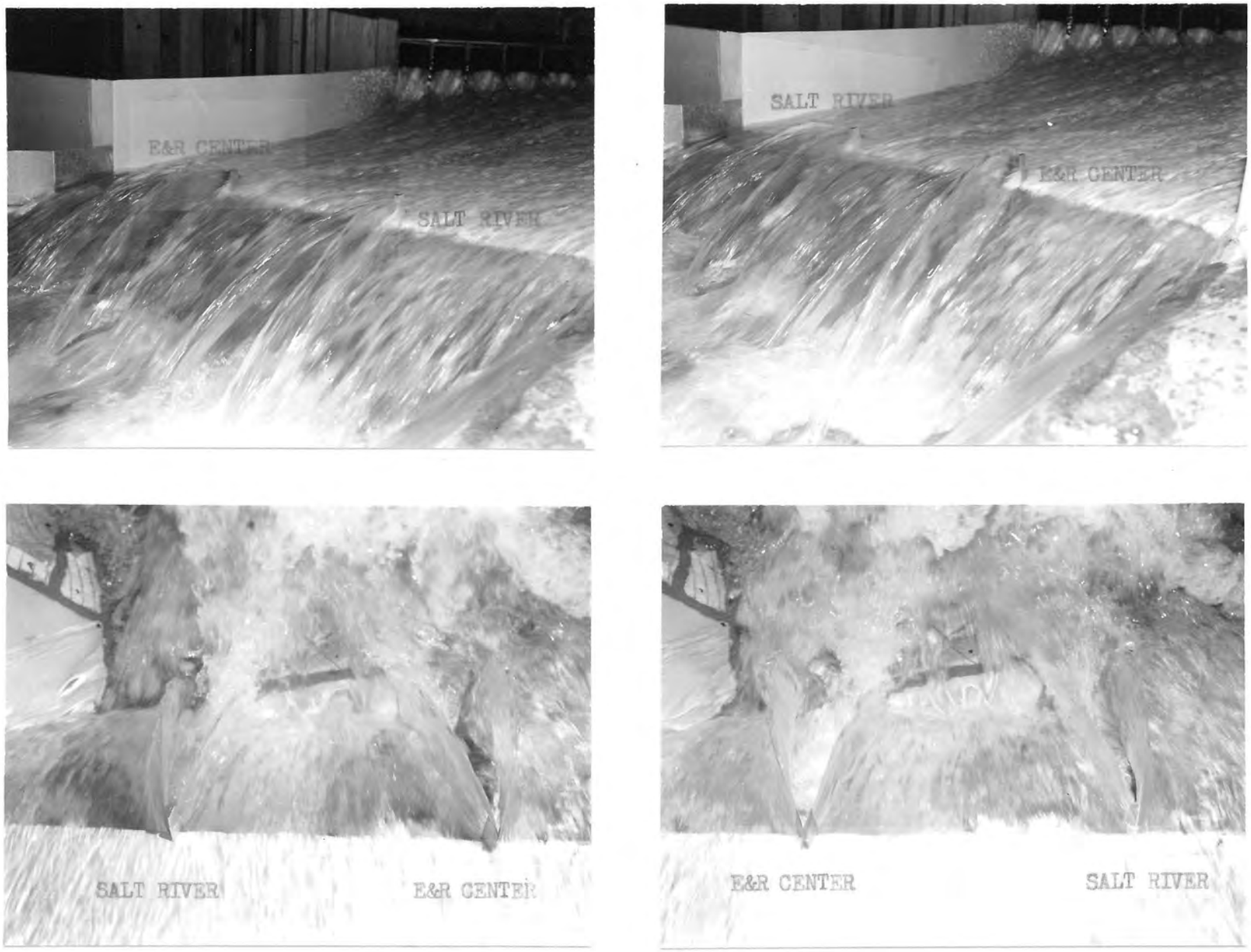
SPLITTER PIERS

Figure 1



PIER OPERATION at 30,000 FT^3/S

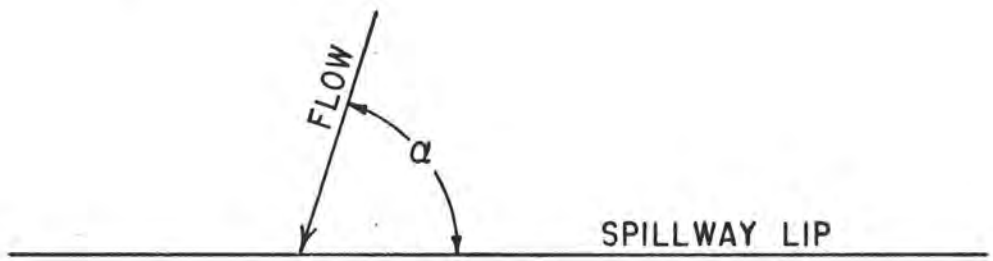
Figure 2



PIER OPERATION at 140,000 FT^3/S

Figure 3

DISCHARGE FT^3/S	α LEFT	α RIGHT	VELOCITY LEFT FT/S	VELOCITY RIGHT FT/S	DEPTH LEFT FT.	DEPTH RIGHT FT.
13,000	81°	78°	25	32	1.5	1.2
30,000	88°	92°	36	41	3.8	3.7
60,000	95°	100°	45	49	6.2	5.5
140,000	95°	90°	48	52	8.7	11.5



LEFT AND RIGHT DESIGNATION BASED ON LOOKING IN THE DIRECTION OF FLOW

TABLE I