PCWA-L-041

Placer County Water Agency

Power System: 24625 Harrison St. • Mail: P.O. Box 667 • Foresthill, California 95631
(530) 367-2291 (530) 885-6917 FAX (530) 367-4440

A Public Agency

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August 19, 2004

Mr. Takeshi Yamashita, Regional Engineer
FEDERAL ENERGY REGULATORY COMMISSION
901 Market Street, Suite 350
San Francisco, CA 94103

Re: FERC Project No. 2079-CA; NATDAM No. CA00856
Ralston Afterbay Dam, State of California No. 1030-4, Placer County

Dear Mr. Yamashita:

On the morning of August 5, 2004, during testing at Oxbow Powerhouse, there was a large release of water from Ralston Afterbay Reservoir due to the accidental opening of two of the five radial gates at Ralston Afterbay Dam. This release of water began at about 6:00 a.m. and continued until about 7:45 a.m. The testing was intentionally scheduled to occur before recreational activity was expected to pick up downstream. Using the original reservoir area-capacity table, the total amount of water released from the reservoir during this hour and three-quarters was about 1,406 AF. However, the present capacity of the reservoir is only about 60 percent of the original capacity due to the deposition of sediment in the reservoir over the last 38 years. As a result of the presence of this large amount of sediment, the actual amount of water released from the reservoir was probably a small percentage less than 1,400 AF.

As soon as project personnel became aware of the accidental release of most of the water in the reservoir, the Emergency Action Plan, Flowchart 3.C., "Non-Failure Emergency Condition at Ralston Afterbay Dam (Oxbow Dam)", was activated at 7:40 a.m. An Emergency Action Plan Call Log, totaling four pages, is enclosed. Emergency response agencies mobilized quickly and broadcasted flood warnings over the media. They effectively evacuated the river by utilizing helicopters with loudspeakers and personnel dispatched to the various access points along the river. There were no deaths, no one was hurt, and reported property damage has been minimal. Reported property damage has been one mining dredge, for which we have received a claim for $1900, and three aluminum boats.

Investigation and gathering of data began immediately after the incident on August 5. Enclosed is a copy of the chart from the gauging station located on the Middle Fork American River 1.6 miles downstream from the powerhouse, USGS No. 11433300, "Middle Fork American River Near Foresthill, CA,"; a copy of the single-sheet, handwritten summery prepared by the contract hydrographer; a copy of the every-fifteen-minute gauging station readings; a copy of the rating table up through the maximum flow that occurred at the gauging station on August 5; a copy of

Water Conservation Is A Moral Obligation

the California Department of Water Resources Data Exchange Center graph of flow at the gauging station which was printed out from their internet site; and an approximate graph of the flow at the gauging station versus time. As can be seen, the flow began increasing at the gauging station about 15 minutes after the gates began opening, and the flow peaked at 5,850 cfs at about 7:20 a.m. Flows receded to minimum instream flow requirement levels by approximately 10:15 a.m.

Also enclosed is a copy of the reservoir elevation chart and a graph of this chart which shows that the reservoir elevation slowly decreased from 1175.95 feet above sea level to 1175.60 at about 6:00 a.m. From there, over the next hour and three-quarters, the reservoir elevation dropped to 1154.63, although probably not in a straight line as is shown on the graph. Part of the data on the actual chart is not available due to the float hanging up in the float well. Immediately after one of the Operators manually closed radial gate No. 1, the last of the two gates to be closed, he measured the reservoir elevation with a Sounding Reel/Mechanical Counter reservoir gage attached to the upstream side of the dam. The elevation measured was 1154.63, at 7:50 a.m.

A copy of the SCADA alarm log from the master SCADA computer at Ralston Powerhouse is enclosed. This printout begins with a System Status Report at 1:04 a.m. on August 5. The time tags are about 14 minutes ahead of actual time. To aid in tracking the actual times, actual times have been handwritten to the right of a number of the actual events throughout the four pages of this printout. As can be seen, the action began with the two operators and one technician entering the powerhouse at 5:33:05 a.m. In reading the SCADA log, it will be noted that often several adjacent events have the same time tag. This is due to the fact that the SCADA remote terminal unit (RTU) at the powerhouse that captures the sensor data can only time-tag the alarms to the nearest second. As a result, adjacent events in the log that all have the same time tag have not necessarily occurred in the order in which they are listed. To determine the actual order, the electrical drawings must be reviewed to determine the control sequence, and the personnel who were doing the testing must be consulted.

In addition to considerable review by Placer County Water Agency Project personnel, on August 12, Kevin Goishi and Joe Minkstein of PG&E reviewed what happened with the two operators, the technician and me first at the powerhouse, then at the dam. PG&E is still investigating the incident and they have no findings available at this time. They will prepare and provide to us a report and they estimate it will be available in two to three weeks. We will send a copy to you at that time.

To assist in understanding the SCADA log, the following three summaries of key events taken from the SCADA log have been prepared and copies are enclosed:

- Electrical, Mechanical, Hydraulic and Operator Sequence of Events
- Radial Gate Timeline
- Oxbow Powerhouse Main Generator & Ralston Afterbay Dam Engine-Generator timeline

This data reveals that three black starts of the main generator were completed, after the generator was shutdown by the PG&E operator at Drum Switching Center via SCADA and released to our employees under the black start test clearance. Following these three black starts, the operator manually started the generator with the intent of synchronizing the generator to the line, which was eventually achieved, and releasing the generator back to the Drum operator. The operator reported that during the last two starts, the start that began at 7:01:41 and the start that began at 7:12:17 a.m., the generator had difficulty achieving synchronous speed. More governor speed level raises were required than are normally required. Unknown to the operators and the technician, the water head on the Francis turbine was significantly dropping as the reservoir dropped, which would require the wicket gates to be opened more than usual to bring the unit up to synchronous speed.

In the alarm log, it should be noted that when the station service bus was killed at 6:27:22 a.m., the unit did not automatically start under the black start feature. The technician reported that a defective 27X-2 feature cutout switch (no continuity) was discovered. He replaced the switch which corrected the problem. In addition, when the operator shutdown the unit at 7:08:56, SSB No. 1 automatically opened but SSB No. 2 did not automatically close. The technician reported that this was due to an intermittent bad contact in the Auto/Manual 43SS (Station Service) Control Switch that was corrected by exercising the switch several times. It appears that these problems, until corrected, also resulted in time delays between when the plant was put in the dark and the main generator started.

By examining the Radial Gate Timeline, it is evident that, unknown to the employees in the powerhouse, radial gates 1 & 4 operated various times during the testing. It appears radial gates 1 and 2 moved in the open direction about the time when station service was first transferred to the engine-generator at the dam. Only the radial gate limit switch positions are logged by SCADA. Therefore, we do not know when the radial gates were actually moving or what direction they were moving. In addition, we cannot tell how far they opened. All we know is that it appears both gates were moving up and then down several times before finally, at 6:43 going in the open direction. The radial gates require about 15 to 20 minutes to go full open. When the two operators arrived at the dam, gate No. 1 was full open and gate No. 2 was about 10 feet open. Therefore, gate No. 2 was not being continuously raised from the last limit switch "open" indication that was logged at 6:43:05 or the gate would have also been fully open when the operators arrived at the dam at 7:26:05.

The only piece of equipment that has been found damaged is the engine-generator transfer switch. This transfer switch was a three-phase Zenith Automatic Transfer Switch rated for 200 amps that had been in service for about 38 years. Along with control relays and circuitry, it contains two sets of three contactors for alternatively connecting the load to the normal supply, which is from the Oxbow Powerhouse Station Service bus, or the emergency supply, which is from the engine-generator at the dam. When the normal source of power to the dam is lost, the engine-generator automatically starts. Normally about 1 minute and 20 seconds after the engine-generator starts, the emergency operating solenoid is energized, causing the load to transfer to the engine-generator. As the transfer switch contact mechanism mechanically locks into the emergency position, it actuates a cutout switch which de-energizes the emergency operating solenoid. Approximately 1 minute and 36 seconds after the normal source of power is restored,

the transfer switch normal operating solenoid is actuated which causes the load to be switched to the normal supply. A cutout switch is then actuated, removing voltage from the normal coil, and the transfer switch is again locked mechanically in position. After a cool-down period, the engine-generator shuts itself down.

When the transfer switch was inspected the morning of August 5, after the two radial gates had been closed, both the emergency operating solenoid and the normal operating solenoid were found burned out. It does not appear they were burned out the first time power at the dam was switched to the engine-generator at 5:57:20 because, subsequently, an engine-generator "stop" indication was logged at 6:11:42 after station service transferred back to the main generator. The last engine-generator indication that was logged due to automatic operation of the engine-generator was a "start" at 6:27:30. It appears it was at this time that one or both of the operating coils burned out because no more engine-generator "stops" were logged. The normal source of power to the dam was supplied to the dam from 6:30:32 to 6:42:12, almost 12 minutes, but the engine-generator did not shut down. It should have shut down but it appears that it did not shut down because of the burned out operating coils. The engine-generator was found running when the operators arrived at the dam at about 7:26 a.m. and power from the engine-generator through the transfer switch contactor was used to manually close the radial gates to stop the flow of water from the dam.

The original engine-generator at the dam was replaced with a new engine-generator last year. However, the old transfer switch was not replaced with the new transfer switch that was received with the new engine-generator. The new engine-generator was connected to the old transfer switch and it was planned to replace the old transfer switch with the new transfer switch at some future time. The new switch was installed on August 5, 2004 to replace the failed transfer switch.

Since the evidence seems to be that the transfer switch operating coils did not burn out the first time they operated to switch power to the engine-generator, and since it appears that radial gates 1 and 4 hoist motors first operated the first time that power was switched to the engine-generator, the operating coils burning out did not cause the radial gates to come open. However, while the coil failure itself may not have caused the incident, it is possible that balky action of the switch could have created power transients or voltage spikes prior to actual failure of the coils and led to their eventual failure. In addition, a black start test was performed on July 29. The station service at Oxbow Powerhouse was killed, removing the normal source of power to the dam, the engine-generator started and the load at the dam was switched to the engine-generator, and no gates came open. Within the powerhouse, black start was not successful and it was planned, after a minor wiring change, to test it again, which was done on August 5th. Presently, we do not know why the gates came open on August 5th but did not come open on July 29. The Ralston Afterbay Dam engine-generator is started and run monthly.

During the black start test the PG&E Drum operator took no action on the SCADA indications based on the assumption that the powerhouse was cleared for local control for the black start testing. Once informed of the Ralston Afterbay problem by the PCWA operator at approximately 0730, Drum contacted the PG&E helicopter and arranged for a flyover of the downstream area. Based on emergency response agencies' air traffic in the area, the flight was

later recalled. Drum personnel also called to initiate an EAP notification at that time, but found out that PCWA had already initiated the EAP. During our meeting with the PG&E representatives on August 12, we learned there was some confusion regarding the limits of the clearance for the black start testing. It was obvious that both the Drum powerhouse operator and our operators understood that Oxbow Powerhouse was in the clearance boundaries and that, therefore, we were responsible for what happened at the powerhouse, but there was uncertainty, in reviewing what happened at the dam after the incident, concerning the division of responsibility between the Drum operator and the Project operators regarding monitoring the dam. To remedy this in the future, greater care will need to be exercised in defining clearance boundaries and clearly understanding who is going to watch what.

As can be seen from the SCADA log, the SCADA seems to have worked fine during the incident. Without the SCADA generated alarm log, our knowledge of what happened would probably be severely limited. The existing SCADA system is 16 years old and it is currently planned for replacement in 2007. Factors that contributed to the delayed response to the incident include the lack of indications in the Oxbow control room of spillgate operation and a full range reservoir elevation readout. The existing reservoir elevation readout is limited due to a ten foot operating range for the floatwell that drives the readout. Alternatively, if an operator had been stationed at Ralston Powerhouse during the testing, since a SCADA master computer is located at Ralston Powerhouse, the operator would have been able to read the SCADA log and see the radial gate limit switches go open, and the operator would have been able to monitor the reservoir level. The first logging of Afterbay Gate #1 open at 5:57:20 and Afterbay Gate #4 open at 5:57:22 would have alerted the operator to either check these two gates himself at the dam or call and have one of the operators at Oxbow Powerhouse check them. This should have allowed the incident to have been interrupted before any serious consequences resulted. Stationing an operator at the dam to monitor the engine-generator operation and to check the spillway periodically may also have allowed the incident to have been interrupted much earlier.

Enclosed is a four page statement titled, "Site Evaluation – Ralston Afterbay gate Sequencing Controller – August 10, 2004, that we received from Jerry Kelley of Sierra Control Systems, Inc. along with a table showing the readings on the morning of the incident on the front panel of each controller for all the various readings and parameters that are pertinent to each controller. In his statement, Mr. Kelley describes the connection and intended operation of the controllers and the testing and evaluation that was performed on site on August 10th While he found the equipment in good working order and could not replicate the malfunction, he speculates on a possible scenario that could potentially cause a controller to malfunction (a wildly fluctuating input voltage). Based on this hypothesis, he recommends the controller be DC powered or the addition of a uninterruptible power supply between the controller and the 117 volt AC supply. The controllers are 10 years old. We have no reason for suspecting that the age of the controllers played a role in the incident. One big question is why only gates 1 and 4 operated (they are connected to one controller when in "Float" mode), but gates 2 and 3 never operated (they are connected to the other controller when in "Float" mode). Under normal operating conditions, if the reservoir rises above 1177.11, the controller for gates 2 and 3 will operate first to begin slowly opening one gate, while monitoring both the actual reservoir elevation and the rate of rise of reservoir elevation. The controller for gates 1 and 4 will not operate unless the reservoir continues to rise and reaches 1177.61 feet.

If the problem is the controller, it is unknown at the present time why the controller for gates 1 and 4 operated but the controller for gates 2 and 3 did not. Additional testing to try and learn what happened is being planned. Pending the outcome of the additional testing, the gates and gate controllers have been placed on manual control and the circuit breakers on the AC circuits that supply the radial gate hoist motors have been opened and tagged. If there are any additional black start tests at Oxbow Powerhouse between the present time and when this investigation is completed and follow-up actions are implemented, the gate controllers will continue to be out-of-service, as described in the previous sentence, and a qualified employee will be stationed at the engine-generator building to monitor the operation of the engine-generator and transfer switch and to keep an eye on the dam and spillway.

A copy of the Tudor Engineering Company report, sent under cover of a letter dated August 6, 1973, and concerning a similar incident which occurred on August 20, 1971, is enclosed. Also included are a letter report dated December 9, 1971 from PG&E concerning this incident and a test report prepared by Tudor Engineering Company concerning tests which were performed on July 18, 1974. We have not found anything yet in this material that has shed any light on the August 5th incident.

As far as lessons learned and planned corrective measures, it is important to carefully look out beyond the location where testing and work is planned to any other locations where actions at the cleared site could have undesirable effects. For instance, in the future if testing is being performed at Oxbow Powerhouse, or a similar site, that could cause things to happen at another site, such as Ralston Afterbay Dam, it will be prudent to have a qualified person at the affected site to monitor that everything is happening in a normal manner.

A written operations manual is important for training and reference when planning work. When an unexpected event occurs, the training, knowledge, and experience of the involved personnel are the most important factor. In this situation, the personnel took the appropriate steps to control the incident once they realized what was occurring at the dam. The actions taken demonstrate that the personnel had the necessary training, knowledge and experience. The response to the incident was delayed, not because of uncertainty or inexperience, but due either to lack of instrumentation in the powerhouse to give personnel indications that something unexpected was happening, or the absence of an operator at either Ralston Powerhouse or at the dam.

Our operations personnel take PG&E sponsored training courses in basic electricity, powerhouse operation, print reading and safety. They also use commercially available training for operators and training modules that we have developed in-house. Our operators visit Ralston Afterbay Dam daily to check and make sure that everything is okay and routinely test equipment in accordance with industry practice.

Our environmental contractor, Jones and Stokes Associates, has spent about four days inspecting and collecting environmental data on the river downstream of the dam. In addition, we also have two years of pre-event environmental data for several sites both upstream and downstream that will be helpful in quantifying the impacts of this event. We should have a qualitative report

within 30 days and a more complete, quantitative report by the end of January, 2005 after Jones and Stokes collects BMI data in the Fall.

If you have any questions, please call me at (530) 885-6917.

Sincerely,

PLACER COUNTY WATER AGENCY

Stephen J. Jones
Power System Manager

Enclosure

cc: David Breninger
Edward Tiedemann
Kevin Goishi, PG&E
David A. Gutierrez

Ralston Afterbay Dam Sudden Radial Gate Opening - August 5, 2004
Emergency Action Plan Call Log

Time

7:30 a.m. Jones receives phone call from Fleming that radial gate #1 at Ralston Afterbay Dam is 100 % open and gate #4 is starting to open.

7:40 a.m. After questioning Fleming further and discussing briefly with Mattson, Jones activated the Emergency Action Plan, Flowchart 3.C., "Non-Failure Emergency condition at Ralston Afterbay Dam (Oxbow Dam)". Jones called 911 and reported the emergency condition to 911 operator, Wendy. Specifically, Jones reported that one radial gate at Ralston Afterbay Dam had opened all the way and another radial gate had opened part way, resulting in a sudden and rapidly increasing abnormal flow of water from the dam that would pose a serious hazard to anyone in or close to the river. Jones gave a rough estimate of a four to five foot leading-edge wave as the release flowed downstream and about three and one-half hours for the wave to reach the Highway 49 bridge at the confluence of the Middle Fork and the North Fork. Jones stressed the importance of finding and warning anyone on the river as soon as possible to move to a safe distance from the river.

7:43 a.m. Fleming called Jones and reported that radial gates #1 and #4 were closed.

7:45 a.m. Mattson called Drum Powerhouse to arrange for helicopter reconnaissance of the canyon. Drum was aware of gate problem, and would call Wise Powerhouse to contact Duke Holdcroft the pilot (it turns out, he was on another mission, and needed to go back and refuel).

7:50 a.m. Jones called local California State Fish & Game Warden Jim Randall, 530-367-2122, and got his answering machine. Jones left a message concerning what had happened and that the rapid release of water had entrained sediment in the water, creating a turbid condition.

7:51 a.m. Jones called Horseshoe Bar Mining Association, 530-367-5777. Call was answered by Bob Simons who reported no one was hurt in that area but that four aluminum boats had been washed away (one was later re-covered).

7:56 a.m. Jones called Nate Rangel's cell phone and left a message. Mr. Rangel represents the commercial rafting companies that use the Middle Fork American River. Jones left a message that Oxbow Powerhouse would not be able to run because of the unexpected gate opening and significant discharge of water, and that, therefore, rafting would not be possible that day.

7:57 a.m. Jones receives a call from Lisa Cary, Placer County Office of Emergency Services. Ms. Cary connects Jones with Dick Simons. Information is

exchanged and plans are confirmed. Mr. Simons reported that OES would call California State OES and report the incident.

8:00 a.m. Mattson talked to Mike Grima at California Department of Fish & Game Region 2 and notified him of the release.

8:02 a.m. Jones receives a call from Kevin Goishi, PG&E. Mr. Goishi asked if the contractor at the Auburn Pumps construction site had been notified. Jones replied, "No." Mr. Goishi said he would call Einar Maisch and let him know what had happened so Mr. Maisch could notify the contractor.

8:04 a.m. Jones called the Bureau of Reclamation Hydro System Controller and reported the gate opening and water release to Paul Beitz.

8:05 a.m. Wendy at 911 called Mattson and said deputies were headed toward Driver's Flat, Mammoth Bar, and the confluence of the Middle and North Forks.

8:05 a.m. Twice before 8:00 a.m., Jones had tried to call the PCWA General Manager's office but had got an answering machine. At 8:05 a.m., Darcy Granieri answered the phone and said she would have someone call Jones back.

8:08 a.m. General Manager Dave Breninger called Jones. There was discussion about where people might most likely be on the river and the need to focus on getting people out of harm's way.

8:10 a.m. Wendy, Sheriff's Department, called (530-886-5375). She reported that Sheriff's deputies, State Parks rangers and OES representatives were on their way to various known recreation areas along the river to notify people of the water release and get them a safe distance from the river.

8:15 a.m. Jones called John Scott, FERC Deputy Regional Engineer, and reported the incident and what had already been done. Mr. Scott asked several questions which Jones tried to answer.

8:27 a.m. Jones called State Safety of Dams and reported the incident to Ms. Rebecca Dominguez.

8:32 a.m. Jones called the State-Federal Flood Operations Center, but the phone line was busy.

8:39 a.m. Tim Dabney, US Forest Ranger, Georgetown District, called Jones to obtain information about the incident.

8:44 a.m. Richard Johnson, US Forest Ranger, Foresthill District, called Jones to offer help.

Ralston Afterbay Dam Sudden Radial Gate Opening - August 5, 2004
Emergency Action Plan Call Log

8:45 a.m. Mattson received call from Greg Armstrong from Nate Rangel's Rafting Organization (2nd in command); he gave phone numbers of 925-932-8993 ext 103, and 925-997-9999 cell. Reported 11 campers at Otter Creek on overnight trip – said they were experienced, and he didn't foresee a problem. He would call other rafting organizations to notify them of cancellation. Also said no need to post sign at Mosquito Ridge road – they would handle. He will call back after 1 pm today to see if rafting OK tomorrow.

8:49 a.m. Fish and Game warden Jim Randall called Jones. He had got the message Jones had left earlier. He was listening to the Sheriff's Department deputies over the emergency radio and he said they were expressing a lot of questions concerning the time the water would show up at various locations along the river, and how high the water would rise. He was also listening to the personnel in the CHP helicopter that was flying the river looking for people.

8:50 a.m. Frank Nann called Wise about Duke's helicopter location. Evans and Richardson reported Duke 15 minutes from Auburn, then would refuel and pick up Scott Bigley.

9:00 a.m. Kevin Goishi, PG&E, called. He said that PG&E had been reporting that 1,000 acre-feet had been released over a time span of one-half hour.

9:00 a.m. Jennifer Paget at Gold Hill District of Folsom Lake, Parks and Rec called Mattson and wanted to know any concerns. Mattson explained the situation to her, which relieved her concern (she was hearing all sorts of rumors).

~9:00 a.m. Mike Zumot, State Safety of Dams, called Mattson to get update, and said two of their people would be onsite soon. Wanted as many specifics as possible.

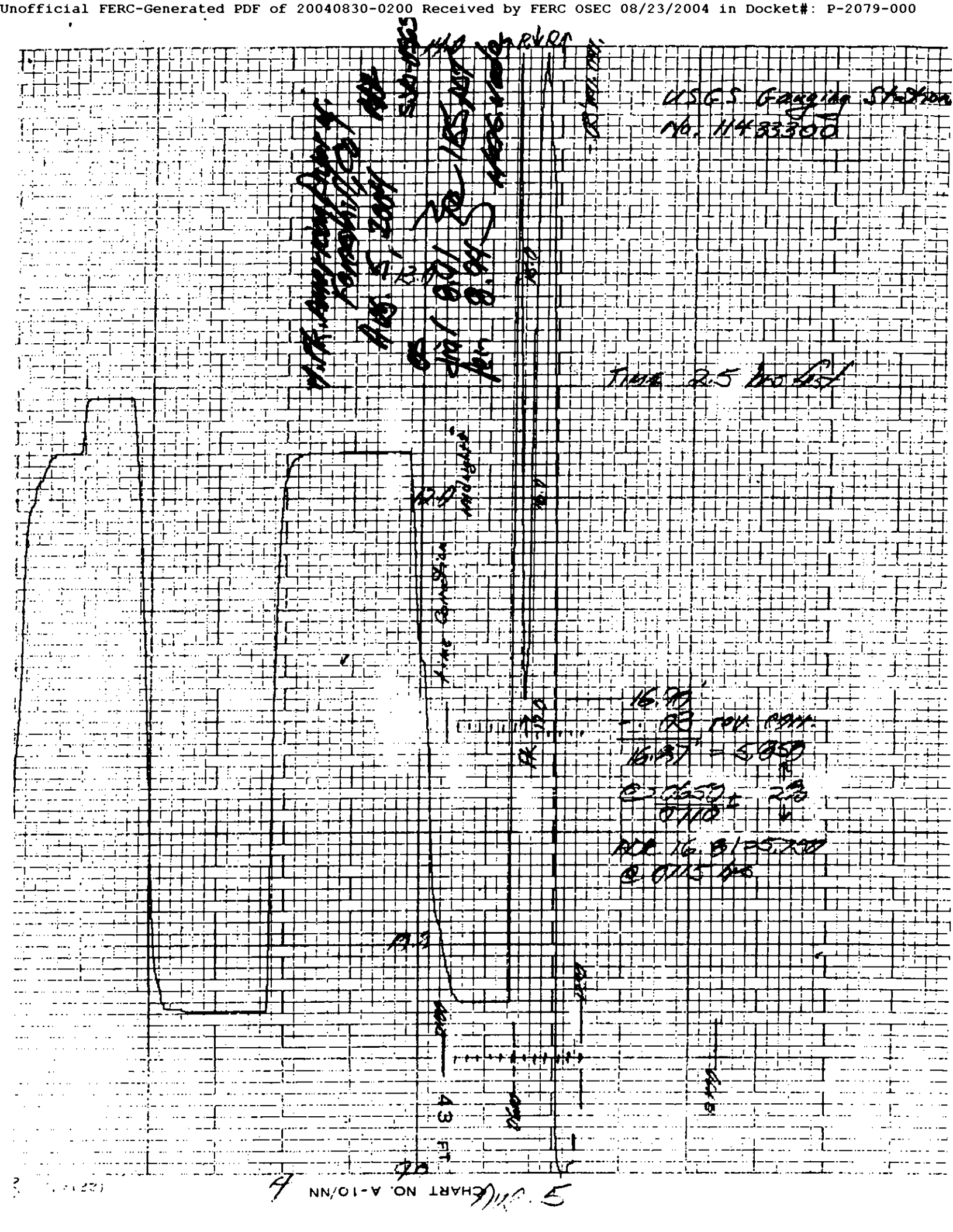
9:10 a.m. Mattson called Ken Amaral, PG&E Hydro Clerk, to cancel Duke's flight. A lot of helicopters already in canyon.

9:17 a.m. Jones began trying to call the State Water Rights Control Board (SWRCB) and the Regional Water Quality Control Board (RWQCB), but the phone numbers Jones had were either the wrong numbers or were no longer any good. Finally, Jones was able to call Ms. Sheila Penafiel (?) of the SWRCB and report the incident.

~9:30 a.m. Phil Scordelis of FERC called Mattson to report that he and John Onderdonk would be on site tomorrow at 9 am to review situation.

Ralston Afterbay Dam Sudden Radial Gate Opening - August 5, 2004
Emergency Action Plan Call Log

9:34 a.m. Jones called staff person at RWQCB, 916-464-3291, who said that California State OES routinely reports these kinds of incidents to both the SWRCB and the RWQCB.



211 [illegible] AMERICAN RIVER NEAR FORESTHILL, CA WY 2004

EDIT GAGE HEIGHTS

Date [illegible]

AM	:00	:15	:30	:45		:00	:15	:30	:45
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18	[illegible]	12.23	12.23	[illegible]	19	[illegible]	12.23	12.23	12.23
20	12.23	[illegible]	12.23	12.23	21	[illegible]	[illegible]	11.74	11.46
22	11.31	11.29	11.20	10.92	23	10.54	10.26	10.17	10.11

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EDIT GAGE HEIGHTS

Date [illegible]3/05/04

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06	[illegible]	9.77	13.91	14.96	07	15.93	16.81	16.7[illegible]	15.93
08	15.21	14.25	14.00	13.93	09	13.67	13.53	12.86	12.11
10	10.30	9.07	9.03	9.96	11	9.98	8.91	8.91	8.90
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Table 39 16.81 = 5,750 cfs

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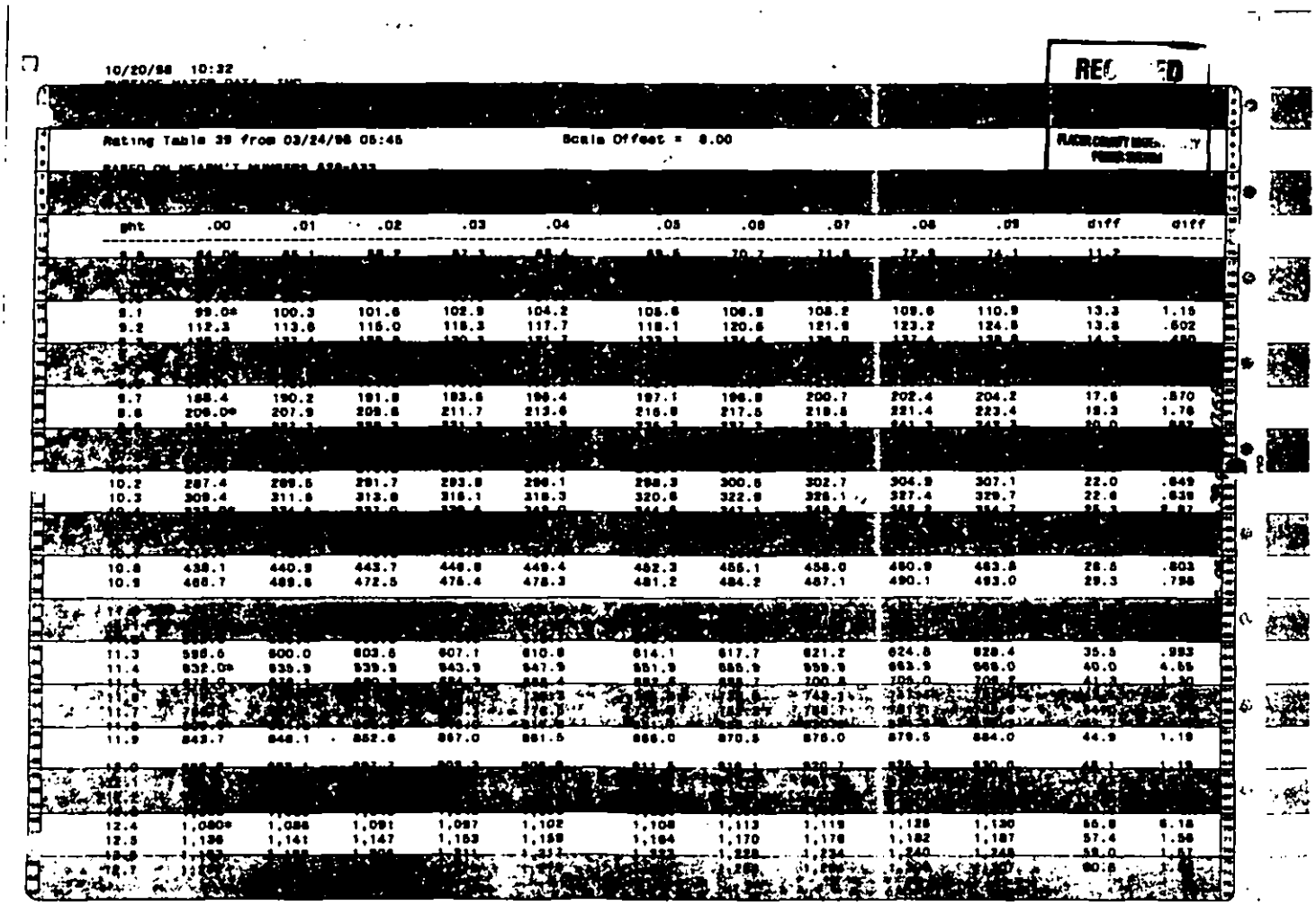


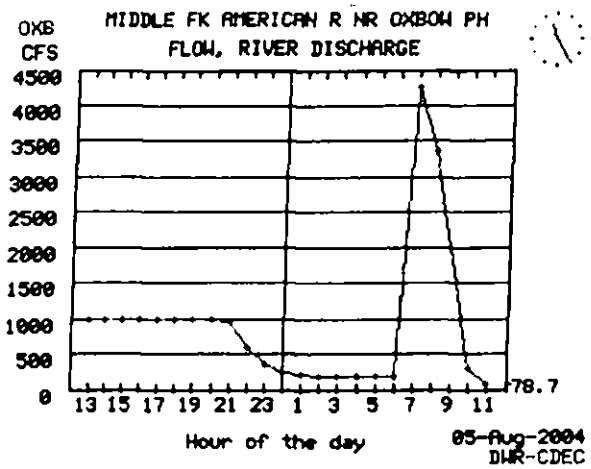
10/20/98 10:32

Rating Table 39 from 03/24/98 05:45 Scale Offset = 0.00

ght	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09	diff	diff
9.1	99.04	100.3	101.6	102.9	104.2	105.6	106.9	108.2	109.6	110.9	13.3	1.19
9.2	112.3	113.6	115.0	116.3	117.7	119.1	120.5	121.9	123.2	124.6	13.8	.502
9.7	188.4	190.2	191.8	193.6	195.4	197.1	198.8	200.7	202.4	204.2	17.8	.870
9.8	206.04	207.9	209.8	211.7	213.6	215.6	217.5	219.5	221.4	223.4	19.3	1.76
10.2	287.4	289.5	291.7	293.8	296.1	298.3	300.5	302.7	304.9	307.1	22.0	.849
10.3	309.4	311.6	313.8	316.1	318.3	320.6	322.9	325.1	327.4	329.7	22.6	.839
10.8	438.1	440.9	443.7	446.6	449.4	452.3	455.1	458.0	460.9	463.8	28.8	.803
10.9	466.7	469.6	472.5	475.4	478.3	481.2	484.2	487.1	490.1	493.0	29.3	.736
11.3	596.6	600.0	603.6	607.1	610.8	614.1	617.7	621.2	624.8	628.4	35.5	.993
11.4	632.04	635.9	639.9	643.9	647.9	651.9	655.9	659.9	663.9	668.0	40.0	4.55
11.9	843.7	848.1	852.6	857.0	861.5	866.0	870.5	875.0	879.5	884.0	44.9	1.19
12.4	1,080*	1,086	1,091	1,097	1,102	1,108	1,113	1,119	1,125	1,130	56.8	6.18
12.5	1,136	1,141	1,147	1,153	1,159	1,164	1,170	1,176	1,182	1,187	57.4	1.56

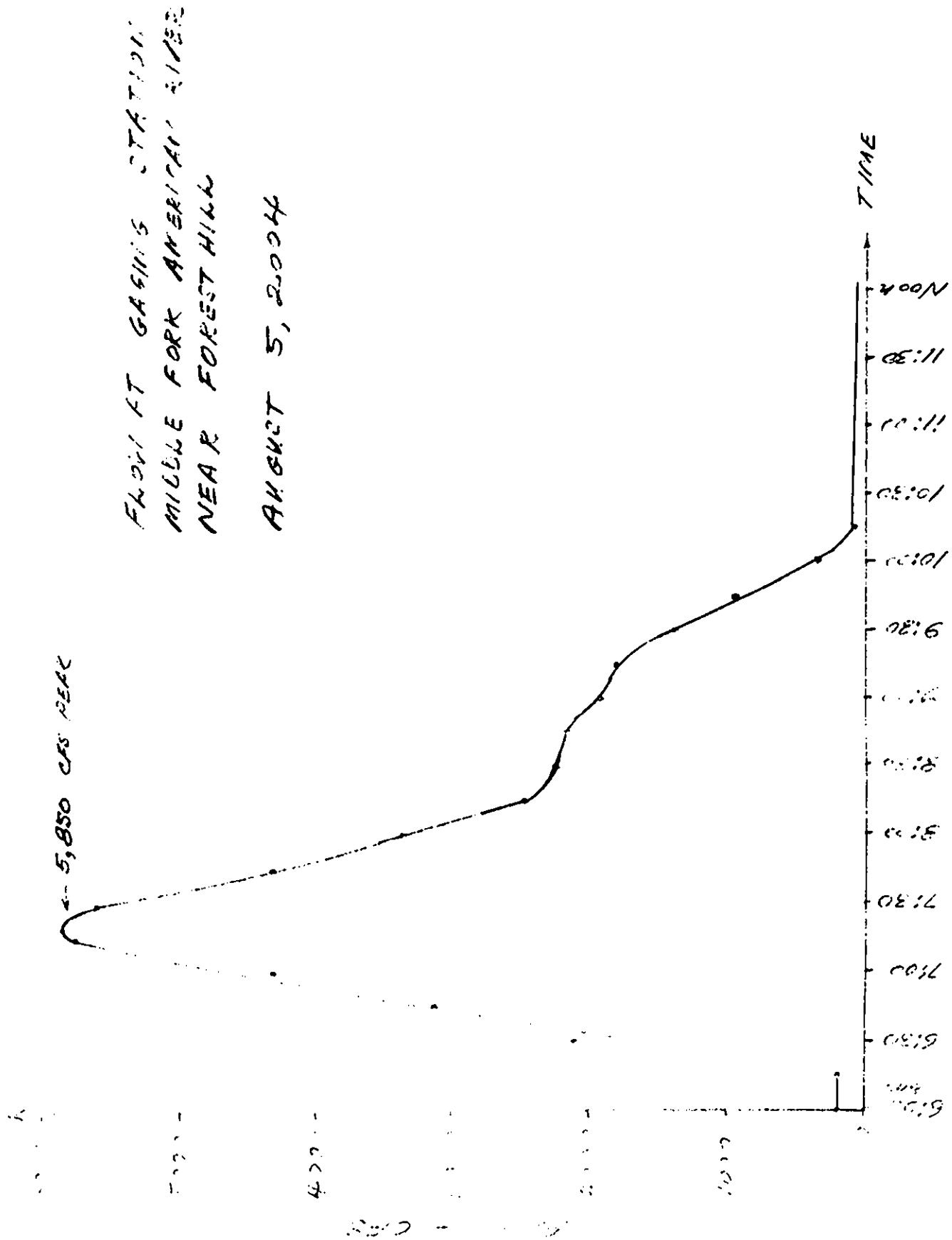
Station R11

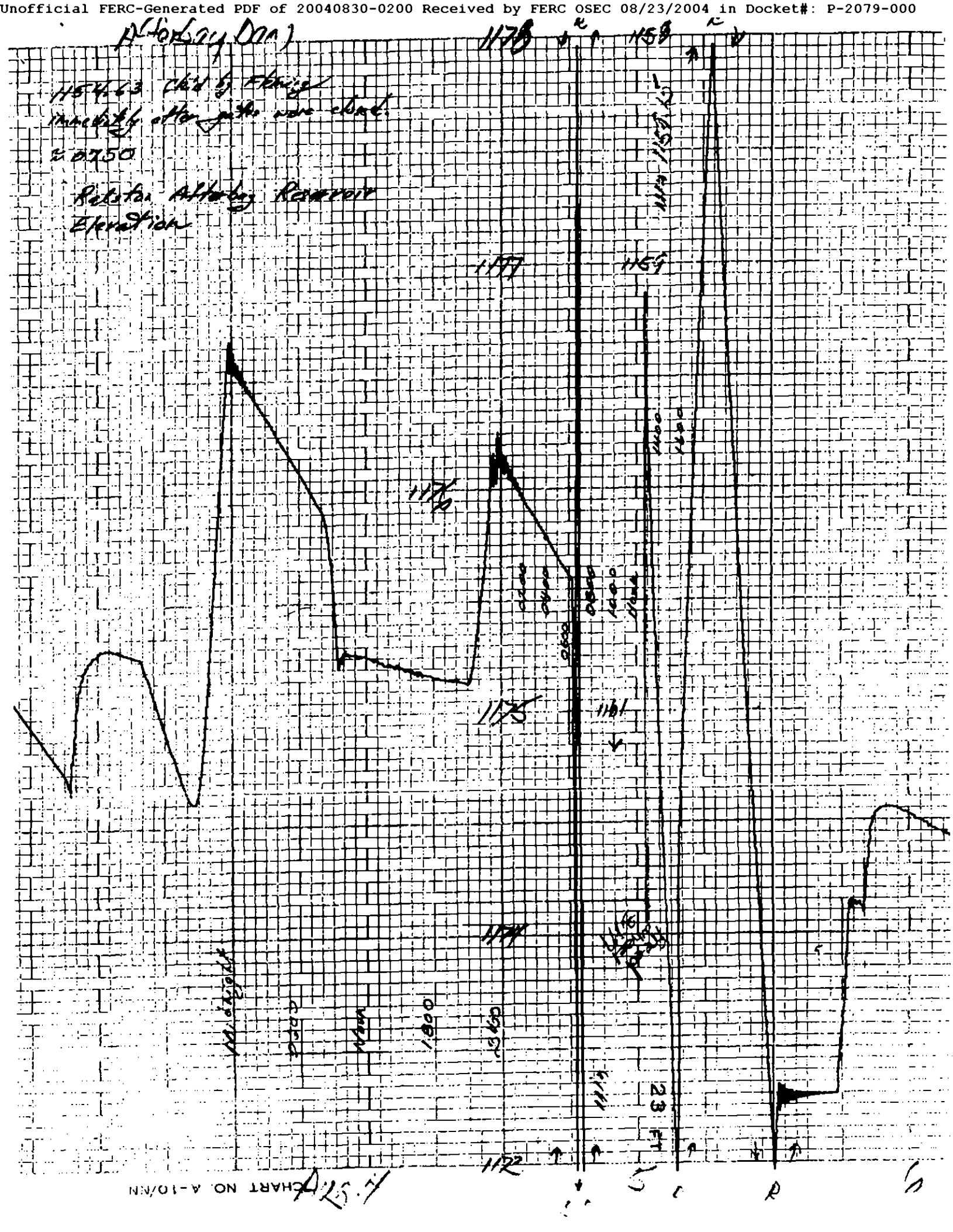
12.8	1,313	1,319	1,326	1,331	1,337	1,344	1,350	1,356	1,362	1,369	62.1	1.89
13.2	1,571	1,578	1,584	1,591	1,598	1,605	1,612	1,619	1,625	1,632	66.8	1.62
13.3	1,639	1,646	1,653	1,660	1,667	1,674	1,681	1,688	1,695	1,703	70.2	1.63
13.8	2,012	2,021	2,029	2,038	2,046	2,054	2,063	2,071	2,080	2,088	84.5	2.02
13.9	2,097	2,105	2,114	2,123	2,131	2,140	2,149	2,157	2,166	2,175	86.5	2.04
14.3	2,455	2,465	2,474	2,483	2,493	2,502	2,512	2,521	2,531	2,540	94.8	2.09
14.4	2,5804	2,589	2,599	2,608	2,618	2,627	2,637	2,646	2,656	2,665	95.0	.178
14.9	3,045	3,056	3,066	3,076	3,087	3,097	3,108	3,118	3,128	3,139	106.1	2.06
16.4	3,820	3,832	3,845	3,857	3,869	3,882	3,894	3,906	3,919	3,931	123.7	2.49
16.5	3,744	3,756	3,769	3,781	3,794	3,806	3,819	3,832	3,844	3,857	126.2	2.50
18.0	4,4004	4,416	4,431	4,447	4,463	4,478	4,494	4,510	4,526	4,542	157.5	21.2
16.8	5,224	5,242	5,259	5,276	5,294	5,312	5,329	5,347	5,366	5,382	176.6	3.76
16.8	5,4004	5,416	5,433	5,449	5,466	5,482	5,499	5,516	5,532	5,549	166.3	-10.7
17.0	6,080	6,097	6,116	6,133	6,150	6,168	6,186	6,204	6,221	6,239	177.7	3.16
17.1	6,267	6,278	6,293	6,311	6,329	6,347	6,365	6,384	6,402	6,420	180.8	3.17

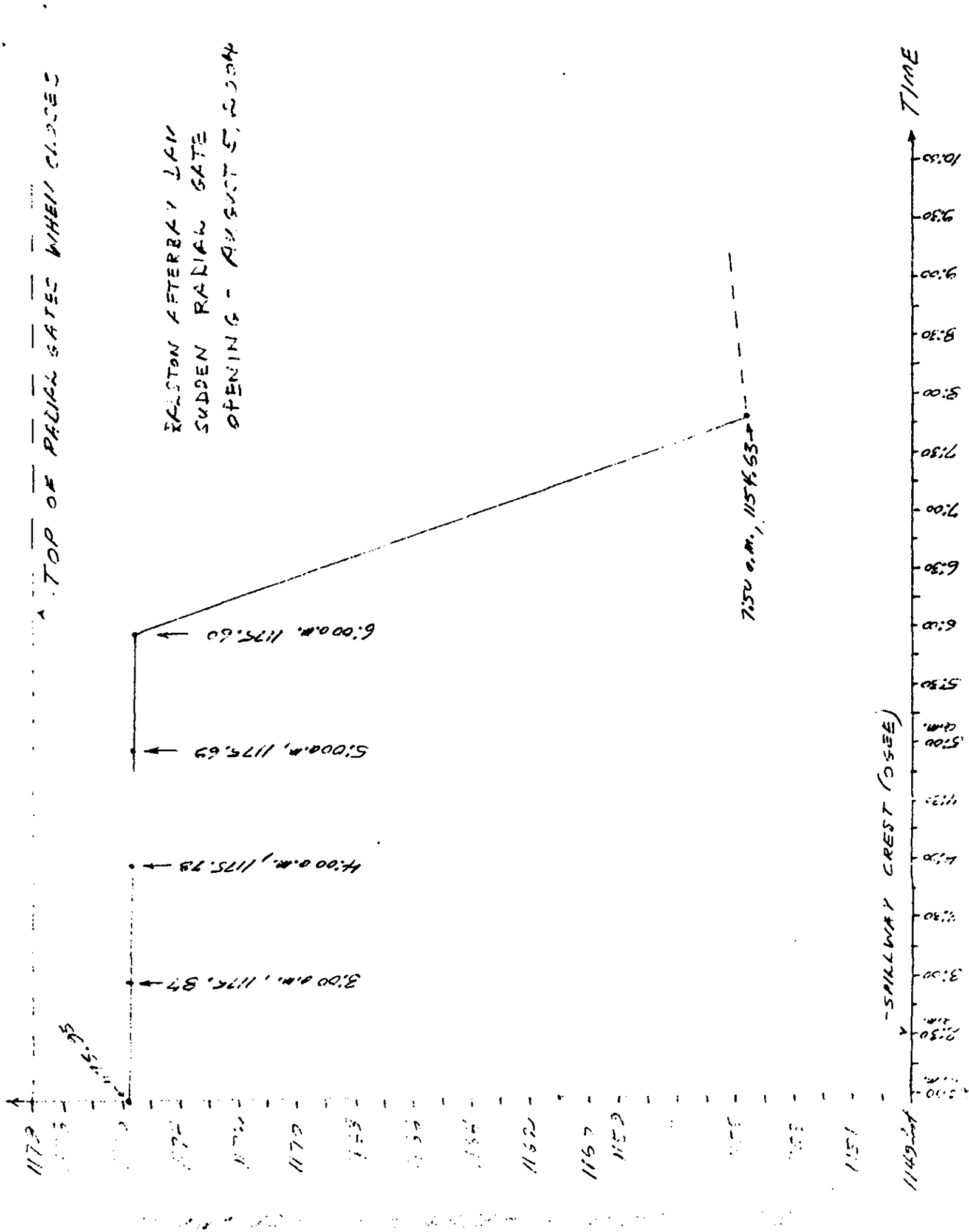


California Department of Water Resources

California Data Exchange Center







AUG5.4

08/05/04 | 00:01:04 SYSTEM STATUS REPORT - COMMUNICATION ALARMS DISABLED

FRENCH MEADOWS POWERHOUSE

GEN KWHR OUT:	199.8	GEN KWHR OUT METER:	83144.6
GEN KWHR IN:	5.2	GEN KWHR IN METER:	8522.4
SS#1 KWHR:	56.3	SS#1 KWHR METER:	45935.0

MIDDLEFORK POWERHOUSE

GEN #1 KWHR OUT:	877.5	GEN #1 KWHR OUT MET	43795.2
GEN #1 KWHR IN:	9.3	GEN #1 KWHR IN MET	4056.9
GEN #2 KWHR OUT:	921.2	GEN #2 KWHR OUT MET	55453.1
GEN #2 KWHR IN:	5.2	GEN #2 KWHR IN MET	3428.4
STA SERV #1 KWHR:	0.0	STA SERV #1 KWHR MET	40005.1
STA SERV #2 KWHR:	313.6	STA SERV #2 KWHR MET	64500.3
STA SERV #3 KWHR:	0.0	STA SERV #3 KWHR MET	24590.6

RALSTON POWERHOUSE

GEN KWHR OUT:	1091.6	GEN KWHR OUT MET	52973.8
GEN KWHR IN:	0.0	GEN KWHR IN MET	0.0
STA SERV #1 KWHR:	180.9	STA SERV #1 KWHR MET	89504.0
STA SERV #2 KWHR:	0.0	STA SERV #2 KWHR MET	0.0

OXBOW POWERHOUSE

GEN KWHR OUT:	79.2	GEN KWHR OUT METE	92127.1
GEN KWHR IN:	0.0*	GEN KWHR IN METE	0.0*
STA SERV #1 KWHR:	38.3	STA SERV #1 KWHR METE	97432.9
STA SERV #2 KWHR:	0.0	STA SERV #2 KWHR METE	14000.0

FRENCH MEADOWS POWERHOUSE RTU ACCUMULATORS

GEN OUT	2284.6
GEN IN	692.4
SS#1	145.0

MIDDLEFORK POWERHOUSE RTU ACCUMULATORS

GEN #1 OUT	6402.2
GEN #1 IN	184.9
GEN #2 OUT	1872.1
GEN #2 IN	162.4
STA SERV #1	187.1
STA SERV #2	15.3
STA SERV #3	3669.6

RALSTON POWERHOUSE RTU ACCUMULATORS

GEN OUT	534.8
GEN IN	0.0
STA SERV #1	59.0
STA SERV #2	0.0

OXBOW POWERHOUSE RTU ACCUMULATORS

GEN OUT	364.1
GEN IN	
STA SERV #1	12.9
STA SERV #2	0.0

08/05/04	05:47:05 OXBOW PH DOOR OPEN/CLOSE	OPEN	5:33:05
08/05/04	05:52:42 OXBOW SS#1 BREAKER STATUS	OPEN	
08/05/04	05:52:42 OXBOW SS#2 BREAKER STATUS	CLOSED	
08/05/04	05:52:42 OXBOW GENERATOR ON/OFF	STOPPED	5:38:05
08/05/04	05:52:42 OXBOW TURBINE GATE POSITION	CLOSED	
08/05/04	05:52:42 OXBOW OCB42 OPEN/CLOSED	OPEN	
08/05/04	05:52:45 OX VOLT ADJ POS	NORMAL	
08/05/04	06:07:45 OXBOW TRANSFER SWITCH LOC/REM	LOCAL	5:53:45
08/05/04	06:09:55 OXBOW SS#2 BREAKER STATUS	OPEN	5:55:55
08/05/04	06:09:55 OXBOW CB 42 ANNUNCIATOR ALARM	ALARM	
08/05/04	06:10:03 OXBOW STA SRV BUS UNDERVOLTAGE	ALARM	
08/05/04	06:10:03 OXBOW ENGINE GENERATOR	RUNNING	5:56:03
08/05/04	06:10:08 OXBOW ANNUNCIATOR NORM/ALARM	ALARM	

08/05/04	06:11:20	OXBOW	AFTERBAY GATE #1	OPEN
08/05/04	06:11:22	OXBOW	AFTERBAY GATE #4	OPEN
08/05/04	06:11:47	OXBOW	MAIN FAN FAILURE	ALARM
08/05/04	06:13:20	OXBOW	STAT BATT UNDRVOLTAGE	ALARM
08/05/04	06:19:39	OXBOW	GENERATOR ON/OFF	RUNNING
08/05/04	06:19:39	OXBOW	TRANSFER SWITCH LOC/REM	REMOTE
08/05/04	06:19:43	OXBOW	TURBINE GATE POSITION	OPEN
08/05/04	06:20:07	OXBOW	TURBINE GATE POSITION	CLOSED
08/05/04	06:20:18	OXBOW	MAIN FAN FAILURE	NORMAL
08/05/04	06:20:18	OXBOW	SS#1 BREAKER STATUS	CLOSED
08/05/04	06:20:18	OXBOW	STA SRV BUS UNDERVOLTAGE	NORMAL
08/05/04	06:20:18	OXBOW	CB 42 ANNUNCIATOR ALARM	NORMAL
08/05/04	06:20:18	OXBOW	WATER LEVEL CHANNEL FAIL	MULTIPLE STATUS CHANGES
08/05/04	06:20:18	OXBOW	WATER LEVEL CHANNEL FAIL	NORMAL
08/05/04	06:20:20	OXBOW	GOV STNDBY OIL PMP OPRTD	ALARM
08/05/04	06:20:20	OXBOW	TURBINE GATE POSITION	OPEN
08/05/04	06:20:37	OXBOW	GOV STNDBY OIL PMP OPRTD	NORMAL
08/05/04	06:21:26	OXBOW	OCB42 OPEN/CLOSED	CLOSED 06:07:26
08/05/04	06:22:27	OXBOW	TRANSFER SWITCH LOC/REM	LOCAL
08/05/04	06:22:40	OXBOW	SS#1 BREAKER STATUS	OPEN
08/05/04	06:22:40	OXBOW	SS#2 BREAKER STATUS	CLOSED
08/05/04	06:22:40	OXBOW	GENERATOR ON/OFF	STOPPED 06:09:40
08/05/04	06:22:40	OXBOW	TURBINE GATE POSITION	CLOSED
08/05/04	06:22:40	OXBOW	OCB42 OPEN/CLOSED	OPEN
08/05/04	06:25:42	OXBOW	ENGINE GENERATOR	STOPPED 06:11:42
08/05/04	06:27:14	OXBOW	STAT BATT UNDRVOLTAGE	NORMAL
08/05/04	06:27:56	OXBOW	ANNUNCIATOR NORM/ALARM	NORMAL
08/05/04	06:33:37	OXBOW	AFTERBAY GATE #4	CLOSED 06:19:37
08/05/04	06:33:49	OXBOW	AFTERBAY GATE #4	OPEN 06:19:49
08/05/04	06:41:22	OXBOW	SS#2 BREAKER STATUS	OPEN 05:27:22
08/05/04	06:41:22	OXBOW	STA XFMR #2 UNDERVOLTAGE	MULTIPLE STATUS CHANGES
08/05/04	06:41:22	OXBOW	STA XFMR #2 UNDERVOLTAGE	NORMAL
08/05/04	06:41:22	OXBOW	CB 42 ANNUNCIATOR ALARM	ALARM
08/05/04	06:41:22	OXBOW	AFTERBAY GATE #1	CLOSED
08/05/04	06:41:22	OXBOW	AFTERBAY GATE #4	CLOSED
08/05/04	06:41:30	OXBOW	STA SRV BUS UNDERVOLTAGE	ALARM
08/05/04	06:41:30	OXBOW	ENGINE GENERATOR	RUNNING 06:27:30
08/05/04	06:41:35	OXBOW	ANNUNCIATOR NORM/ALARM	ALARM
08/05/04	06:42:49	OXBOW	MAIN FAN FAILURE	ALARM
08/05/04	06:43:08	OXBOW	AFTERBAY ANNUNCIATOR	ALARM
08/05/04	06:43:27	OXBOW	AFTERBAY GATE #1	OPEN 06:29:27
08/05/04	06:43:27	OXBOW	AFTERBAY GATE #4	OPEN
08/05/04	06:43:30	OXBOW	MAIN FAN FAILURE	NORMAL
08/05/04	06:43:30	OXBOW	SS#2 BREAKER STATUS	CLOSED 06:29:30
08/05/04	06:43:30	OXBOW	STA SRV BUS UNDERVOLTAGE	NORMAL
08/05/04	06:43:30	OXBOW	CB 42 ANNUNCIATOR ALARM	NORMAL
08/05/04	06:43:43	OXBOW	AFTERBAY GATE #1	CLOSED 06:29:43
08/05/04	06:43:43	OXBOW	AFTERBAY GATE #4	CLOSED
08/05/04	06:43:45	OXBOW	WATER LEVEL CHANNEL FAIL	ALARM
08/05/04	06:44:29	OXBOW	SS#2 BREAKER STATUS	OPEN 06:30:29
08/05/04	06:44:29	OXBOW	CB 42 ANNUNCIATOR ALARM	ALARM
08/05/04	06:44:29	OXBOW	WATER LEVEL CHANNEL FAIL	NORMAL
08/05/04	06:44:32	OXBOW	SS#2 BREAKER STATUS	CLOSED 06:30:32
08/05/04	06:44:32	OXBOW	CB 42 ANNUNCIATOR ALARM	NORMAL
08/05/04	06:44:32	OXBOW	WATER LEVEL CHANNEL FAIL	ALARM
08/05/04	06:46:05	OXBOW	AFTERBAY GATE #1	OPEN 06:32:05
08/05/04	06:46:05	OXBOW	AFTERBAY GATE #4	OPEN
08/05/04	06:46:05	OXBOW	WATER LEVEL CHANNEL FAIL	NORMAL
08/05/04	06:46:46	OXBOW	ANNUNCIATOR NORM/ALARM	NORMAL
08/05/04	06:53:57	OXBOW	STA XFMR #2 UNDERVOLTAGE	ALARM
08/05/04	06:54:04	OXBOW	STA XFMR #2 UNDERVOLTAGE	NORMAL
08/05/04	06:54:11	OXBOW	STA XFMR #2 UNDERVOLTAGE	ALARM
08/05/04	06:54:17	OXBOW	STA XFMR #2 UNDERVOLTAGE	NORMAL

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08/05/04	06:54:27	OXBOW STA XFMR #2 UNDERVOLTAGE	ALARM	
08/05/04	06:54:29	OXBOW STA XFMR #2 UNDERVOLTAGE	MULTIPLE	STATUS CHANGES
08/05/04	06:54:29	OXBOW STA XFMR #2 UNDERVOLTAGE	NORMAL	
08/05/04	06:54:31	OXBOW STA XFMR #2 UNDERVOLTAGE	MULTIPLE	STATUS CHANGES
08/05/04	06:54:31	OXBOW STA XFMR #2 UNDERVOLTAGE	ALARM	
08/05/04	06:56:06	OXBOW TRANSFER SWITCH LOC/REM	REMOTE	06:42:06
08/05/04	06:56:12	OXBOW SS#2 BREAKER STATUS	OPEN	06:42:12
08/05/04	06:56:12	OXBOW CB 42 ANNUNCIATOR ALARM	ALARM	
08/05/04	06:56:12	OXBOW AFTERBAY GATE #1	CLOSED	06:42:12
08/05/04	06:56:12	OXBOW AFTERBAY GATE #4	CLOSED	
08/05/04	06:56:20	OXBOW STA SRV BUS UNDERVOLTAGE	ALARM	
08/05/04	06:56:25	OXBOW ANNUNCIATOR NORM/ALARM	ALARM	
08/05/04	06:57:05	OXBOW AFTERBAY GATE #1	OPEN	06:43:26
08/05/04	06:57:05	OXBOW AFTERBAY GATE #4	OPEN	
08/05/04	06:57:56	OXBOW MAIN FAN FAILURE	ALARM	
08/05/04	06:58:21	OXBOW GENERATOR ON/OFF	RUNNING	06:44:21
08/05/04	06:58:24	OXBOW TURBINE GATE POSITION	OPEN	
08/05/04	06:59:08	OXBOW MAIN FAN FAILURE	NORMAL	
08/05/04	06:59:08	OXBOW SS#1 BREAKER STATUS	CLOSED	06:45:04
08/05/04	06:59:08	OXBOW STA SRV BUS UNDERVOLTAGE	NORMAL	
08/05/04	06:59:08	OXBOW CB 42 ANNUNCIATOR ALARM	NORMAL	
08/05/04	06:59:08	OXBOW WATER LEVEL CHANNEL FAIL	ALARM	
08/05/04	06:59:12	OXBOW WATER LEVEL CHANNEL FAIL	NORMAL	
08/05/04	07:00:16	OXBOW OCB42 OPEN/CLOSED	CLOSED	06:46:16
08/05/04	07:01:08	OXBOW STA XFMR #2 UNDERVOLTAGE	NORMAL	
08/05/04	07:01:27	OXBOW TRANSFER SWITCH LOC/REM	LOCAL	06:47:27
08/05/04	07:01:31	OXBOW SS#1 BREAKER STATUS	OPEN	06:47:31
08/05/04	07:01:31	OXBOW SS#2 BREAKER STATUS	CLOSED	
08/05/04	07:01:31	OXBOW GENERATOR ON/OFF	STOPPED	
08/05/04	07:01:31	OXBOW TURBINE GATE POSITION	CLOSED	
08/05/04	07:01:31	OXBOW OCB42 OPEN/CLOSED	OPEN	
08/05/04	07:03:27	OXBOW ANNUNCIATOR NORM/ALARM	NORMAL	
08/05/04	07:05:40	OXBOW TRANSFER SWITCH LOC/REM	REMOTE	06:51:27
08/05/04	07:13:41	OXBOW SS#2 BREAKER STATUS	OPEN	06:59:41
08/05/04	07:13:41	OXBOW STA XFMR #2 UNDERVOLTAGE	ALARM	
08/05/04	07:13:41	OXBOW CB 42 ANNUNCIATOR ALARM	ALARM	
08/05/04	07:13:49	OXBOW STA SRV BUS UNDERVOLTAGE	ALARM	
08/05/04	07:13:54	OXBOW ANNUNCIATOR NORM/ALARM	ALARM	
08/05/04	07:14:42	OXBOW COOLING WATER AUTO STRAI	ALARM	
08/05/04	07:15:09	OXBOW MAIN FAN FAILURE	ALARM	
08/05/04	07:15:41	OXBOW GENERATOR ON/OFF	RUNNING	07:01:41
08/05/04	07:15:44	OXBOW TURBINE GATE POSITION	OPEN	
08/05/04	07:16:28	OXBOW MAIN FAN FAILURE	NORMAL	
08/05/04	07:16:28	OXBOW COOLING WATER AUTO STRAI	NORMAL	
08/05/04	07:16:28	OXBOW SS#1 BREAKER STATUS	CLOSED	07:02:28
08/05/04	07:16:28	OXBOW STA SRV BUS UNDERVOLTAGE	NORMAL	
08/05/04	07:16:28	OXBOW CB 42 ANNUNCIATOR ALARM	NORMAL	
08/05/04	07:16:28	OXBOW WATER LEVEL CHANNEL FAIL	ALARM	
08/05/04	07:16:31	OXBOW WATER LEVEL CHANNEL FAIL	NORMAL	
08/05/04	07:17:58	OXBOW ANNUNCIATOR NORM/ALARM	NORMAL	
08/05/04	07:20:30	OXBOW TRANSFER SWITCH LOC/REM	LOCAL	07:06:30
08/05/04	07:21:14	OXBOW OCB42 OPEN/CLOSED	CLOSED	07:07:14
08/05/04	07:21:28	OXBOW WEARING RING AUTO STRAIN	ALARM	
08/05/04	07:21:35	OXBOW WEARING RING AUTO STRAIN	NORMAL	
08/05/04	07:21:59	OXBOW TRANSFER SWITCH LOC/REM	REMOTE	07:07:59
08/05/04	07:22:53	OXBOW TRANSFER SWITCH LOC/REM	LOCAL	07:08:53
08/05/04	07:22:56	OXBOW SS#1 BREAKER STATUS	OPEN	07:08:56
08/05/04	07:22:56	OXBOW CB 42 ANNUNCIATOR ALARM	ALARM	
08/05/04	07:22:56	OXBOW GENERATOR ON/OFF	STOPPED	
08/05/04	07:22:56	OXBOW TURBINE GATE POSITION	CLOSED	
08/05/04	07:22:56	OXBOW OCB42 OPEN/CLOSED	OPEN	
08/05/04	07:23:05	OXBOW STA SRV BUS UNDERVOLTAGE	ALARM	
08/05/04	07:23:09	OXBOW ANNUNCIATOR NORM/ALARM	ALARM	

AUG5.4

08/05/04	07:23:48	OXBOW SS#2 BREAKER STATUS	CLOSED	07:09:14
08/05/04	07:23:48	OXBOW STA XFMR #2 UNDERVOLTAGE	NORMAL	
08/05/04	07:23:48	OXBOW STA SRV BUS UNDERVOLTAGE	NORMAL	
08/05/04	07:23:48	OXBOW CB 42 ANNUNCIATOR ALARM	NORMAL	
08/05/04	07:24:13	OXBOW ANNUNCIATOR NORM/ALARM	NORMAL	
08/05/04	07:24:32	OXBOW WEARING RING AUTO STRAIN	ALARM	
08/05/04	07:24:40	OXBOW WEARING RING AUTO STRAIN	NORMAL	
08/05/04	07:26:17	OXBOW GENERATOR ON/OFF	RUNNING	07:12:17
08/05/04	07:26:20	OXBOW TURBINE GATE POSITION	OPEN	
08/05/04	07:26:28	OXBOW TRANSFER SWITCH LOC/REM	REMOTE	07:12:28
08/05/04	07:31:35	OXBOW TRANSFER SWITCH LOC/REM	LOCAL	07:17:35
08/05/04	07:32:47	OXBOW SS#1 BREAKER STATUS	CLOSED	
08/05/04	07:32:47	OXBOW SS#2 BREAKER STATUS	OPEN	07:18:47
08/05/04	07:32:47	OXBOW OCB42 OPEN/CLOSED	CLOSED	
08/05/04	07:33:05	OXBOW INTAKE GATE TRIP ALARM	ALARM	07:19:05
08/05/04	07:33:05	OXBOW ANNUNCIATOR NORM/ALARM	ALARM	
08/05/04	07:33:14	OXBOW INTAKE GATE NORMAL/SLIP	SLIP	
08/05/04	07:33:17	OXBOW INTAKE GATE NORMAL/SLIP	NORMAL	
08/05/04	07:33:35	OXBOW GENERATOR ON/OFF	STOPPED	07:19:55
08/05/04	07:33:35	OXBOW TURBINE GATE POSITION	CLOSED	
08/05/04	07:34:00	OXBOW SS#1 BREAKER STATUS	OPEN	07:20:00
08/05/04	07:34:00	OXBOW SS#2 BREAKER STATUS	CLOSED	
08/05/04	07:34:00	OXBOW OCB42 OPEN/CLOSED	OPEN	
08/05/04	07:40:05	AFTERBAY DOOR ALARM	OPEN	07:26:05
08/05/04	07:48:35	OXBOW AFTERBAY GATE #4	CLOSED	07:34:35
08/05/04	07:50:31	OXBOW WEARING RING LO WTR FLOW	ALARM	
08/05/04	07:56:30	OXBOW AFTERBAY GATE #1	CLOSED	07:42:30
08/05/04	08:14:36	MF #2 NEEDLE POS	OPEN	
08/05/04	08:15:22	MF #1 NEEDLE POS	OPEN	
08/05/04	08:17:52	OXBOW WATER LEVEL CHANNEL FAIL	ALARM	
08/05/04	08:17:59	OXBOW ENGINE GENERATOR	STOPPED	08:03:59
08/05/04	08:33:09	OXBOW ENGINE GENERATOR	RUNNING	08:19:09
08/05/04	08:34:12	OXBOW ENGINE GENERATOR	STOPPED	08:20:12
08/05/04	08:53:45	RA NEEDLE POS	OPEN	
08/05/04	09:27:24	RA LOAD CONTROL	FLOAT	
08/05/04	09:27:40	MF2 VOLT ADJUST	NORMAL	
08/05/04	09:29:19	MF1 VOLT ADJUST	NORMAL	
08/05/04	09:30:10	MF1 VOLT ADJUST	ABOVE	
08/05/04	09:31:34	FM TURBINE GATE POSITION	OPEN	
08/05/04	09:32:40	MF2 VOLT ADJUST	ABOVE	
08/05/04	09:51:15	MF INTERBAY DOOR POS	OPEN	
08/05/04	10:15:03	MF INTERBAY DOOR POS	CLOSED	
08/05/04	10:51:36	RA PH DOOR POS	OPEN	
08/05/04	11:04:07	R3 FR MEADOWS STREAM LOW FLOW	NORMAL	
08/05/04	11:04:07	R3 FLOW ALARMS	NORMAL	
08/05/04	11:04:09	R3 FR MEADOWS STREAM FLOW	5.04 NORMAL	
08/05/04	11:14:06	R-11 GAGING STATION	9.01 LO	9.01
08/05/04	12:13:20	OXBOW WEARING RING LO WTR FLOW	NORMAL	
08/05/04	12:32:38	OXBOW WATER LEVEL CHANNEL FAIL	NORMAL	
08/05/04	12:38:53	OX ANN RESET CTRL		
08/05/04	12:38:56	OXBOW ANNUNCIATOR NORM/ALARM	NORMAL	
08/05/04	13:21:50	FM POWERHOUSE DOOR POSITION	OPEN	
08/05/04	13:29:27	OXBOW INTAKE GATE TRIP ALARM	NORMAL	
08/05/04	13:33:24	OXBOW INTAKE GATE NORMAL/SLIP	SLIP	
08/05/04	13:33:34	OXBOW INTAKE GATE NORMAL/SLIP	NORMAL	
08/05/04	13:46:13	OXBOW AFTERBAY GATE #1	OPEN	
08/05/04	13:46:46	OXBOW AFTERBAY GATE #1	CLOSED	
08/05/04	13:56:26	OXBOW TRANSFER SWITCH LOC/REM	REMOTE	
08/05/04	13:58:21	OXBOW PH DOOR OPEN/CLOSE	CLOSED	
08/05/04	14:03:53	OXBOW WATER LEVEL CHANNEL FAIL	ALARM	
08/05/04	14:06:38	FM POWERHOUSE DOOR POSITION	CLOSED	

Ralston Afterbay Dam Sudden Radial Gate Opening - August 5, 2004
Electrical, Mechanical, Hydraulic and Operator Sequence of Events

Time

5:33:05 a.m. Fleming, Houchell and Nypl enter Oxbow Powerhouse to test Black Start.

5:38:42 a.m. Oxbow generator shutdown by Drum Powerhouse Operator. The station service supply switched from the generator, through a 4160 volt to 208 volt transformer, to the 60 KV transmission line, through a 60 KV to 208 volt transformer. This station service supply switch occurs automatically *with station service breaker No. 1 opening and station service breaker No.* 2 closing.

5:53:45 a.m. Operator switches Manual/Automatic Transfer Switch Device 43/CS from Remote to Local

5:55:55 a.m. Station Service breaker No. 2 was manually opened, killing the station service, to create the conditions which would call for a black start of the generator. This also killed the normal source of power to the dam.

5:56:03 a.m. The emergency engine-generator at the dam started.

5:57:20 a.m. Radial gate No. 1 limit switch "gate open" indication occurred 1 minute and 17 *seconds after the engine-generator started, which time was most likely* when the engine-generator transfer switch at the dam automatically switched from the normal source of power to the engine-generator.

5:57:22 a.m. Radial gate No. 4 limit switch "gate open" indication was logged by SCADA.

6:05:39 a.m. Operator switches Manual/Automatic Transfer Switch Device 43/CS from Local to Remote and the Oxbow generator automatically starts under black start conditions (the main generator will not start with Device 43/CS *in Local).*

6:06:18 a.m. Station Service Breaker (SSB) No. 1 closes, energizing the station service bus

6:07:26 a.m. Generator breaker closes, connecting the generator to the 60 KV transmission line through the step-up transformer.

6:08:27 a.m. Operator switches Manual/Automatic Transfer Switch Device 43/CS from Remote to Local.

6:08:40 a.m. Operator turns the Start/Stop Control Switch Device 1/CS to "Stop", initiating shutdown of the main generator, which causes SSB No. 1 to open, SSB No. 2 to close.

Ralston Afterbay Dam Sudden Radial Gate Opening - August 5, 2004
Electrical, Mechanical, Hydraulic and Operator Sequence of Events

6:11:42 a.m. Emergency engine-generator at the dam "stop" indication logged by SCADA. After normal power is restored at the dam, the engine-generator transfer switch will wait about 1 minute, 36 seconds before switching back to the normal power and initiating engine-generator shutdown. The engine-generator will then come to a stop about 3 minutes, 45 seconds later.

6:19:37 a.m. Radial gate No. 4 limit switch "close" indication received, indicating that the radial gate is closed.

6:19:49 a.m. Radial gate No. 4 limit switch "open" indication received, indicating that the radial gate is open. This indication does not reveal if the hoist motor is operating and continuing to increase the radial gate opening.

6:27:22 a.m. SSB No. 2 is opened, killing the station service bus to simulate black start conditions. Radial gates 1 and 4 limit switch "close" indication received.

6:27:30 a.m. Emergency Engine Generator at the dam starts.

6:29:27 a.m. Radial gates 1 and 4 limit switch "open" indication received one minute and 57 seconds after the engine-generator starts.

6:29:30 a.m. SSB No. 2 is closed, re-energizing the station service bus.

6:29:43 a.m. Radial gates 1 and 4 limit switch "close" indication received.

6:30:29 a.m. SSB No. 2 opened, de-energizing the station service bus.

6:30:32 a.m. SSB No. 2 closed, energizing the station service bus.

6:32:05 a.m. Radial gates 1 and 4 limit switch "open" indication received.

6:42:06 a.m. Operator switches Manual/Automatic Transfer Switch Device 43/CS from Local to Remote.

6:42:12 a.m. SSB No. 2 opened, de-energizing the station service bus, simulating a black start condition. Radial gates 1 and 4 limit switch "closed" indication received.

6:43:05 a.m. Radial gates 1 and 4 limit switch "open" indication received.

6:44:21 a.m. Oxbow generator successfully starts under black start condition.

6:45:08 a.m. SSB No. 1 closes, energizing the station service bus.

6:46:16 a.m. Oxbow generator synchronizes to the line and main breaker closes.

Ralston Afterbay Dam Sudden Radial Gate Opening - August 5, 2004
Electrical, Mechanical, Hydraulic and Operator Sequence of Events

6:47:27 a.m. Operator switches Manual/Automatic Transfer Switch Device 43/CS from Remote to Local.

6:47:31 a.m. Operator turns the Start/Stop Control Switch Device 1/CS to "Stop", initiating shutdown of the main generator. SSB No. 1 opens and SSB No. 2 closes.

6:51:27 a.m. Operator switches Manual/Automatic Transfer Switch Device 43/CS from Local to Remote.

6:59:41 a.m. SSB No. 2 opened, de-energizing the station service bus, simulating a "black start" condition.

7:01:41 a.m. Oxbow generator automatically starts under black start condition.

7:02:28 a.m. SSB No. 1 closes, energizing the station service bus.

7:06:30 a.m. Operator switches Manual/Automatic Transfer Switch Device 43/CS from Remote to Local.

7:07:14 a.m. Oxbow generator main breaker closes.

7:07:59 a.m. Operator switches Manual/Automatic Transfer Switch Device 43/CS from Local to Remote.

7:08:53 a.m. Operator switches Manual/Automatic Transfer Switch Device 43/CS from Remote to Local.

7:08:56 a.m. Operator turns the Start/Stop Control Switch Device 1/CS to "Stop", initiating shutdown of the main generator. SSB No. 1 opens but SSB No. 2 does not close.

7:09:48 a.m. SSB No. 2 closes.

7:12:17 a.m. Operator turns the Start/Stop Control Switch Device 1/CS to "Start". Oxbow generator starts.

7:12:28 a.m. Operator switches Manual/Automatic Transfer Switch Device 43/CS from Local to Remote.

7:17:35 a.m. Operator switches Manual/Automatic Transfer Switch Device 43/CS from Remote to Local.

7:18:47 a.m. SSB No. 1 closes, SSB No. 2 opens and generator main breaker closes.

7:19:05 a.m. Oxbow tunnel intake gate trip alarm received.

Ralston Afterbay Dam Sudden Radial Gate Opening - August 5, 2004
Electrical, Mechanical, Hydraulic and Operator Sequence of Events

7:19:35 a.m. Operator turns the Start/Stop Control Switch Device 1/CS to "Stop", initiating shutdown. Oxbow generator begins shutting down.

7:20:00 a.m. SSB No. 1 opens and SSB No. 2 closes.

7:26:05 a.m. Fleming and Hounchell arrive at dam and open door to building containing the radial gate float controllers. Float control transfer switch turned from float mode to manual mode which disconnects the float controllers from the radial gate control circuit. Hounchell them ran to radial gate No. 4 control panel and Fleming ran to radial gate No. 1 control panel. They opened the radial gate control cabinets and manually closed the gates by holding the close button closed. Since the outdoor phone is located at the radial gate No. 1 control panel, Fleming called Jones to report the incident while the gate was closing.

7:34:35 a.m. Radial gate No. 4 limit switch "close" indication received.

7:42:30 a.m. Radial gate No. 1 limit switch "close" indication received.

8:03:59 a.m. Dam engine-generator stopped signal received.

8:19:09 a.m. Dam engine-generator running signal received.

8:20:12 a.m. Dam engine-generator stopped signal received.

Ralston Afterbay Dam Sudden Radial Gate Opening - August 5, 2004
Radial Gate Timeline

Time

5:57:20 a.m. Radial gate No. 1 limit switch "gate open" indication.

5:57:22 a.m. Radial gate No. 4 limit switch "gate open" indication.

(Gate No. 4 – 22 minutes, 15 seconds)

6:19:37 a.m. Radial gate No. 4 limit switch "close" indication received, indicating that the radial gate is closed.

(Gate No. 4 – 12 seconds)

6:19:49 a.m. Radial gate No. 4 limit switch "open" indication received, indicating that the radial gate is open. This indication does not reveal if the hoist motor is operating and continuing to increase the radial gate opening.

(Gate 1 – 30 min, 2 sec. Gate 2 – 7 min, 33 sec.)

6:27:22 a.m. Radial gates 1 and 4 limit switch "close" indication received.

(2 min, 5 sec.)

6:29:27 a.m. Radial gates 1 and 4 limit switch "open" indication received.

(16 sec.)

6:29:43 a.m. Radial gates 1 and 4 limit switch "close" indication received.

(2 min, 22 sec.)

6:32:05 a.m. Radial gates 1 and 4 limit switch "open" indication received.

(10 min, 7 sec.)

6:42:12 a.m. Radial gates 1 and 4 limit switch "closed" indication received.

(53 sec.)

6:43:05 a.m. Radial gates 1 and 4 limit switch "open" indication received.

(43 minutes)

7:26:05 a.m. Fleming and Hounchell arrive at dam and open door to building containing the radial gate float controllers. Float control transfer switch turned from float mode to manual mode which disconnects the float controllers from the radial gate control circuit.

Ralston Afterbay Dam Sudden Radial Gate Opening - August 5, 2004
Radial Gate Timeline

(Gate 4 – about 8 minutes (only open 10 feet))

7:34:35 a.m. Radial gate No. 4 limit switch "close" indication received.

(Gate 1 – about 16 minutes, (open all the way))

7:42:30 a.m. Radial gate No. 1 limit switch "close" indication received.

Ralston Afterbay Dam Sudden Radial Gate Opening - August 5, 2004
Oxbow Powerhouse Main Generator Timeline
Ralston Afterbay Dam Engine-Generator Timeline

5:38:42 a.m. Oxbow generator shutdown by Drum Powerhouse Operator.

5:55:55 a.m. Station Service breaker No. 2 was manually opened, simulating a black start condition.

5:56:03 a.m. *The emergency engine-generator at the dam started.*

6:05:39 a.m. Oxbow generator starts under black start conditions.

6:08:40 a.m. Operator turns the Start/Stop Control Switch Device 1/CS to "Stop", initiating shutdown of the main generator.

6:11:42 a.m. *Emergency engine-generator at the dam "stop" indication logged by SCADA.*

6:27:22 a.m. SSB No. 2 is opened, killing the station service bus to simulate black start conditions.

6:27:30 a.m. *Emergency Engine Generator at the dam starts.*

6:42:12 a.m. SSB No. 2 opened, de-energizing the station service bus, simulating a black start condition.

6:44:21 a.m. Oxbow generator starts under black start condition.

6:47:31 a.m. Operator turns the Start/Stop Control Switch Device 1/CS to "Stop", initiating shutdown of the main generator.

6:59:41 a.m. SSB No. 2 opened, de-energizing the station service bus, simulating a "black start" condition.

7:01:41 a.m. Oxbow generator starts under black start condition.

7:08:56 a.m. Operator turns the Start/Stop Control Switch Device 1/CS to "Stop", initiating shutdown of the main generator.

7:12:17 a.m. Operator turns the Start/Stop Control Switch Device 1/CS to "Start". Oxbow generator starts.

7:19:05 a.m. Oxbow tunnel intake gate trip alarm received.

7:19:35 a.m. Operator turns the Start/Stop Control Switch Device 1/CS to "Stop", initiating shutdown. Oxbow generator begins shutting down.

8:03:59 a.m. *Dam engine-generator stopped signal received as a result of engine-generator being manually shutdown.*

Site Evaluation
Ralston Afterbay Gate Sequencing Controller
August 10, 2004

OVERVIEW

At the request of Placer County Water Agency (PCWA), Sierra Control Systems, Inc. performed an on-site evaluation of the two Model 6532 Gate Sequencing Controllers in service at the Ralston Afterbay Dam on August 10, 2004. The evaluation was requested in response to an incident that occurred on August 5, 2004, during which gates #1 and #4 automatically opened and released a large amount of water downstream. Sierra Control Systems, Inc. was the manufacturer of the gate controllers, which were delivered to PCWA in the spring of 1994 and have been in service ever since. The intent of the evaluation was to determine what caused the gates to open and to identify any equipment problems that may have resulted in the control system malfunction.

RALSTON AFTERBAY CONTROL SYSTEM DESCRIPTION

Four radial gates, located along the top of the Ralston Afterbay Dam are automatically operated by two Model 6532 controllers. Controller A automatically raises(opens) and lowers(closes) gates 2 & 3 as necessary to maintain the afterbay level at the setpoint designated by the operator. In a like manner, Controller B controls the operation of gates 1 & 4. For the Ralston Afterbay installation the controller setpoints are adjusted to a level much higher than the normal level of the afterbay such that automatic open commands are generated only during unusually high water (flood) situations.

A single board computer is installed in each controller to control all monitoring and control functions. Salient features of the controller are noted as follows.

- A PID (Proportional, Integral, Differential) control algorithm is employed which calculates the need for a command (level < setpoint = close command; level > setpoint = open command). If a command is required, an open(close) contact closure is activated for a timed period. This open(close) command causes the gate to move in the appropriate direction.
- Only one of the four output contact closures is allowed to be active at any one time. In other words, Controller B can open gate 1 or gate 4, but not both at the same time. Neither can it open one gate and close the other simultaneously.
- Once a command has been issued, a time interval, defined by the reset period setting of the controller (600 seconds for Controllers A and B), must elapse before any output is re-enabled.
- Prior to issuing a gate raise/lower command the controller compares the position of each gate. If the gate positions differ by more than an

adjustable setting, the gate selected for the impending open/close command is the one that will reduce the gate position difference. This gate sequencing control scheme keeps both gates at roughly the same position.

- If the setpoint is much higher than the a-bay level (normal condition) close commands are regularly issued at periodic intervals to the appropriate gate until it is completely closed (gate position = 0.0 % open). Once the gate is full closed the periodic close commands cease.

EVALUATION FINDINGS

A Sierra Control Systems, Inc. engineer, Jerry Kelley, and the PCWA lead technician, Frank Nann, spent approximately 6 hours on site evaluating the performance of the Model 6532 controllers. All controller operator-adjustable settings were verified to be the same as those recorded at the time of the water release incident. Care was taken to make no component substitutions in an attempt to replicate the exact configuration that was in place at the time of the incident.

Testing was aided by having two identical controllers (A & B) in place – both receiving the same digital water level input. The output responses of both controllers could be tested and compared. It was assumed that if a controller did exhibit a problem, it would be controller B because gates 1 & 4 were the ones that had opened during the incident. All tests were conducted with the gate motor actuators de-energized to prevent any actual gate movement.

The setpoints for the controllers were modified and proper controller outputs were verified. Test devices were installed in place of the actual gate position sensors, and proper gate sequencing was verified. Tests were repeated with the site operating on generator power to simulate the conditions at the time of the incident, and no abnormalities could be found.

At one point in the testing it appeared that controller B was not issuing close commands at the interval expected. Further investigation raised the possibility of intermittent operation of one of the output driver ICs (integrated circuit) of the single board computer at which point the Single Board Computer for controller B was replaced. Later in testing, however, controller B (with the new computer board) again only issued close commands on an irregular basis. The condition was then observed on controller A. The once-promising lead turned out to be a normal condition. The gate position sensing circuitry has a little "ripple" on the signal input. Whenever the gate indicated greater than 0.0% - i.e. 0.1% - the close command output was enabled. Otherwise it was disabled. This false-lead example is presented to indicate the extent to which all features of the controller were tested, verified and properly explained.

The bottom line for the day's testing is that no controller malfunction of any sort was observed during the evaluation. It should be noted that while the controllers appear to be functioning properly, we could only approximate the conditions the day of the incident. We tested that the controllers output relay contact closures operated properly. We could not verify that the gate actuator electro-mechanical components all functioned as expected due to the procedural restrictions on gate movement at the time.

DISCUSSION & RECOMMENDATIONS

Using the available information (SCADA alarm summary printout) for reconstructing the sequence of events it is difficult to derive a hypothesis as to why gates #1 and #4 opened. It is also difficult to explain why gate #2 and #3 did not exhibit the same characteristics as gates #1 and #4. A review of the SCADA log does show, however, that during the time period of the incident there were numerous electrical system alarms: ENGINE GENERATOR RUNNING, STAT BATT UNDRVOLTAGE, STA SRV BUS UNDERVOLTAGE, STA XFMR #2 UNDERVOLTAGE MULTIPLE STATUS CHANGES, SS#1 BREAKER STATUS, SS#2 BREAKER STATUS. Also, at the time of the incident the automatic transfer switch failed. It appears that there is sufficient evidence to suggest that there were some severe voltage transients on the 120 VAC power to Controllers A and B.

As stated previously, the program of the Single Board Computer prevents more that one output from being active at any one time. Yet the SCADA logs show in more than one instance that gates 1 & 4 apparently opened at the same or nearly the same time. A scenario that could possibly explain the condition is that the Single Board Computer program was not running at the time of the incident. The computer card may have "locked up" in a manner similar to that which occurs to a desktop PC.

A wildly fluctuating input voltage could have caused the Single Board Computer to operationally fail. The Single Board Computer circuit is equipped with a watchdog reset circuit which will reboot the card and restart the program in the event of a failure. It does take time (less than 3 seconds), however, to recognize a failure and reboot. During that time interval the status of the output relays is indeterminate. Possibly, for a short time both open relays (as well as close relays) could have been energized. Testing would have to be conducted to determine if such a condition could trigger a sustained open command in the external circuitry. Possibly an abnormal combination of gate open/close relays could open up high current paths that would be difficult to break with a set of contacts once normal relay status is restored.

To sustain this scenario we need to explain why Controller A did not exhibit the same response. Possibly its power supply is more resistant to input voltage

fluctuations, and it did not lock up. Maybe its watchdog circuit is faster at restoring normal operation. Another explanation is that it would be possible for Controller A to lock up while its output relays remained off (the circuitry of the Single Board Computer is set up so that the outputs have to be enabled by program activity, but that feature cannot accommodate the infinite number of failure possibilities). Finally, maybe both Controllers operated identically throughout the incident, and the gate actuator circuitry connected to each controller responded differently.

The preceding discussion centered on the hypothesis that the sequence of events of the incident was triggered by fluctuating voltages. Future testing may provide additional information that would be helpful in analyzing the situation. As the manufacturer of the controllers, however, Sierra Control Systems, Inc. recommends that both controllers be powered by either an Uninterruptible Power Supply (UPS) or directly from the 48vdc station battery to stabilize the controller input power and thus minimize/eliminate the possibility of future program execution failure.

RALSTON AFTERBAY DAM
Radial Gate Controllers
Selector Switch Settings

Selector Switch Setting	Function	Setting for Gates 2 & 3 Controller	Setting for Gates 1 & 4 Controller
0	Reservoir forebay elevation, feet	n/a	n/a
1	Setpoint (reservoir elevation controller will seek to maintain), feet	1177.11	1177.61
2	Gates 2 & 1 response times, respectively, seconds	41.8	39
3	Deadband, feet	0.15	0.15
4	Reset period, seconds (The time interval between successvie control actions.)	603	601
5	Gates 2 & 1 maximum run times, respectively, seconds (the duration of a control action)	30	30
6	Low level alarm, feet	1173.02	1174.3
7	High level alarm, feet	1176.01	1176.01
8	Last command length, seconds	30	30
9	Average water level	1171.24	1171.23
10	Next command countdown	countdown	countdown
11	Blank		
12	Gates 3 & 4 response times, respectively, seconds	42	41
13	Active gate	1	1
14	Malfunction code	0	0
15	Gates 3 & 4 maximum run times, respectively, seconds	30	30
16	Gates 2 & 1 positions, respectively	0.3	0.3
17	Gates 3 &4 positions, respectively	0.3	0.3
18	Gate difference	0.2	0.2
19	Difference setpoint, percent	12.5	10.5

TUDOR ENGINEERING COMPANY
CONSULTING ENGINEERS AND PLANNERS
149 NEW MONTGOMERY STREET
SAN FRANCISCO, CALIFORNIA 94105
TELEPHONE (415) 982-8338 CABLE "TENGCO"

Mr. E. J. Tiedemann
Kronick, Moskovitz, Tiedemann & Girard
Attorneys at Law
555 Capitol Mall, Suite 855
Sacramento, California 95814

August 6, 1973

File: 513.10

Subject: Placer County Water Agency
Spillway Gate Incident - August 20, 1971

Dear Mr. Tiedemann:

Transmitted herewith is our report which investigates and determines the cause for the gate opening which resulted in the incident of August 20, 1971. The corrective action which was taken by the Placer County Water Agency's staff after the incident will prevent similar erroneous actions.

This report is being provided to you in partial fulfillment of our agreement with Placer County Water Agency dated August 12, 1972. This report along with a report entitled "Engineering Analysis of the Spillway Gates-Ralston Afterbay Dam -Middle Fork Interbay Dam," August 1973, fulfills our agreement.

If you wish further explanation or clarification of any aspect of this report, or the other report, please do not hesitate to call upon us.

Very truly yours,

TUDOR ENGINEERING COMPANY

Carl W. Otto

C. W. Otto

CWO/DCW/aj

RALSTON AFTERBAY GATE OPENING

1. Introduction: On August 20th, 1971 approximately at 8:15 p.m. a fault developed on the transmission line that carries power away from the Middle Fork of the American River Project. This incident was immediately brought to the attention of the Agency's staff in Foresthill, since power was also interrupted there. Oxbow Power Plant relayed off the line and shutdown. As a result of this shutdown the emergency generator located at the Ralston Afterbay Dam on the right abutment started automatically after its normal start-up delay. Upon restoration of power spillway gates 1 and 2 at the Ralson Afterbay dam raised to a fully opened position. The water level about 1.7 miles downstream of Ralston Afterbay dam at the gaging station-Middle Fork of the American River at Foresthill rose from about 7.2 to 11.85 feet on the gage scale in approximately one-half hour period. The water level information was obtained from a print of the recorder's chart at the gaging station, and is shown on plate 1. The flow of water at the gaging station over the same period increased from approximately 1,100 to 8,690 cubic feet per second. A gate open alarm was sounded at Ralston Powerhouse and an operator traveled from the powerhouse to the Ralston Afterbay Dam to close the gates. This report describes the investigation that was conducted to determine the cause of the incident and recommends corrective action to be taken so that the incident cannot be repeated.

2. Analysis of Problem: The incident regarding the opening of the Ralston Afterbay Gates No. 1 and 2 was the result of several almost unrealted events. The first being that the water level recorders which provide the signal to raise or lower the gates were wired to move the indicator to the upper end of the scale on power failure. All recorders have been rewired since August 20, 1971, to achieve a downward operation. The second event was that the timers for the Gates No. 1 and 2 had been placed manually in the zero time position. This is borne out by a notation in the daily operation log written by the first man to reach the dam after the opening. The setting of the timers in the zero position has been a normal procedure when it was decided to operate the gates manually. The third event was the failure of Oxbow Powerhouse to supply power to the Dam. The fourth event is the inherent warm up time delay of the tube type recorder.

A. Conditions prior to power failure (see Plate 2), were as follows:

(1) Gates 3 and 4 were out of service.

(2) Controller set points were above the recorder elevation indication.

(3) Transfer switches for Gates 1 and 2 were in "Float" position.

(4) Relay RL/I was energized because timer T2 was manually at zero.

(5) Relay TX/I and TX/L were energized because of (2.) above.

(6) Relay AX/L was energized.

(7) Contactor L was not energized because gates were closed and limit switch LS-L was open.

B. The sequence of events which occurred after failure of the primary source of power is as follows:

(1) Power failed all relays become de-energized and recorder cools sending indicator to high end of scale.

(2) The engine generator starter turns over the engine until the engine starts.

(3) Engine generator comes to speed and voltage and transfer switch applies voltage to controls. (See Plate 3).

(4) Relay RL/I is energized since timer T2 is de-energized.

(5) Relay TX/R is energized since recorder is at high end of scale above controller set point.

(6) Relay TX/I is energized after its short time delay. (The purpose of this relay is to prevent energizing of the circuit as the result of reservoir wave action).

(7) As a result of RL/I, TX/R and TX/I being energized relay AX/R becomes energized causing the gate to start opening.

(8) When the recorder warmed up sufficiently the indicator traveled down rapidly (4 seconds full travel) to pass the controller set point and home in on the reservoir level.

(9) When passing through the set point relay TX/R drops out to initiate the drop out of relay AX/R and contactor R (See Plate 4). Before the AX/R relay is open, relays TX/L and AX/L are energized to re-energize relay AX/R and contactor R. The contactor R blocking contact prevents the energizing of contactor L.

C. The above sequence of events was simulated by turning off the power to the recorder, waiting for it to cool and then restoring power. The condition of relay AX/L, AX/R and contactor R being energized after restoration of power occurred in several instances.

The R seal-in contact at the starter was the disconnected and the same conditions were again simulated. The same conditions with relays AX/L, AX/R and contactor R being energized occurred.

D. As a result of the field investigative work, changes were made in the wiring by the Agency's operating staff since the incident of August 20, 1971. The changes made are:

(1) The seal in contacts for the R and L contactors have been disconnected.

(2) The seal in contacts of relays AX/R and AX/L have been disconnected.

(3) The recorders have been reconnected so that they would cause the gates to move downward.

3. Recommended corrective action: It should be emphasized that the changes in wiring have been made so that the incident of August 20, 1971 cannot occur again. No additional corrective action is necessary to prevent a future incident as described herein. We commend the Agency's staff for their analysis and action on this problem.

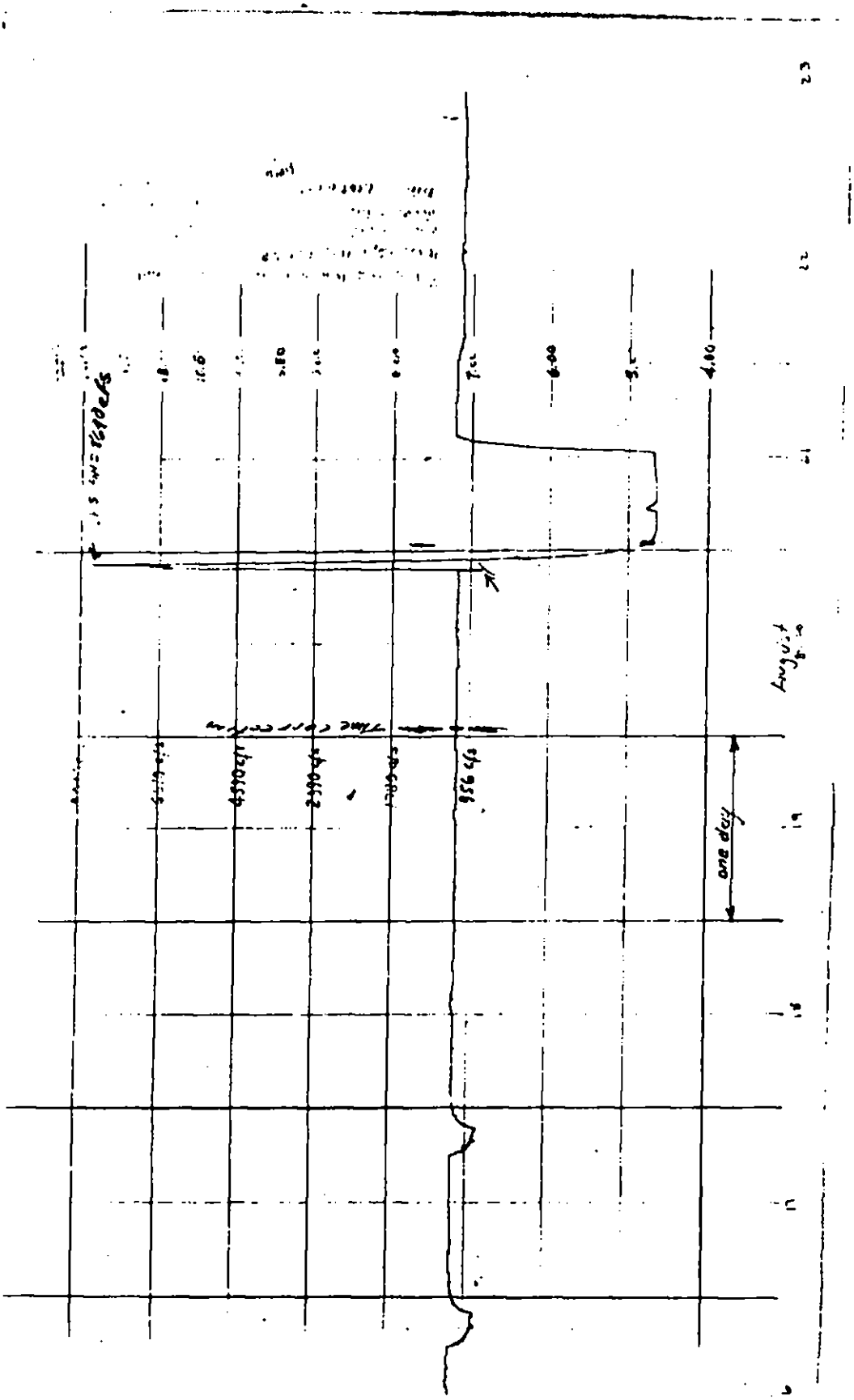
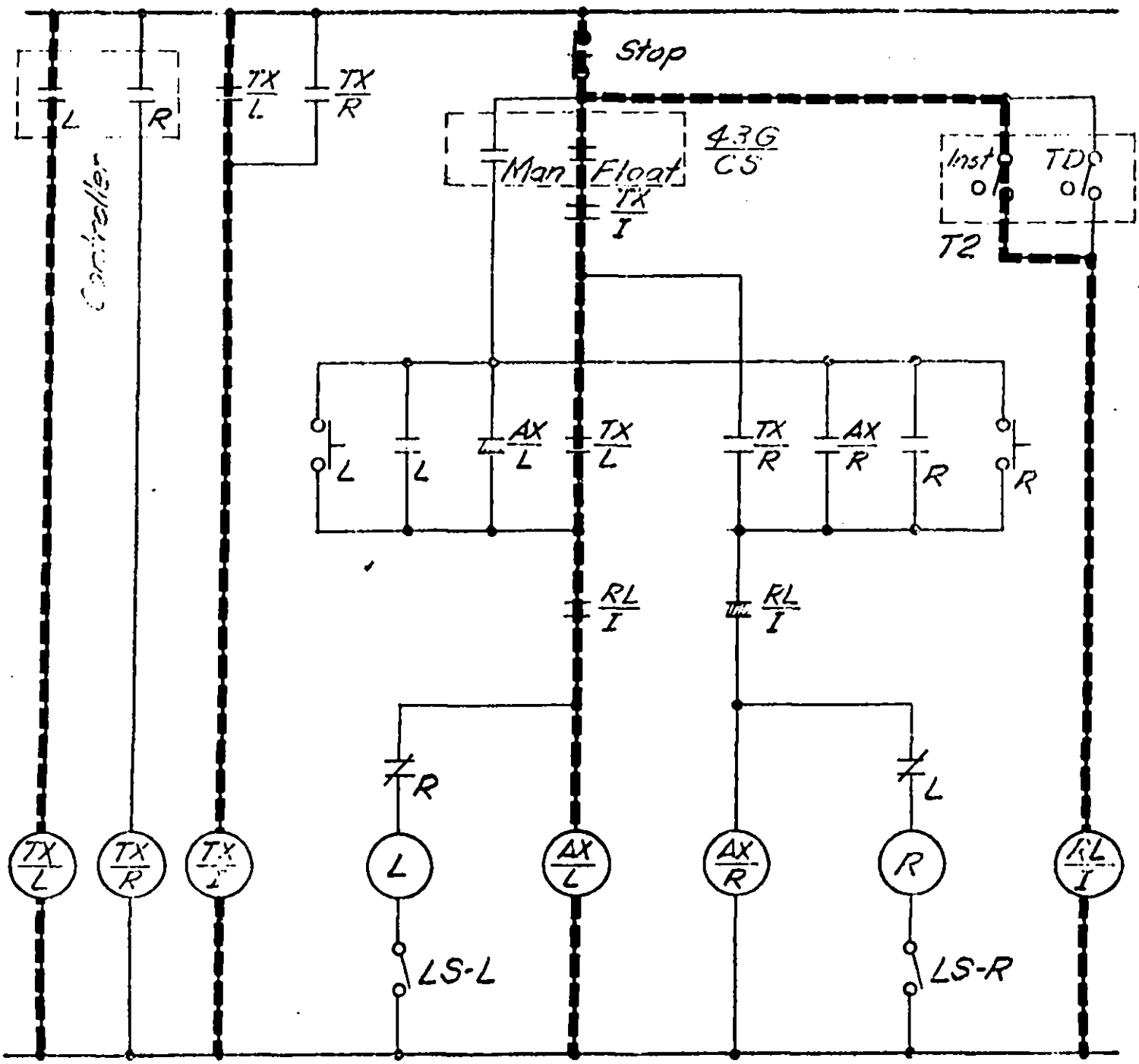


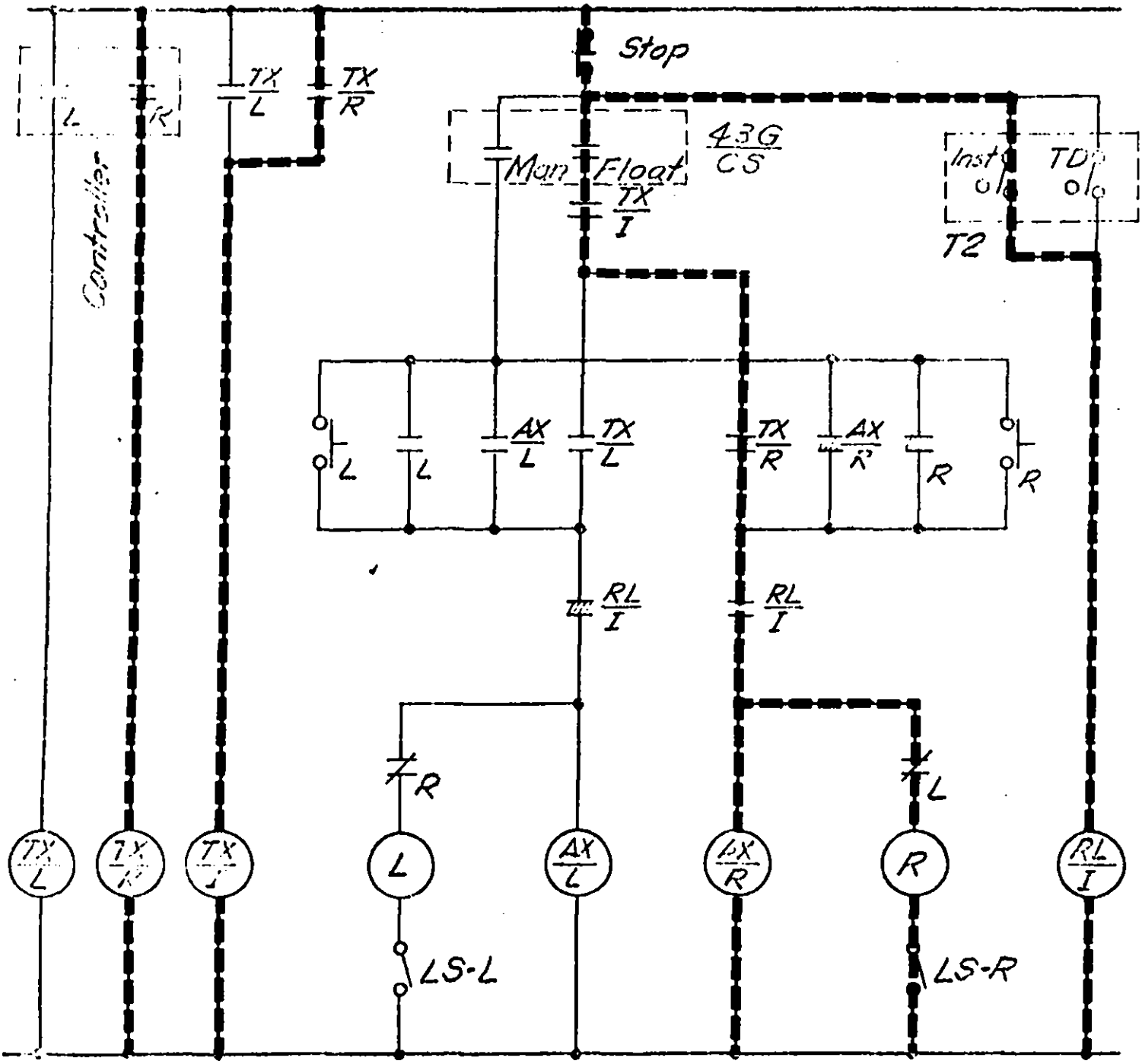
Chart from flow recorder, Middle Fork of the American River near Foresthill - August 17 - 22, 1970 - Chart shows Ralston Afterbay gate opening.

PLATE 1



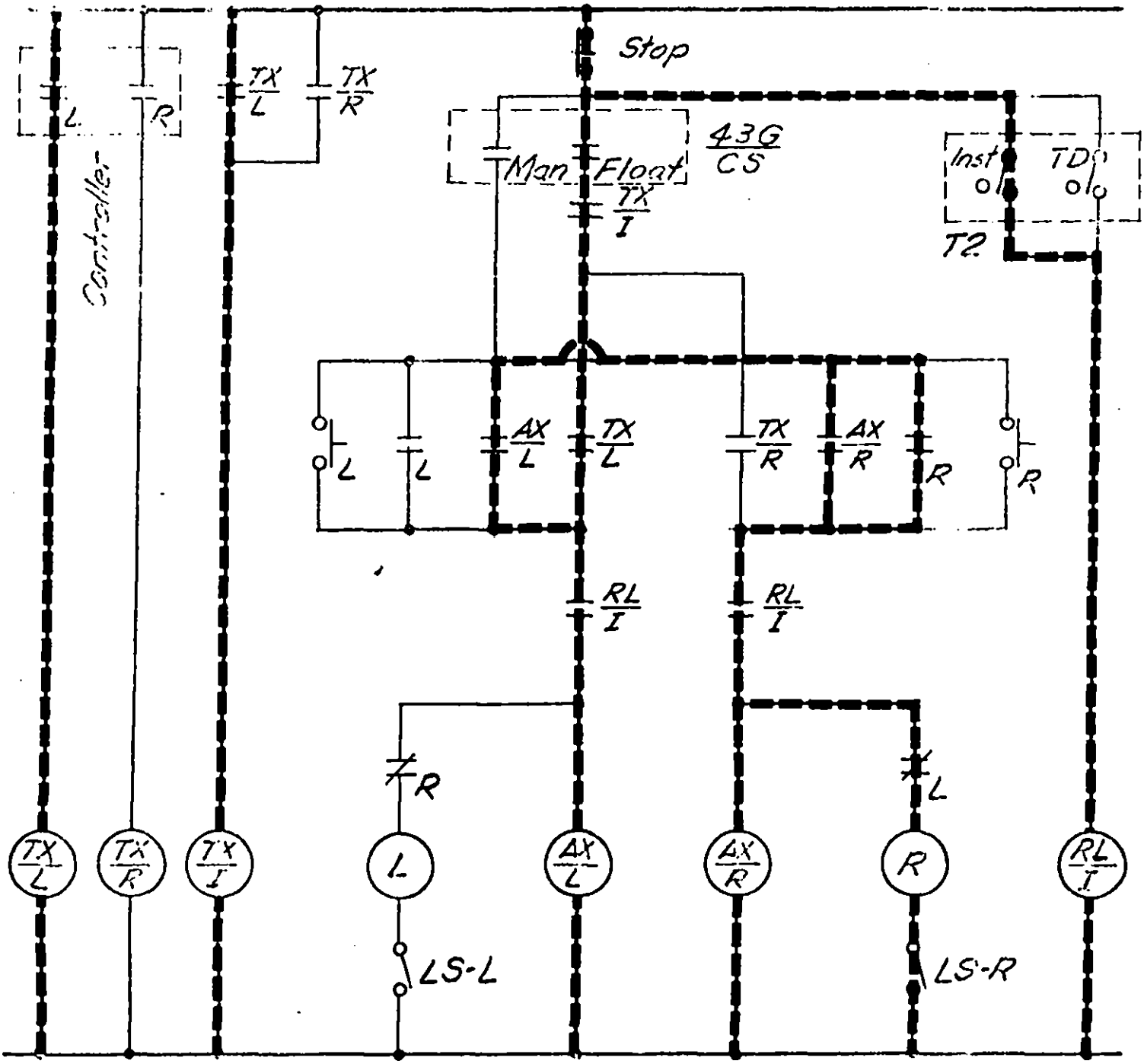
CONDITION PRIOR TO POWER FAILURE

Plate 2



CONDITION ON POWER RESTORATION

Plate 3



CONDITION AFTER RECORDER WARM UP

Plate 4

PACIFIC GAS AND ELECTRIC COMPANY

PG&E — 77 BEALE STREET • SAN FRANCISCO, CALIFORNIA 94106 • (415) 781-4211 • TWX 910-372-6587

HUGH R. DANIELS
MANAGER
HYDRO GENERATION DEPARTMENT
ELECTRIC OPERATIONS

X Relston questions

December 9, 1971

Mr. James S. Martin, Project Manager
Placer County Water Agency
P. O. Box 667
Foresthill, California 95631

Dear Jim:

Attached is a copy of a report prepared by Mr. R. Plummer of this Company's Engineering Department on the recent test of Oxbow Dam radial gates.

As indicated under the conclusions, the inspection and tests did not reveal the cause of malfunction of the gate controls; however, as the report points out, several additional steps had to be taken to completely check out the radial gate operation at Oxbow.

It is recommended that the Agency thoroughly check the wiring as provided under paragraph (b) of the conclusions and undertake to prepare a description of operation as provided under paragraph (g).

Additional comments will be provided you regarding establishing fixed set points, pulse lengths and control connections as soon as possible. It would be helpful, in the meantime, if you could send us copies of the recording charts of flows during the malfunction period.

During the inspection it was observed:

(a) That the radial gate chain links were badly in need of cleaning and lubrication. It is suggested, as temporary expedient, that the chains be lubricated with a penetrating oil and that after the runoff period next spring, the chains be removed (perhaps one at a time), cleaned, provided with alemite fittings, lubricated and returned to service. Perhaps Caterpillar Tractor, who has helped us on similar problems, can help you on this matter. The Company has been using "Lubriplate" as a successful lubricant for such chain installations.

(b) Gears on gate hoists should be similarly lubricated.

(c) Gate hoist housings should be locked to avoid opening and damage by outsiders.

(d) A program should be established for operating these gates at least once every other year.

(e) The gate hoist gearing on the #1 gate was unusually noisy. It is suspected that there may be a bearing problem.

We will be glad to discuss with you any aspect of the attached report or suggested measures to be taken.

Sincerely,

Hugh K Linsley

Attachment

FCWA POWER SYSTEMS DIVISION		
CIRCULATE	To	Initial Date
MANAGER	✓	7-21-7.
ASST. SUPV.		
MECH. FOREMAN	✓	7-24-7.
ELEC. FOREMAN	✓	8-2-72
TECH. ASSN.	✓	8-24-72
SERVICE FOREMAN		
FILE	✓	
ANSWERED		

MEMORANDUM
MALFUNCTION OF RALSTON AFTERBAY DAM GATES
REPORT OF FIELD TESTS

1. Reference Data: Attached

   a. PG&E System Dispatcher's Office, Office Items of August 21, 1971 page 2 and 3.

   b. PCWA Inter-Office Memo, J. Martin to J. Bernard, August 30, 1971

   c. PCWA Letter to Federal Power Commissions, August 31, 1971

2. Introduction

An inspection and field test were made on November 19 to determine if possible the cause of false operation of the dam gates. Present were Robert Plummer, Jim Hall and Don Singer of PG&E and Vern Higgens, PCWA technician and other PCWA maintenance personnel.

Before the test, the reservoir water level was lowered to spillway crest elevation 1149 to permit free operation of the gates without releasing water. (Top of gate, elevation 1179; max. WL, 1178) The water level transmitting slide wire was set to give a mid-scale WL indication on the recorder (Scale 0-5 feet)

By adjustment of the set point on the controllers, gates 1, 2, 3 and 4 were operated in the automatic mode in the raise and lower directions and the control actions observed.

The operation test was reported on gate 1 using the emergency engine-generator power. There was no malfunction of any equipment during these tests.

After the automatic controls were tested, all five gates were placed on manual control and tested for operation of the five limit switches on each gate.

Inspection and tests did not reveal the cause of the malfunction of the two gates.

3. Information from PCWA (Vern Higgens)

   a. Gates 1 and 2 were on automatic control (float) and both opened during the 12 kv power failure. (Note: The report that the recorder pointer moved up scale does satisfactorily explain malfunction of two gates)

   b. Gates 3 and 4 were on manual control and therefore remained closed.

c. Gate 5 is designed for manual control only and therefore remained closed.

d. Previous 12 kv line outages have not caused the gates to open on automatic control

e. Gate control settings

Recorder 0 to 5 ft. scale controls the water level in the reservoir from elevation 1174 to 1179.

Gate	Set Point		Timers	
	Point	Elev.	On	Off
1	60	1177.0	4 seconds	3 minutes
2	64	1177.4	4 "	5 "
3	68	1177.8	11 "	5 "
4	72	1178.2	11 "	10 "

4. Field Observations

a. Recorders (2) have been reconnected so that the pointer moves to the lower end of the scale during warm-up period. This was done after 8/20/71. The report that the pointer moved up-scale does not explain the failure of two gates.

b. On power failure the recorders remain at the WL indicated at time of power failure. When power is restored, pointers now move full scale (down) for approximately 10 seconds until recorders warm up, then return to the correct WL position.

c. Recorders are stable on system power but oscillate about .02 scale divisions when operating on power from emergency engine-generator. Approximate 60 hertz oscillation probably from enginer generator governor. This oscillation of the recorder caused the controller to alternately pulse the raise and lower relays about every 10 seconds. Dead band adjustment setting is too close for enginer-generator power operation.

d. Seal-in contacts on raise and lower relays coils, R and L (at gate hoist) and AX/R and AX/L (GE panel) were removed after 8/20/71. Note: These appear to be only in the manual control according to the two elementary diagrams and should not have effected the automatic control.

e. Raise and lower pulse timers are in the manual control as well as the automatic control. It has been the practice to re-set the timers for longer on and shorter off periods when manual gate tests are made.

f. All four gates responded properly to the on time-off time pulses in both raise and lower directions when observed on this date (11/19/71)

g. Elementary diagram for gate control is not complete, G.E. shows only equipment by G.E., Rundel shows only Rundel equipment. The exact method of connecting the two diagrams is not available.

h. Description of Operation for outlining facilities does not exist although required by the Contract. The set points for the gate operation, and for Oxbow load control are not documented anywhere in either the description of operation or the start-up report. The same is true of the on-time, off-time pulses. Present settings on this equipment should be reviewed and documented.

i. Emergency power supply engine-generator operated properly on normal power supply failure test. The main AC breaker was tripped manually simulating power failure. The emergency generator

(1) started after time delay of 30 seconds

(2) transfer switch to emergency power operated 20 seconds later to restore AC power

(3) emergency power at 218v, which is about 10 volts above normal.

(4) transfer back to normal power supply 2 minutes after power is restored

(5) recorder oscillates about .02 ft. at about 60 hertz frequency when emergency engine generator is operating.

j. Gate hoist operating rate measured on gate No. 1 was 1 ft./ 55 seconds.

5. Conclusion

a. Inspection and tests did not reveal cause of the malfunction of the gate controls.

b. Gate control did not fail to operate properly during test, however, wiring should be thoroughly checked and complete gate control elementary should be made. (Information on wiring taken on this trip should be adequate for this purpose.

c. Elementary diagram should be carefully reviewed for sneak circuits, contact race problems and proper seal-in circuits and modified if necessary to prevent any recurrence of this malfunction.

d. Set points, timing pulse length, proportional band settings should be reviewed for:

(1) Oxbow turbine load control
(2) Oxbow pressure regulator synchronous bypass control
(3) Afterbay dam gates 1, 2, 3, 4.

e. Control of water should be coordinated with discharge from Ralston Powerhouse so that all water is normally released thru the Oxbow turbine or pressure regulator on synchronous bypass operation. The afterbay radial gates should open to release water only when the inflow to the afterbay exceeds the release capacity of Oxbow PH.

f. Modify the afterbay annunciator as required to prevent false alarms and trouble calls. The Ralston operator can then keep the annunciator bell drops reset and rely on the alarm signals.

g. Prepare a Description of Operation for the afterbay dam to record the control system and operation settings.

h. Provide the same for the Interbay Dam.

In general above comments (a) to (g) also apply to Interbay Dam.

RGPlummer
11/29/71

cc: HRDaniels/DCSinger
AGStrassburger/KSharp

TEST REPORT
SPILLWAY GATES AND APPURTENANCES
RALSTON AFTERBAY DAM
AND
MIDDLE FORK INTERBAY DAM

FOR
MIDDLE FORK AMERICAN RIVER PROJECT
PLACER COUNTY WATER AGENCY

PREPARED BY
TUDOR ENGINEERING COMPANY
SAN FRANCISCO, CALIFORNIA

RALSTON AFTERBAY DAM

Tests were performed on the Ralston Afterbay Dam on July 18, 1974 to verify that the operation of all spillway gates was in accordance with the settings that were established by the computer analysis as indicated in the report "Engineering Analysis of Spillway Gates Ralston Afterbay Dam and Middle Fork Interbay Dam" submitted to the District on August 6, 1973.

The following personnel were present at the afterbay dam tests:

John Seitter	Placer County Water Agency
John Spangler	Placer County Water Agency
Robert Coolidge	Placer County Water Agency
Donald Singer	Pacific Gas and Electric Company
George Fee	Pacific Gas and Electric Company
James Dudman	Pacific Gas and Electric Company
William Holmberg	Tudor Engineering Company

It was decided that in order to conserve water the actual opening of the gates would be prevented by electrically disconnecting the motor leads at each of the four individual combination starter units on the spillway structure.

The initial stage of the test involved verification of the setting of the controllers. It was found that a misinterpretation of the setting data required the readjustment of the controllers. After this readjustment the test was performed by physically raising the float to simulate an increase in water level in the reservoir. The float unit potentiometer feeds the water level recorders in the gate control house. The water level recorders retransmit a potentionmeter position directly proportional to the water level to the gate controllers.

The level at which the gate control unit actuates a raise operation is calculated as follows:

$$L.O. = 1174.0 + (\text{Set Point})/200 - (\text{Proportional Band\%})/40$$

The level at which the gate control unit actuates a close operation is calculated as follows:

$$L.C. = L.O. - (\text{Dead Band})/200$$

During the tests the timers associated with gate opening increment (on time) and with the interval between opening increment (off time) were verified to be in accordance with the required values.

The following is a listing of recommended settings and test results:

	Gate 1		Gate 2	
	Settings	Test	Settings	Test
Set Point	650	——	700	——
Proportional Band	30%	——	40%	——
Dead Band	120	——	120	——
Gate Open Elevation	1176.5	1176.5	1176.5	1176.5
Gate Close Elevation	1175.9	1175.8	1175.9	1175.7
On Time (Sec.)	10	10	5	5
Off Time (Min.)	7	7	6	6

	Gate 3		Gate 4	
	Settings	Test	Settings	Test
Set Point	800	----	850	----
Proportional Band	50%	----	50%	----
Dead Band	150	----	200	----
Gate Open Elevation	1176.75	1176.75	1177.0	1177.0
Gate Close Elevation	1176.0	1175.9	1176.0	1175.9
On Time (Sec.)	15	15	20	20
Off Time (Min.)	10	10	11	11

A test of the emergency generator was performed. The start-up sequence operated properly. The shut-down sequence did not properly separate the unit from the load. A faulty relay and the transfer switch have been reworked since the test and they now operate as intended.

The annunciator at the dam has been reconnected to eliminate the erroneous alarms on undervoltage, gate open and gate overtravel. The door alarm contacts for the gate control house have been installed and connected via Oxbow Powerhouse to Ralston Powerhouse.

MIDDLE FORK INTERBAY DAM

Tests were performed on Middle Fork Interbay Dam on July 19, 1974 by Jim Dudman of PG&E Company and by John Spangler of PCWA to verify that the operation of all of the spillway gates was in accordance with the settings that were established by the computer analysis as indicated in the report "Engineering Analysis of Spillway Gates Ralston Afterbay Dam and Middle

Fork Interbay Dam," submitted to the District on August 6, 1973.

The test at these points was found to be satisfactory but operations required the resetting of the controls to a higher elevation as indicated by the computer analysis covered by the Tudor letter of January 29, 1974 and as later modified for gate operation increments by PCWA Power Systems Division Personnel.

On July 30, 1974 final tests were performed by John Seitter and John Spangler of PCWA and William Holmberg of Tudor Engineering Company to verify that the operation of all of the spillway gates was in accordance with the modified settings.

It was decided that in order to conserve water, the actual opening of the gates would be prevented by electrically disconnecting the motor leads at each of the four individual combination starter units on the spillway structure. The test was performed by physically raising the float to simulate an increase in water level in the reservoir. The float unit potentiometer feeds the water level recorders in the gate control house. The water level recorders retransmit a potentiometer position directly proportional to the water level to the gate controllers.

The level at which the gate control unit actuates a raise operation is calculated as follows:

L. O. = 2524.0 + (Set Point)/200 - (Proportional Band %)/40

The level at which the gate control unit actuates a close operation is calculated as follows:

L. C. = L. O. - (Dead Band)/200

During the tests the timers associated with gate opening increment (On Time) and with the interval between opening increment (Off Time) were verified to be in accordance with the required values.

The following is a listing of recommended settings and test results:

	Gate 1		Gate 2	
	Settings	Test	Settings	Test
Set Point	SUPV.		980	--
Proportional Band			28	--
Dead Band			150	--
Gate open elevation			2528.20	2528.35
Gate close elevation			2527.45	2527.64
On Time (sec.)			10	10
Off Time (min.)			7	7

	Gate 3		Gate 4	
	Settings	Test	Settings	Test
Set Point	920	--	980	
Proportional Band	33	--	24	
Dead Band	120	--	120	
Gate open elevation	2527.78	2527.82	2528.30	2528.50
Gate close elevation	2527.18	2529.15	2527.70	2527.90
On Time (sec.)	5	5	15	15
Off Time (min.)	6	6	10	10

The alarm points for gate undervoltage and for gate overtravel were rewired through a timer to reduce erroneous annunciations in the Middle Fork Powerhouse. The door alarm contacts for the gate control house was connected in parallel with the Middle Fork Powerhouse door alarm for transmission to Ralston Powerhouse and to Drum Powerhouse by supervisory control equipment.