Form DFC-11
(12-61)
Bureau of Reclamation

INFORMATIONAL ROUTING

HYDRAULICS BRANCH
OFFICIAL FILE COPY

Memorandum
Water Systems Automation Team Leader, Code 430

Denver, Colorado
October 30, 1978

Chief, Hydraulics Branch

ACTING Chief, Division of Research

Application of Automatic Upstream Control for Canal Gates on the Wellton-Mohawk Main Outlet Drain (MOD) and Main Outlet Drain Extension (MODE) - Colorado River Basin Salinity Control Project, Title I, Arizona
(Your April 28, 1978 Memorandum)

The application of the proportional plus proportional reset (P+PR) mode of automatic upstream control has been completed for the nine check gates on the Wellton-Mohawk Outlet Drain (MOD) and the Main Outlet Drain Extension (MODE) upstream from the Yuma Desalting Plant. The attached table lists the required control parameters for the P+PR for each drain check gate and includes the control parameters for the Bypass Drain downstream of the Yuma Desalting Plant. The Bypass Drain Control Parameters were published in our research report No. GR-78-4 dated August 1977, entitled, "Study of an Automatic Upstream Control System for Canals," and are included in the attached table for your convenience.

The required P+PR control algorithms, and associated logic, for the MOD and MODE remain the same as for the Bypass Drain and are described in detail in the GR-78-4 research report. The P+PR control parameters for the Bypass Drain also remain the same except the reset dead bands, RDB, for the Bypass Drain check gates were increased from 0.015 m to 0.024 m to provide better stability characteristics at steady-state flow conditions.

The required P+PR control parameters have been furnished for the MODE check No. 10, station 107+58, which has been proposed to be manually controlled during initial operation. It was necessary to develop the parameters for automatic upstream control of check No. 10 during this study to make certain future automatic control will be compatible to the controllers upstream and downstream.

Numerous mathematical model computer runs simulating the MOD, MODE, and the Bypass Drain were made to test the performance and stability of the P+PR upstream control system. These simulation studies included emergency shutdown of the Yuma Desalting Plant, shutdown of the Wellton-Mohawk well

PAP 367

PAP 367

*GPO-1977-778-40

pumps as a result of an assumed power outage, the startup of the well pumps after power is restored, and small and large flow changes at low and high initial flow conditions. The results of the simulation studies are not included in this memorandum because of the bulk of time history plots that were produced. However, anyone interested in reviewing the time history plots may contact Mr. Clark P. Buyalski, code 1532.

It has not been determined how accurately the mathematical model simulates the Drain System. Therefore, it is important to have someone available to observe the initial operation of the P+PR controllers to verify the control system operates with stability and with the desirable response characteristics.

E.R. Swanson

Attachment

Copy to: 240
250
270
700
1530
1532
(with attachment to each)

CPBuyalski:emk-s

TABLE OF P+PR CONTROL PARAMETERS
FOR AUTOMATIC UPSTREAM CONTROL OF THE
MOD - MODE - BYPASS DRAIN SYSTEM

Drain section	Check No.	Station km/ft	P-Gain[1/] K1	PR-Gain[1/] per second K2	Target YT m	Target YT ft	Reset deadband ±RDB m	Reset deadband ±RDB ft
	1	12.8 419+76.7		Free flow 10-ft Parshall flume, $Q = 39.38H_a^{1.6}$				
	2	9.3 305+32.0	2.0	0.00058	1.83	6.01	0.024	0.08
MOD	3	7.3 240+00.0	1.6	0.00058	1.47	4.82	0.024	0.08
	4	4.2 137+98.0	1.6	0.00058	1.54	5.07	0.024	0.08
	5	1.7 54+38.0	1.6	0.00058	1.54	5.07	0.024	0.08
	6	0.1 AH 19.4 BK 2+82.8 AH 636+36.0 BK	0.6	0.00058	1.32	4.33	0.061	0.20
	7	13.5 442+74.7	2.0	0.00058	1.77	5.81	0.024	0.08
MODE	8	10.5 345+36.7	1.0	0.00058	1.77	5.81	0.040	0.13
	9	7.1 233+36.7	2.0	0.00058	1.77	5.81	0.024	0.08
	10	3.3 107+67.7	2.0	0.00058	1.77	5.81	0.024	0.08
	11	25.8 845+34.0	1.0	0.00058	1.77	5.81	0.024	0.08
	12	18.6 608+34.0	1.0	0.00058	1.85	6.06	0.024	0.08
BYPASS	13	11.9 390+46.0	1.0	0.00058	1.65	5.41	0.024	0.08
	14	6.0 195+96.0	1.0	0.00058	1.65	5.41	0.024	0.08
	15	0.03 1+11		Free flow 20-ft Parshall flume, $Q = 76.25H_a^{1.6}$				

1/ The values of control parameters K1 and K2, shown for check gate structures No. 2 through 10 (two gates each structure) assume one of the two gates will be operated to null controller error signal (single gate operation) if both gates operate simultaneously, (two-gate operation), the control parameters K1 and K2 must be reduced by a factor of 2.

The following notes are common to all controllers: 1. The gate deadband, GDB for all controllers, is 0.03 m (0.1 ft) for single gate operation and must be reduced by a factor of 2 for two-gate operation. 2. The filter time constant, TC for all controllers is 100 seconds. 3. The maximum discrete time interval,