

**GLEN CANYON DAM**  
**TESTING, IMPLEMENTING, AND MONITORING OF INTERIM OPERATING CRITERIA**  
**August 1 to December 31, 1991**  
**BUREAU OF RECLAMATION**

**I. INTRODUCTION**

On July 30, 1991, Commissioner of Reclamation, Dennis B. Underwood announced that, on August 1, 1991, the Bureau of Reclamation would begin testing interim operating criteria for Glen Canyon Dam. The testing was to determine the suitability of the proposed interim operating criteria as a means of reducing potential damages to the environment of the Glen Canyon Recreation Area and the Grand Canyon National Park until the Glen Canyon Dam Environmental Impact Statement (GCDEIS) and final operating criteria are approved and implemented. "The interim test period will allow the Bureau of Reclamation time to more fully evaluate data from research flows and to carry out National Environmental Policy Act compliance for the final implementation of interim flows. This protects one of the nation's greatest resources while meeting basic water and power needs," said Secretary of the Interior Lujan. A copy of the news release announcing the testing of interim operating criteria is appended as Appendix I.

On November 1, 1991, following a 3-month testing of interim flow criteria, completion of an environmental assessment and a concluding Finding of No Significant Impact related to the proposed interim operations, and consummation of an exception criteria agreement, Secretary Lujan announced that Reclamation would implement interim operations effective November 1, 1991. The interim operations included adoption of the operating criteria that had been tested. A copy of the November 1, 1991, news release is also included in Appendix I.

This document is a compilation of information related to: (1) development and adoption of the interim flow criteria, (2) the development and adoption of exception criteria, (3) the completion of National Environmental Policy Act compliance, (4) the monitoring of flow criteria from August 1 through December 31, 1991, (5) the monitoring of exception criteria from inception through December 31, 1991, and (6) the initial resource response. Information is briefly described in the paragraphs hereafter and included in greater detail as appended.

**II. DEVELOPMENT AND ADOPTION OF INTERIM OPERATING CRITERIA**

The development of interim test flows is described in a brief documentation entitled "Testing of Proposed Glen Canyon Dam Interim Operating Criteria," dated July 30, 1991, and distributed with Commissioner Underwood's news release of July 30, 1991. That document was used as the basis for an updated document entitled, "Development and Adoption of Glen Canyon Dam Interim Operating Criteria." The recent document, Appendix II, outlines the procedure and adoption of the interim operations implemented November 1, 1991, including the criteria and permitted variations.

The criteria will remain in effect, unless otherwise modified, until the Record of Decision is completed and the long-term operating criteria for Glen Canyon Dam are implemented. The GCDEIS has recently been rescheduled for completion in May 1994 and a Record of Decision in July 1994.

### III. DEVELOPMENT AND ADOPTION OF EXCEPTION CRITERIA

With the implementation of interim test flow on August 1, 1991, exception criteria used during the June 1990 to July 1991 research flow were extended. The criteria allow deviation from the interim flow criteria for response to power system disturbances or other emergency situations and for power system regulation. On October 21, 1991, after extensive consultation with the Cooperating Agencies and input by interested public interests, Western Area Power Administration's Area Manager and Reclamation's Regional Director entered into an interagency agreement. The agreement incorporates the emergency and system regulation provisions which were in place during research flows and, in addition, includes "financial criteria," as means of avoiding the expense of purchasing replacement firm capacity and energy during the interim period. The financial criterion element is conditional. The primary conditions included limiting the use of financial criteria to not more than 3 percent of the time (22 hours) in any consecutive 30-day period, being subject to review and renewal periodically, and reporting the use and costs associated with the financial criteria. The exception criteria agreement is included herewith as appendix III.

### IV. NEPA COMPLIANCE

The development of interim operating criteria was initiated in February 1991 and has been an open process involving the Cooperating Agencies and interested parties. A draft Environmental Assessment was completed in September 1991 and was distributed for review on October 2, 1991, to over 80 agencies, Native American groups, and public and private organizations. Comments were incorporated to the extent practical into the final Environmental Assessment that was completed on October 30, 1991. According to the provisions of the National Environmental Policy Act of 1969, as amended, and the Council on Environmental Quality's Regulations for Implementing the Procedural Provisions of NEPA, the Bureau of Reclamation determined that an environmental impact statement is not required for implementation of the Glen Canyon Dam interim operating criteria. A document entitled, Glen Canyon Dam Interim Operating Criteria - Finding of No Significant Impact and Environmental Assessment, dated October 31, 1991, was prepared and subsequently distributed to interested parties. As a part of the public process, formal consultation with representatives of the Basin States was accomplished at a meeting in Las Vegas, Nevada, on October 28, 1991. A copy of the Finding of No Significant Impact is attached hereto as Appendix IV.

### V. MONITORING OF FLOW CRITERIA

The operating criteria parameters: maximum daily flows, minimum daily flows, daily fluctuation, and ramp rates are monitored at Glen Canyon Dam using Reclamation's Supervisory Control And Data Acquisition (SCADA) system. In addition, the discharge and river stage changes have been monitored at downstream gaging stations

below Glen Canyon Dam, at Lees Ferry, and near Grand Canyon Village, in closer proximity to the resources in the Glen Canyon National Recreation Area and within the Grand Canyon. Appendix V includes the following charts:

Glen Canyon Dam Release Data

Charts V-1 to V-5 Trace of Releases (Sep. thru Dec.)  
Charts V-6 to V-9 Max., Min., Daily Fluctuations (Sep. thru Nov.)  
Charts V-10 to V-14 Hourly Ramp Rates (Sep. thru Dec.)  
Chart V-15 Ramp Rates at Gage below Glen Canyon Dam (Nov.)  
Chart V-16 Ramp Rates at Lees Ferry Gage (Nov.)

Lees Ferry Gage

Charts V-17 to V-21 Trace of Flow (Aug. thru Dec.)  
Charts V-22 to V-26 Trace of River Stage (Aug. thru Dec.)

Grand Canyon Gage

Charts V-27 to V-31 Trace of Flow (Aug. thru Dec.)  
Charts V-22 to V-36 Trace of River Stage (Aug. thru Dec.)

The SCADA data at Glen Canyon Dam is recorded in megawatts of energy and requires conversion to flow, cubic feet per second (cfs). The release (flow) plotting was not made for August and accordingly is not shown for that location.

During the test period and throughout the months of November and December, the maximum flow of 20,000 cfs was adhered to as shown on the various charts. Also the minimum flow of 5,000 cfs at night and 8,000 cfs between the hours of 7 am and 7 pm were met throughout the period. There were, during the month of August, some deviations from the 8,000 cfs change per day because of misunderstanding in defining a day. Based on a midnight to midnight day there would have been no deviation but based on a running 24-hour period as plotted on Chart V-7 there is an apparent deviation. About October 1, 1991, the criteria were clarified to reflect a 24-hour period and the resulting deviations occurred only on October 17th and October 27th resulting from system disturbances that are exceptions under the exception criteria. There have been other minor emergency related deviations during the period as described under monitoring of exception criteria.

Deviations from the ramp rate criteria have occurred periodically, and particularly, when Glen Canyon Dam is following the power load under system regulation. Such deviations are allowed under the generator regulation exception criteria. Ramp rates are shown on Charts V-10 thru V-14. In particular, the down ramp limit of 1,500 cfs per hour has been periodically exceeded during periods when the load drops off and the steam and gas turbine plants have been slow to respond, requiring Glen Canyon generation to drop off faster than the criterion permits. In reviewing Charts V-10 thru V-14, it is notable that there has been improvement with time due to experience and due to minimizing the time that Glen Canyon Dam is on generator regulation. The ramp rate effects are dampened as the flow moves downstream. Chart V-15, for November, illustrates the ramp rate at the gage about one-half mile below the dam, showing fewer and lesser deviations than at the dam. Also Chart V-16 illustrates the ramp rates at the Lees Ferry Gage, about 16.5 miles below the dam, to be well within the established limits.

Charts V-17 to V-36 are tracings of flow and river stage for the Lees Ferry and Grand Canyon Gages. There are some data gaps as reflected by straight lining between data points. The reduced flow on weekends is evident from the tracings. It can be noted that the daily fluctuation limits the stage change to about 1.5 feet per day at the Glen Canyon gage and about 3 feet per day at the Grand Canyon gage that was one of the basic criteria for adopting the daily fluctuations of from 5,000 to 8,000 cfs, depending on the volume of monthly release. During the higher volume months, the higher stages accommodate a greater flow for the incremental depths because of the wider river widths and more efficient flow characteristics.

**VI. MONITORING OF EXCEPTION CRITERIA**

The monitoring of exception criteria includes: (1) documenting the reasons for deviations from operating criteria, (2) maintaining records of the costs associated with interim operations and specifically financial exception criteria, (3) periodic coordination meetings between the operators of Western and the Glen Canyon Dam, and (4) monthly coordination meetings between the Area Manager for Western's Salt Lake City area office and the Regional Director for Reclamation's Upper Colorado Regional Office regarding budget and funding concerns.

Appendix VI includes an interim operations report from Western regarding scheduling procedures to accommodate the operating criteria, an analysis of the ramp rate deviations from the criteria, and the expenses associated with interim operations.

Western has not used the financial exception criteria during this reporting period. Deviations of the exception criteria for system disturbances and generator regulation have been introduced under the previous monitoring of operating criteria paragraph. Deviations for emergency purposes have caused the daily fluctuation to be exceed on October 17 and October 27 and is visible on the flow charts for those days. The ramp rate deviations from the criteria have on occasion been associated with system disturbances but are more commonly associated with generator regulation. As previously discussed, the ramp rate deviations are damped out within the first few miles below the dam and are well below the limits at the Lees Ferry gage. Analyses of ramp rate deviations are included in the Western report, Appendix VI.

The estimated net expenses of interim operations are also included in the Western report. Summary of estimated costs by month is shown in the following tabulation:

<u>Month</u>	<u>Net Expense</u>
August	\$580,976
September	\$484,717
October	\$175,266
November	\$283,016
December	\$229,589

Coordination meetings between Western and Reclamation operators have been held on a monthly basis in Page or Montrose. These meetings have been productive in resolving questions regarding daily fluctuation problem through adoption of a 24-hour running period, resolving problems initially experienced in transitioning from one monthly volume to another, and in resolving a difference

in the factors used to convert SCADA data to flow. The meetings have also been effective in improving communications and resolving operational concerns.

The Area Manager for Western's Salt Lake City area office and the Regional Director for Reclamation's Upper Colorado Regional Office met many times in developing the exception criteria and interagency agreement signed on October 21, 1991. Formal coordination meetings were held December 17, 1991, subsequent to a December 16 meeting of the operators. Operations were reviewed including some of the operational adjustments that had been made. Monitoring of interim operations were also reviewed and in particular the ramp rate deviations. Subsequent to the meeting, the ramp rates at the gage below the dam and at Lees Ferry were analyzed to determine the downstream dampening effect. Western Area Power Administration, Salt Lake City Area Office (SLCAO) initiated an expedited rate adjustment process to recover costs associated with a projected purchase power expense during interim operations and to cover the increasing costs of environmental studies.

On December 1, 1991, the SLCAO increased the rate it charges its firm power customers from 14.5 mills per kilowatt-hour to 16.2 mills per kilowatt-hour, an 11.7 percent rate increase. This rate increase, which will remain in effect until October 1, 1992, is designed to recover \$11.6 million per year. However, because the rate will only be in effect for 10 months, providing 8 months of revenue collections by the end of fiscal year 1992, the SLCAO will only recover 67 percent or \$7.7 million of the increased costs and investments.

The SLCAO is currently involved in another rate adjustment process to develop a new firm power rate that is planned to go into effect October 1, 1992. This rate will replace the expedited rate and will be designed to recover costs associated with interim flows, increased environmental costs, and increased operational and maintenance costs.

#### VI. RESOURCE RESPONSE TO INTERIM OPERATIONS

Monitoring of the resources has been limited to ongoing GCES activities during this initial period. However, development of a monitoring program focusing on critical resources has been under development since October 1991. The plan is expected to be presented to and approved by the Cooperating Agencies at their April 2-3, 1992, meeting. The presentation that follows is based on qualitative effects of the interim operations on the resources in the canyon. Largely, the ecosystem and biological process take longer than a few months in manifesting operational changes. However, preliminary effects of interim operations are outlined below by resource.

**Sediment** - The interim flows were designed to reduce two critical parameters of operation that have detrimental impact to the sediment resources in the Grand Canyon, the ramp rate and the total change in flow level over a daily period. It was the intent of the interim flows to limit the fluctuations in both terms of change per day and rate of change.

The effects seen to date include: reduction in the overall erosion rates at the beaches in the Grand Canyon. This is evidenced by a reduced amount of rill erosion, reduced bank seepage and reduced

slumping of the sediment resources. There has been a reduction but not a total cessation of the erosion process. The sediment erosion is still occurring, though at a reduced rate, as a result of the limited sediment supply, the changing flow levels and variable ramp rates. Bank failures and bank slumping occur in the Grand Canyon related to the drying out of beach sediments and the formation of steep slopes with little main channel support. The marshes that have started to reestablish themselves in the Grand Canyon have not shown a definitive effect as related to the interim flows as of yet. Time and flow levels will dictate how the marshes respond.

**Endangered Species** - The effect of the interim flows on the endangered species in the Grand Canyon is separated into three categories: terrestrial species, aquatic species, and plant species.

**Terrestrial species.** There has not been enough time to determine the impact of the interim flows on the endangered Peregrine Falcon or the Southern Bald Eagle. The Peregrines are already departing the Canyon for the season and the Bald Eagles will not begin coming into the Canyon until late November and December. It is anticipated that the interim flows may affect availability of the food resources of the Bald Eagle.

**Aquatic Species.** There has not been enough time to document any specific ecological impacts on the endangered and native fishes species in the Grand Canyon. The Humpback Chub (Gila cypha) has just completed its spawning cycle for the year and the young of the year and juvenile humpback chubs are beginning to migrate into the Colorado River proper. The impacts that have occurred have been specifically related to the habitat used by the young fish. Backwaters, side channels and channel margins should be stabilized by the interim flows. It is necessary to maintain the flow levels as stable as possible to enhance the habitat availability.

**Plant Species.** There has not been enough time to document any specific ecological impacts on the endangered and native plant species in the Grand Canyon under the interim flows. The major impacts that we will be looking for include the physical sediment resources necessary for plant substrate and growth rates.

**Trout** - There has not been enough time to document the specific effects of the interim flows on the trout that live in the Colorado River. The effects will fall into three broad categories; Biological process, food resources and physical habitat.

**Biological processes.** The trout growth has not shown any change as related to the interim flows.

**Food Resources.** The food base in the area above Lee's Ferry has shown some initial signs of recovery under the interim flow period. Specifically the diatoms have begun to recolonize the rocks at the 5,000 cfs level and are building up in layers. There has not been enough time to document any specific changes in the Cladophora glomerata or the Gammarus lacustris populations.

**Physical Habitat.** A limited amount of information has been collected to document the impacts of the interim flow on the physical habitat used by the trout species. The majority of the habitat issues will be focused on the winter spawning period. To date, with a reduction in fluctuations, the physical habitat has been increased for the juvenile and adult trout. Limited areas still exist for natural reproduced fish.

**Cultural Resources** - A limited amount of information has been collected on the effects of the interim flows on the Cultural Resources. The Spencer Ferry above Lee's Ferry is a specific area of concern.

The sediment resources in the Grand Canyon have begun to stabilize in the Canyon at the interim flow levels. Sediment erosion has decrease and therefore the loss of cultural resources has been reduced. Under the interim flow the minimum flows are above 8,000 cfs for a greater time and therefore the Spencer Ferry is covered by water and exposure minimal.

**Recreation** - The effects of the interim flows on the recreation in the Grand Canyon has shown positive relationships under the first months of the interim flow. Reduced fluctuations and higher minimum flow have allowed for a safer passage of river trips through the Grand Canyon.

A summary of monitoring efforts associated with interim operations is included in Appendix VII.

**APPENDIX I**

**News Releases**

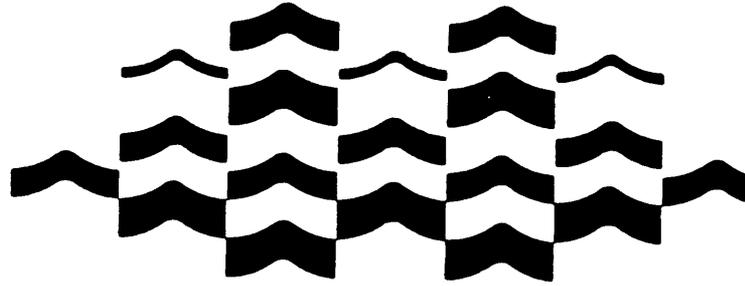
July 30, 1991 - Reclamation Implements Interim Flow  
Test at Glen Canyon Dam

November 1, 1991 - Interior Secretary Lujan Implements Glen Canyon Dam  
Operating Criteria

## News Release

Upper Colorado Region

Salt Lake City, Utah  
Barry D. Wirth (801)524-5403  
For Release July 30, 1991



### RECLAMATION IMPLEMENTS INTERIM FLOW TEST AT GLEN CANYON DAM

Commissioner of Reclamation Dennis B. Underwood today announced that, on August 1, 1991, the Bureau of Reclamation will begin testing proposed interim flows at Glen Canyon Dam on the Colorado River.

"The test will be used to determine the suitability of the proposed interim flows," Underwood said. "The interim flows which Secretary of the Interior Manuel Lujan is to announce by November 1, 1991, will remain in effect until the Glen Canyon Dam Environmental Impact Statement (GCDEIS) is completed in late 1993 and final criteria for operation of the facility are approved and implemented."

On July 27, 1989, Lujan directed Reclamation to prepare an EIS to determine the impacts of Glen Canyon Dam operations on the downstream ecological and environmental resources within Grand Canyon National Park and Glen Canyon National Recreation Area. As part of this process, research flows were initiated at the dam in June 1990 so scientists could study specific, known flow releases and their effects on the resources of the two areas. The research flows will conclude on July 31, 1991.

"The interim test period will allow the Bureau of Reclamation time to more fully evaluate data from research flows and to carry out National Environmental Policy Act compliance for the final implementation of interim flows. This protects one of our nation's greatest resources while meeting basic water and power needs," said Lujan.

For the 90-day test period, maximum flows from the dam will be restricted to 20,000 cubic feet per second (cfs), with a minimum flow of 8,000 cfs between 7 a.m. and 7 p.m., and a minimum nighttime flow of 5,000 cfs. Flows will not be allowed to increase more than 2,500 cfs each hour, or decrease more than 1,500 cfs each hour. In addition, maximum daily fluctuations

would be limited to 5,000 - 8,000 cfs, depending on the monthly volume of water to be released from the dam. Criteria have been established that would allow these flows to be exceeded for short periods during emergency situations. The test of interim flows will not interfere with water deliveries, pursuant to interstate compacts and other applicable laws.

The Bureau of Reclamation is the lead agency of a cooperative effort to produce the GCDEIS. The cooperating agencies include (Department of the Interior) U.S. Fish and Wildlife Service, National Park Service and Bureau of Indian Affairs; (Department of Energy) Western Area Power Administration; (State of Arizona) Arizona Game and Fish Department; The Navajo Nation; and the Hopi, Havasupai, and Hualapai Tribes.

Work on the GCDEIS is progressing. A draft document is expected to be distributed for public comment in mid-1992.

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**TESTING OF PROPOSED  
GLEN CANYON DAM INTERIM OPERATING CRITERIA  
BUREAU OF RECLAMATION  
July 30, 1991**

**Background**

On July 27, 1989, the Secretary of the Interior directed that an environmental impact statement be prepared on the effect of the operation of Glen Canyon Dam on the downstream environmental and ecological resources of the Glen Canyon National Recreation Area and Grand Canyon National Park.

The Bureau of Reclamation was designated as the lead agency for preparation of the Glen Canyon Dam Environmental Impact Statement (GCDEIS). Cooperating agencies include Arizona Game and Fish Department, The Hualapai Tribe, National Park Service, Western Area Power Administration, Bureau of Indian Affairs, Department of Interior Office of Environmental Affairs, The Havasupai Tribe, The Navajo Nation, The Hopi Tribe, and the U.S. Fish and Wildlife Service.

The GCDEIS and associated Glen Canyon Environmental Studies (GCES) are on schedule to evaluate the impacts of current and alternative dam operations on the downstream environmental and ecological resources of the Glen Canyon National Recreational Area and Grand Canyon National Park. As part of the GCES, research flows were designed for June 1990 through July 1991 to help determine the impact of Glen Canyon Dam operations. The preparation of the GCDEIS will lead to a long-range plan for operating Glen Canyon Dam by late 1993.

Although the commitment to prepare an EIS initiated a resolution process, the issue of interim protection of the downstream environmental and ecological resources remained outstanding.

The Commissioner of Reclamation testified before Congress, on behalf of the Secretary of the Interior, that the Secretary will implement interim flows within 90 days of completion of the GCES research flows. The research flows will be concluded by July 31, 1991. Accordingly, interim flows at Glen Canyon Dam should be implemented by November 1, 1991, and remain in place until the final decision is made.

An administrative process to develop interim operating criteria for Glen Canyon Dam was initiated in February 1991, and presented to the cooperating agencies for the GCDEIS on February 28, 1991. The interim criteria were further discussed at cooperating agencies meetings held on April 3 and 4, 1991, June 13 and 14, 1991, and July 1 and 2, 1991, and were presented at interested parties meetings the evenings of April 3, 1991, June 13, 1991, and July 1, 1991.

The process to develop interim operating criteria included input from the Research/Scientific Group, the Ecological/Resource Managers, and the Power/Water Managers. Recommendations of these groups primarily focus on protection of resources for which they have management responsibilities or other

vested interests. Reclamation developed an option focused on balancing the management and use of resources and in pursuit of an implementable plan. These preliminary proposals are summarized in an attachment to this issue document.

Four parameters which relate to potential impacts on downstream resources are the focus of Glen Canyon Dam operations. These include: maximum flow, minimum flow, daily fluctuation of flow, and the rate of change in flows over a 1-hour period (referred to as ramp rates). Limiting flood related damages, as current operations provide, during the interim period is common to all proposals. Interim operating criteria would not interfere with water deliveries pursuant to interstate compacts and other applicable laws or with operations to avoid anticipated spills (often referred to as flood control releases).

#### Issues

Primary issues that relate to interim operating criteria for Glen Canyon Dam are as follows:

- 1) Reduction of impacts on the environmental and ecological resources in Glen Canyon and Grand Canyon associated with operational change.
- 2) Potential impacts on Western's customers in terms of service and costs.
- 3) Financial cost and funding of replacement power as a result of interim operating criteria.
- 4) NEPA compliance.

The issue of impacts on environmental and ecological resources in the Glen and Grand Canyons has been highly publicized and relate to: erosion of elevated beaches, replenishment of sand deposits in the river channel, endangered and native fish and trout, aquatic food base, and terrestrial vegetation.

Impacts on power customers are related to contract commitments, transmission, interconnected system responsibility, rate implications, and replacement power.

The financial cost of interim operating criteria is of concern during this period of drought when revenues are low. Funding is currently inadequate to support normal operation and maintenance, EIS, and study costs. Further costs associated with interim criteria will make the situation worse.

NEPA compliance is an important issue in terms of implementing interim operating criteria. What form NEPA compliance will take depends upon the ultimate decision as to interim operating criteria.

## Evaluations

The evaluation performed to date of interim flow proposals has been limited to utilizing the best scientific and research data available and the best judgment of those involved in research efforts, recognizing that GCES are still in progress. In most instances, evaluations are necessarily limited to qualitative rather than a more desirable quantitative assessment. Further, it must be recognized that interim flows will be a short-term measure, pending completion of the EIS. Accordingly, assessment will be more limited than might otherwise be expected. Evaluations to date of the proposals have been made on the basis of the operating parameters in the paragraphs that follow.

Maximum flow - The maximum release is based on two primary objectives: (1) to reduce erosion of elevated sand beaches, and (2) to limit the sand being transported out of the system. Another objective is to reduce impacts on Native American cultural sites. Maximum releases in the order of 20,000 cfs are supported by the information available as of July 21, 1991. The 20,000 cfs maximum is sufficient to make water deliveries of 8.23 million acre-feet (maf) to the Lower Basin. Annual deliveries significantly over 8.23 maf could require some upward adjustment in the maximum release. However, the probability of annual deliveries greater than 8.23 maf is very low in 1992 and into 1993. The limitation restricts peak energy production and precludes the use of available generating capacity except for emergency exceptions.

Minimum flow - The minimum release is based on sufficient flow to: (1) reduce impacts on trout spawning and from stranding pools, (2) reduce impacts on native fishes, (3) reduce impacts on aquatic vegetation, (4) reduce impacts on vegetation and, (5) reduce impacts on recreation. A minimum flow of 5,000 cfs appears to meet these objectives. A minimum mean daily flow of 8,000 cfs has been recommended by the Ecological Resource Managers to support aquatic vegetation and facilitate more effective habitat in backwater areas. Accomplishment of these objectives could be achieved by adopting a 8,000 cfs minimum flow from 7 a.m. to 7 p.m. and no less than 5,000 cfs during the night. The changes would be made in accordance with adopted ramp rates.

Daily fluctuations - The reasons for limiting daily fluctuations are to: (1) reduce impacts on elevated beach erosion and associated sediment transport, (2) reduce impacts on fishes associated with spawning, stranding and backwater areas. From preliminary research data set forth in a supporting document of July 21, 1991, a daily fluctuation of 5,000 cfs would alleviate much, but not all, of the erosion impacts on elevated beaches. Some flexibility in daily fluctuation appears to be possible in recognition of stage-discharge relationships in accordance with the additional information documented as of July 21, 1991. A stage change limitation of 3 feet could restrict daily change to 5,000 cfs for maximum release in the magnitude of 10,000 cfs. However, for flows of the 20,000 cfs magnitude, fluctuation up to 8,000 cfs fall within the 3 foot stage limit. Due to variability of cross sections, beach formations, and the location of beaches, there is a variance in stage-discharge relationships. Generally, a maximum fluctuation of 5,000 cfs during low release months, 6,000 for medium release months, and 8,000 cfs for high release months would likely reduce beach erosion to tolerable levels. The daily fluctuation limitation restricts power demands, limits energy resource potential, and impacts energy commitments. The daily fluctuation limitation has the most severe impact on energy production of any of the interim flow parameters.

Ramp rates - Ramp rates, or the flow fluctuation over a 1-hour period impact on: (1) erosion of elevated sand beaches and in other critical areas and, (2) trout spawning and stranding native fishes in the backwater areas. Ascending ramp rates of 4,000 cfs is an approximate threshold level above which impacts are accelerated. Reclamation proposed a limit of 8,000 cfs over a 4-hour period. This longer term limitation may, or may not, be important depending

upon the daily fluctuation allowed. Ascending rates of 2,500 cfs/hour closely approximate the Scientific recommendation when considering attenuation. Descending ramp rates are more critical in protecting the resources impacted by fluctuations. Based on the reduction in daily fluctuations and attenuation effects, 1,500 cfs/hour appears to be a reasonable descending ramp rate.

#### Recommendations

Based on the latest information available and the preceding evaluations, Reclamation proposes the following interim operating criteria:

<u>Parameter</u>	
Maximum Flow	20,000 cfs <sup>1</sup>
Minimum Flow	5,000 cfs - nighttime 8,000 cfs - 7 a.m. to 7 p.m.
Ramp Rates	
Ascending	8,000 cfs/4 hours not to exceed 2,500 cfs/hour
Descending	1,500 cfs/hour

Daily Fluctuations 5,000/8,000 cfs<sup>2</sup>

Research flows are scheduled to end on July 31, 1991, and interim operating criteria are to be implemented by November 1, 1991. During that 90-day period, appropriate NEPA compliance will be completed. With high visibility and interest in protecting resources in Glen and Grand Canyons, testing of the proposed interim operating criteria prior to their implementation is desirable.

The test will be conducted as follows:

(1) The above proposed interim operating criteria for Glen Canyon Dam will be implemented on a test basis on August 1, 1991. It is recognized that a transition period may be necessary in recognition of power contracts, replacement energy, and other arrangements which are associated with modified operations. This transition period will be as short as possible.

(2) A monitoring program will evaluate performance of the proposed criteria. The monitoring will focus on identifying residual problems. Local protective measures, in addition to modification of operations, will be considered to reduce residual impacts during interim flows as appropriate.

(3) Exception criteria used during research flows will be extended for the test period beginning August 1, 1991. By August 15 it is anticipated that Reclamation and Western, with input from the Department of Interior, will draft and agree to revised exception criteria to be put in place at that time. This will also provide a test of the exception criteria.

By November 1, 1991, we anticipate the completion of any necessary NEPA compliance which will allow for final implementation of interim operating criteria.

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<sup>1</sup> To be evaluated and potentially increased as necessary for years when delivery to the Lower Basin exceeds 8.23 maf.

<sup>2</sup> Daily fluctuation limit of 5,000 cfs for months with release volumes less than 600,000 af, 6,000 cfs for monthly release volumes of 600,000 to 800,000 af and 8,000 cfs for monthly volumes over 800,000 af.

**GLEN CANYON DAM INTERIM OPERATING CRITERIA  
SUMMARY OF PRELIMINARY PROPOSALS**

June 25, 1991

Parameter	Historical	R/S Group	E/RM Group	USBR Option	WAPA
Max. Release (cfs)	31,500	20,000	20,000	20,000(1)(2) 22,000(3)	31,500
Min. Release (cfs)	3,000/1000	5,000	8,000	5,000(4)	3,000/ 5,000
Ramp Rates cfs/hr.				<u>4 hour/1 hour</u>	
Up	No Limit	2,000	2,000	8,000/4,000(4)	No Limit
Down	No Limit	1,000	1,000	4,800/2,000(1) 8,000/2,500(2) (3)	4,000/ 5,000
Daily Change (cfs)	30,500	5,000	5,000	8,000(1) 11,000(2) 15,000(3)	No Limit

R/S Group = Research /Scientific Group - Recommendations For Interim Operating Procedures For Glen Canyon Dam - April 10, 1991

E/RM Group = Ecological/Resource Managers - Letter Report - Review of Interim Flow Recommendations - March 29, 1991

USBR = Bureau of Reclamation - Presented at Cooperating Agencies meeting on June 13 - 14, 1991, including a phased approach which was dropped from consideration.

WAPA = Western Area Power Administration - Letter and Concept of Interim Operating Criteria - May 22, 1991 - Comments on the WAPA concept was submitted by the Colorado River Energy Distribution Association and the Upper Colorado River Commission on May 29, 1991.

**Notes:**

- (1) Low monthly volume - less than 600,000 acre-feet
- (2) Medium monthly volume - 600,000 to 800,000 acre-feet
- (3) High monthly volume - over 800,000 acre-feet
- (4) All months



# DEPARTMENT of the INTERIOR

## news release

OFFICE OF THE SECRETARY  
For Release November 1, 1991

Steve Goldstein (o) 202-208-6416  
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### INTERIOR SECRETARY LUJAN IMPLEMENTS GLEN CANYON DAM OPERATING CRITERIA

Secretary of the Interior Manuel Lujan announced that effective November 1, 1991, the Bureau of Reclamation will implement interim operating criteria at Glen Canyon Dam on the Colorado River. The criteria will remain in effect until the Glen Canyon Dam Environmental Impact Statement (GCDEIS) is completed in late 1993 and final criteria for the operation of the facility are approved and implemented.

"The interim flows will help ensure the protection of downstream resources in the Grand Canyon until the EIS is completed in 1993," said Commissioner of Reclamation Dennis B. Underwood. "We will continue to gather information from the ongoing Glen Canyon environmental studies pending completion of the EIS and implementation of a Record of Decision."

The interim operations limit the daily flow fluctuations to approximately 3 feet or less in the Grand Canyon. The maximum flow would be limited to 20,000 cubic feet per second (cfs); any release greater than 20,000 cfs will require further evaluation and consultation.

Minimum flows would be 5,000 cfs between 7 pm and 7 am and 8,000 cfs between 7 am and 7 pm. The rate of change in the powerplant output would be limited to 2,500 cfs per hour for increasing flows and 1,500 cfs per hour for decreasing flows.

Incorporated in the interim operating criteria are exception criteria which provide for exceeding the flow to respond to emergency situations, system regulation needs, and to reduce the probability of high-cost replacement power purchases. The exception criteria are set forth in an October 21, 1991, Interagency Agreement between the Bureau of Reclamation and the Western Area Power Administration.

"The interim operations were tested between August 1 and October 31, 1991, by the Bureau of Reclamation in order to more fully evaluate data from research flows," Underwood said.

(more)

On July 27, 1989, Lujan directed the preparation of an environmental impact statement on the effects of the operation of Glen Canyon Dam on the downstream environmental and ecological resources of the Glen Canyon National Recreation Area and Grand Canyon National Park.

Reclamation is the lead agency of a cooperative effort to produce the GCDEIS. The cooperating agencies include the Arizona Game and Fish Department, Bureau of Indian Affairs, Fish and Wildlife Service, Havasupai Indian Tribe, Hopi Tribe, Hualapai Indian Tribe, National Park Service, Navajo Nation, and Western Area Power Administration.

- DOI -

GLEN CANYON DAM INTERIM OPERATING CRITERIA  
NOVEMBER 1, 1991

Introduction

These interim operating criteria for the Glen Canyon Dam, Colorado River Storage Project are promulgated pursuant to the Colorado River Storage Project Act of 1956 (43 U.S.C. 620, et seq.) and Federal reclamation law and are subject to the requirements of section 602 of the Colorado River Basin Project Act of 1968 (43 U.S.C. 1552). They shall remain in effect until final operating criteria are promulgated upon the completion of an environmental impact statement and record of decision on the operation of the Glen Canyon Dam. The annual plan of operation for the Glen Canyon Dam shall continue to be governed by section 602 of the Colorado River Basin Project Act (43 U.S.C. 1552) and by the "Criteria for Coordinated, Long-Range Operation of Colorado River Reservoirs" promulgated pursuant thereto (Federal Register, Vol. 35, No. 112, June 10, 1970).

Interim Operating Criteria

<u>Parameter</u>	<u>Operating Criteria</u>
Maximum Flow	20,000 cfs <sup>1</sup>
Minimum Flow	5,000 cfs - nighttime 8,000 cfs - 7 a.m. to 7 p.m. <sup>2</sup>
Ramp Rates	
Ascending	8,000 cfs/4 hours not to exceed 2,500 cfs/hour
Descending	1,500 cfs/hour
Daily Fluctuations (over a 24 hour period)	5,000/8,000 cfs <sup>3</sup>

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<sup>1</sup>To be evaluated and potentially increased as necessary for years when delivery to the Lower Basin exceeds 8.23 maf.

<sup>2</sup>The 8,000 cfs minimum flow requirement from 7 a.m. to 7 p.m. will be shifted to 8 a.m. and 8 p.m. respectively beginning the last Sunday in October and ending the first Sunday in April, Arizona local standard time.

<sup>3</sup>Daily fluctuation limit of 5,000 cfs for months with release volumes less than 600,000 af, 6,000 cfs for monthly release volumes of 600,000 to 800,000 af and 8,000 cfs for monthly volumes over 800,000 af.

## Variations from the Interim Operating Criteria

Variations from the interim operating criteria will be permitted under certain conditions. These variations, which are referred to as "exception criteria," are set forth in the interagency agreement between "United States Department of Energy Western Area Power Administration Salt Lake City Area and United States Department of Interior Bureau of Reclamation Upper Colorado Region Glen Canyon Dam Exception Criteria and Associated Interim Operating Procedure," dated October 21, 1991, which agreement is incorporated in its entirety in these interim operating criteria by this reference.

**APPENDIX II**  
**Development and Adoption**  
**of**  
**Glen Canyon Dam**  
**Interim Operating Criteria**  
**October 30, 1991**

DEVELOPMENT AND ADOPTION  
OF  
GLEN CANYON DAM INTERIM OPERATING CRITERIA  
BUREAU OF RECLAMATION  
OCTOBER 30, 1991

**Background**

On July 27, 1989, the Secretary of the Interior directed that an environmental impact statement be prepared on the effect of the operation of Glen Canyon Dam on the downstream environmental and ecological resources of the Glen Canyon National Recreation Area and Grand Canyon National Park.

The Bureau of Reclamation was designated as the lead agency for preparation of the Glen Canyon Dam Environmental Impact Statement (GCDEIS). Cooperating agencies include Arizona Game and Fish Department, The Hualapai Tribe, National Park Service, Western Area Power Administration, Bureau of Indian Affairs, Department of Interior Office of Environmental Affairs, The Havasupai Tribe, The Navajo Nation, The Hopi Tribe, and the U.S. Fish and Wildlife Service.

The GCDEIS and associated Glen Canyon Environmental Studies (GCES) are scheduled to evaluate the impacts of current and alternative dam operations on the downstream environmental and ecological resources of the Glen Canyon National Recreational Area and Grand Canyon National Park. As part of the GCES, research flows were designed for June 1990 through July 1991 to help determine the impact of Glen Canyon Dam operations. The preparation of the GCDEIS will lead to a long-range plan for operating Glen Canyon Dam in 1994.

Although the commitment to prepare an EIS initiated a resolution process, the issue of interim protection of the downstream environmental and ecological resources remained outstanding.

The Commissioner of Reclamation testified before Congress in 1990 and 1991, on behalf of the Secretary of the Interior, that the Secretary would implement interim flows within 90 days of completion of the GCES research flows. The research flows were concluded July 31, 1991. Accordingly, interim flows at Glen Canyon Dam were to be implemented by November 1, 1991, and remain in place until the final operating criteria decision was made.

An administrative process to develop interim operating criteria for Glen Canyon Dam was initiated in February 1991, and presented to the cooperating agencies for the GCDEIS on February 28, 1991. The interim criteria were further discussed at cooperating agencies meetings held on April 3 and 4, 1991, June 13 and 14, 1991, and July 1 and 2, 1991, and were presented at interested parties meetings the evenings of April 3, 1991, June 13, 1991, and July 1, 1991.

On July 30, 1991, Commissioner Underwood announced the testing of proposed interim operating criteria to begin August 1, 1991, and continue until

November 1, 1991, when interim operating criteria would be implemented. Subsequently, Cooperating Agencies meetings were held on September 16 and 17, 1991, and October 15 and 16, 1991, to discuss National Environmental Policy Act (NEPA) compliance and exception criteria for interim operations. Interested parties meetings were also held in conjunction with Cooperating Agencies meetings.

The process to develop interim operating criteria included input from the Research/Scientific Group, the Ecological/Resource Managers, and the Power/Water Managers. Recommendations of these groups primarily focus on protection of resources for which they have management responsibilities or other vested interests. Reclamation developed an option focused on balancing the management and use of resources and in pursuit of an implementable plan. These preliminary proposals and the selected test flow criteria are summarized on the following page.

Four parameters that relate to potential impacts on downstream resources are the focus of Glen Canyon Dam operations. These include: maximum flow, minimum flow, daily fluctuation of flow, and the rate of change in flow over a 1-hour period (referred to as ramp rates). Limiting flood related damages, as current operations provide, during the interim period is common to all proposals. Interim operating criteria would be developed to not interfere with water deliveries pursuant to interstate compacts and other applicable laws or with operations to avoid anticipated spills (often referred to as flood control releases).

#### Issues

Primary issues that relate to interim operating criteria for Glen Canyon Dam are as follows:

- 1) Reduction of impacts on the environmental and ecological resources in Glen Canyon and Grand Canyon associated with operational change.
- 2) Potential affects on Western's customers in terms of service and costs.
- 3) Financial cost and funding of replacement power as a result of interim operating criteria.
- 4) NEPA compliance.

The issue of impacts on environmental and ecological resources in the Glen and Grand Canyons has been highly publicized and includes: erosion of elevated beaches, replenishment of sand deposits in the river channel, endangered and native fish and trout, aquatic food base, terrestrial vegetation, cultural, and archeological values.

Impacts on power customers are related to contract commitments, transmission, interconnected system responsibility, rate implications, and replacement power. The financial cost of interim operating criteria is also of concern during this period of drought when revenues are low. Funding is currently inadequate to support normal operation and maintenance, EIS, and study costs. Exception criterion is an important element to reduce the probability of having to purchase firm energy and capacity during the interim period.

**GLEN CANYON DAM INTERIM FLOWS**  
**SUMMARY OF OPERATING CRITERIA RECOMMENDATIONS**

July 30, 1991

Parameter	Historical	R/S Group	E/RM Group	USBR Option	WAPA	TEST FLOW
Max. Release (cfs)	31,500	20,000	20,000	20,000(1)(2) 22,000(3)	31,500	20,000
Min. Release (cfs)	3,000/1000	5,000	8,000	5,000(4)	3,000/ 5,000	5,000/ 8,000
Ramp Rates cfs/hr.				<u>4 hour/1 hour</u>		4hr/1hr
Up	No Limit	2,000	2,000	8,000/4,000(4)	No Limit	8,000/ 2,500
Down	No Limit	1,000	1,000	4,800/2,000(1) 8,000/2,500(2) (3)	4,000/ 5,000	1,500
Daily Change (cfs)	30,500	5,000	5,000	8,000(1) 11,000(2) 15,000(3)	No Limit	5000(1) 6000(2) 8000(3)

R/S Group = Research /Scientific Group - Recommendations For Interim Operating Procedures For Glen Canyon Dam - April 10, 1991

E/RM Group = Ecological/Resource Managers - Letter Report - Review of Interim Flow Recommendations - March 29, 1991

USBR = Bureau of Reclamation - Presented at Cooperating Agencies meeting on June 13-14, 1991, including a phased approach which was dropped from consideration

WAPA = Western Area Power Administration - Letter and Concept of Interim Operating Criteria - May 22, 1991 - Comments on the WAPA concept was submitted by the Colorado River Energy Distribution Association and the Upper Colorado River Commission on May 29, 1991.

Notes:

- (1) Low monthly volume - less than 600,000 acre-feet
- (2) Medium monthly volume - 600,000 to 800,000 acre-feet
- (3) High monthly volume - over 800,000 acre-feet
- (4) All months

## Evaluations

The development of interim operating criteria was limited to use the best scientific and research data available and the best judgment of those involved in research efforts, recognizing that GCES are still in progress. In most instances, evaluations are necessarily limited to qualitative rather than a more desirable quantitative assessment. Further, it must be recognized that interim operations will be a temporary measure, pending completion of the EIS. Accordingly, assessment was more limited than might otherwise be expected. Evaluations of the initial proposals were made on the basis of the operating parameters in the paragraphs that follow.

Maximum flow - The maximum release is based on two primary objectives: (1) to reduce erosion of elevated sand beaches, and (2) to limit the sand being transported out of the system. Another objective is to reduce impacts on Native American sacred and cultural sites. Maximum releases in the order of 20,000 cfs are supported by preliminary research data test flows, the Environmental Assessment and Finding of No Significant Impact. The 20,000 cfs maximum is sufficient to make water deliveries of 8.23 million acre-feet (maf) to the Lower Basin. Annual deliveries significantly over 8.23 maf will require further review and coordination regarding the maximum release. The maximum flow limitation restricts peak energy production and precludes the use of available generating capacity except for conditions identified under exception criteria.

Minimum flow - The minimum release is based on sufficient flow to: (1) reduce impacts on trout spawning and from stranding pools, (2) reduce impacts on native fishes, (3) reduce impacts on aquatic vegetation, (4) reduce impacts on vegetation and, (5) reduce impacts on recreation. A minimum flow of 5,000 cfs appears to meet these objectives. A minimum mean daily flow of 8,000 cfs has been recommended by the Ecological Resource Managers to support aquatic vegetation and facilitate more effective habitat in backwater areas. Accomplishment of these objectives could be achieved by adopting a 8,000 cfs minimum flow from 7 a.m. to 7 p.m. and no less than 5,000 cfs during the night. The transitional changes would be made according to adopted ramp rates.

Daily fluctuations - The reasons for limiting daily fluctuations (defined as any consecutive 24 hour period) are to: (1) reduce impacts on elevated beach erosion and associated sediment transport, (2) reduce impacts on fishes associated with spawning, stranding and backwater areas. Preliminary research data and observations during test flows indicate limiting a daily fluctuation in river stage to 3 feet would alleviate much, but not all, of the erosion impacts on elevated beaches. Some flexibility in daily fluctuation appears to be possible in recognition of stage-discharge relationships according to the additional information documented as of July 21, 1991. A stage change limitation of 3 feet could restrict daily change to 5,000 cfs for maximum release in the magnitude of 10,000 cfs. However, for flows of the 20,000 cfs magnitude, fluctuations up to 8,000 cfs fall within the 3 foot stage limit. Due to variability of cross sections, beach formations, and the location of beaches, there is a variance in stage-discharge relationships. Generally, a maximum fluctuation of 5,000 cfs during low release months, 6,000 for medium

release months, and 8,000 cfs for high release months would likely reduce beach erosion to tolerable levels. The daily fluctuation limitation restricts power demands, limits energy resource potential, and affects energy commitments. The daily fluctuation limitation has the most severe impact on energy production of any of the interim flow parameters.

Ramp rates - Ramp rates, or the flow fluctuation over a 1-hour period impact on: (1) erosion of elevated sand beaches and in other critical areas and, (2) trout spawning and stranding native fishes in the backwater areas. Ascending ramp rates of 4,000 cfs is an approximate threshold level above which impacts are accelerated. Reclamation proposed a limit of 8,000 cfs over a 4-hour period. This longer term limitation may, or may not, be important depending upon the daily fluctuation allowed. Ascending rates of 2,500 cfs/hour closely approximate the Scientific recommendation when considering attenuation. Descending ramp rates are more critical in protecting the resources affected by fluctuations. Based on the reduction in daily fluctuations and reflecting attenuation effects, 1,500 cfs/hour appears to be a reasonable descending ramp rate.

### Testing of Interim Operating Criteria

Using the best information available and the preceding evaluations, Reclamation implemented the following interim operating criteria for testing during the period August 1, 1991, to November 1, 1991.

<u>Parameter</u>	<u>Interim Operating Criteria</u>
Maximum Flow	20,000 cfs <sup>1</sup>
Minimum Flow	5,000 cfs - nighttime 8,000 cfs - 7 a.m. to 7 p.m.
Ramp Rates	
Ascending	8,000 cfs/4 hours not to exceed 2,500 cfs/hour
Descending	1,500 cfs/hour

Daily Fluctuations 5,000/8,000 cfs<sup>2</sup>

With high visibility and interest in protecting resources in Glen and Grand Canyons, testing of the proposed interim operating criteria was adopted before final implementation.

The proposed interim operating criteria were tested during August, September, and October of 1991. Releases in August and September typically varied from about 10,000 cfs to 18,000 cfs and releases in October typically varied from about 6,000 cfs to 11,000 cfs.

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<sup>1</sup> To be evaluated and potentially increased as necessary for years when delivery to the Lower Basin exceeds 8.23 maf.

<sup>2</sup> Daily fluctuation limit of 5,000 cfs for months with release volumes less than 600,000 af, 6,000 cfs for monthly release volumes of 600,000 to 800,000 af and 8,000 cfs for monthly volumes over 800,000 af.

Stream gaging stations below Glen Canyon Dam, at Lee's Ferry and at Grand Canyon Village were used to monitor the discharge and river stage. Monitoring confirmed that the daily fluctuation limits met the target change in river stage of about 3 feet in the narrow reaches of the Grand Canyon and resulted in stage changes of about 1.5 feet in wider reaches. Exception criterion was used only twice during the month of October to provide energy on an emergency basis. The events occurred October 17 and 30 when pre-scheduled power resources became unavailable and it was necessary to increase generation at Glen Canyon Dam for short periods of time. This resulted in the daily fluctuation limit to be in the range of 8,000 cfs rather than the 5,000 cfs prescribed rate. These emergency situations are infrequent, of short duration, and limited magnitude and appear not to cause significant damages to downstream resources. Deviation from exception criteria for generator regulation occurs more frequently but is required to adjust for system load changes. The deviations are of short duration and are attenuated between the dam and the Lees Ferry gage. This deviation is expected to continue during interim operations. It can be minimized by limiting the generator regulation at Glen Canyon Dam to those periods when it cannot be met from other units within the system.

Ongoing GCES activities were used to monitor the effects flow releases affects during the test period. Observations of the environment downstream from Glen Canyon Dam substantiated a reduction in the overall erosion rates at beaches, the beginning of marsh re-establishment, some initial signs of recovery in the biological food base, an increase in trout habitat, stability of cultural resources, and safer passage of river trips. There has not been enough time to determine any changes in endangered or special status species or trout populations.

The Western Area Power Administration was able to satisfy its long-term firm electric service contracts with purchases from interconnected utilities. Increased purchases were required during peak load period both on weekdays and weekends. These purchases have been limited to non-firm energy rather than firm energy and capacity purchases.

### Exception Criteria

An agreement to allow exception criteria for continued emergency situations and generator regulation, permitted during research flows, and an additional element encompassing financial criteria were discussed at Cooperating Agencies meetings held on September 16 and 17, 1991, and on October 15 and 16, 1991, and were presented at interested parties meetings the evenings of September 16, 1991, and October 15, 1991. An agreement was signed on October 21, 1991, between the United States Department of Energy, Western Area Power Administration, Salt Lake City Area and the United States Department of the Interior, Bureau of Reclamation, Upper Colorado Region; entitled "Glen Canyon Dam Exception Criteria and Associated Operating Procedures." The agreement limits use of the financial exception criteria to approximately 3 percent of the time (22 hours) in any 30 consecutive days. Financial exception criteria was not unanimously accepted by the Cooperating

Agencies, and accordingly, requires periodic renewal. The interagency agreement has been adopted as an integral part of the interim operating criteria.

### **NEPA Compliance**

A draft Environmental Assessment on the Glen Canyon Dam Interim Operating Criteria was prepared by Reclamation and distributed to the Cooperating Agencies and interested parties on October 2, 1991. Comment from Cooperating Agencies and interested parties were incorporated where practical into the final Environmental Assessment that was completed on October 30, 1991. Based upon the Environmental Assessment, a Finding of No Significant Impact was prepared and signed on October 31, 1991.

### **Monitoring of Interim Operating Criteria**

The monitoring program will focus on the three elements: (1) evaluation of the performance of the interim operating criteria (2) evaluation of the impacts of the exception criteria on the flows and on the resources and, (3) evaluation of the general resource responses to the interim criteria. In addition, the following elements will be evaluated: sediment, endangered species, native fish, sediment transport, cultural resources, wetlands, trout, recreation, and economics. Specific elements of the monitoring program will be implemented as a part of the ongoing GCES research program. No new research efforts are anticipated to support the assessments of the interim operating criteria.

### **Interim Operating Criteria**

The interim operating criteria resulting from the above process and evaluations are described on the following attachment and were implemented on November 1, 1991.

GLEN CANYON DAM INTERIM OPERATING CRITERIA  
NOVEMBER 1, 1991

Introduction

These interim operating criteria for the Glen Canyon Dam, Colorado River Storage Project are promulgated pursuant to the Colorado River Storage Project Act of 1956 (43 U.S.C. 620, et seq.) and Federal reclamation law and are subject to the requirements of section 602 of the Colorado River Basin Project Act of 1968 (43 U.S.C. 1552). They shall remain in effect until final operating criteria are promulgated upon the completion of an environmental impact statement and record of decision on the operation of the Glen Canyon Dam. The annual plan of operation for the Glen Canyon Dam shall continue to be governed by section 602 of the Colorado River Basin Project Act (43 U.S.C. 1552) and by the "Criteria for Coordinated, Long-Range Operation of Colorado River Reservoirs" promulgated pursuant thereto (Federal Register, Vol. 35, No. 112, June 10, 1970).

Interim Operating Criteria

<u>Parameter</u>	<u>Operating Criteria</u>
Maximum Flow	20,000 cfs <sup>1</sup>
Minimum Flow	5,000 cfs - nighttime 8,000 cfs - 7 a.m. to 7 p.m. <sup>2</sup>
Ramp Rates	
Ascending	8,000 cfs/4 hours not to exceed 2,500 cfs/hour
Descending	1,500 cfs/hour
Daily Fluctuations (over a 24 hour period)	5,000/8,000 cfs <sup>3</sup>

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<sup>1</sup>To be evaluated and potentially increased as necessary for years when delivery to the Lower Basin exceeds 8.23 maf.

<sup>2</sup>The 8,000 cfs minimum flow requirement from 7 a.m. to 7 p.m. will be shifted to 8 a.m. and 8 p.m. respectively beginning the last Sunday in October and ending the first Sunday in April, Arizona local standard time.

<sup>3</sup>Daily fluctuation limit of 5,000 cfs for months with release volumes less than 600,000 af, 6,000 cfs for monthly release volumes of 600,000 to 800,000 af and 8,000 cfs for monthly volumes over 800,000 af.

Variations from the Interim Operating Criteria

Variations from the interim operating criteria will be permitted under certain conditions. These variations, which are referred to as "exception criteria," are set forth in the interagency agreement between "United States Department of Energy Western Area Power Administration Salt Lake City Area and United States Department of Interior Bureau of Reclamation Upper Colorado Region Glen Canyon Dam Exception Criteria and Associated Interim Operating Procedure," dated October 21, 1991, which agreement is incorporated in its entirety in these interim operating criteria by this reference.

**APPENDIX III**

**Interagency Agreement  
and  
Amendment 1**

**between**

**United States Department of Energy  
Western Area Power Administration  
Salt Lake City Area**

**and**

**United States Department of the Interior  
Bureau of Reclamation  
Upper Colorado Region**

**Glen Canyon Dam Exception Criteria  
and Associated Interim Operating Procedures**

INTERAGENCY AGREEMENT

BETWEEN

UNITED STATES DEPARTMENT OF ENERGY  
WESTERN AREA POWER ADMINISTRATION  
SALT LAKE CITY AREA

AND

UNITED STATES DEPARTMENT OF THE INTERIOR  
BUREAU OF RECLAMATION  
UPPER COLORADO REGION

GLEN CANYON DAM EXCEPTION CRITERIA  
AND ASSOCIATED INTERIM OPERATING PROCEDURE

INTERAGENCY AGREEMENT

BETWEEN

UNITED STATES DEPARTMENT OF ENERGY  
WESTERN AREA POWER ADMINISTRATION  
SALT LAKE CITY AREA  
AND

UNITED STATES DEPARTMENT OF THE INTERIOR  
BUREAU OF RECLAMATION  
UPPER COLORADO REGION

GLEN CANYON DAM EXCEPTION CRITERIA  
AND ASSOCIATED INTERIM OPERATING PROCEDURE

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INTERAGENCY AGREEMENT

BETWEEN

UNITED STATES DEPARTMENT OF ENERGY  
WESTERN AREA POWER ADMINISTRATION  
SALT LAKE CITY AREA

AND

UNITED STATES DEPARTMENT OF THE INTERIOR  
BUREAU OF RECLAMATION  
UPPER COLORADO REGION

GLEN CANYON DAM EXCEPTION CRITERIA  
AND ASSOCIATED INTERIM OPERATING PROCEDURE

1. PREAMBLE

THIS AGREEMENT is made this 21 day of October, 1991, pursuant to the Acts of Congress approved June 17, 1902 (32 Stat. 388); April 11, 1956 (70 Stat. 105); August 4, 1977 (91 Stat. 565); the Transfer of Functions and Property Agreement, dated March 26, 1980; and Acts amendatory or supplementary to the foregoing Acts; between THE UNITED STATES DEPARTMENT OF ENERGY, Western Area Power Administration, hereinafter called "Western," represented by the officer executing this Agreement or a duly appointed successor, and THE UNITED STATES DEPARTMENT OF THE INTERIOR, Bureau of Reclamation, hereinafter called "Reclamation," represented by the officer executing this Agreement or a duly appointed successor; each sometimes hereinafter individually called Party, or both sometimes hereinafter collectively called the Parties.

2. EXPLANATORY RECITALS

2.1 Reclamation is a Federal agency with management responsibilities for dam operations and power generation at Glen Canyon Dam.

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2.2 Western is a Federal agency responsible for the marketing and delivery of power and energy from Glen Canyon Dam.

2.3 Reclamation and Western have entered into the aforementioned Transfer of Functions and Property Agreement which, among other things, delineates each Party's responsibilities for power system operations including provision of operating reserves, development of schedules, optimizing reserve generation, and cooperation in controlling system voltage.

2.4 Reclamation and Western have joint responsibilities in managing the Upper Colorado River Basin Fund (Basin Fund) consistent with sound business principles.

2.5 Reclamation, as a representative of the Department of the Interior, has a trust responsibility to the Indian tribes and their resources associated with the Grand Canyon area and the operation of Glen Canyon Dam.

2.6 Western has entered into firm electric service contracts with various entities committing the sale of Colorado River Storage Project (CRSP) firm power and energy.

2.7 On July 30, 1991, the Commissioner of Reclamation announced Glen Canyon Dam Test Flows (Test Flows) which set forth new Test Flows and Interim Operating Criteria for water releases

1 from Glen Canyon Dam with the objective of protecting  
2 downstream resources.

3  
4 2.8 Reclamation and Western have an obligation to give  
5 consideration to the impacts of Test Flows and subsequent  
6 Interim Operating Criteria on revenues in the Basin Fund.

7  
8 2.9 Reclamation is requiring Western to adhere to the Test Flows  
9 and subsequent Interim Operating Criteria except for the  
10 situations described herein.

11  
12 2.10 The following Exception Criteria and associated operational  
13 procedures (Procedures) have been jointly prepared and agreed  
14 to by Western and Reclamation, after consultation with the  
15 Cooperating Agencies and interested parties involved with the  
16 development of the Glen Canyon Dam Environmental Impact  
17 Statement (EIS), for use during the Test Flows and subsequent  
18 interim operations. These Procedures are intended to be  
19 applicable to subsequent Interim Operating Criteria as directed  
20 by the Secretary of the Interior. A list of Cooperating  
21 Agencies is attached hereto as Exhibit A.

22  
23 3. AGREEMENT

24 The Parties agree to the terms and conditions set forth herein.  
25  
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27

1           4.     TERM OF AGREEMENT

2           4.1     This Agreement shall become effective on the date of execution  
3                     and shall remain in effect until the date of implementation of  
4                     the record of decision associated with the Glen Canyon Dam EIS.

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6           4.2     The provision of Unloaded Capacity pursuant to Section 3.2 of  
7                     this Agreement will be initially for the period from the date  
8                     of execution and for 90 days thereafter; Provided, That those  
9                     provisions will be amended or they shall continue in full force  
10                    and effect for the period(s) thereafter, as agreed upon by the  
11                    Parties and in consultation with the Cooperating Agencies.

12  
13          4.3     The Parties and the Cooperating Agencies shall periodically  
14                    review, not less often than every 3 months, operations under  
15                    this Agreement, and the Parties hereto shall put into effect  
16                    such modifications as a result of such review, which  
17                    modifications shall be evidenced by amendment to this  
18                    Agreement. Western and Reclamation will regularly report to  
19                    the Glen Canyon Dam EIS Cooperating Agencies at Cooperating  
20                    Agency meetings on the actual operations under this Agreement,  
21                    use of Exception Criteria, and identifiable impacts associated  
22                    with the use of Exception Criteria.



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entity's system at a decreased cost and with greater reliability in meeting WSCC criteria.

5.6 Integrated Value Across the Hour with reference to generation measurement means that the generation, and the corollary water releases, are measured by summing the total deviations with time across the hour and dividing this number by the total number of deviations in the hour.

5.7 Interim Operating Criteria or Test Flows are described in Exhibit D, attached hereto.

5.8 North American Electric Reliability Council (NERC) was formed in 1968 to promote the reliability of bulk electric supply by the electric systems of North America; to conduct interregional studies which relate to the reliability of the bulk electric systems and to make information appropriately available; to encourage and assist the development of interregional reliability arrangements among Regional Electric Reliability Councils and their members; to exchange information with respect to planning and operating matters relating to the reliability of bulk electric supply; and to review periodically regional and interregional activities on reliability. Western is required to report monthly to NERC as to system control performance.

1           5.9     Regulation Control is the use of automatic generation control  
2                   to adjust the power output of electric generators within a  
3                   prescribed area in response to changes in the system frequency,  
4                   time error, and tie-line loading, so as to maintain the  
5                   Scheduled Level of generation in accordance with prescribed  
6                   NERC criteria. This results in instantaneous changes in the  
7                   Glen Canyon Dam generation.

8  
9                   Regulation Control is used at Glen Canyon Dam as a real-time-  
10                   computer-driven change to the hourly schedule. These changes  
11                   which occur many times during the hour are both positive and  
12                   negative in relation to the schedule. The resulting output  
13                   from Glen Canyon generators is an envelope of generation swings  
14                   that are frequent, small in magnitude, and the mean of which  
15                   approximates the original schedule.

16  
17           5.10    Scheduled Level is an established hourly programming of the  
18                   Glen Canyon Dam generation.

19  
20           5.11    System Emergency is defined under Guide III. of the NERC  
21                   Operating Procedure. In general, System Emergencies involve  
22                   the loss of either a significant generation resource or a  
23                   significant transmission resource that leads to an imbalance in  
24                   the delivery, frequency, or voltages of power supply.

25  
26           5.12    Unloaded Capacity is that operable capacity at Glen Canyon  
27                   which is physically able but not presently serving load.

1           5.13   Western Systems Coordinating Council (WSCC) is one of nine  
2                   regional electric reliability councils of NERC and covers most  
3                   of all of 11 western states, two Canadian provinces, and a  
4                   small portion of Mexico.  
5

6           6.       POWER SYSTEM OPERATIONS

7           6.1       Pursuant to Western's firm electric service contractual  
8                   commitments and in accordance with the guidelines and criteria  
9                   of the NERC, WSCC, and revised IPP operating agreement,  
10                  Adequate Generating Capacity must be available to meet system  
11                  regulation needs, maintain transmission reliability, maintain  
12                  operating reserve requirements, and serve firm load  
13                  requirements.  
14

15          6.2       In consideration of power operating guidelines and criteria,  
16                  and in accordance with the following provisions of this  
17                  Agreement, Reclamation will make Unloaded Capacity available  
18                  from the Glen Canyon Dam Powerplant to the power system under  
19                  Emergency Situations so that Western can continue to operate  
20                  within utility industry standards. For emergencies greater  
21                  than one hour's duration, the procedures to resume operations  
22                  consistent with Interim Operating Criteria are described in  
23                  Exhibit B, attached hereto.  
24

25          6.3       This Procedure at Glen Canyon Dam shall be implemented in order  
26                  to provide adequate, reliable, and secure services, and to  
27                  avoid replacement capacity purchases which would become

1 necessary if the Glen Canyon Dam Interim Operating Criteria  
2 were adopted without Exception Criteria.  
3

4 6.4 Western shall, in all instances where the requirements to  
5 exceed Interim Operating Criteria are known sufficiently in  
6 advance, notify Reclamation and the Cooperating Agencies of its  
7 intent to utilize Unloaded Capacity.  
8

9 7. EMERGENCY SITUATIONS AND REGULATION

10 7.1 Glen Canyon Dam generation shall continue to be available to  
11 respond to CRSP System Emergencies as well as to applicable  
12 interconnected System Emergencies as defined by the NERC, WSCC,  
13 or as required pursuant to the IPP Agreement.  
14

15 7.2 If a purchased or supplemental resource becomes unavailable to  
16 Western, it is agreed that Glen Canyon Dam generation will be  
17 available to support firm load until another source of energy  
18 can be found. The generation at Glen Canyon Dam will continue  
19 to be called upon only as a last resort and will be increased  
20 only if other available CRSP or other available generation has  
21 been utilized to maximum allowable levels. Under an  
22 unavailable resource scenario, Western will call for  
23 replacement resources from other interconnected utilities  
24 and/or generation from other Western offices in accordance with  
25 standard utility practice. While additional resources are  
26 being located, other available CRSP generation will be brought  
27 on-line as needed or to the maximum allowable extent to cover

1 load. If additional generation is needed, Glen Canyon Dam  
2 generation will then be increased up to the level needed.  
3

4 7.3 Western will continue to respond to National Park Service  
5 requests for changes in releases for humanitarian reasons  
6 (i.e., rescue and recovery activities).  
7

8 7.4 Should conditions arise pursuant to Sections 7.1, 7.2, or 7.3  
9 of this Agreement which require changes to Glen Canyon Dam  
10 generation outside of Interim Operating Criteria, generation  
11 will be restored at Glen Canyon Dam within appropriate Interim  
12 Operating Criteria in accordance with the provisions of Exhibit  
13 B of this Agreement. (Many times this can be accomplished  
14 within 15 minutes, and only under extraordinary conditions  
15 would this require more than 1 hour.) If, as a result of an  
16 Emergency Situation, generation at Glen Canyon is lost,  
17 generation will be restored as soon as possible. Releases  
18 without generation will be made through the turbines or by-pass  
19 valves as necessary to restore the minimum-release level only  
20 after it has been determined that generation cannot be restored  
21 within a 1-hour time frame. If it is anticipated that  
22 increased Glen Canyon Dam generation will be needed to support  
23 firm load requiring operations outside of Interim Operating  
24 Criteria for more than 1 hour, respective operating supervisors  
25 will be alerted in accordance with the calling list attached as  
26 Exhibit C of this Agreement.  
27

1 7.5 Adequate generation for regulation purposes will be provided at  
2 Glen Canyon Dam and other CRSP facilities pursuant to current  
3 power system operation practices, and generation will be  
4 measured as an Integrated Value Across the Hour. It is agreed  
5 that during Interim Operating Criteria, to the extent  
6 allowable, the Curecanti and/or Flaming Gorge units may be  
7 placed on Regulation Control in addition to Glen Canyon units.  
8

9 7.6 Western will determine which CRSP plants will be placed on  
10 Regulation Control by Reclamation, taking into consideration  
11 sufficient water and associated generation that must be made  
12 available to maintain control area needs on an hourly basis.  
13 If a spill situation at the Crystal Dam becomes likely,  
14 Western/Reclamation will consult regarding water conservation  
15 and other purposes.  
16

17 7.7 For purposes of monitoring compliance with this Procedure, the  
18 Page Supervisory Control and Data Acquisition System will be  
19 the measure of all interim release flows from Glen Canyon Dam.  
20

21 8. OPERATIONS, PERFORMANCE, AND EVALUATION

22 8.1 Western will make every effort to adhere to Interim Operating  
23 Criteria under normal system-operating conditions.  
24

25 8.2 Western will purchase nonfirm energy (interruptible without  
26 capacity) to satisfy its contractual delivery requirements for  
27 firm load. Reclamation will continue to make Unloaded Capacity

1 at Glen Canyon Dam outside of Interim Operating Criteria  
2 available so that energy purchases can be made on a nonfirm  
3 basis to avoid the higher cost of firm power purchases.  
4

5 8.3 On occasions when the need to exceed Interim Operating Criteria  
6 can be anticipated by Western, every effort will be made to  
7 avoid such exceedances during periods of special resource  
8 sensitivity. A listing of sensitive resources and periods of  
9 vulnerability are described in Exhibit E to this Agreement.  
10 Exhibit E will be subject to refinement during the periodic  
11 meetings described in Section 4.3 and the monthly meetings  
12 described in Section 9.1.  
13

14 8.4 Reclamation and Western will review the number of hours in  
15 which the Interim Operating Criteria were exceeded for the  
16 specific purpose of avoiding a high-cost replacement power  
17 purchase purposes for any consecutive 30-day (rolling time)  
18 period. If in any 30-consecutive-day period, operations to  
19 avoid high-cost replacement power purchases exceed Interim  
20 Operating Criteria for more than 3 percent of the 30  
21 consecutive days, the Secretary of the Interior shall suspend  
22 Section 8.2 above, upon 30 days' written notice to Western.  
23 After investigation of cause and consultation with the  
24 Cooperating Agencies, the Secretary of the Interior may  
25 reinstate Section 8.2 above. After such notification and for  
26 the period of suspension, only Exception Criteria for system  
27 regulation and Emergency Situations shall remain.

1 8.5 Reclamation and Western agree that the use of Exception  
2 Criteria for financial reasons will not establish a precedent  
3 for future decisions regarding operating procedures for Glen  
4 Canyon Dam after publication of a final EIS and Record of  
5 Decision.

6  
7 8.6 Reclamation and Western agree that Basin Fund revenues will be  
8 used to fund an adequate scientific monitoring program  
9 associated with this Agreement.

10  
11 9. COORDINATION AND REPORTING

12 9.1 At least monthly, the Salt Lake City Area Manager of Western  
13 and the Upper Colorado Regional Director of Reclamation, or  
14 their designated representatives, will meet to discuss Interim  
15 Operating Criteria and the effects of the Interim Operating  
16 Criteria on Western's and Reclamation's operations and  
17 maintenance budgets. When analysis of future net expenses and  
18 available cash resources indicates the potential for violation  
19 of the Anti-Deficiency Act, appropriate measures (recognizing  
20 the lead time for implementing these measures) including, but  
21 not limited to, deferring or rescheduling Discretionary  
22 Programs, implementing rate adjustments, seeking supplemental  
23 appropriations, and employing other cash management practices  
24 consistent with sound business principles would be taken so  
25 that the Basin Fund is not deficient. Western and Reclamation  
26 operations and scientific personnel and representatives of the  
27 Cooperating Agencies will coordinate and as necessary meet to

1 identify any use of Exception Criteria and impacts of specific  
2 occurrence(s); and to identify effects and provide  
3 recommendations for the meetings described in this section.  
4

5 9.2 Operational communications between Western and Reclamation will  
6 continue through daily morning reports submitted by Western.  
7 These morning reports list any system disturbances that may  
8 have affected CRSP operations during the preceding 24 hours.  
9 In accordance with the provisions of Exhibit C, Reclamation  
10 will be notified when use of Exception Criteria occurs so that  
11 evaluation of the effects can be noted.  
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10. SAFETY

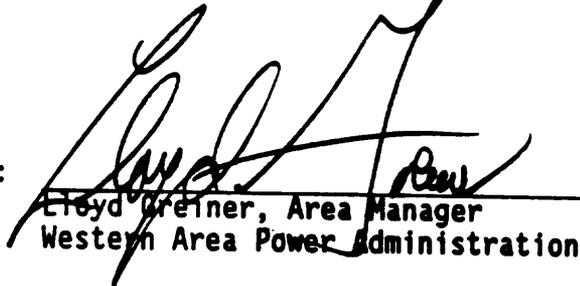
Human safety will not be compromised in order to preserve Interim Operating Criteria.

11. EXHIBITS

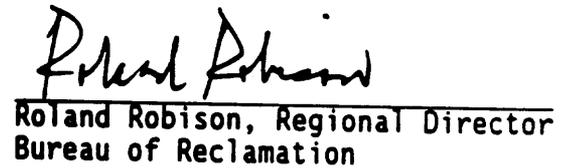
Inasmuch as certain provisions of this Interagency Agreement may change during the term hereof, they may be set forth in exhibits from time-to-time agreed upon by the Parties. The initial Exhibits A, B, C, D and E, and all future exhibits shall be attached hereto and made a part hereof, and each shall be in full force and effect in accordance with its terms unless superseded by a subsequent exhibit.

IN WITNESS WHEREOF, the Parties hereto have caused this Interagency Agreement to be duly executed the day and year first above written.

By:

  
Lloyd Greiner, Area Manager  
Western Area Power Administration

By:

  
Roland Robison, Regional Director  
Bureau of Reclamation

**EXHIBIT A**  
**COOPERATING AGENCIES**

1. Arizona Game and Fish Department
2. Bureau of Indian Affairs
3. Bureau of Reclamation
4. Department of the Interior
5. Fish and Wildlife Service
6. Havasupai Indian Tribe
7. The Hopi Tribe
8. Hualapai Indian Tribe
9. National Park Service
10. The Navajo Nation
11. Western Area Power Administration

EXHIBIT B

PROCEDURES TO RESUME INTERIM OPERATIONS  
FOLLOWING AN EXCEPTION CRITERIA EVENT

1. An event causing releases to be less than minimum flows for periods exceeding 1 hour's duration:
  - a. Return to the current Scheduled Level as quickly as possible if the Scheduled Level can be attained in less than 4 hours. If return to the current Scheduled Level is initiated after 4 hours, ramp up at no greater than 2,500 cfs per hour or at an appropriate rate for resource benefits as agreed upon between Western and Reclamation operations and scientific personnel.
  - b. Use by-pass valves to achieve or maintain a 5,000 cfs minimum (release below a 5,000 cfs minimum for humanitarian emergencies may be an exception).
2. An event causing releases to exceed maximum flows for periods exceeding 1 hour's duration:
  - a. Return to the current Scheduled Level as quickly as possible if the Scheduled Level can be attained in less than 2 hours. If return to the current Scheduled Level is initiated after 2 hours, ramp down at no greater than 2,500 cfs per hour or an appropriate rate for resource benefits as agreed upon between Western and Reclamation operations and scientific personnel.
  - b. If generation cannot follow downramp rate, the by-pass valves may be used to meet downramp requirements.

3. If specific seasonal or ecosystem components require it, the agreed-upon return to Interim Operating Criteria may be modified from the above-stated numbers. The specifics will be discussed during meetings between Western and Reclamation operations and scientific personnel and representatives of the Cooperating Agencies described in Section 9.1 of this Agreement.

EXHIBIT C  
CALLING LIST

This calling list shall be used when system conditions exist pursuant to Sections 7.4, 8.2 and 8.4 of this Agreement.

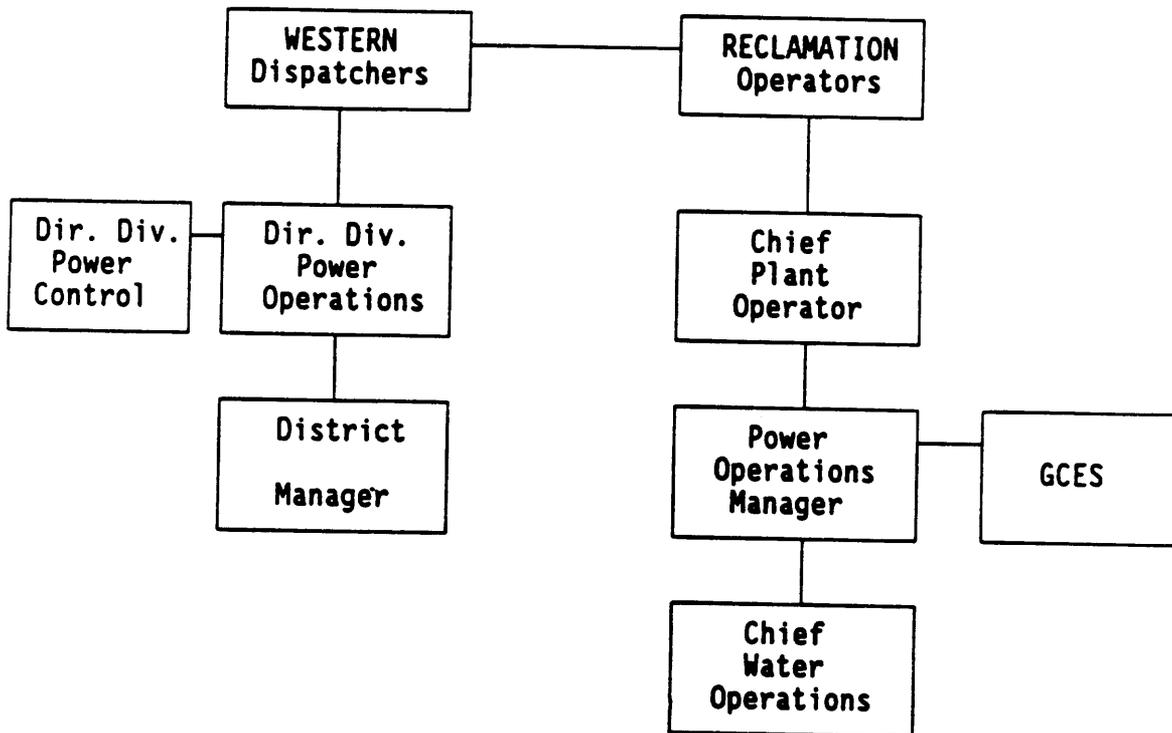


EXHIBIT D

INTERIM OPERATING CRITERIA

1. On July 30, 1991, Reclamation implemented the following test of Interim Operating Criteria:

Parameter

Maximum Flow	20,000 cfs <sup>1</sup>
Minimum Flow	5,000 cfs - nighttime 8,000 cfs - 7 a.m. to 7 p.m. <sup>2</sup>

Ramp Rates

Ascending	8,000 cfs/4 hours not to exceed 2,500 cfs/hour
Descending	1,500 cfs/hour

Daily Fluctuations 5,000/8,000 cfs<sup>3</sup>

2. These Interim Operating Criteria can be amended from time to time by the Secretary of the Interior.

---

<sup>1</sup> To be evaluated and potentially increased as necessary for years when delivery to the Lower Basin exceeds 8.23 maf.

<sup>2</sup>The 8,000 cfs minimum flow requirement from 7 a.m. to 7 p.m. will be shifted to 8 a.m. and 8 p.m. respectively beginning the last Sunday in October and ending the first Sunday in April, Arizona local standard time.

<sup>3</sup> Daily fluctuation limit of 5,000 cfs for months with release volumes less than 600,000 af, 6,000 cfs for monthly release volumes of 600,000 to 800,000 af and 8,000 cfs for monthly volumes over 800,000 af.

EXHIBIT E

CRITICAL ECOSYSTEM ELEMENTS  
GLEN AND GRAND CANYONS

1. The Interim Operating Criteria have been designed to reduce the impact of Glen Canyon Dam operations on the natural resources in the Glen and Grand Canyons. Deviations from the Interim Operating Criteria may affect the resources of concern. The level of impact will vary depending upon the magnitude, duration, timing and frequency of the deviation.
2. The natural resources in the Glen and Grand Canyons will have varying levels of impact depending on time of the year and extent of the flow change. The information presented below is to be used by the operators of both Western and Reclamation in their decision process as related to deviations from the interim operations. During the months of greater potential resource impacts, additional coordination should be sought from the Environmental Studies' scientists prior to initiating an exception to the interim operations.
3. Listed below are critical periods of time for selected natural resources in the Glen and Grand Canyons.

Deviations Lower Than the Minimum (5,000 cfs)

<u>Resource</u>	<u>Impact</u>	<u>Critical Period</u>
Trout	Stranding adults Stranding eggs	December - March December - March
Cladophora	Freezing Desiccation	December - February June - August
Native Fish	Larval stranding	May - August
Vegetation	Desiccation	May - September

Deviations Higher than the Maximum (20,000 cfs)

<u>Resource</u>	<u>Impact</u>	<u>Critical Period</u>
Vegetation	Flooding	May - June
Insects	Flooding	May - September
Waterfowl	Flooding nests	May - June
Passerine Birds	Flooding nests	May - June
Native Fish	Washed out of backwaters	March - October
Reptiles	Flooding	May - September

4. The resources and impacts listed above represent both critical resources and indicators for the ecosystem. The Procedures to Resume Interim Operations Following an Exception Criteria (Exhibit B) should be used in general to return to Interim Operating Criteria following an exception. However, during the critical periods identified above, all efforts should be made to avoid deviating from the interim operations levels. If an exception from interim operations occurs, the Environmental Studies' scientists should be contacted to provide additional guidance on how to return to the Interim Operating Criteria. If contact cannot be established, the criteria defined in Exhibit B should be followed.
5. As additional data from the Environmental Studies are collected and analyzed, modification of the above stated resources will be made as appropriate.

AUTHENTICATED COPY

INTERAGENCY AGREEMENT

BETWEEN

UNITED STATES DEPARTMENT OF ENERGY  
WESTERN AREA POWER ADMINISTRATION  
SALT LAKE CITY AREA

AND

UNITED STATES DEPARTMENT OF THE INTERIOR  
BUREAU OF RECLAMATION  
UPPER COLORADO REGION

FOR

GLEN CANYON DAM EXCEPTION CRITERIA  
AND  
ASSOCIATED INTERIM OPERATING PROCEDURE

INTERAGENCY AGREEMENT  
BETWEEN  
UNITED STATES DEPARTMENT OF ENERGY  
WESTERN AREA POWER ADMINISTRATION  
SALT LAKE CITY AREA  
AND  
UNITED STATES DEPARTMENT OF THE INTERIOR  
BUREAU OF RECLAMATION  
UPPER COLORADO REGION  
FOR  
GLEN CANYON DAM EXCEPTION CRITERIA  
AND  
ASSOCIATED INTERIM OPERATING PROCEDURE

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INTERAGENCY AGREEMENT  
BETWEEN

UNITED STATES DEPARTMENT OF ENERGY  
WESTERN AREA POWER ADMINISTRATION  
SALT LAKE CITY AREA

AND

UNITED STATES DEPARTMENT OF THE INTERIOR  
BUREAU OF RECLAMATION  
UPPER COLORADO REGION

FOR

GLEN CANYON DAM EXCEPTION CRITERIA  
AND  
ASSOCIATED INTERIM OPERATING PROCEDURE

11 1 PREAMBLE

12 This Interagency Agreement Amendment is made this 14th day of  
13 February 1992, between the UNITED STATES OF AMERICA, Western Area  
14 Power Administration (Western) and THE UNITED STATES DEPARTMENT OF THE  
15 INTERIOR, Bureau of Reclamation, as part of Interagency Agreement No.  
16 91-SLC-0180, pursuant to the same authorities as the Original Agreement, and  
17 subject to all of the provisions of the Original Agreement except as herein  
18 amended.  
19

20 2 EXPLANATORY RECITALS

- 21 2.1 The Parties hereto entered into that certain Original Agreement No.  
22 90-SLC-0180, dated October 21, 1991, hereinafter called the Original  
23 Agreement.  
24  
25 2.2 The Parties desire to extend the term (Section 4.2) of the Original  
26 Agreement from January 19, 1992, through April 17, 1992.  
27  
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3 AGREEMENT

The Parties agree to the terms and conditions set forth herein.

4 MODIFICATION OF SECTION 4 OF THE ORIGINAL AGREEMENT

(TERM OF AGREEMENT)

Section 4.2 of the Original Agreement is hereby deleted and the following substituted therefor:

"4.2 The term of this Agreement related to those provisions of Unloaded Capacity pursuant to Section 8.2 of this Agreement will be extended from January 19, 1992, through April 17, 1992; Provided, That those provisions will be amended or they shall continue in full force and effect for the period(s) thereafter as agreed upon by the Parties, and in consultation with the Cooperating Agencies, as evidenced by the execution of future amendments to this Agreement."

5 ORIGINAL INTERAGENCY AGREEMENT TO REMAIN IN EFFECT

Except as modified by this Amendment, the Original Agreement shall remain in full force and effect.

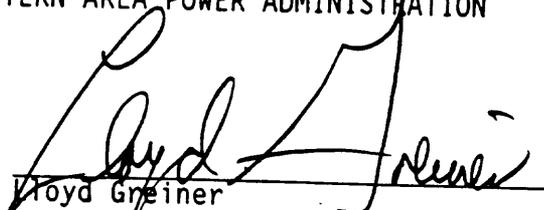
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IN WITNESS WHEREOF, the Parties hereto have caused this Amendment No. 1 to be  
duly executed the day and year first above written.

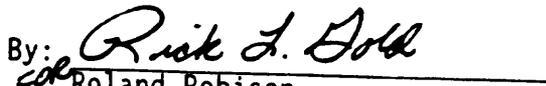
U.S. DEPARTMENT OF ENERGY  
WESTERN AREA POWER ADMINISTRATION

U.S. DEPARTMENT OF THE INTERIOR  
BUREAU OF RECLAMATION

By:

  
Lloyd Greiner  
Area Manager  
Salt Lake City Area Office  
Western Area Power Administration  
Salt Lake City, Utah

By:

  
Roland Robison  
Regional Director  
Upper Colorado Region  
Bureau of Reclamation  
Salt Lake City, Utah

**APPENDIX IV**

**Finding of No Significant Impact**

**Glen Canyon Dam**

**Interim Operating Criteria  
Arizona**

UNITED STATES DEPARTMENT OF THE INTERIOR  
BUREAU OF RECLAMATION

UPPER COLORADO REGION  
SALT LAKE CITY, UTAH

FINDING OF NO SIGNIFICANT IMPACT

GLEN CANYON DAM INTERIM OPERATING CRITERIA  
ARIZONA

Recommended: *Larry Wellbank* 10/31/91  
Regional Environmental Officer Date

Approved: *Robert Johnson* 10/31/91  
Regional Director Date

## **FINDING OF NO SIGNIFICANT IMPACT**

### **Glen Canyon Dam Interim Operating Criteria Arizona**

In accordance with the National Environmental Policy Act of 1969, as amended, and the Council on Environmental Quality's Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (40 CFR Parts 1500-1508), the Bureau of Reclamation (Reclamation) has determined that an environmental impact statement (EIS) is not required for implementation of the Glen Canyon Dam interim operating criteria, Arizona.

### **BACKGROUND**

The Secretary of the Interior, on July 27, 1989, directed the preparation of an EIS on the effects of the operation of Glen Canyon Dam on the environmental and ecological resources on the Colorado River downstream of Glen Canyon Dam in Glen Canyon National Recreation Area and Grand Canyon National Park. The EIS and associated Glen Canyon Environmental Studies are currently being undertaken to evaluate the impacts of current and alternative dam operations on the downstream resources. The environmental studies included research flows from June 1990 through July 1991 to help determine the impact of alternative dam operations. Following completion of the EIS and subsequent Record of Decision (ROD) in about 3 years, final operating criteria for Glen Canyon Dam will be implemented.

To provide interim protection of downstream resources until completion of the ROD, the Secretary of the Interior committed to implement interim operating criteria within 90 days of completion of the research flows. The interim operating criteria are to be implemented by November 1, 1991, and continue until a decision is made on the final operating criteria.

The interim operating criteria are a temporary measure designed to ameliorate the rate of adverse change on downstream resources resulting from past dam operations, and to continue to gather information on those changes pending completion of the current EIS on dam operations and a final decision on permanent long-term operating criteria.

### **PROPOSED ACTION**

The Glen Canyon Dam interim operating criteria, low fluctuating flow alternative, would protect downstream Colorado River resources pending completion of the Glen Canyon Dam EIS and the ROD selecting and implementing a final plan for operating Glen Canyon Dam. It would permit release of water from Glen Canyon Dam in a manner that would decrease the magnitude of daily fluctuating flows and ramping rates in order to reduce the adverse effects of current powerplant operations on downstream beaches, sediment-dependent resources, and aquatic resources. Fluctuating flows for power generation would be well below existing levels.

Daily fluctuations would be limited to 5,000, 6,000, or 8,000 cubic feet per second (cfs), depending on monthly release volumes. The maximum flow under a fluctuating flow regime would be limited to 20,000 cfs; any release greater than 20,000 cfs, in order to avoid anticipated spills or in years when the annual release exceeds 8.23 million acre-feet (maf), would be evaluated with the Cooperating Agencies and the seven Basin States.

Minimum flows would be 5,000 cfs between 7 p.m. and 7 a.m. and 8,000 cfs between 7 a.m. and 7 p.m. The 8,000 cfs minimum flow requirement from 7 a.m. to 7 p.m. will be shifted to 8 a.m. and 8 p.m. respectively beginning the last Sunday in October and ending the first Sunday in April, Arizona local standard time. Ramping rates would be limited to 2,500 cfs per hour for increasing flows and 1,500 cfs per hour for decreasing flows.

The scheduled annual and monthly release volumes would be determined using existing practices based on considerations for maintaining conservation storage, avoiding spills, balancing storage between lakes Powell and Mead, and when possible, meeting power needs, recreational demands, and fish and wildlife concerns.

Operational and financial exception criteria are elements of the low fluctuating flow alternative. Exception criteria provide for the criteria described above to respond to system disturbances or other emergency conditions, for system regulation, and as a means of avoiding the expense of purchasing replacement firm capacity and energy. The use of the latter exception (termed financial exception criteria) would be limited to 3 percent (22 hours) of any consecutive 30-day period. The hydropower resource would display minimal increases in system-wide power production costs, but with financial exception criteria in place, increased power purchase costs to consumers should be minor. The exception criteria are detailed in an October 21, 1991, Interagency Agreement between Reclamation and Western Area Power Administration.

A detailed discussion of the proposed interim operating criteria and environmental consequences is found in the October 1991 final Environmental Assessment on the Glen Canyon Dam Interim Operating Criteria:

## ENVIRONMENTAL IMPACT

The proposed action would not constitute a major Federal action having significant effects on the quality of the human environment. The environmental assessment and subsequent comments indicate that impacts to the human environment would be short term and minor. Summarized below are the impacts of low fluctuating flows including the financial exception criteria element.

1. The proposed action would not affect climate, geology/topography, aesthetics, water supply, water quality, or air quality.
2. Sediment resources would be impacted less than under current operations. Even the most adverse condition—decreasing flow coupled with a flow decrease of more than 8,000 cfs over 24 hours—would occur infrequently and would be rapidly attenuated downstream.

3. **Vegetation in the New High Water and fluctuating zones would benefit from the proposed operation, and vegetation in the Old High Water Zone would continue to decline at the present rate.**
4. **Because wildlife is closely tied to the riverine vegetation habitat, the effects on wildlife are equal to and are mediated by the minor effects on vegetation.**
5. **Native fishes and rainbow trout would be minimally benefitted from the proposed flow regime.**
6. **Endangered species would not be adversely affected because proposed interim operations have been designed to assist in reducing adverse impacts to downstream natural resources and to endangered, threatened, or proposed endangered species.**
7. **Cultural resources would be impacted less than under current operations. Reclamation and the National Park Service are consulting with the Arizona State Historic Preservation Officer and the Advisory Council on Historic Preservation for compliance with Section 106 of the National Historic Preservation Act.**
8. **Recreational resources would be improved by lower fluctuations and better access to the Glen Canyon reach of the river for angling and day-use rafting, and through improved camping/trip scheduling opportunities for white-water boaters.**
9. **Implementation of interim operating criteria would protect Indian trust assets in Glen and Grand Canyons from loss or damage until a long-term change in Glen Canyon Dam operations is implemented. The impacts to Indian trust assets would be identical to those presented above.**

**An environmental monitoring program, including periodic reports, would be carried out while the interim operating criteria are in effect. The program would evaluate flow characteristics, impacts of the exception criteria on flows and resources, and resources responses to the flows. The Interagency Agreement provides a mechanism for revising the flows to protect resources.**

**APPENDIX V**

**Monitoring of Flow Criteria**

# Glen Canyon Dam Hourly Releases

Instantaneous Values

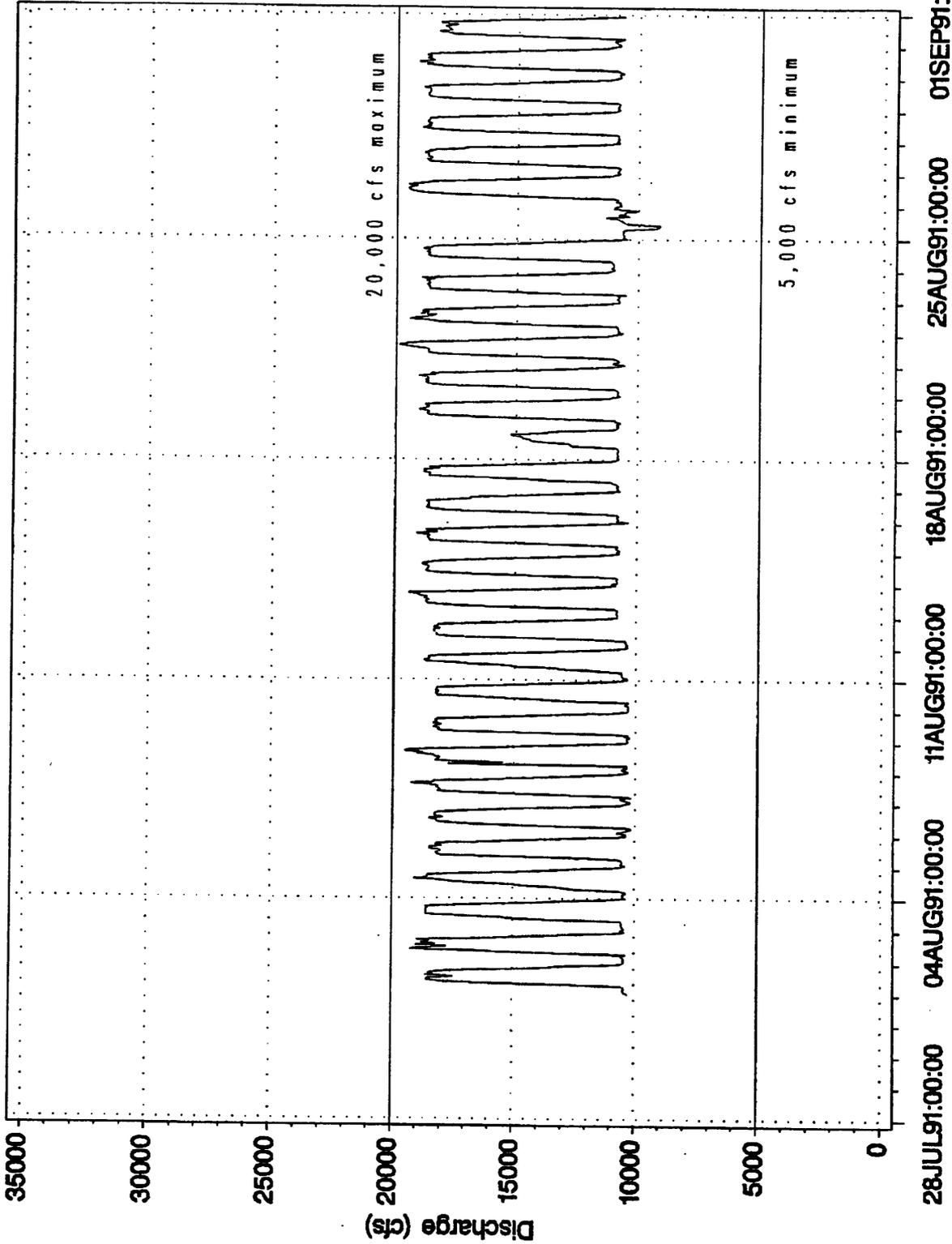


Chart V-1

# Glen Canyon Dam Hourly Releases

Instantaneous Values

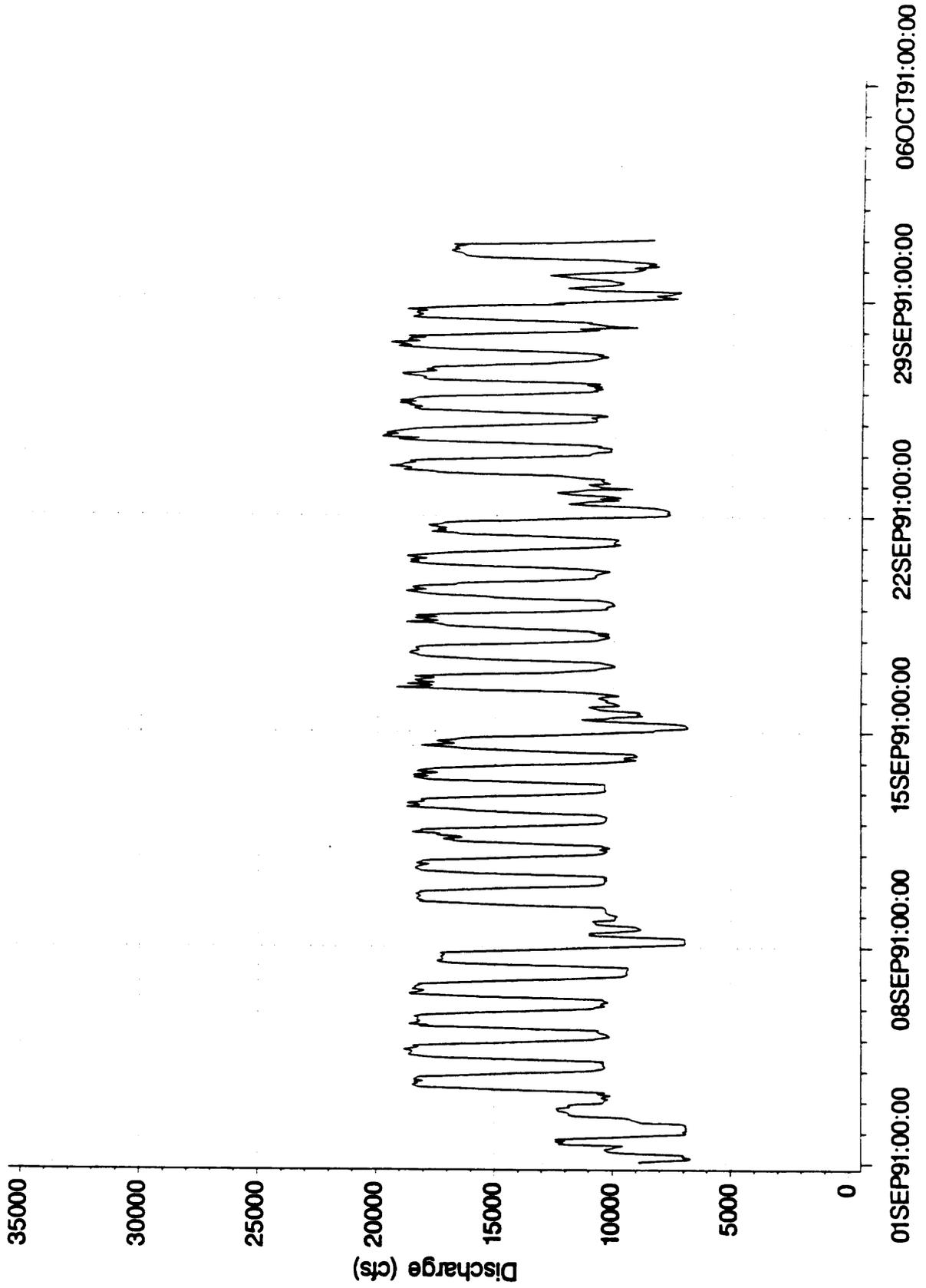


Chart V-2

Date and Time

# Glen Canyon Dam Hourly Releases

Instantaneous Values

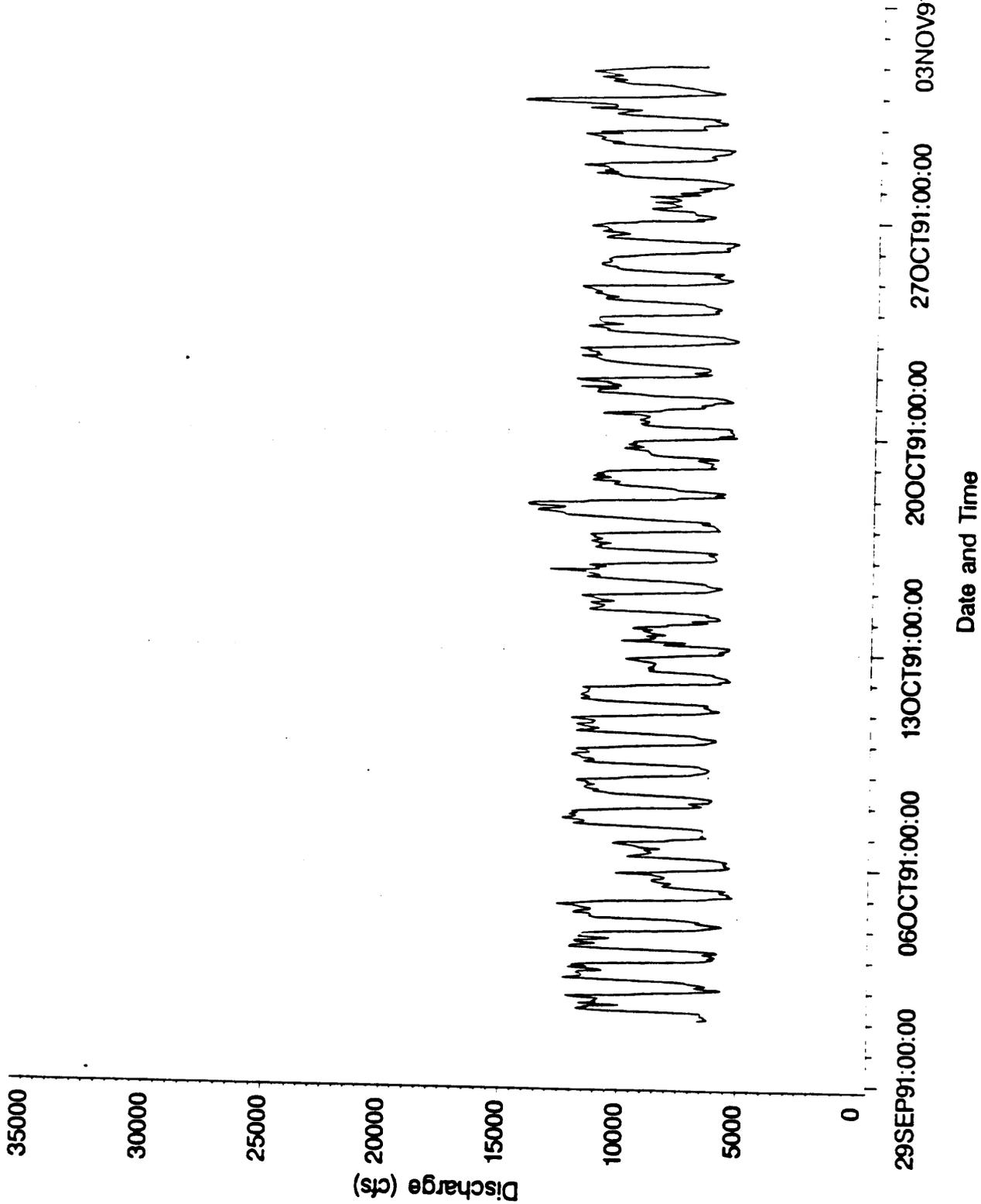


Chart V-3

# Glen Canyon Dam Hourly Releases

Instantaneous Values

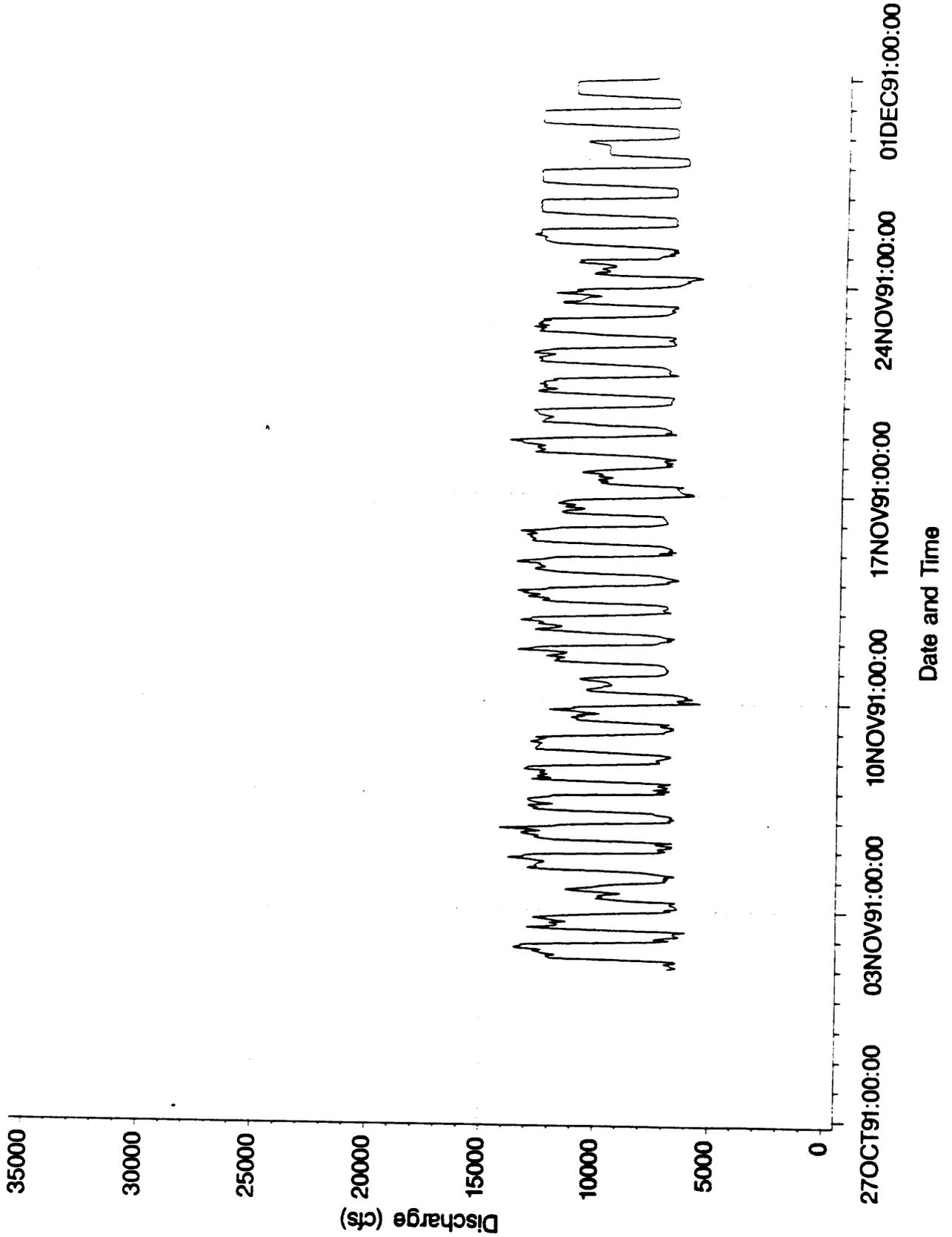


Chart V-4

# Glen Canyon Dam Hourly Releases

Instantaneous Values

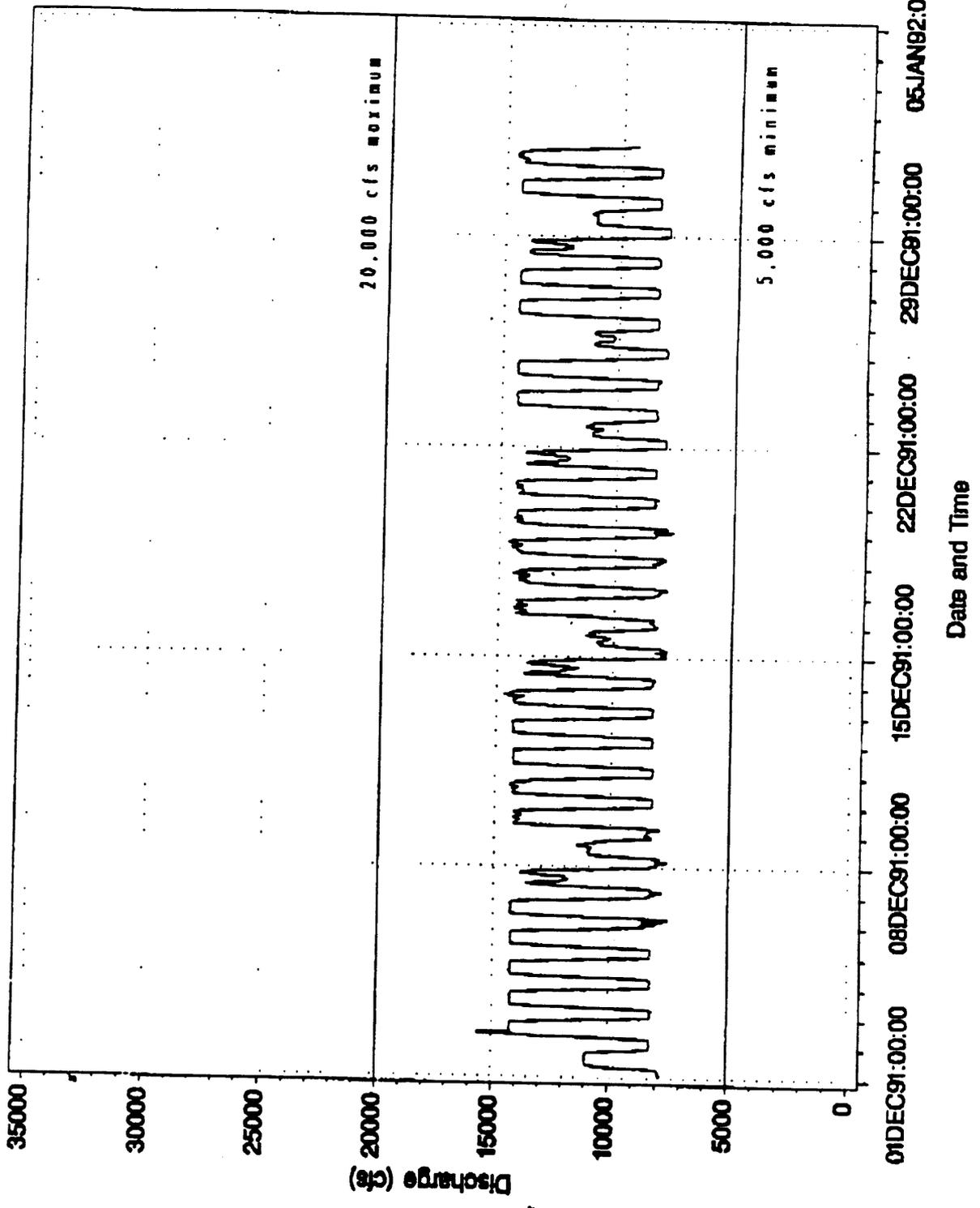


Chart V-5

Glen Canyon Dam Hourly Releases  
Daily Mean, Min, Max, and Range (cfs)

Date	Mean	Min	Max	Range
01AUG91	14437	10290	18613	8323
02AUG91	14481	10338	19219	8881
03AUG91	14452	10419	18598	8179
04AUG91	14162	10392	19084	8692
05AUG91	14693	10392	18490	8098
06AUG91	14606	10149	18490	8341
07AUG91	14657	10176	19246	9070
08AUG91	15130	10284	19515	9231
09AUG91	14655	10203	18355	8152
10AUG91	14082	10284	18274	7990
11AUG91	14164	10338	18745	8407
12AUG91	14691	10333	18366	8033
13AUG91	15157	10766	19394	8628
14AUG91	15073	10766	18853	8087
15AUG91	15045	10711	19097	8386
16AUG91	14908	10360	18691	8331
17AUG91	14610	10711	18826	8115
18AUG91	12489	10739	15233	4494
19AUG91	15120	10680	19001	8321
20AUG91	15104	10734	19028	8294
21AUG91	15254	10544	19868	9324
22AUG91	15146	10625	19407	8782
23AUG91	15083	10490	18947	8457
24AUG91	14870	10978	18877	7899
25AUG91	10478	9126	11353	2227
26AUG91	15297	10729	19529	8800
27AUG91	15185	10756	18877	8121
28AUG91	15122	10783	18958	8175
29AUG91	15126	10810	18904	8094
30AUG91	15131	10674	19121	8447
31AUG91	14651	10615	18290	7675

# Glen Canyon Dam Hourly Releases

Daily Min, Mean, Max, and Range

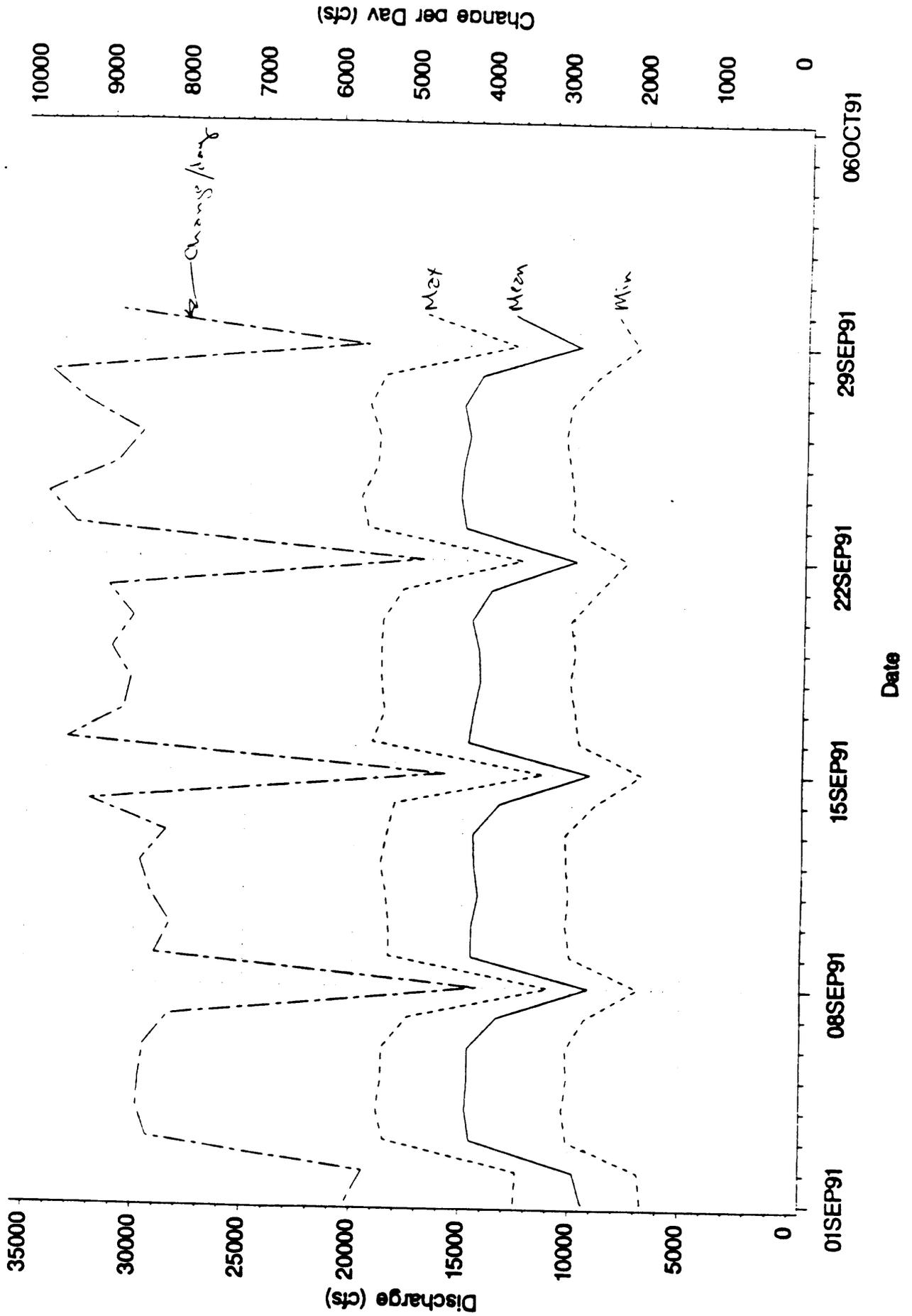
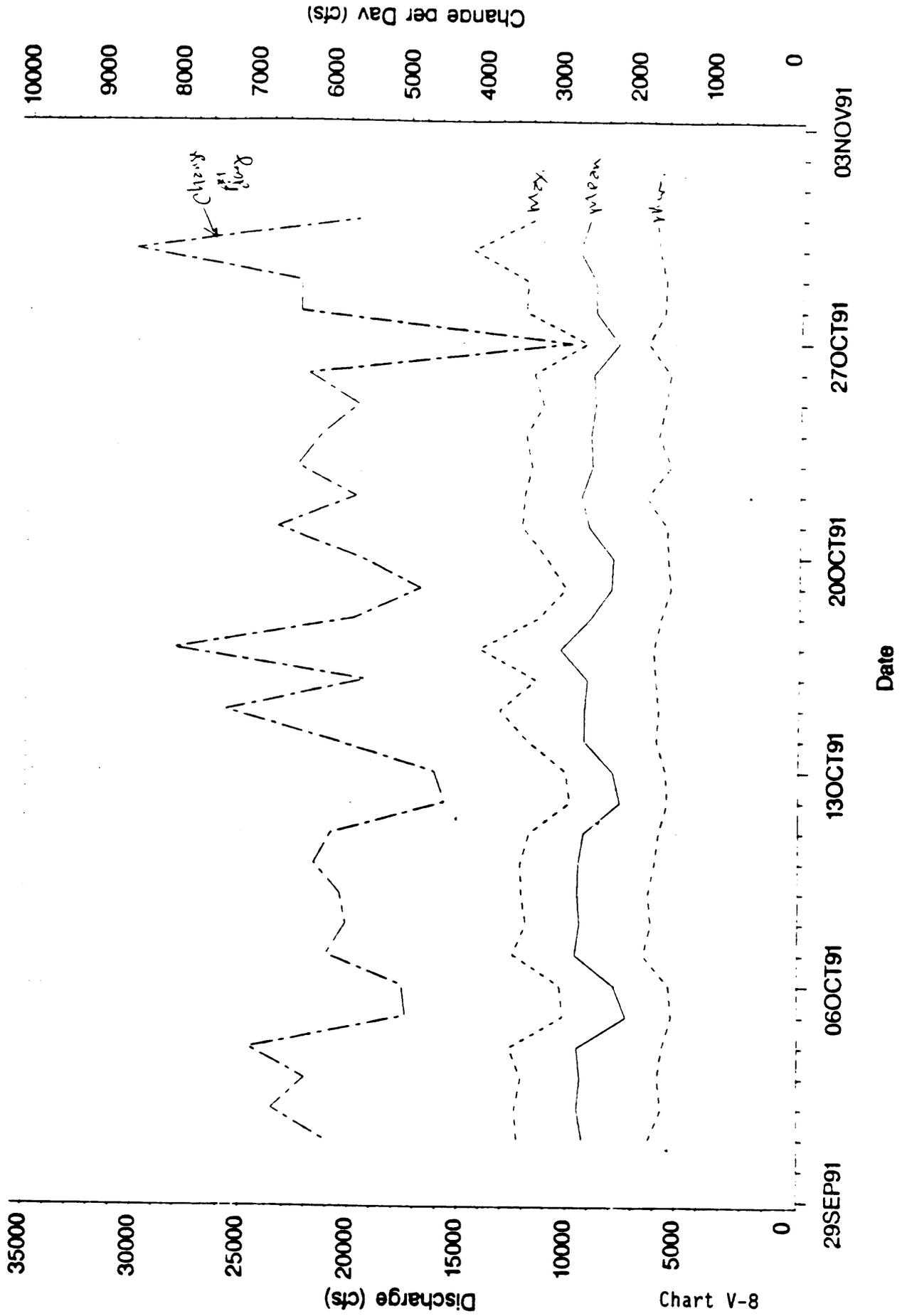


Chart V-7

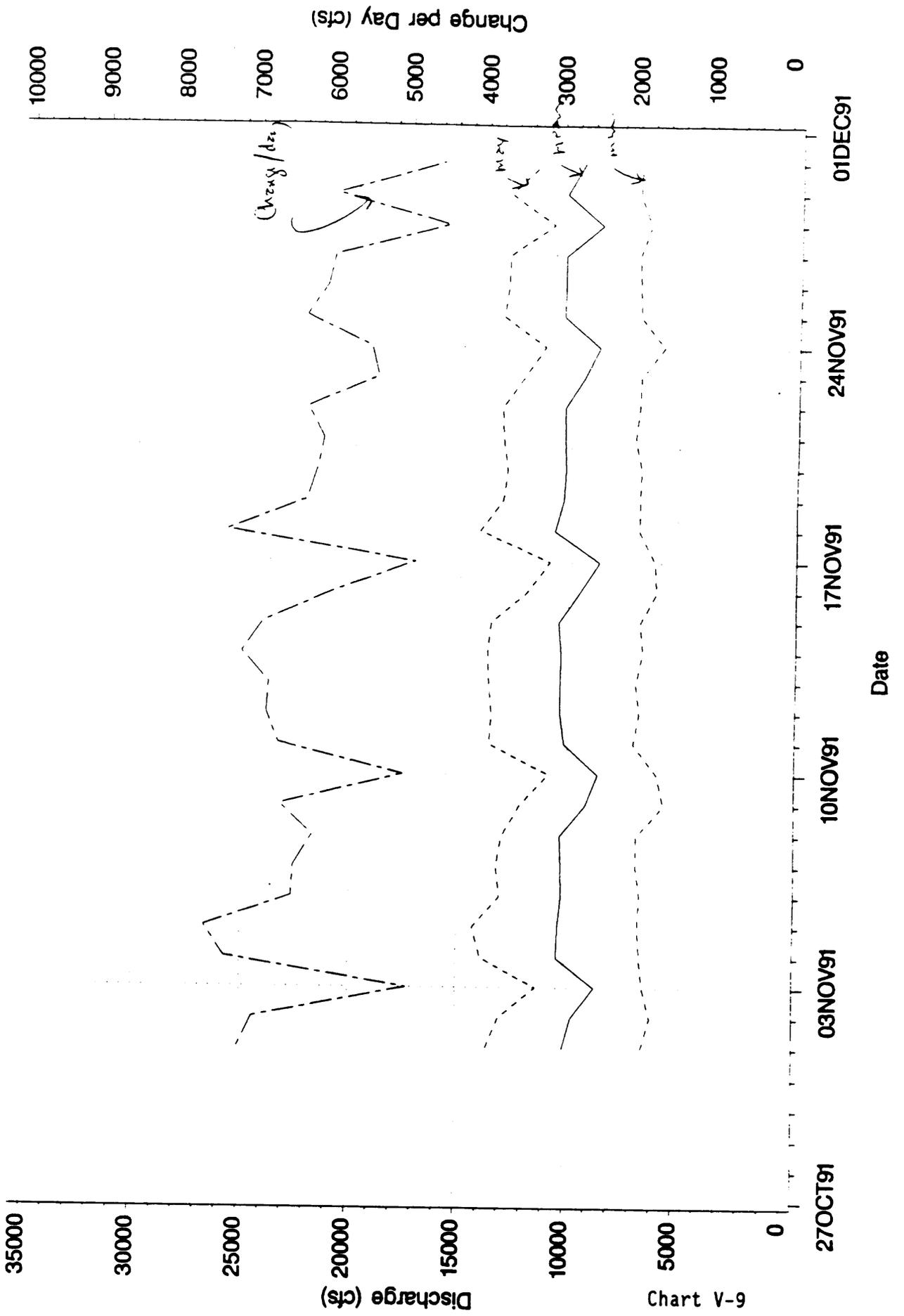
# Glen Canyon Dam Hourly Releases

Daily Min, Mean, Max, and Range



# Glen Canyon Dam Hourly Releases

Daily Min, Mean, Max, and Range



# Glen Canyon Dam Hourly Releases

Hourly Ramping Rates (cfs/hour)

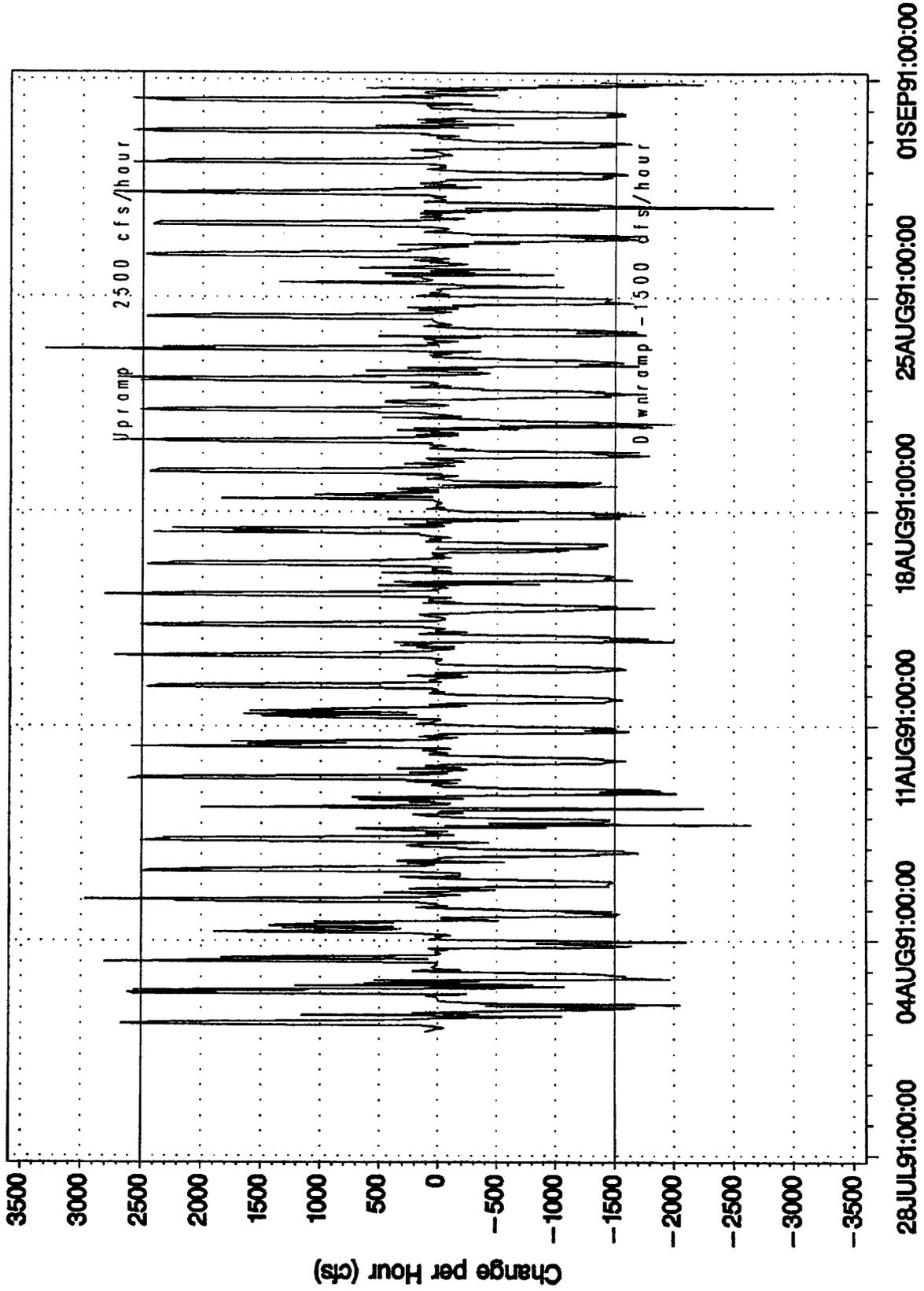


Chart V-10

# Glen Canyon Dam Hourly Releases

Hourly Ramping Rates (cfs/hour)

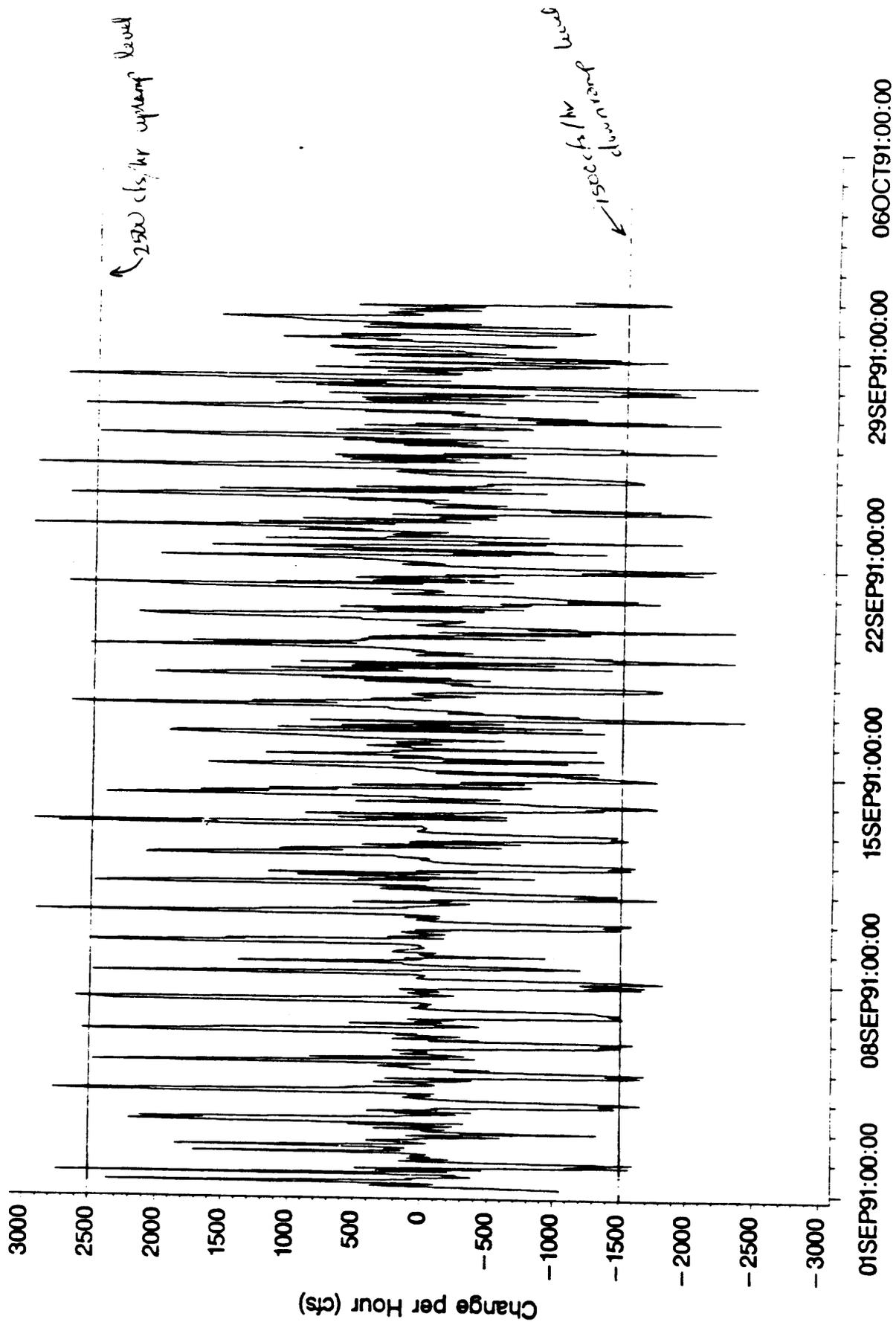


Chart V-11

# Glen Canyon Dam Hourly Releases

Hourly Ramping Rates (cfs/hr)

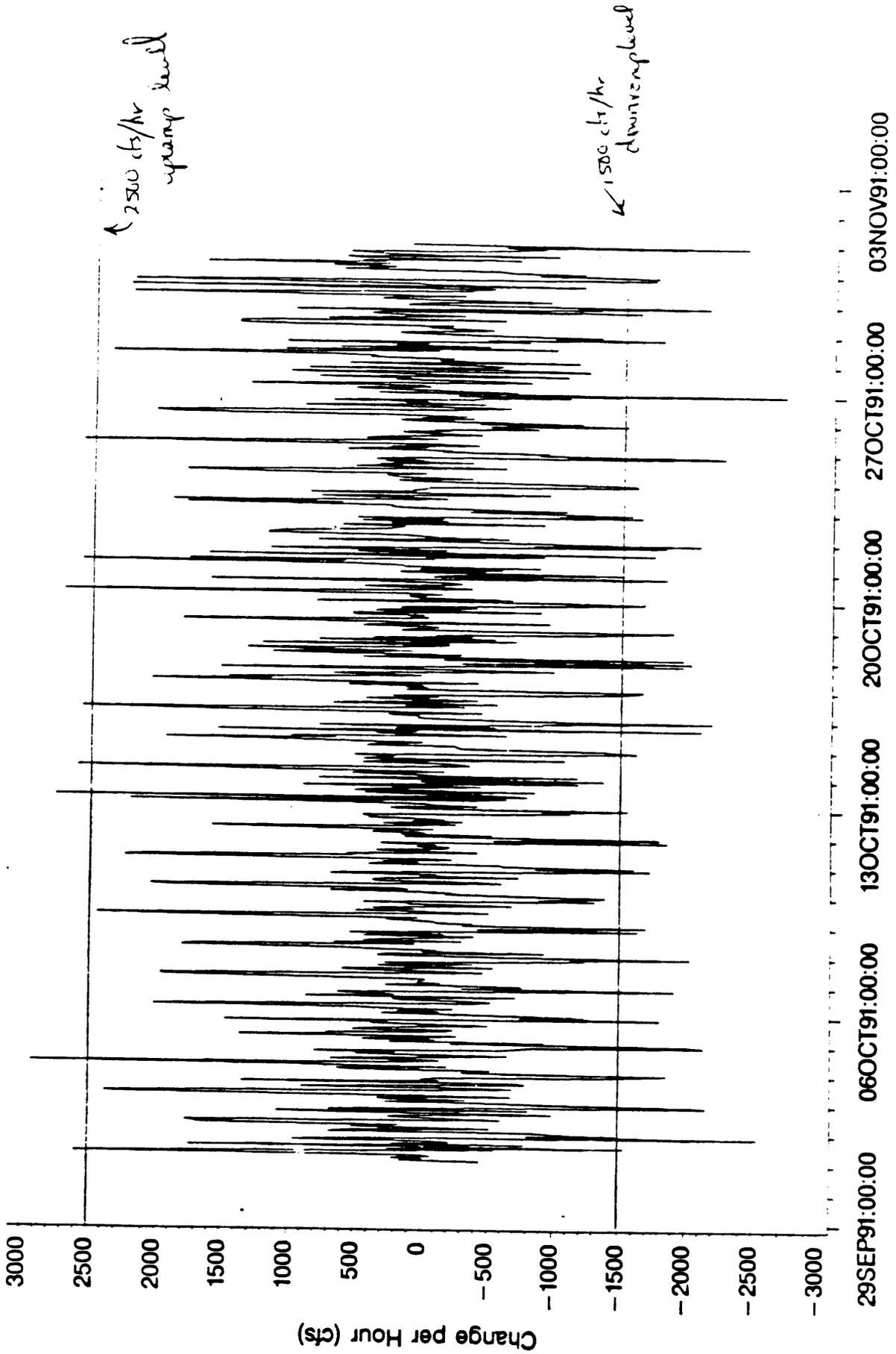


Chart V-12

# Glen Canyon Dam Hourly Releases

Hourly Ramping Rates (cfs/hour)

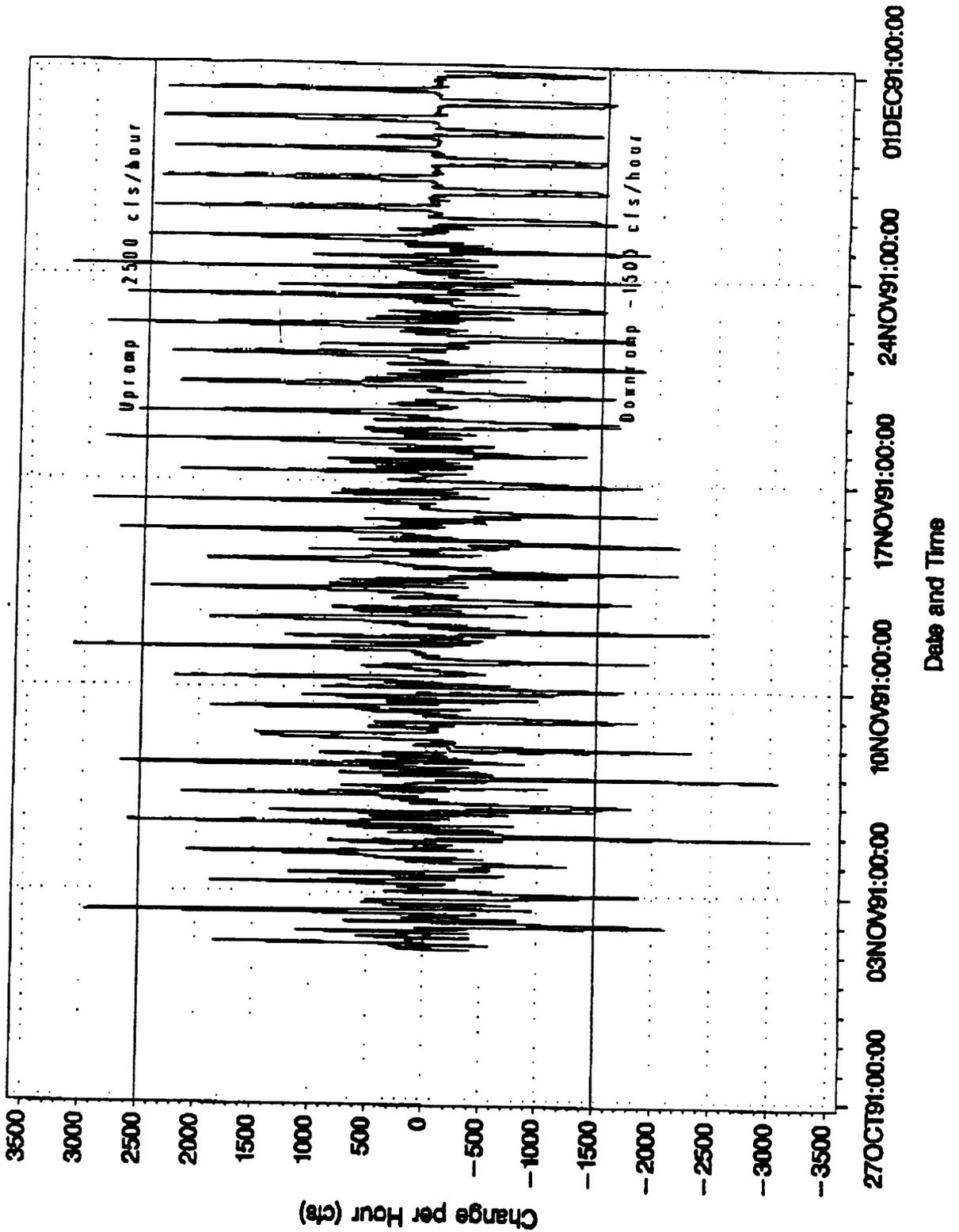


Chart V-13

# Glen Canyon Dam Hourly Releases

## Hourly Ramping Rates (cfs/hour)

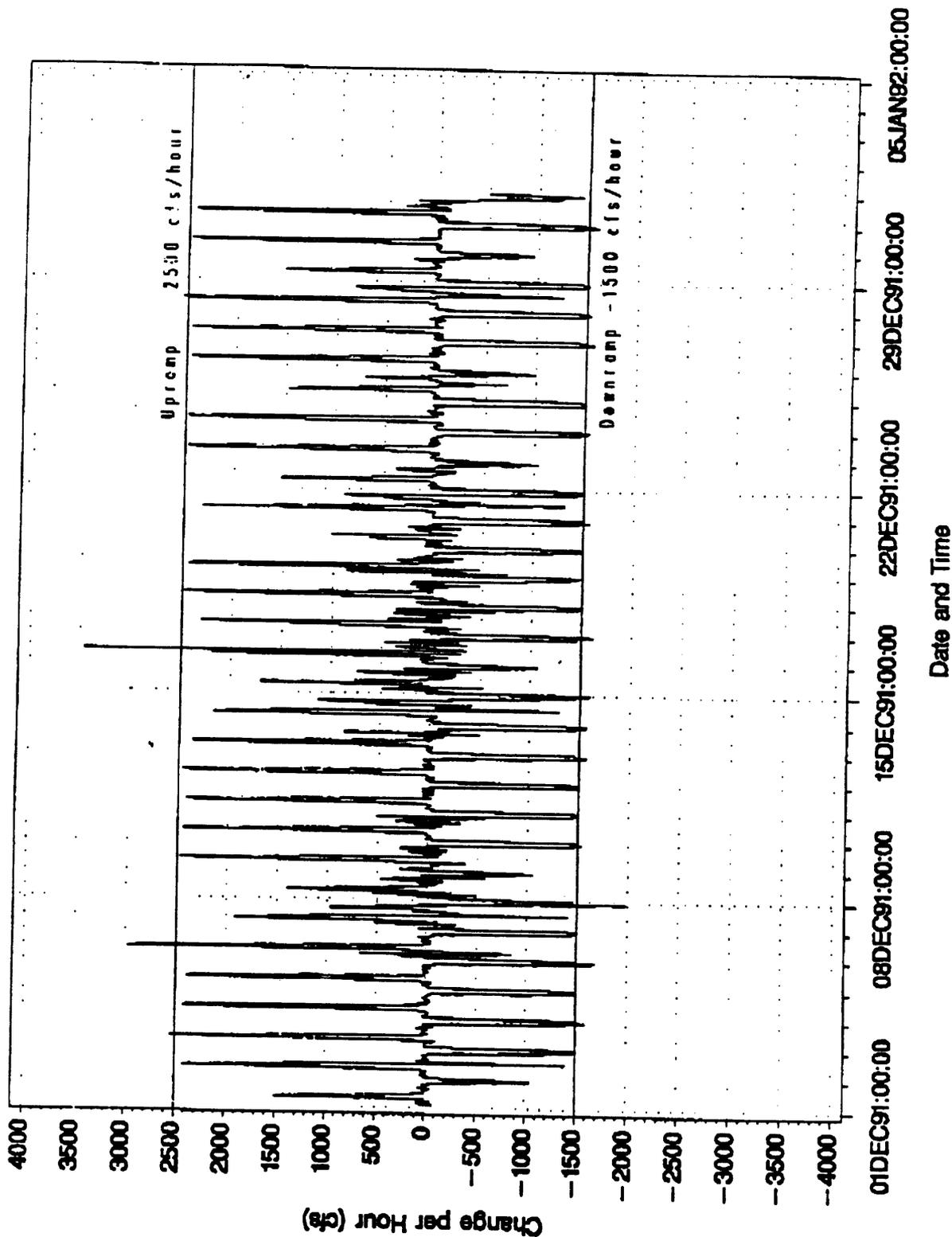
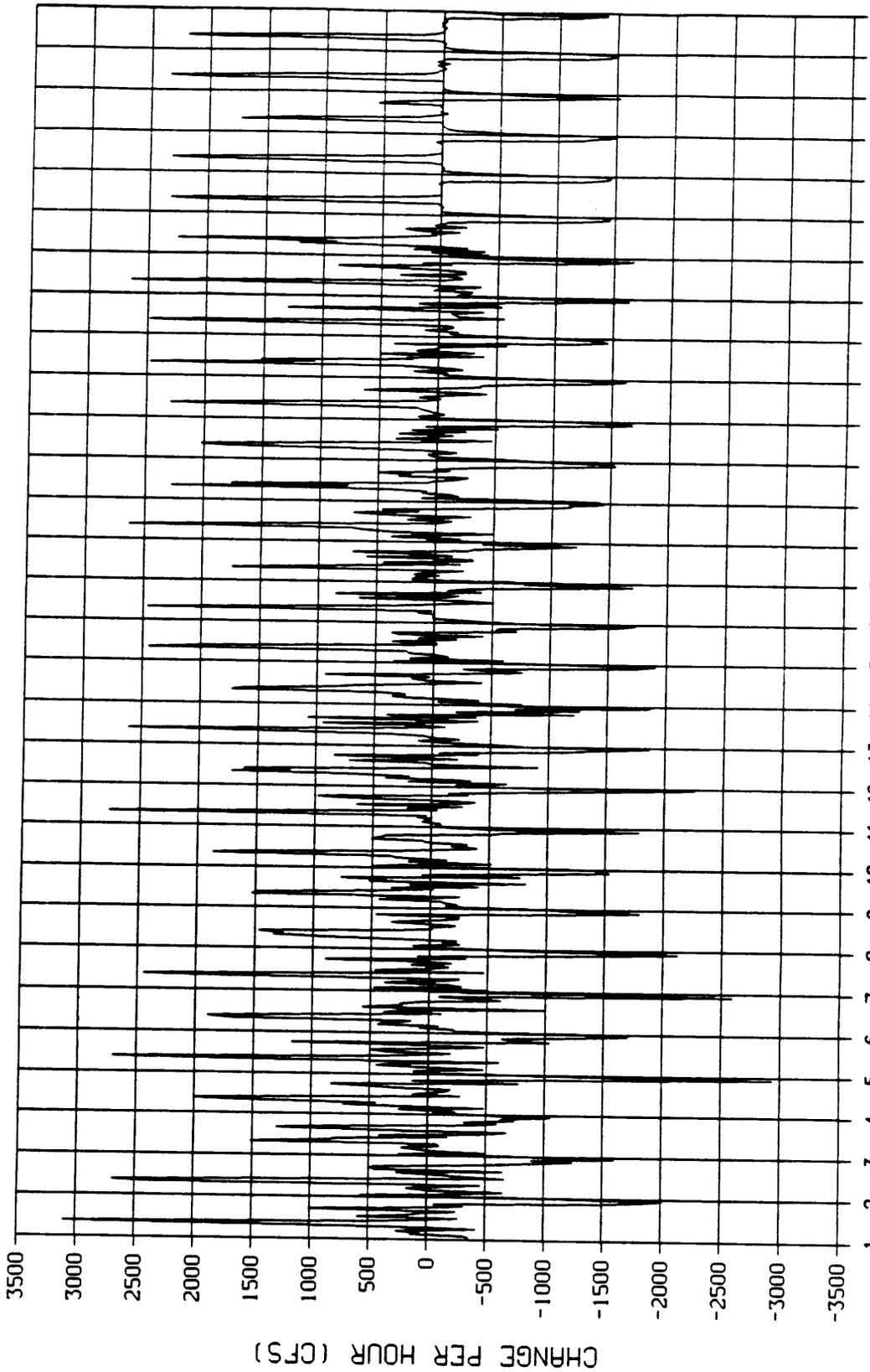


Chart V-14

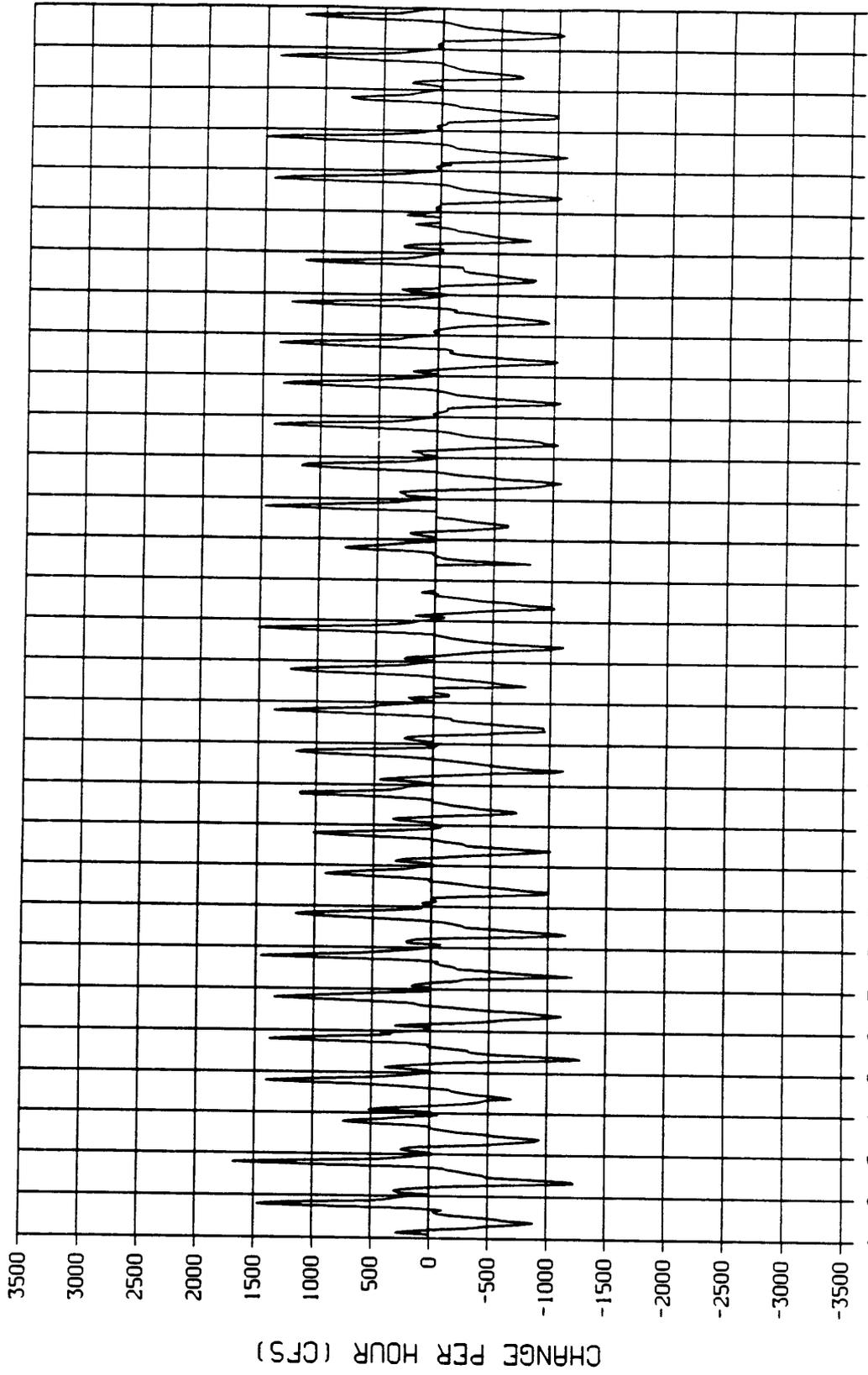
# COLORADO RIVER BELOW GLEN CANYON HOURLY RAMPING RATES (CFS/HR)



NOVEMBER 1991  
DECEMBER

Chart V-15

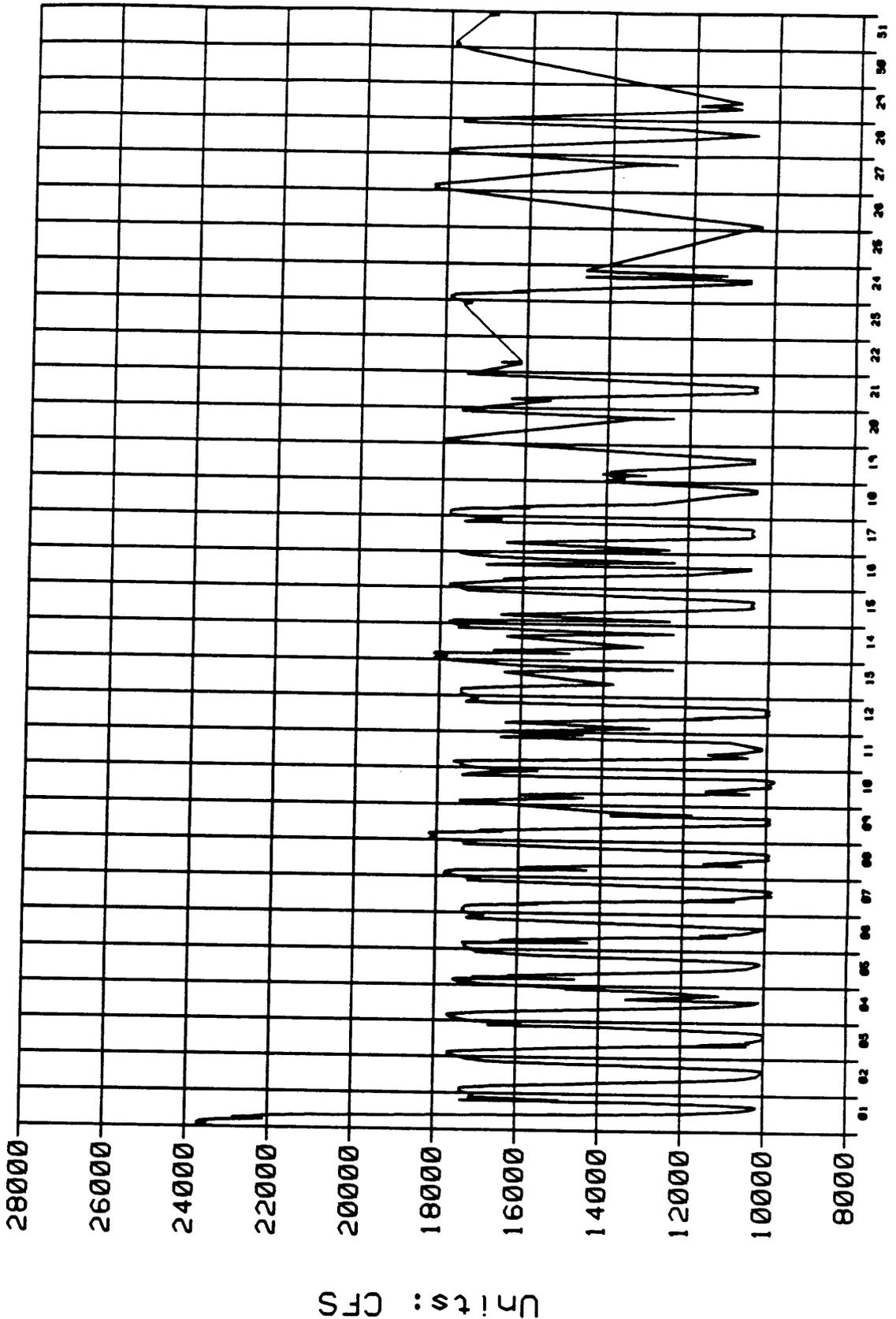
# COLORADO RIVER AT LEES FERRY HOURLY RAMPING RATES (CFS/HR)



NOVEMBER  
1991  
DECEMBER

Chart V-16

Data From 01-AUG-1991 Through 31-AUG-1991  
Plotted 12-SEP-91 08:29:38

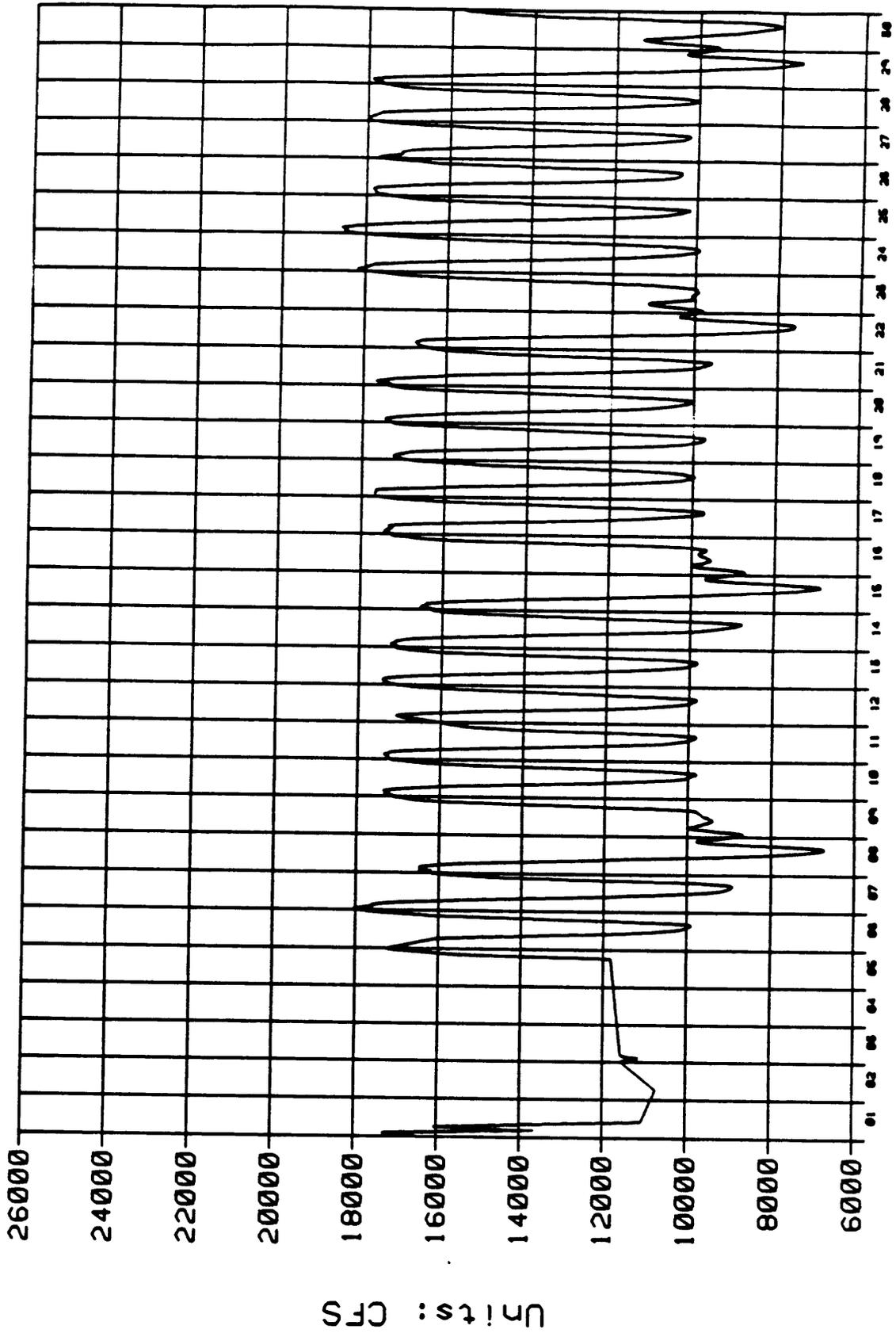


Units: CFS

Chart V-17

CLFA \_\_\_\_\_ 0  
COLORADO RIVER NEAR LEES FERRY, ARIZONA  
Flow Rate (cfs)

Data From 01-SEP-1991 Through 30-SEP-1991  
Plotted 11-OCT-91 13:56:04



Units: CFS

Chart V-18

CLFA COLORADO RIVER NEAR LEES FERRY, ARIZONA  
Flow Rate (CFS)

0

Date From 01-OCT-1991 Through 31-OCT-1991  
Plotted 21-NOV-91 12:00:45

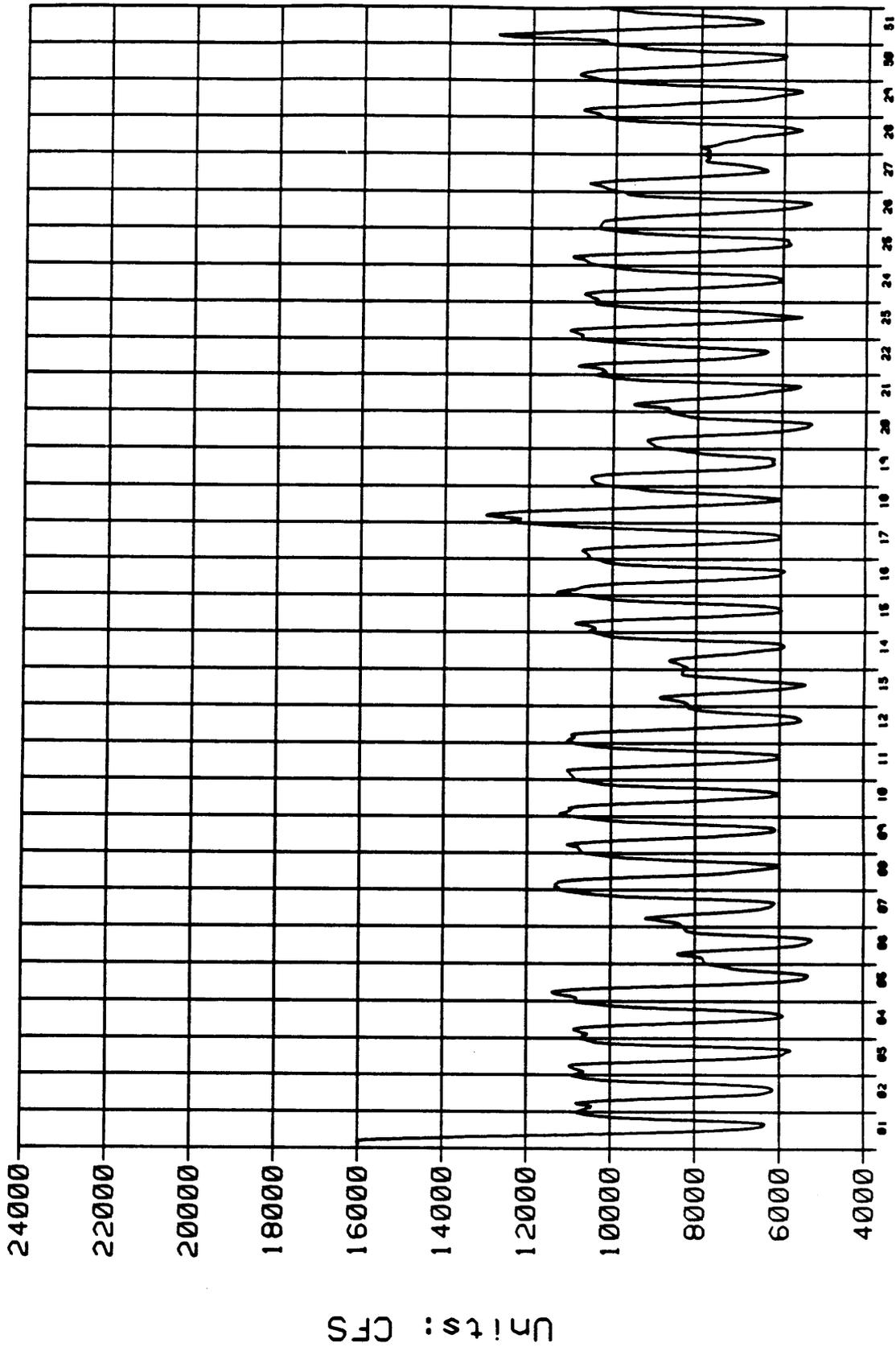
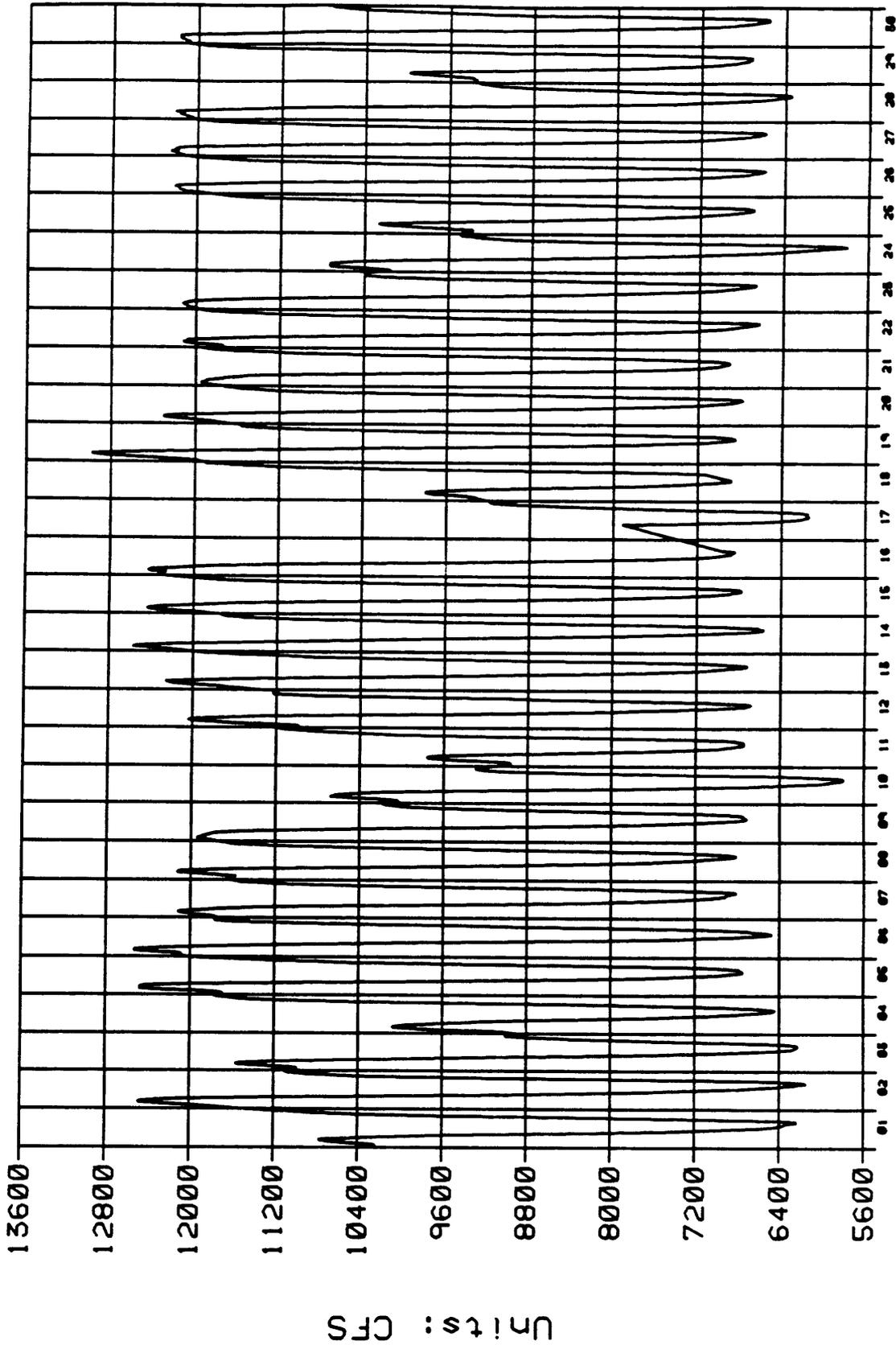


Chart V-19

CLFA COLORADO RIVER NEAR LEES FERRY, ARIZONA  
Flow Rate (cfs)

Date From 01-NOV-1991 Through 30-NOV-1991  
Plotted 7-JAN-92 14:57:17

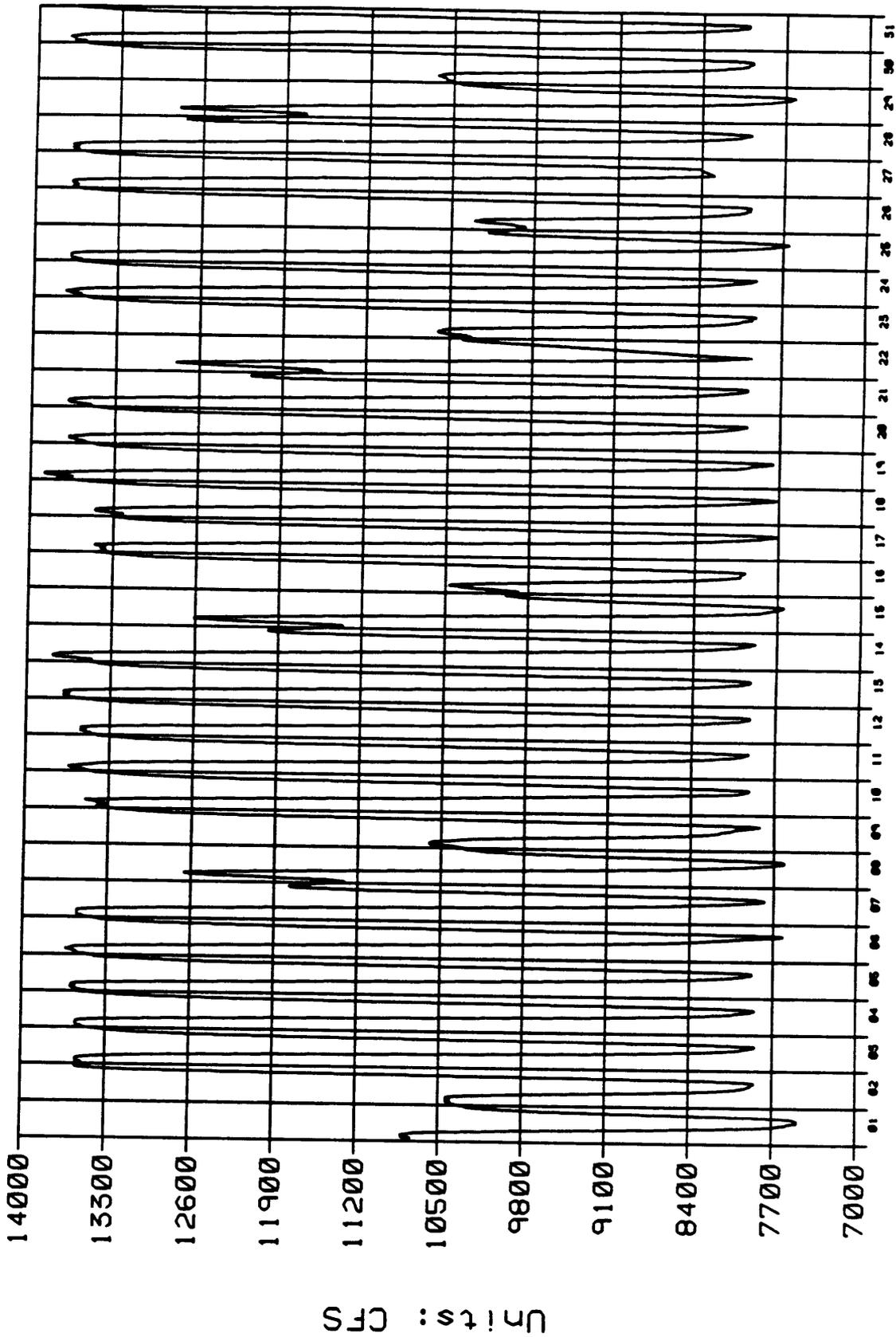


Units: CFS

Chart V-20

CLFA COLORADO RIVER NEAR LEES FERRY, ARIZONA  
Flow Rate (cfs)

Data From 01-DEC-1991 Through 31-DEC-1991  
Plotted 7-JAN-92 11:22:09

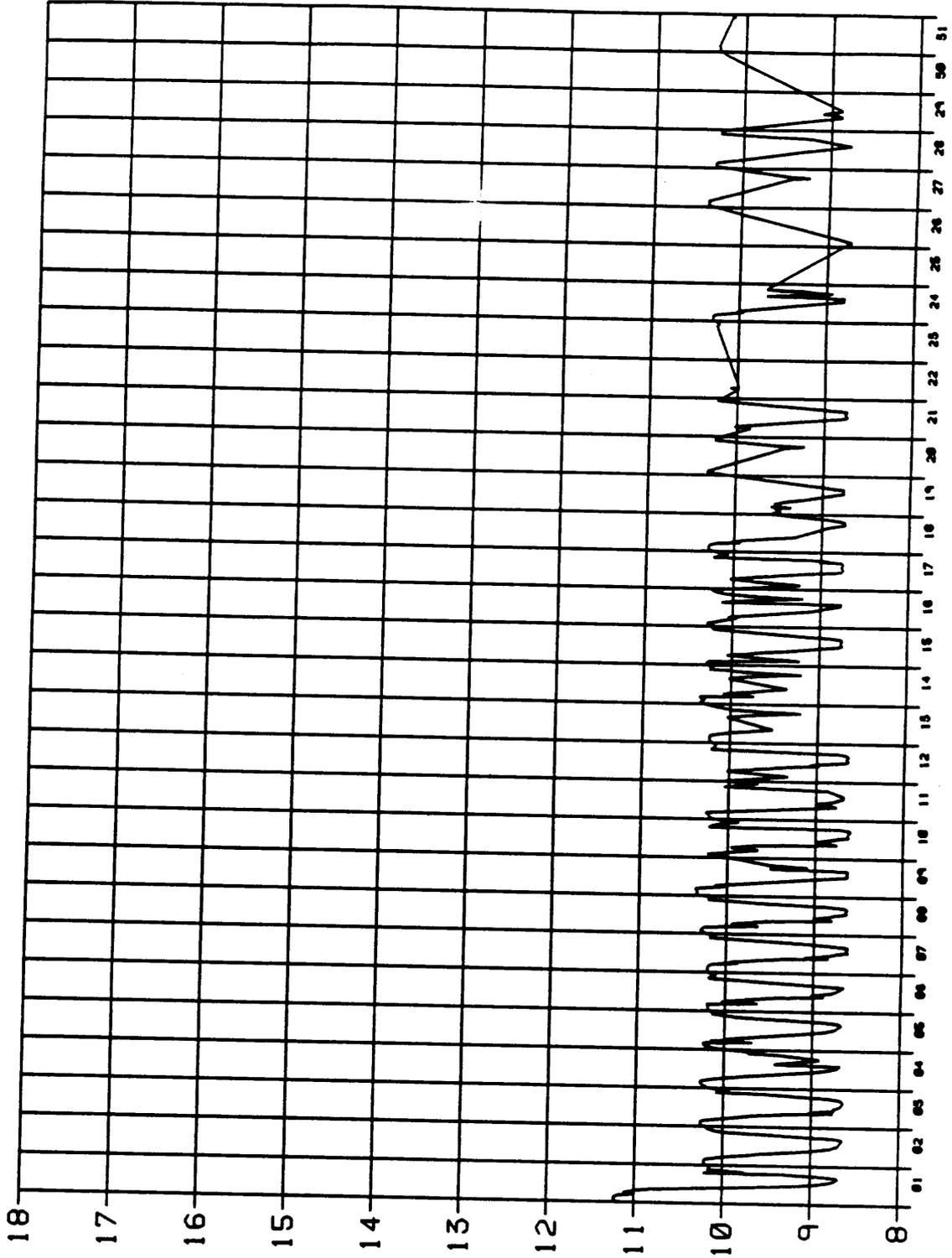


Units: CFS

Chart V-21

CLFA 0 COLORADO RIVER NEAR LEES FERRY, ARIZONA  
Flow Rate (CFS)

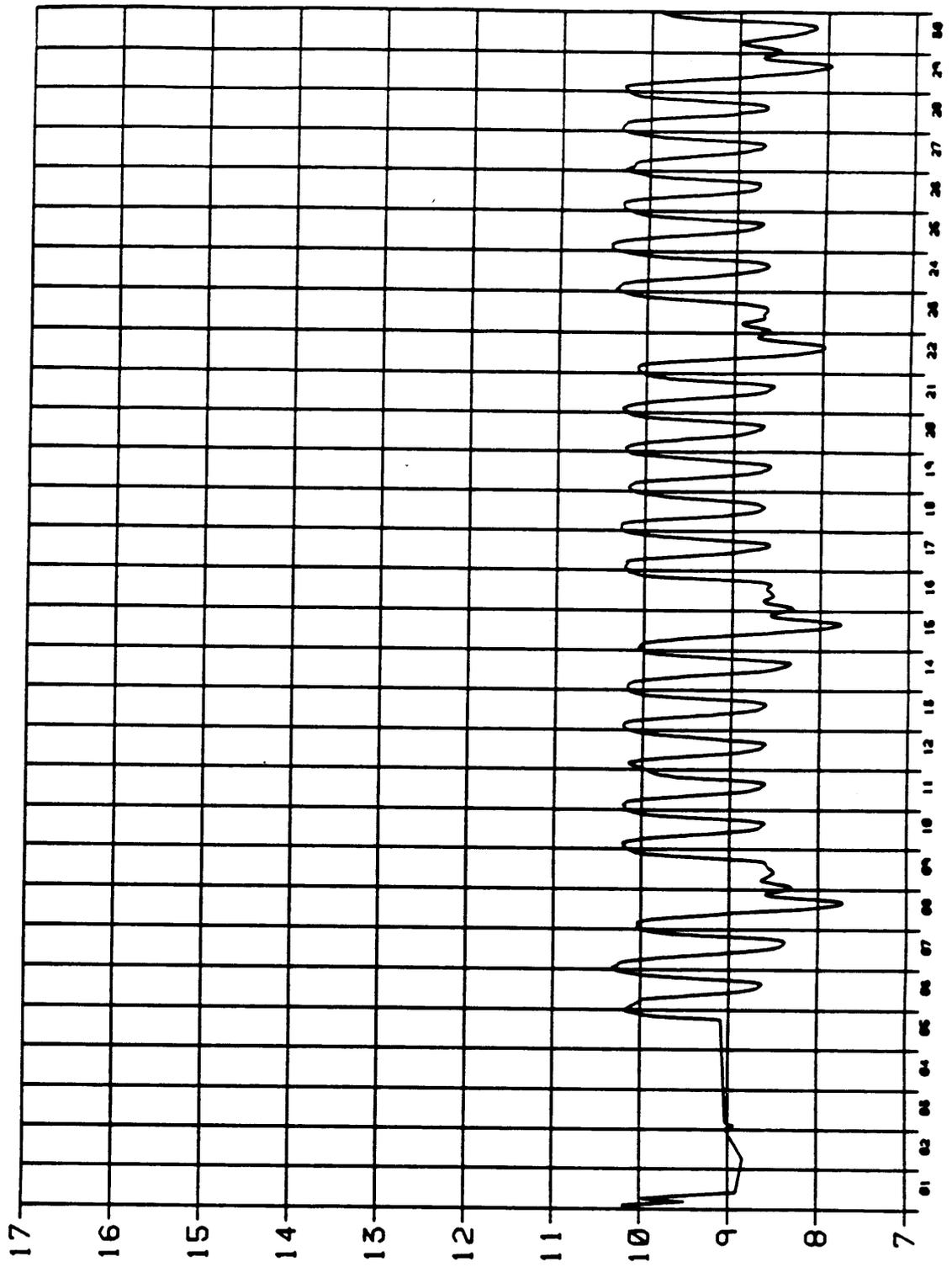
Data From 01-AUG-1991 Through 31-AUG-1991  
Plotted 12-SEP-91 08:47:40



Units: FEET

CLFA \_\_\_\_\_ GH  
COLORADO RIVER NEAR LEES FERRY, ARIZONA  
Gege Height (feet)

Date From 01-SEP-1991 Through 30-SEP-1991  
Plotted 11-OCT-91 13:59:14

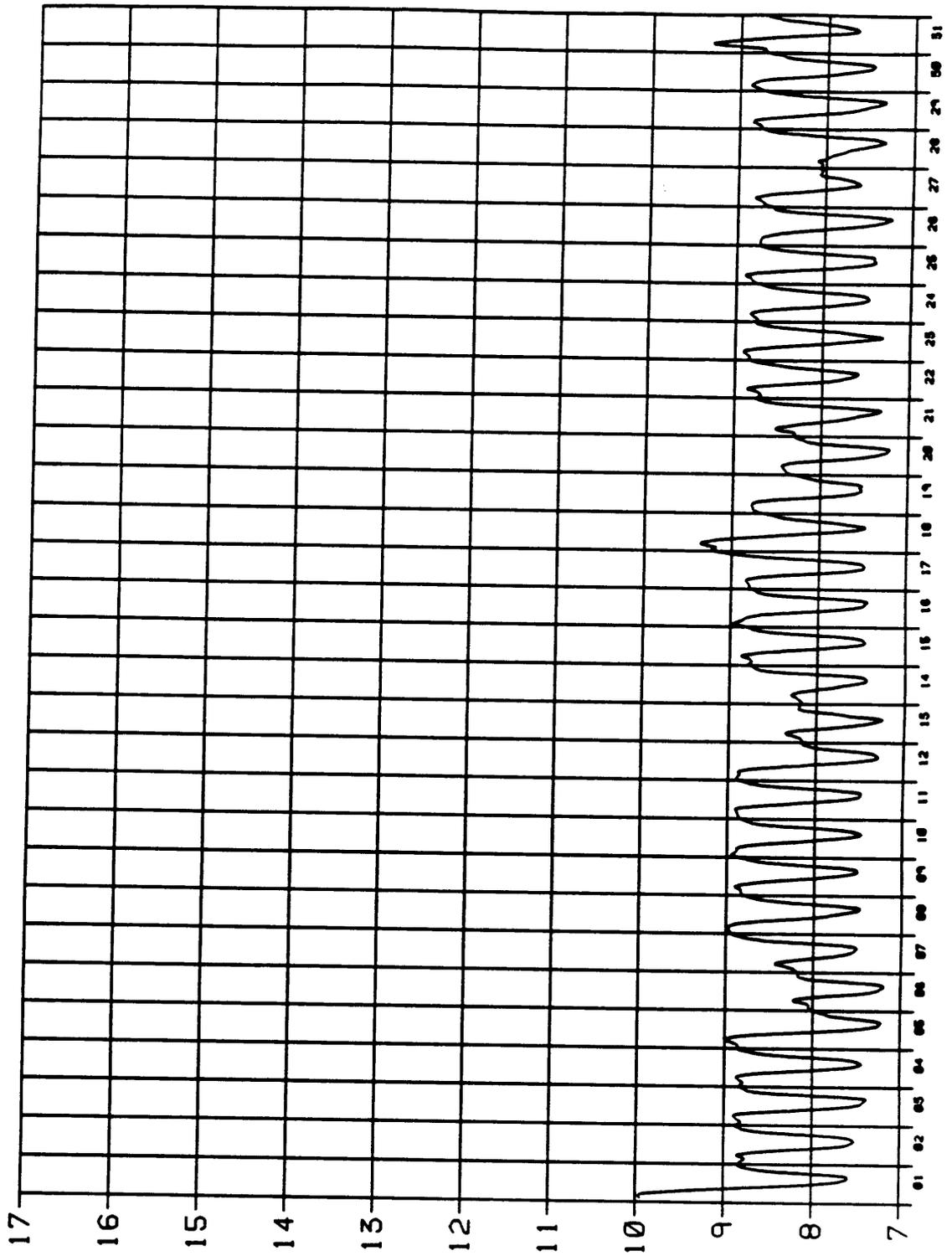


Units: FEET

Chart V-23

CLFA \_\_\_\_\_ GH  
COLORADO RIVER NEAR LEES FERRY, ARIZONA  
Gage Height (feet)

Date From 01-OCT-1991 Through 31-OCT-1991  
Plotted 21-NOV-91 12:02:26

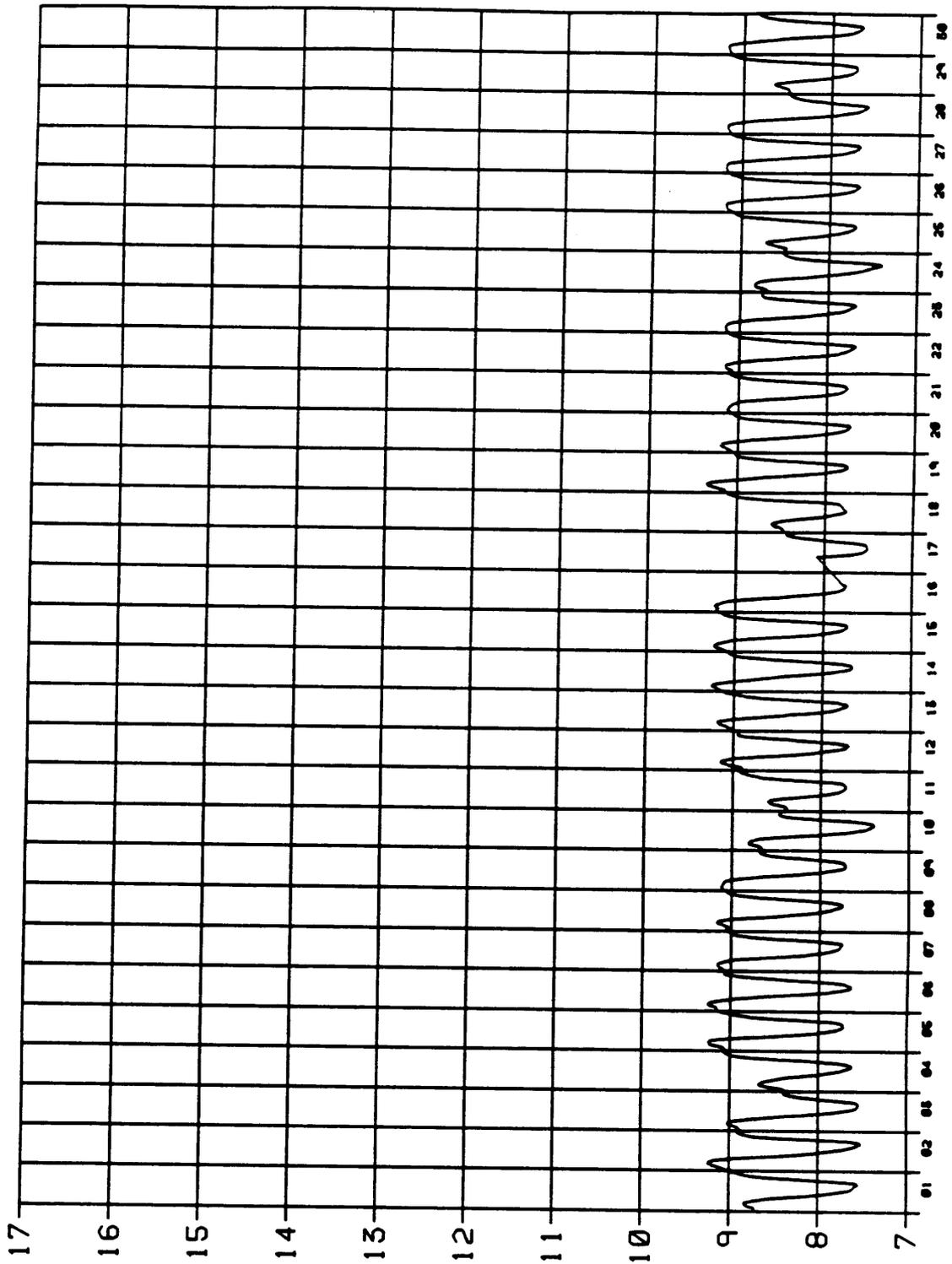


Units: FEET

Chart V-24

CLFA \_\_\_\_\_ GH  
COLORADO RIVER NEAR LEES FERRY, ARIZONA  
Gage Height (feet)

Date From 01-NOV-1991 Through 30-NOV-1991  
Plotted 7-JAN-92 15:02:36

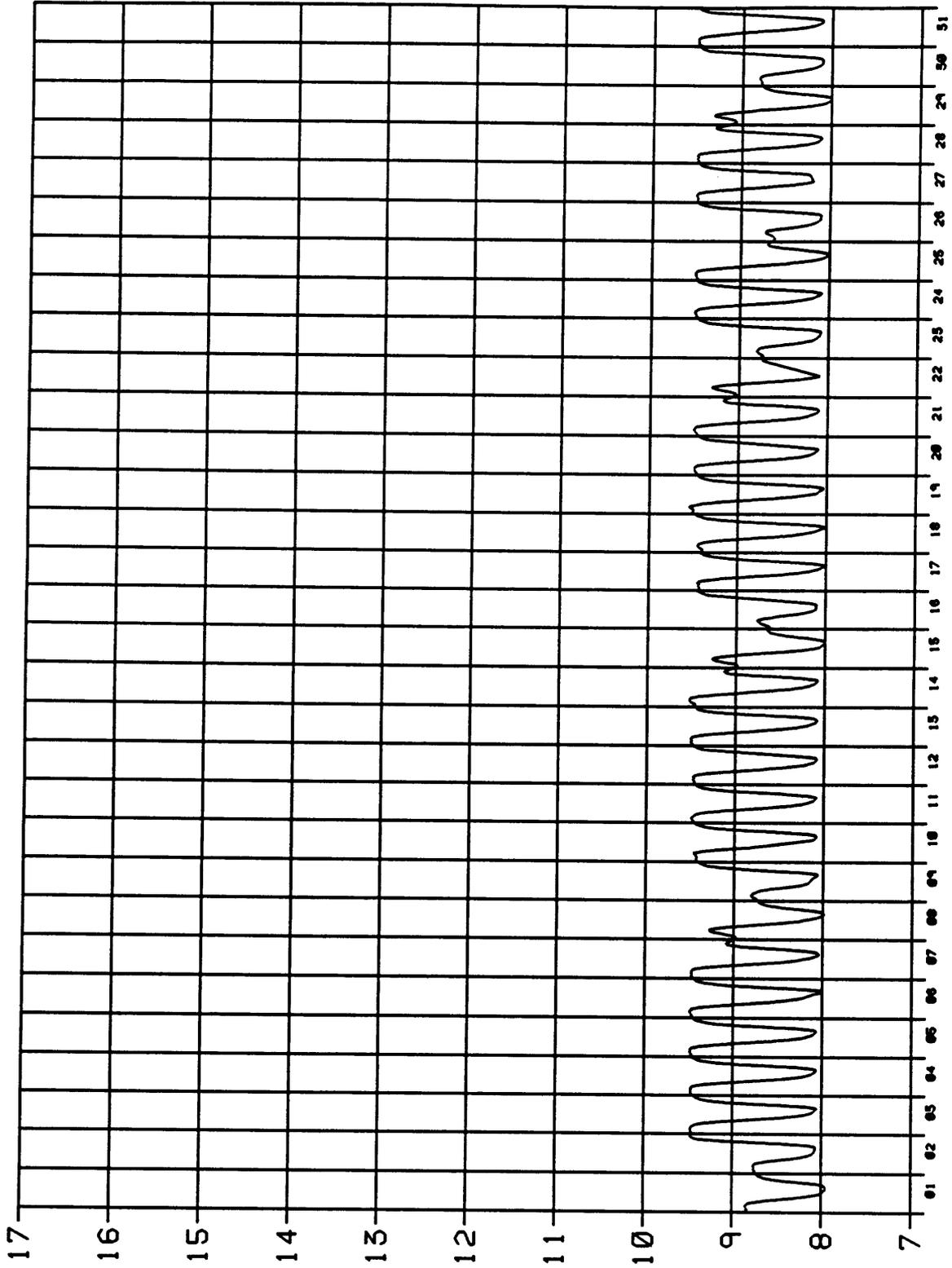


Units: FEET

Chart V-25

CLFA COLORADO RIVER NEAR LEES FERRY, ARIZONA  
— GH Gege Height (feet)

Data From 01-DEC-1991 Through 31-DEC-1991  
Plotted 7-JAN-92 11:32:03



Units: FEET

Chart V-26

CLFA \_\_\_\_\_ GH  
COLORADO RIVER NEAR LEES FERRY, ARIZONA  
Gage Height (feet)

Date From 01-AUG-1991 Through 31-AUG-1991  
Plotted 12-SEP-91 08:28:16

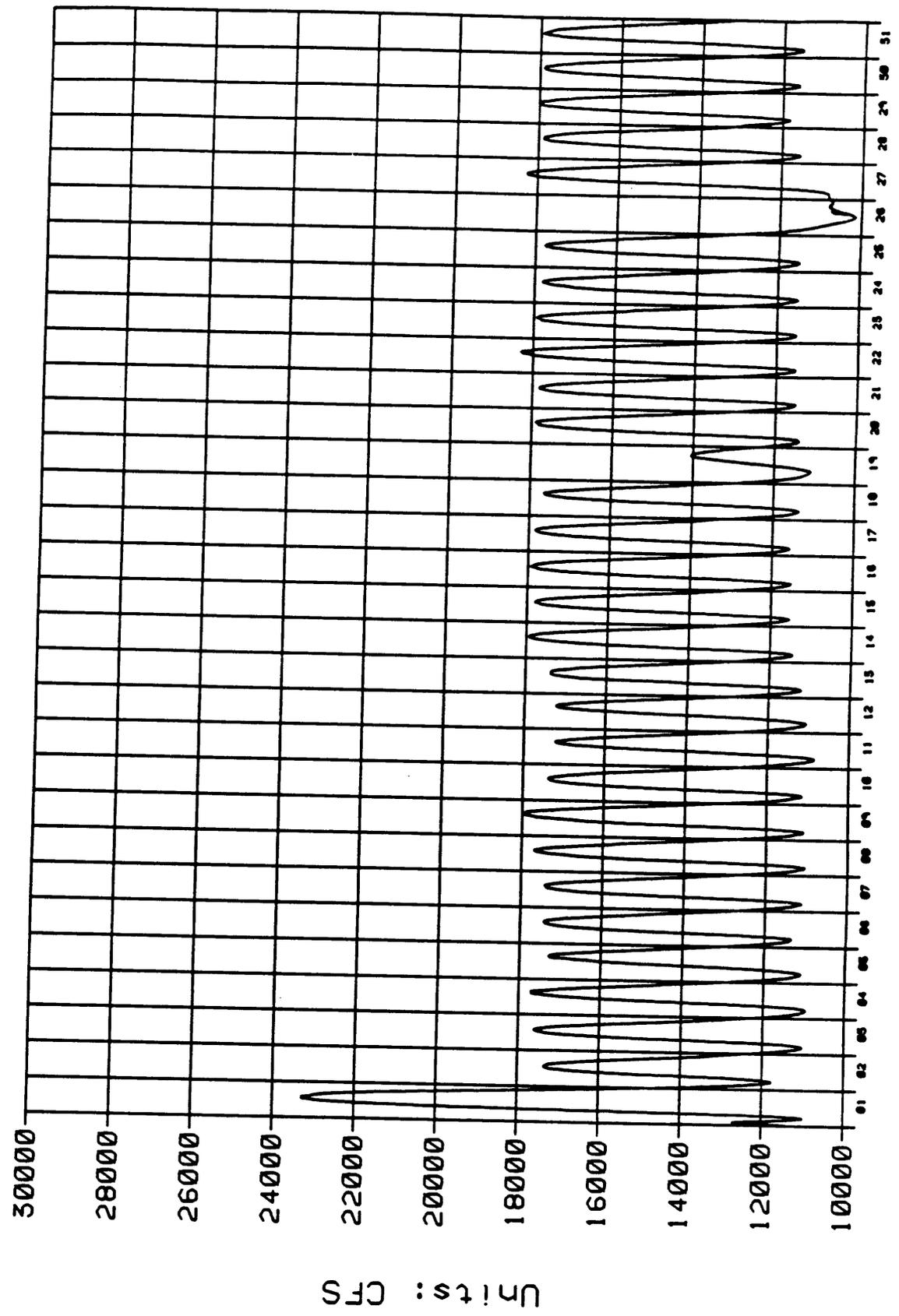


Chart V-27

CGCA 0 COLORADO RIVER NEAR GRAND CANYON VILLAGE, ARIZONA  
Flow Rate (CFS)

Data From 01-SEP-1991 Through 30-SEP-1991  
Plotted 11-OCT-91 14:09:30

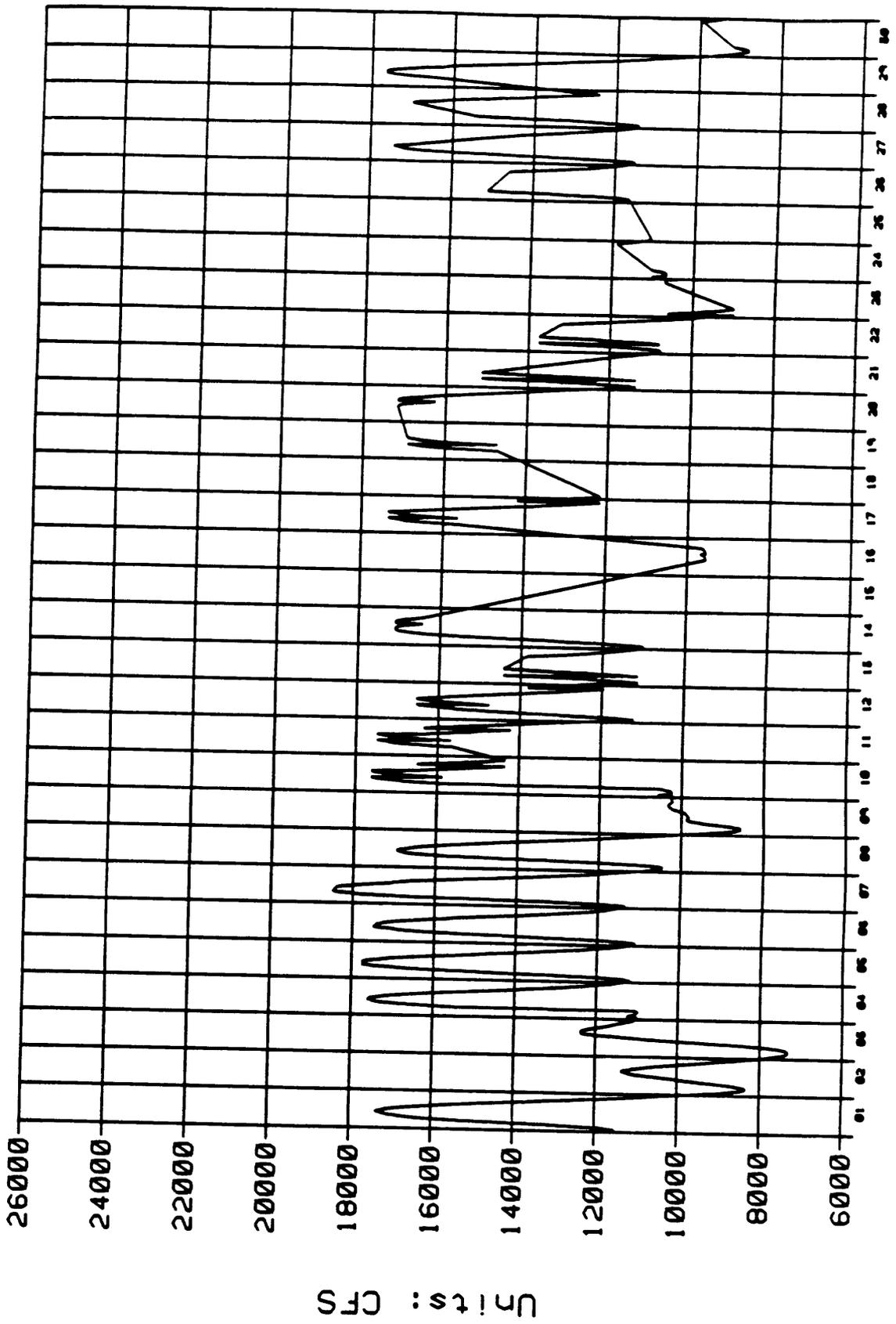


Chart V-28

CGCA \_\_\_\_\_ 0 COLORADO RIVER NEAR GRAND CANYON VILLAGE, ARIZONA  
Flow Rate (cfs)

Date From 01-OCT-1991 Through 31-OCT-1991  
Plotted 21-NOV-91 11:56:52

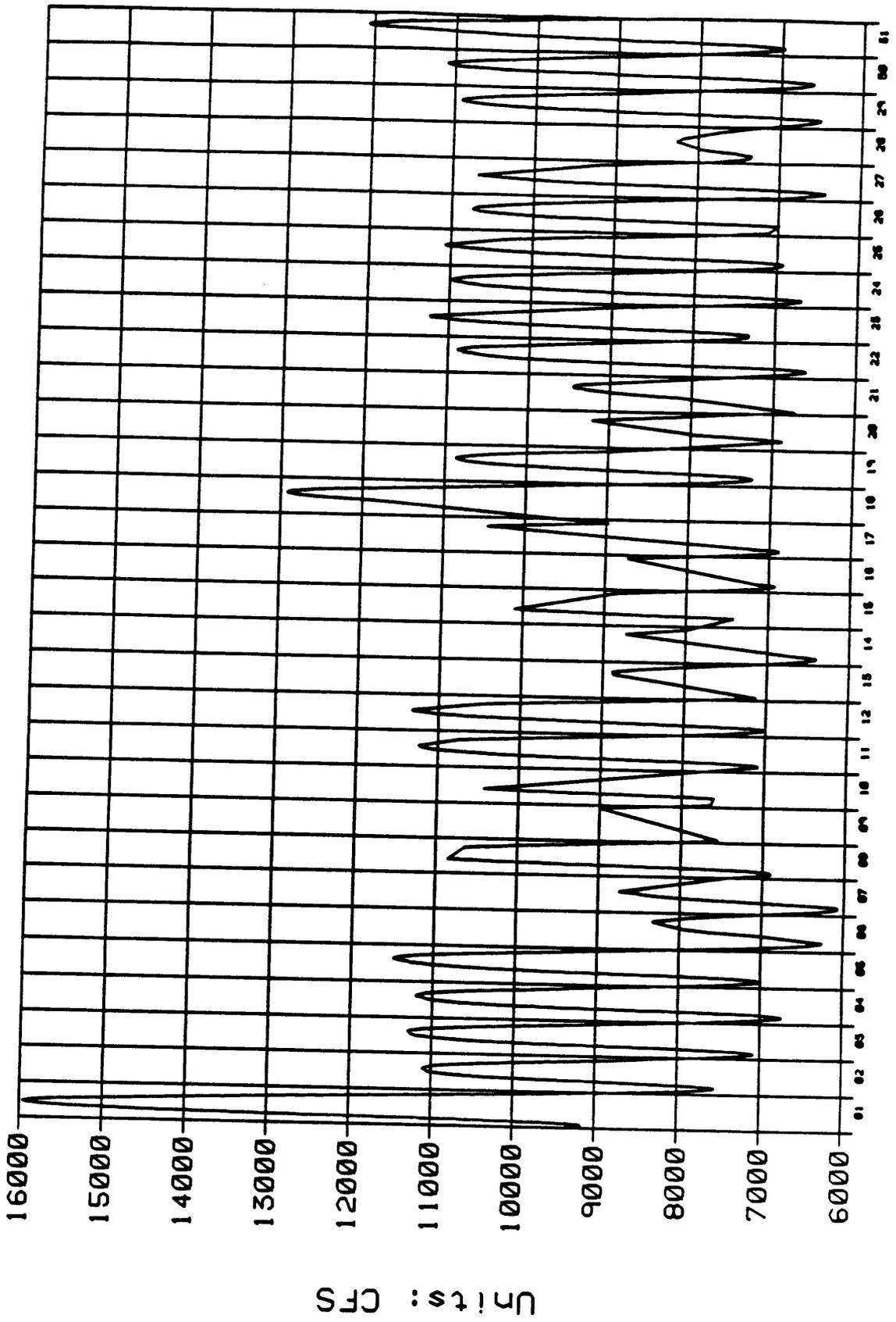
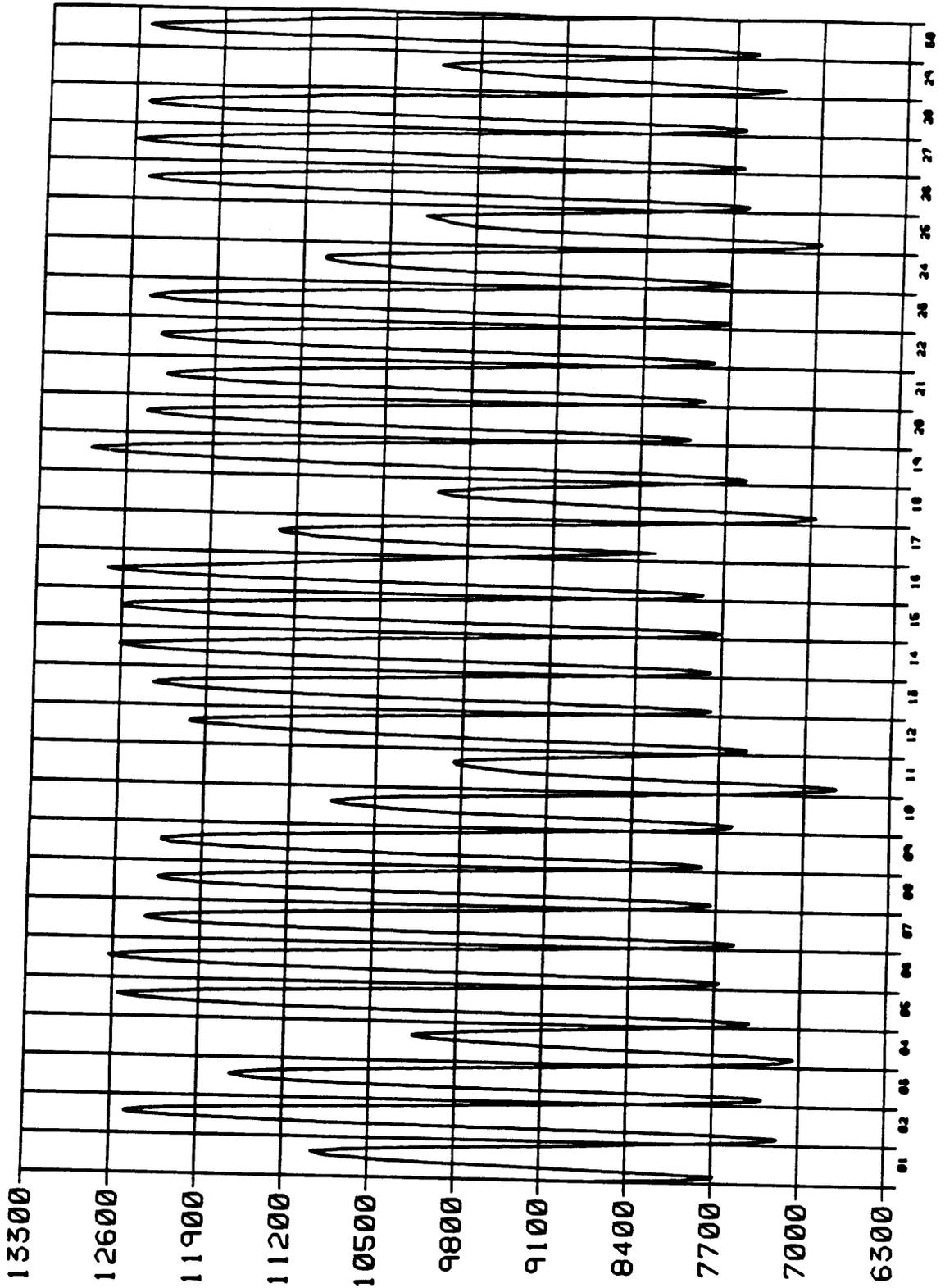


Chart V-29

CGCA \_\_\_\_\_ 0 COLORADO RIVER NEAR GRAND CANYON VILLAGE, ARIZONA  
Flow Rate (CFS)

Date From 01-NOV-1991 Through 30-NOV-1991  
Plotted 7-JAN-92 14:46:24

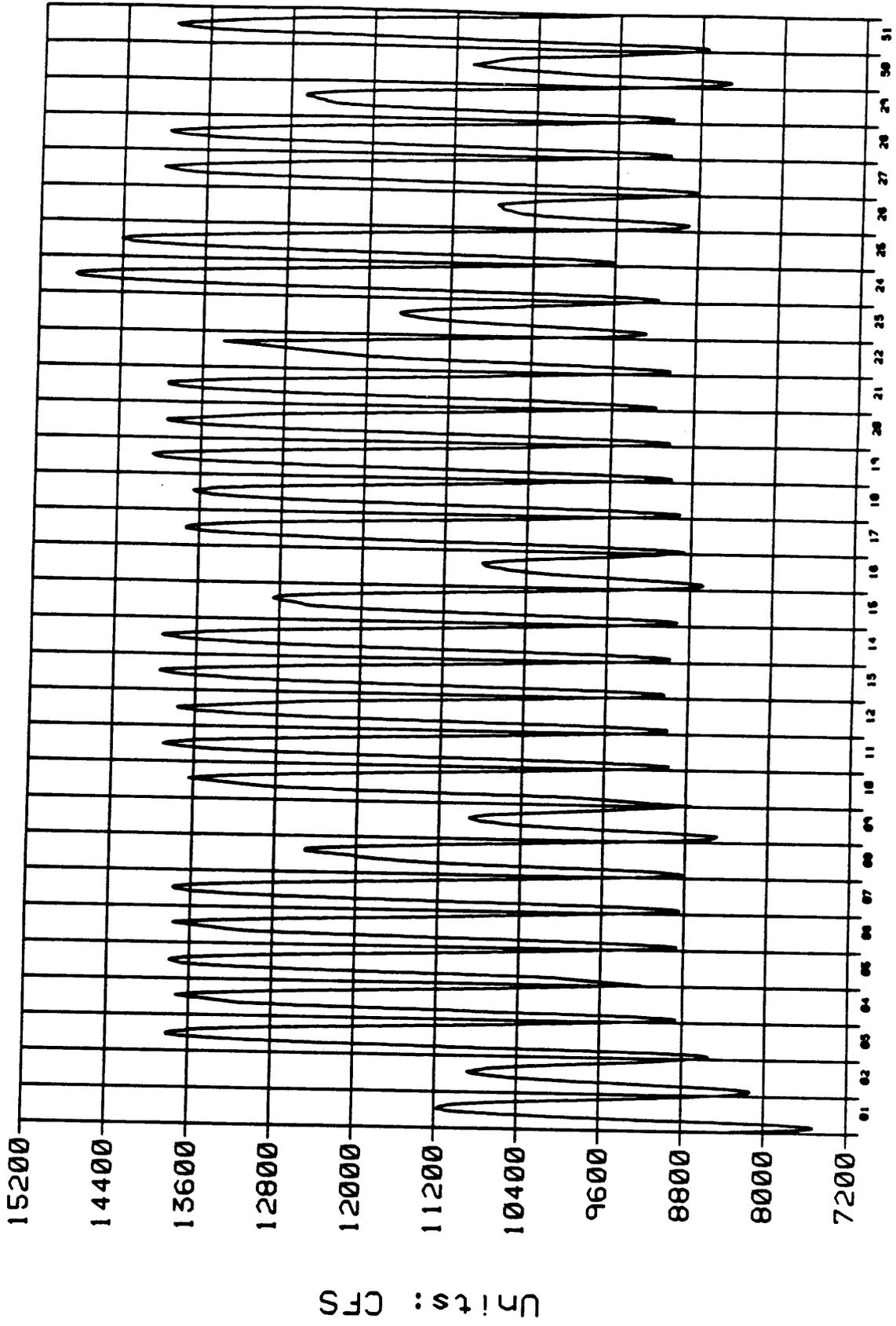


Units: CFS

Chart V-30

CGCA COLORADO RIVER NEAR GRAND CANYON VILLAGE, ARIZONA  
Flow Rate (cfs)

Date From 01-DEC-1991 Through 31-DEC-1991  
Plotted 7-JAN-92 11:15:52

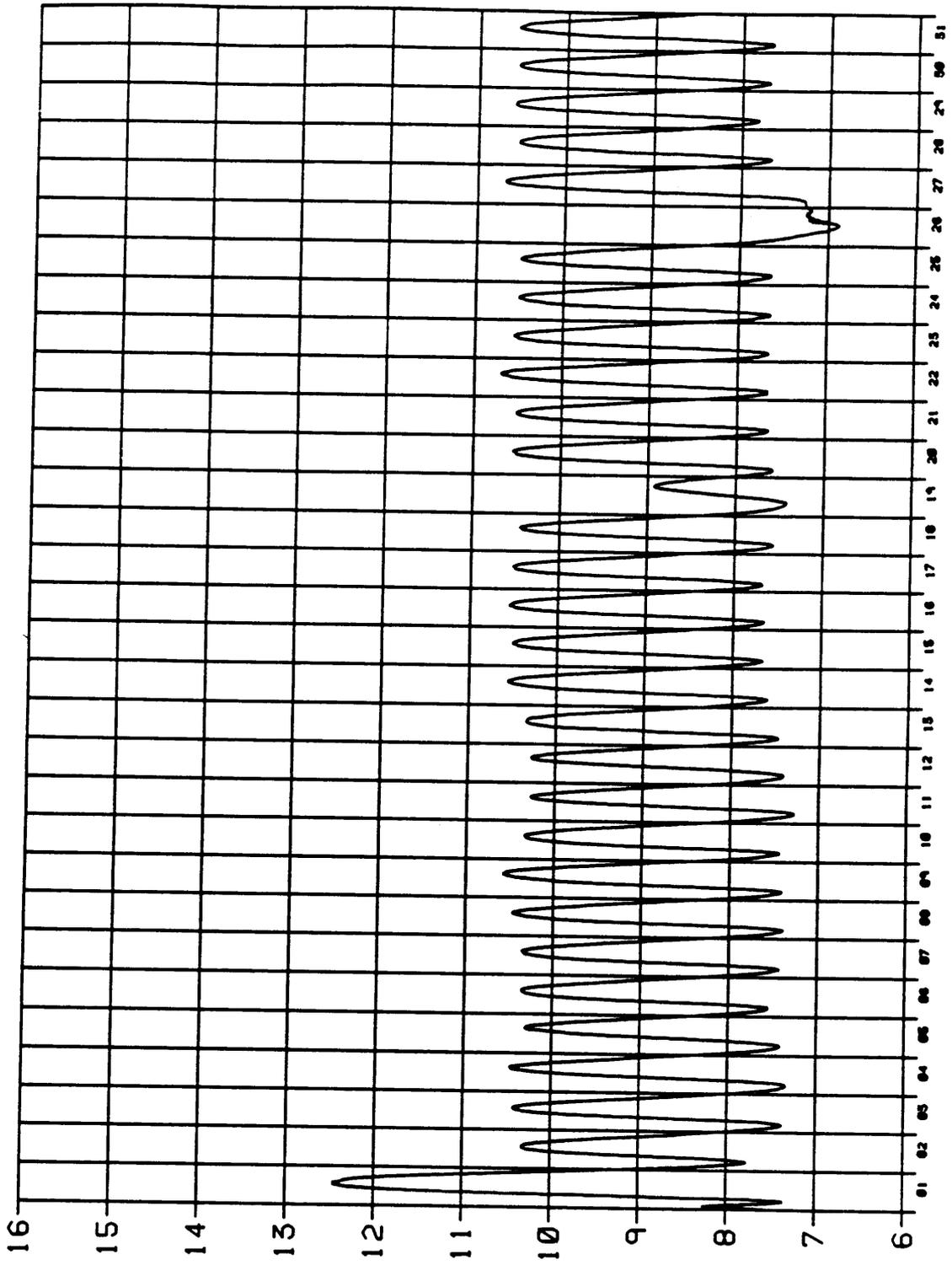


Units: CFS

Chart V-31

CGCA \_\_\_\_\_ 0 COLORADO RIVER NEAR GRAND CANYON VILLAGE, ARIZONA  
Flow Rate (Cfs)

Date From 01-AUG-1991 Through 31-AUG-1991  
Plotted 12-SEP-91 08:45:37

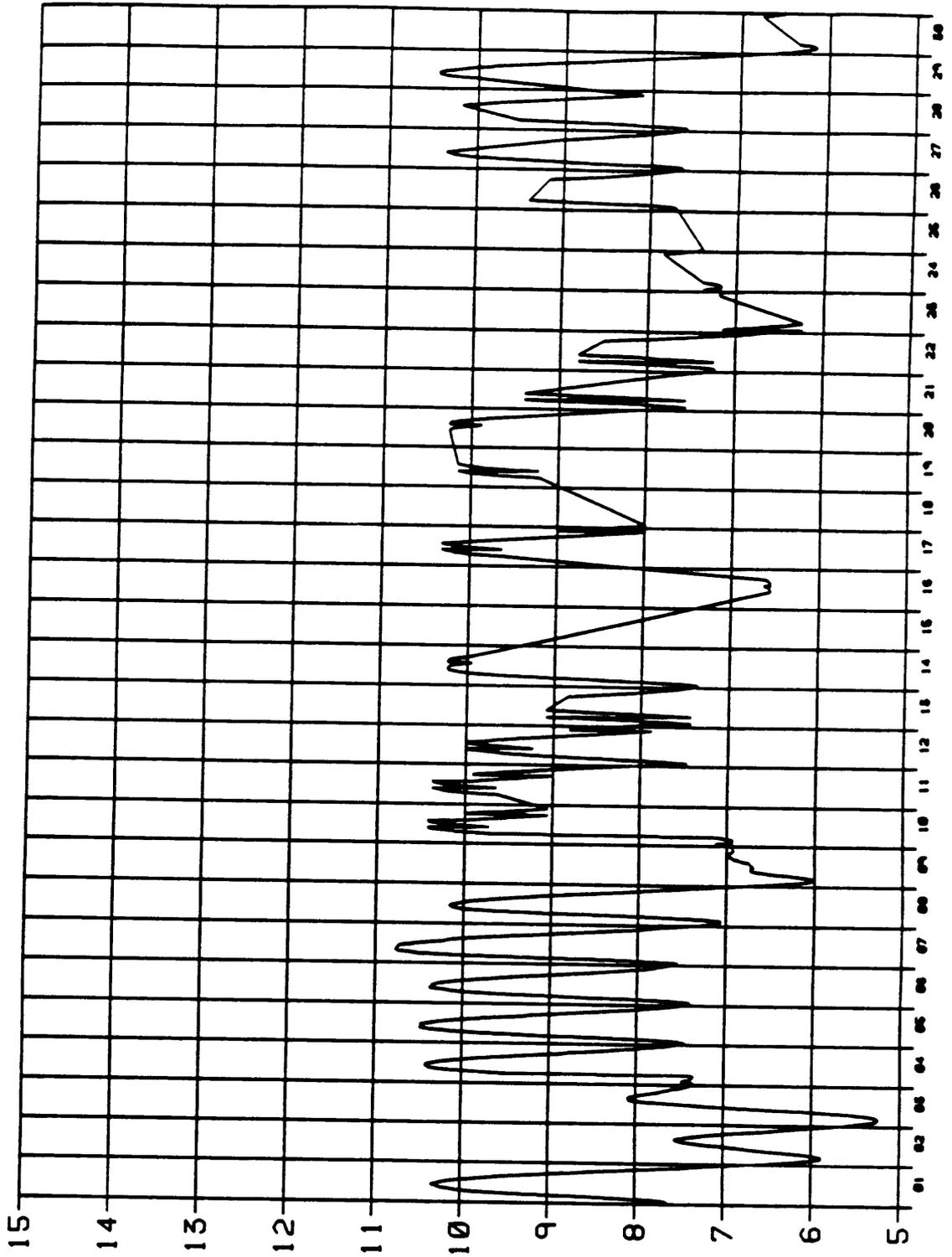


Units: FEET

Chart V-32

CGCA \_\_\_\_\_ GH  
COLORADO RIVER NEAR GRAND CANYON VILLAGE, ARIZONA  
Gage Height (feet)

Date From 01-SEP-1991 Through 30-SEP-1991  
Plotted 11-OCT-91 14:12:38

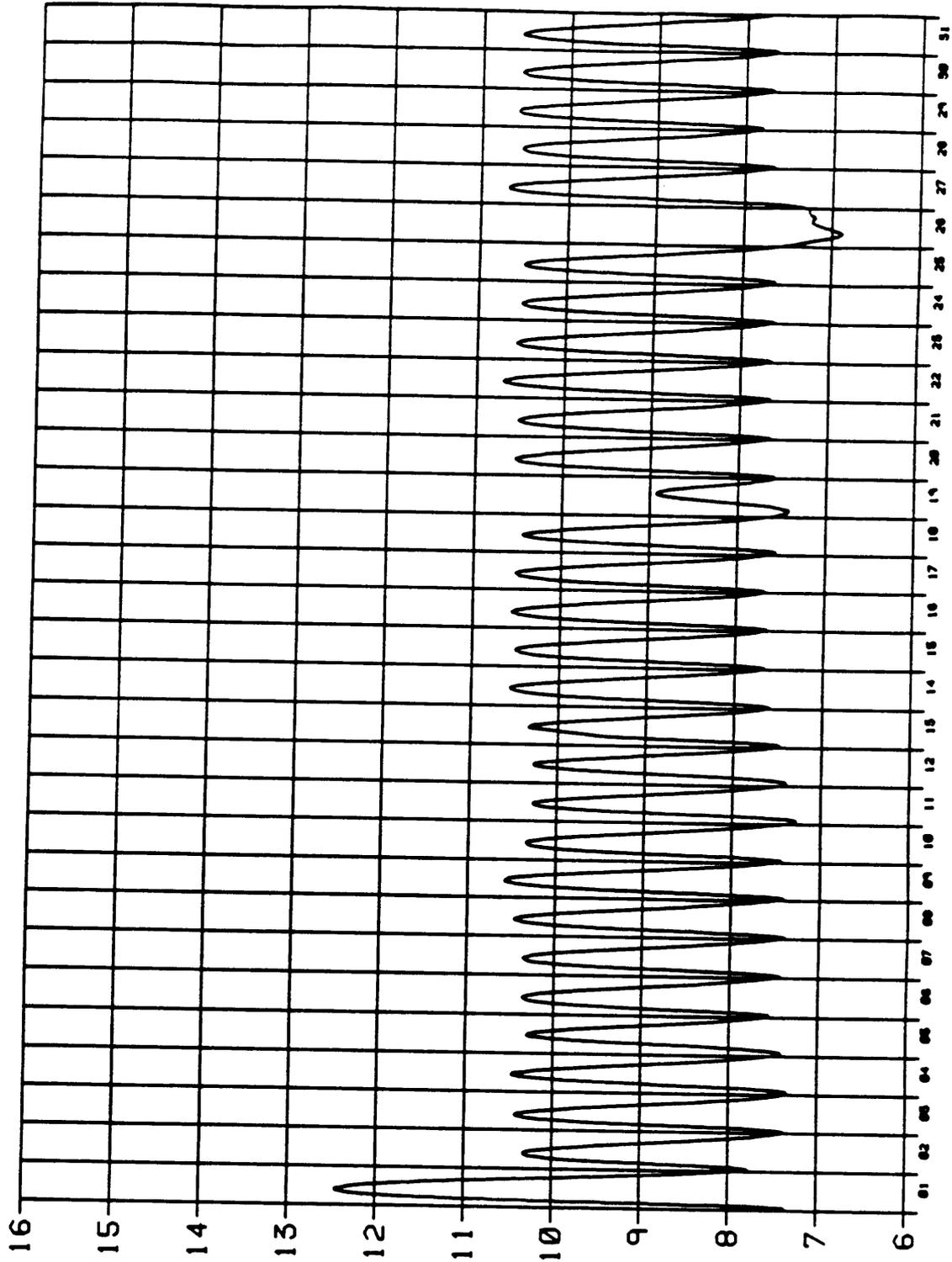


Units: FEET

Chart V-33

CGCA \_\_\_\_\_ GH  
COLORADO RIVER NEAR GRAND CANYON VILLAGE, ARIZONA  
Gage Height (feet)

Date From 01-AUG-1991 Through 31-AUG-1991  
Plotted 11-OCT-91 14:16:53

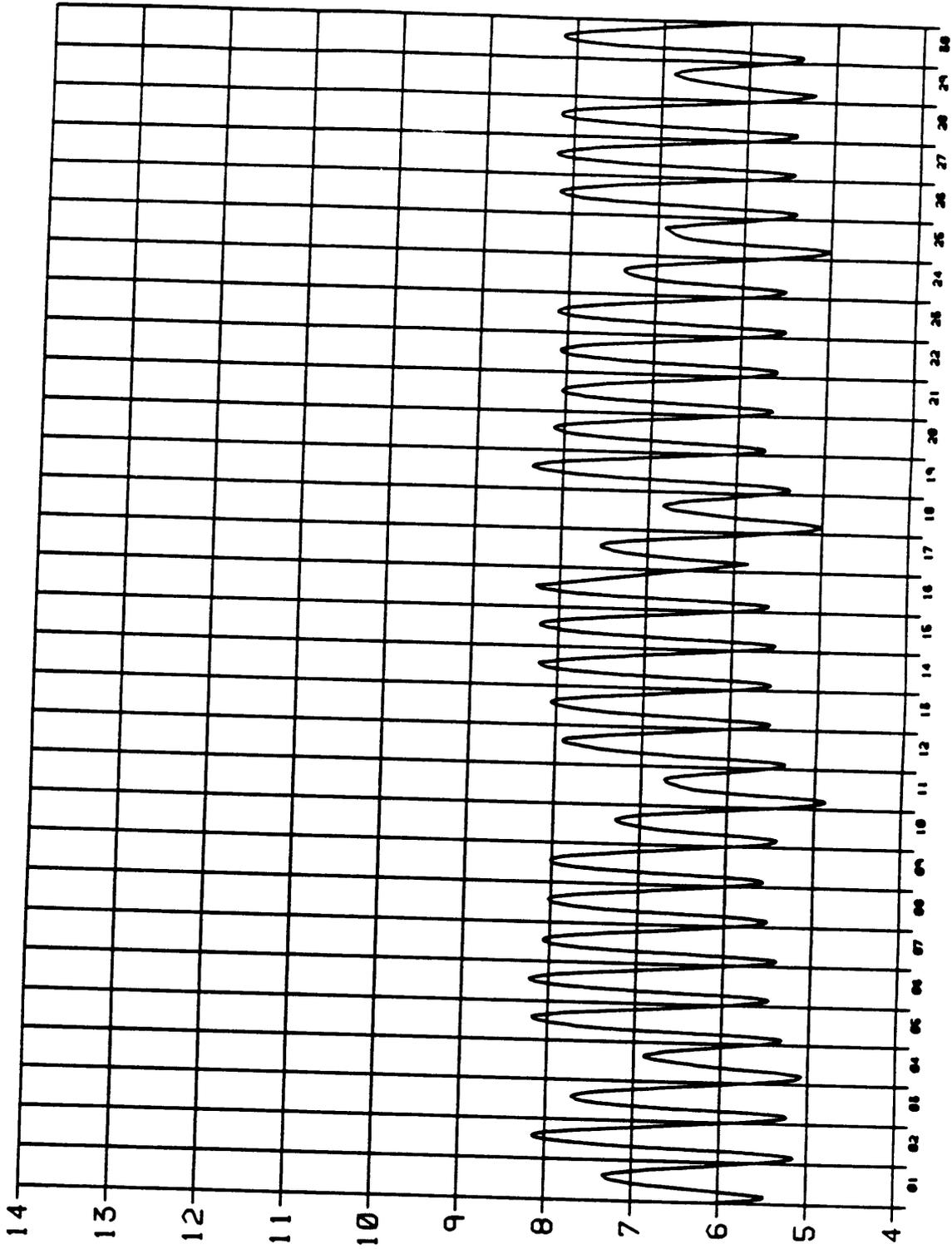


Units: FEET

Chart V-34

CGCA \_\_\_\_\_ GH  
COLORADO RIVER NEAR GRAND CANYON VILLAGE, ARIZONA  
Gage Height (feet)

Date From 01-NOV-1991 Through 30-NOV-1991  
Plotted 7-JAN-92 14:52:12

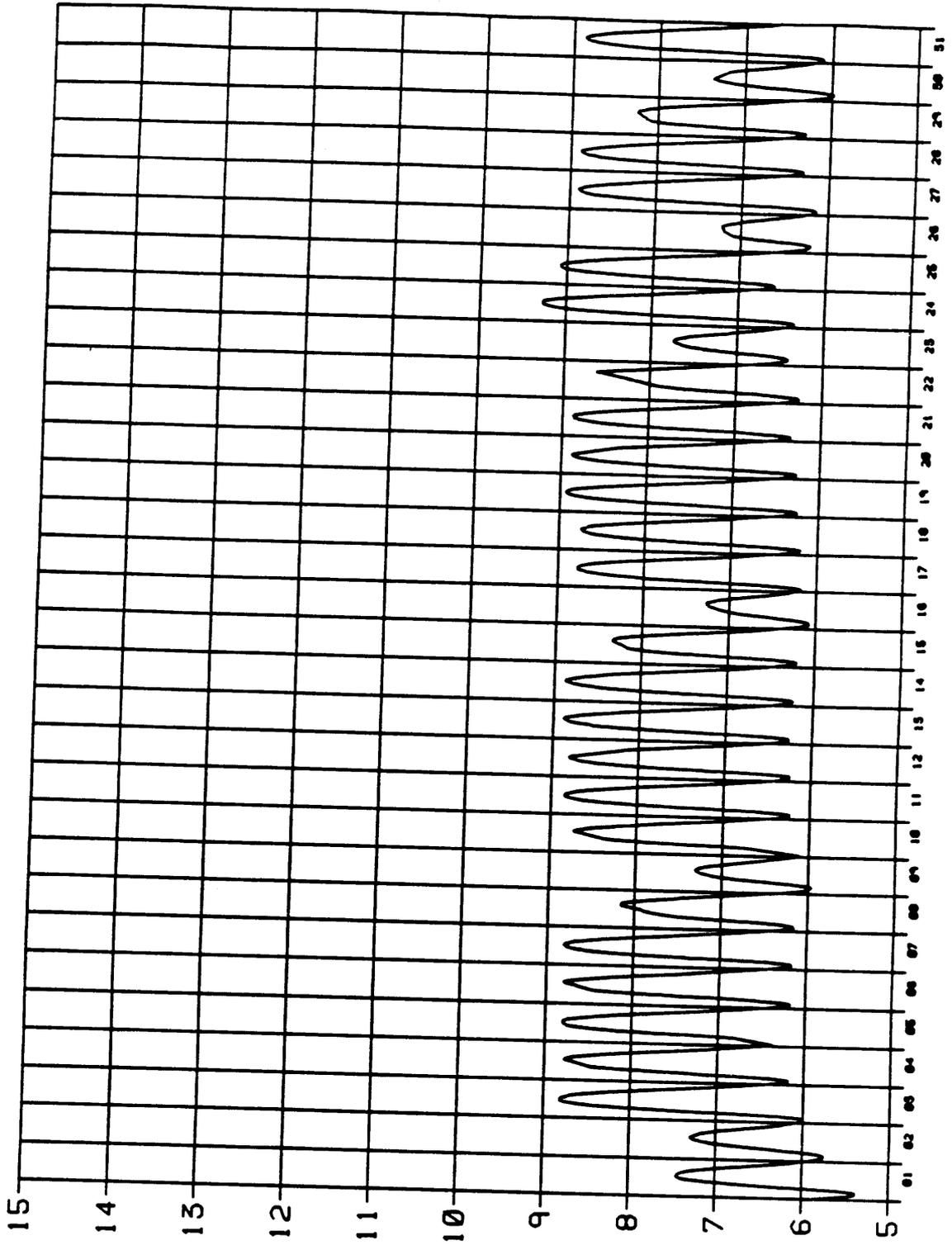


Units: FEET

Chart V-35

CGCA \_\_\_\_\_ GH  
COLORADO RIVER NEAR GRAND CANYON VILLAGE, ARIZONA  
Gage Height (feet)

Date From 01-DEC-1991 Through 31-DEC-1991  
Plotted 7-JAN-92 11:19:03



Units: FEET

Chart V-36

USCA  
— GH

COLORADO RIVER NEAR GRAND CANYON VILLAGE, ARIZONA  
Gage Height (feet)

**APPENDIX VI**

**Monitoring of Exception Criteria**

**Western Area Power Administration**

**and**

**Related Charts**

**GLEN CANYON DAM**  
**INTERIM OPERATIONS REPORT**  
**WESTERN AREA POWER ADMINISTRATION**

**I. INTRODUCTION**

On August 1, 1992, the Secretary of the Interior, Manual Lujan, implemented interim flows at Glen Canyon Dam. These interim flows were a considerable departure from previous operation of the dam and have had a significant impact on the daily operation of Western Area Power Administration's Upper Colorado (WAUC) Control Area.

The impacts of this sudden change in dam operations required Western Area Power Administration (Western) to implement new scheduling procedures for its customers, develop interim release guidelines for real-time operations, purchase higher priced energy during on-peak periods, and increase the firm power rates to its customers to cover the additional costs.

With all these changes in such a short period of time, Western and Western's customers, as well as the utilities interconnected with Western, have been jolted from the familiarity of power operations established over the past 20 years and have had to face the uncertainties of this new mode of operation. All of these changes have been made while having to maintain a stable and reliable power system and operating within the financial constraints of the Upper Colorado River Basin Fund.

Since their inception, Western and the Bureau of Reclamation (Reclamation) have been very successful in meeting the operational parameters of interim flows. Several refinements such as the 24-hour rolling period, the 30-day rolling period, and regulation caused minor problems. However, once these issues were resolved by the Cooperating Agencies, Western and Reclamation operations responded.

The following sections are a review of Power Operations for the reporting period.

**II. SCHEDULING**

**A. Overview of General Scheduling Procedures Under Interim Release Operations**

Scheduling procedures associated with the delivery of Salt Lake City Area Integrated Projects (SLCA/IP) firm capacity and energy have been modified to accommodate the release restrictions imposed on Glen Canyon powerplant with Interim Release constraints.

Under previous scheduling procedures, SLCA/IP contractors were allowed to preschedule their monthly capacity allocation on an hourly basis, within established minimum and/or maximum schedule limits set by contract. Energy is delivered under the capacity up to their monthly energy entitlement as defined in Exhibit A of their electric

service contract. Capacity and associated energy schedules could have been changed hourly (real time) to adjust to changes in system load.

Interim release restrictions have limited Western's ability to accommodate hourly changes in the preschedules due to reduced capacity availability and have required us to request customer prescheduling up to 3 days in advance in order to match firm loads to available project resources and substitute purchases for any hourly deficits. Hourly changes to preschedules has been restricted by the lack of system flexibility. The burden to adjust to changes in real time load has shifted from the contractors' use of their SLCA/IP resource to the contractors' alternate resources. A majority of the alternate resources are thermal in nature with much higher costs associated with them.

After Western receives the contractors' advance firm pre-schedules, project generation is patterned hourly to optimize system capacity. During times of surplus generation, the surplus generation is scheduled when the energy is of greatest value, whenever possible. In times of hourly energy deficiencies, unit capacity is scheduled over system peaks up to the maximum available, and hourly shortages are covered through nonfirm energy purchases.

During periods of normal operations, there were no hourly deficiencies due to restricted flows from Glen Canyon. System energy shortages were supplied through nonfirm purchases scheduled in equal amounts across all hours, divided into on and off-peak periods. Hourly peaks were covered with available project capacity.

Under Interim Operations, Western must determine when the system peak loads will occur and purchase nonfirm energy to cover shortages during specific hours, thus requiring advance scheduling of both project generation and nonfirm purchases. Due to the very narrow ramping restrictions at Glen Canyon, off-peak generation has been increased and energy, normally purchased off-peak when generation was low, is purchased during higher priced on-peak periods.

Interim release conditions have forced scheduling and dispatch personnel to monitor projected water releases and hourly generation levels very carefully. With Interim release conditions, Glen Canyon powerplant must be operated within very specific daily fluctuation limits. Peaking capacity required to serve firm load obligations unavailable at Glen Canyon must be obtained from other project resources. These resources also have daily water limitations which must be maintained. Any large deviations from anticipated generation levels which may occur on a real-time basis could affect prescheduling for several days. To avoid this, a very comprehensive set of interim release guidelines have been developed for dispatchers to use when running the power system during real-time operations. One scheduling individual is solely devoted to see that preschedules are closely coordinated with dispatch. This procedure is much more complicated than what has been required during normal Glen Canyon operations.

### III. REAL-TIME OPERATIONS

#### A. Power Scheduling and Purchases for the Month of October

October was a 550,000 acre-foot release month from Glen Canyon powerplant which allowed a maximum 5,000 cfs daily fluctuation limit. Weekday releases were scheduled at 6,000 cfs (approximately 218 megawatts [MW]) during off-peak hours ramping up to a maximum of 11,000 cfs (approximately 400 MW) during on-peak hours. Saturday and Sunday maximums were not as high due to reduced firm loading conditions.

Flaming Gorge generation capability was limited to one unit (44 MW) for the first 10 days of the month. After that, two units were available (88 MW) while Unit 1 was down for uprating. A total of approximately 975 megawatthours (MWh) of generation were prescheduled from Flaming Gorge on a daily basis with no more than 50 MW of capacity prescheduled in any 1 hour due to restricted flows on the Green River. Reclamation wished to maintain an average flow of 1,800 cfs at the confluence of the Green and Yampa Rivers for Colorado Squawfish fry protection. With minimums set at approximately 28 MW per hour, Flaming Gorge could only generate a total of 375 MWh of additional energy over peak hours. This severely limited the use of Flaming Gorge as a peaking facility during the month of October.

On October 1, Crystal Powerplant was operating at 30 MW per hour (2,000 cfs) or 720 MWh worth of generation available each day. Correspondingly, Morrow Point generated approximately 1,200 MWh per day and Blue Mesa had 995 MWh per day available. Blue Mesa had 90 MW of generation available out of its two units, and 70 MW of capacity was available from Morrow Point. Unit 1 at Morrow Point was taken down for testing and rewind on October 7. Unit 1 testing lasted from October 7 through October 11. During this time, both Morrow Point units were made unavailable and Crystal releases were reduced to approximately 735 cfs (11 MW). Over this 5-day outage, Western lost approximately 1,500 MWh of generation per day (increasing purchases an additional \$30,000 per day) and more importantly, 90 MW of capacity.

With Flaming Gorge restricted and 90 MW of capacity made unavailable from the Aspinall units, system operations were very difficult. Load-following was accomplished by hourly energy purchases and with what little fluctuation left remaining from Blue Mesa and Flaming Gorge. After October 12, Morrow Point Unit No. 2 was made available and releases were increased from Crystal giving back the use of the Aspinall units for system peaking and regulation assistance.

Purchase prices were unusually high for the month of October. Over the first half of the month, they ranged between 22 and 24 mills per kWh. Availability was good except during the 5-day Morrow Point outage which created problems obtaining purchases over peak periods-- 90 MW more than normal. The second half of the month showed drastically increased prices due to very cold weather and some unexpected forced unit outages. Prices rose up to 36-38 mills per kWh at one point and became very difficult to obtain. We did

purchase energy from a combustion turbine one day in order to maintain release criteria on a preschedule basis. We paid 36 mills per kWh for that energy.

B. Power Scheduling and Purchase for the Month of November

November was a 600,000 acre-foot release month from Glen Canyon which allowed a maximum 6,000 cfs daily fluctuation limit. Weekday releases were scheduled to follow a 7,000 cfs (approximately 255 MW) off-peak minimum and ramp up to a maximum of 13,000 cfs (approximately 475 MW) during on-peak periods. Saturday and Sunday maximums were not as high due to reduced firm loading conditions.

Restrictions from Flaming Gorge were removed during the first week in November. Minimums were imposed at 825 cfs (25 MW). Two units were made available for peaking purposes for a total of 94 MW with approximately 1,200 MWh of energy available on a daily basis. During the first half of the month, we took advantage of the available capacity from Flaming Gorge and scheduled up to its maximum capability for peaking purposes avoiding large hourly energy purchases over peak. Towards the end of November, it was decided to leave 35 MW of capacity unscheduled for unusual system conditions and/or for system regulation assistance. This action made it necessary for Western to make an additional 30 MW energy purchase over peak hours at times when the price of energy was 2-3 mills per kWh more costly.

The Aspinall units were a very valuable peaking resource throughout the month of November. Crystal ran at 1,135 cfs all month (17 MW). Morrow Point had 70 MW of capacity available and approximately 825 MWh worth of energy generation daily. Blue Mesa had 90 MW of capacity available with approximately 685 MWh of daily generation available. During November 19-21, Crystal was made unavailable due to transformer maintenance. By-passes from Crystal were set at 600 cfs. This reduced available energy generation from the Aspinall unit a total of 675 MW daily. Although capacity was still available for peaking purposes, additional energy purchases were required. We purchased supplemental energy (outside our seasonal contracts) during this time at around 24 mills per kWh which was about 2 mills per kWh higher than what we were purchasing for because of the need for additional energy.

Nonfirm energy availability was good for most of the month. Prices ranged from 22 mills per kWh to 24 mills per kWh during on-peak periods. There were a few occasions when cold fronts passed through and/or an unanticipated forced outage on a big thermal unit drove prices up to the 28-30 mill range. During those times, we competed more intensely with other utilities on our interconnected system for available energy. On a few occasions, we limited a Colorado Springs purchase from Public Service Company of New Mexico (which was wheeled through our system) in order to purchase the energy for our own needs. When this occurred, the maximum limitation was approximately 50 MW.

C. Power Scheduling and Purchases for the Month of December

December was a 700,000 acre-foot release month from Glen Canyon which allowed a maximum daily fluctuation of 6,000 cfs (218 MW) Weekday generation was patterned to release approximately 8,300 cfs (303 MW) during off-peak periods ramping up to 14,300 cfs (520 MW) during on-peak hours.

Flaming Gorge operations for December were similar to November for the first half of the month. There was approximately 90 MW of capacity available and a daily energy total of 1,200 MWh. On December 14, daily water releases from Flaming Gorge were increased to release approximately 115,000 acre-feet from the reservoir in lieu of the 80,000 acre-feet target set the first of the month. This increased our daily available generation from approximately 1,200 MWh to 1,700 MWh. To accommodate this increased generation requirement, we were forced to remove 35 MW of unscheduled capacity from reserves and use it over peak periods to avoid releasing more than minimum generation during off-peak periods. This worked out because we used Flaming Gorge as a peaking resource and moved the 35 MW of reserve capacity to the Aspinall unit.

The Aspinall unit maintained the same generation and water release patterns as in November. No unusual events occurred. Outages on the units were coordinated with Reclamation to occur over non-peak high load hours to reduce impacts. This will continue to be policy whenever possible so we can maintain capacity availability over peaks.

Purchase availability was good all month. We relied on seasonal arrangements to supply a majority of our needs. December was our peak month and we accommodated some very extreme double-hump daily peaks. With Glen Canyon generation set by release restrictions, we were required to back down other project generation to near minimums during afternoons and cut back all purchases to zero at times. Prices on the economy energy market ranged from 22-29 mills per kWh during the month. Our prices were stable at between 19-23 mills per kWh by contract.

IV. ANALYSIS OF RAMPING EVENTS

A study was conducted which looked at each instance where an hourly ramping rate appeared to deviate from interim flow criteria. The objective of the study was to explain each instance. This was accomplished through research of the operational records and logs kept during the hours of interest. The study period is from August 1, 1991 to December 31, 1991.

The packet titled, "Glen Canyon Dam Interim Flows - Glen Canyon Power Plant Operations, August 1991 thru December 1991" contains specific explanations for each ramping event. Each page consists of (1) a strip chart of real time Glen Canyon Dam operations during the ramping event, (2) a graph of the USGS Lees Ferry Gauge showing river elevation during the ramping event, (3) a graph of hourly integrated Glen Canyon Dam generation during the ramping event, and (4) a brief written explanation of the ramping event.

The strip chart shows a megawatt to hour relationship, with the hourly variable along the horizontal axis. A recording is made on the strip chart every 6 seconds.

The Lees Ferry graph illustrates the river elevation (in feet) for each hour.

The hourly integrated ramp graph provides information about the megawatt change per hour and the cubic feet per second change per hour for all hours in a day.

For the study period, 164 ramping events of interest were found. Of those events, 20 of them were 5 megawatts per hour or less, and were not analyzed due to their small magnitude. Most events were primarily explained by two factors:

1. Western Area Upper Colorado (WUAC) control area regulation was provided for Colorado-Ute Electric Association (CUEA), Deseret Generation and Transmission (DG&T), City of Farmington, and unanticipated changes in internal load from scheduled load. There were 99 instances which were explained by this factor.
2. Limitations of the Flaming Gorge Powerplant or the powerplants of the Aspinall units (Morrow Point, Blue Mesa, and Crystal) to compensate for hourly operational changes. The limitations stem from reservoir and river management, maintenance, and capability of the powerplants. There were 61 instances which were explained by this factor.

Some of the events were explained by other reasons. These reasons include scheduling errors, emergency assistance, unscheduled unit and line outages, Automatic Generation Control (AGC) software problems at Glen Canyon, an inability to purchase generation, and corrections for inadvertent energy imbalances within the control area. These instances, which were more unique, occurred 16 times. Several of the instances were explained by more than one factor occurring in the same hour.

## V. EXPENSES

The net expense of interim releases for the months August, September, October and November of 1991 are listed below:

August 1991	-- \$580,976
September 1991	-- \$484,716
October 1991	-- \$175,266
November 1991	-- \$283,016

Attached with this report are the four spreadsheets of net expense analysis of the 4 months, one for each month. The spreadsheets reflect the changes made to the previous financial assessment of interim releases. Previous analysis considered impacts to firm load only and economy energy sales (opportunity sales) were not included. For the actual interim releases, it is relatively easy to quantify the economy energy sales. However, it was difficult to quantify what the economy energy sales would have been without the interim releases, that is the opportunity costs, or revenues foregone.

In the present assessment, a statistical analysis has been used to calculate the economy energy sales under base case conditions. The first step was to calculate the amount of hourly excess generation associated with historical firm load and total generation amounts. Data were collected from WY 1987

through WY 1990, and assumed representative of operating conditions that Western probably would have experienced without interim release constraints. WY 1987 was chosen because it represents a moderate hydrological condition, allowing for a more diversified and unbiased data set.

The second step was to calculate the amount of monthly nonfirm sales during those four years. When graphed with hourly excess generation in the X axis and the nonfirm sales in the Y axis, there is a curvilinear relationship between these two data sets. A quadratic regression analysis was then performed on the data with the following results:

Multiple R:	0.91256
R Square:	0.83277
Adjusted R Square:	0.82533
F Statistics:	112.043
t <sub>1,1</sub> :	5.107
t <sub>1,2</sub> :	1.075
Equation:	$f(x) = 36082 - 0.00000115(x^2) + 1.509964(x)$

The results of the quadratic regression analysis are promising with a high R square, F, and t-statistics (rejecting both null hypotheses that  $H_0: B_1 = B_2 = 0$ , and  $H_0: B_1, B_2 = 0$ ). The regression curve fits the data well and the model does not violate any regression assumptions; i.e., normality, equality of variance, etc. From this analysis, it appears that the quadratic regression equation will provide a reasonably accurate estimate of economy energy sales for base case conditions. Any results obtained from this model may not be appropriate during wet hydrological conditions.

Economy energy sales or other sales (as referred in the spreadsheets) may include additional monthly or daily firm and/or nonfirm energy deliveries. Economy energy sales, which are energy sales made after all firm load commitments have been satisfied, are made to maximize the value of the remaining power available. In some years, they are a significant portion of Western's operations. The interim release constraints not only result in a required shift of releases from onpeak to offpeak when economy energy sales are of lesser value, but also result in loss of flexibility in mixing the resources and taking advantage of the market conditions. For example, in September, Western made a considerable amount of forced sales. The market was active and market prices were between \$26 to \$33 per MWh. If we were selling in the market, we would have taken advantage of the market and would have sold at an average price of \$27 per MWh instead of the actual energy price of \$21.61 per MWh. Also, we would have had economy energy sales of 60,834 MWh, instead of 32,161 MWh. Hence, for the month of September, \$947,479 is the opportunity sales lost due to interim releases.

In October the market was down and inactive and a price of \$23.57 per MWh would have been the sale price no matter whether we had interim release constraints or not. But Western would have made sales of 36,734 MWh instead of 7,826 MWh, and so the opportunity sale cost in October is \$681,343.

Finally, the statistical model could be improved if some other factors, which may influence the nonfirm sales, such as average temperature days, market sales prices could be transformed into quantifiable and clean data.

Opportunity costs should be quantified and included since sales revenues are foregone, with interim release constraints imposed.

**TABLE 1**  
**AUGUST 1991 SUMMARY**  
**NET EXPENSE ANALYSIS**

	<u>Base Case (Without Interim Release)</u> MWh	<u>Actual (With Interim Release)</u> MWh
Firm Load & Losses	606,080	606,080
GC Generation	402,353	402,353
Other CRSP/IP Generation	139,289	139,289
Purchases	66,155	73,982
Off Peak	41,258	4,642
On Peak	24,897	69,340
Other Imports	36,953	4,446
Other Sales	38,670	13,990
Purchase Prices		
Off Peak	\$ 14.14	\$ 14.89
On Peak	\$ 17.54	\$ 20.63
Other Imports Price (Avg. Estimated Purchase Price)	\$ 17.20	\$ 20.27
Sales Price	\$ 23.00	\$ 17.32
Purchase Expense	\$1,020,080	\$1,499,424
Off Peak	\$ 583,393	\$ 69,098
On Peak	\$ 436,687	\$1,430,326
Other Imports Expense	\$ 635,592	\$ 90,120
Other Sales	\$ 889,410	\$ 242,307
Net Expense	\$ 766,262	\$1,347,238

**Total Net Expense for August 1991: \$580,976**

**TABLE 2**  
**SEPTEMBER 1991 SUMMARY**  
**NET EXPENSE ANALYSIS**

	<u>Base Case (Without Interim Release)</u> MWh	<u>Actual (With Interim Release)</u> MWh
Firm Load & Losses	504,166	504,166
GC Generation	357,494	357,492
Other CRSP/IP Generation	133,724	133,724
Purchases	29,552	41,837
Off Peak	18,141	9,435
On Peak	11,411	32,402
Other Imports	44,230	3,265
Other Sales	60,834	32,161
Purchase Prices		
Off Peak	\$ 14.12	\$ 14.12
On Peak	\$ 19.84	\$ 19.92
Other Imports Price (Avg. Estimated Purchase Price)	\$ 18.53	\$ 18.61
Sales Price	\$ 27.00	\$ 21.61
Purchase Expense	\$ 482,537	\$778,554
Off Peak	\$ 256,151	\$133,200
On Peak	\$ 226,386	\$645,354
Other Imports Expense	\$ 819,582	\$ 60,762
Other Sales	\$1,642,518	\$694,999
Net Expense	(\$ 340,399)	\$144,316

**Total Net Expense for September 1991: \$484,716**

**TABLE 3**  
**OCTOBER 1991 SUMMARY**  
**NET EXPENSE ANALYSIS**

	<u>Base Case (Without Interim Release)</u> MWh	<u>Actual (With Interim Release)</u> MWh
Firm Load & Losses	440,116	440,116
GC Generation	243,066	243,066
Other CRSP/IP Generation	119,600	119,600
Purchases	77,881	76,105
Off Peak	36,674	37,475
On Peak	41,207	38,630
Other Imports	36,303	9,171
Other Sales	36,734	7,826
Purchase Prices		
Off Peak	\$ 15.15	\$ 15.49
On Peak	\$ 21.47	\$ 21.82
Other Imports Price (Avg. Estimated Purchase Price)	\$ 18.19	\$ 18.70
Sales Price	\$ 23.57	\$ 23.57
Purchase Expense	\$1,440,328	\$1,423,101
Off Peak	\$ 555,614	\$ 580,345
On Peak	\$ 884,714	\$ 842,756
Other Imports Expense	\$ 660,352	\$ 171,498
Other Sales	\$ 865,820	\$ 184,473
Net Expense	\$1,234,860	\$1,410,126

**Total Net Expense for October 1991: \$175,266**

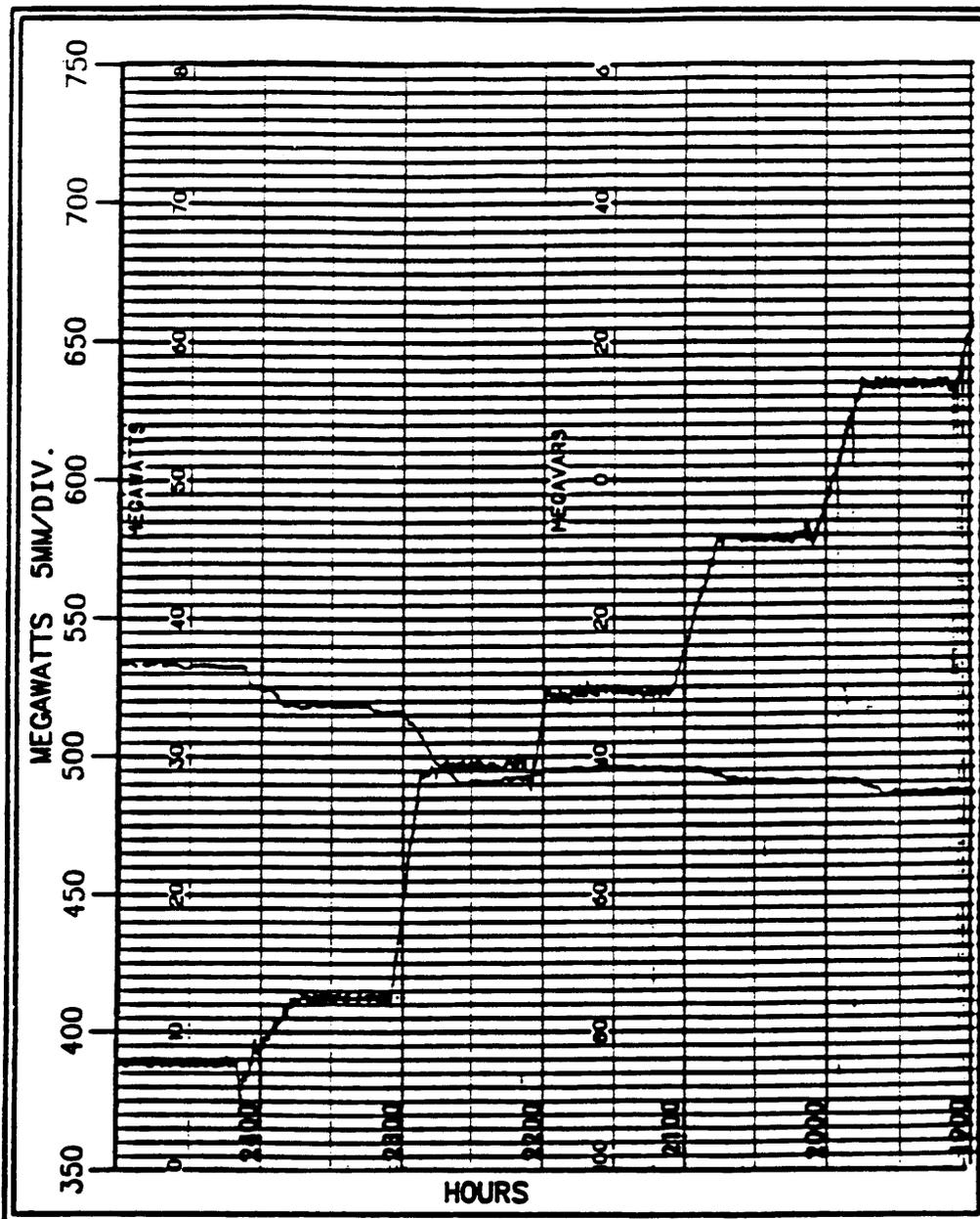
**TABLE 4**  
**NOVEMBER 1991 SUMMARY**  
**NET EXPENSE ANALYSIS**

	<u>Base Case (Without Interim Release)</u> MWh	<u>Actual (With Interim Release)</u> MWh
Firm Load & Losses	460,588	460,588
GC Generation	259,249	259,249
Other CRSP/IP Generation	88,339	88,339
Purchases	112,999	103,792
Off Peak	46,627	43,986
On Peak	66,373	59,806
Other Imports	37,083	12,143
Other Sales	36,082	2,935
Purchase Prices		
Off Peak	\$ 15.28	\$ 15.43
On Peak	\$ 22.06	\$ 22.71
Other Imports Price (Avg. Estimated Purchase Price)	\$ 18.89	\$ 19.63
Sales Price	\$ 26.66	\$ 26.37
Purchase Expense	\$2,176,638	\$2,037,223
Off Peak	\$ 712,458	\$ 678,740
On Peak	\$1,464,180	\$1,358,483
Other Imports Expense	\$ 700,498	\$ 238,367
Other Sales	\$ 961,946	\$ 77,384
Net Expense	\$1,915,190	\$2,198,206

**Total Net Expense for November 1991: \$283,016**

AUGUST 3, 1991

GLEN CANYON GENERATION



TIME: HE 2400

ACTUAL RAMP MW (CFS): -81 (-2177)

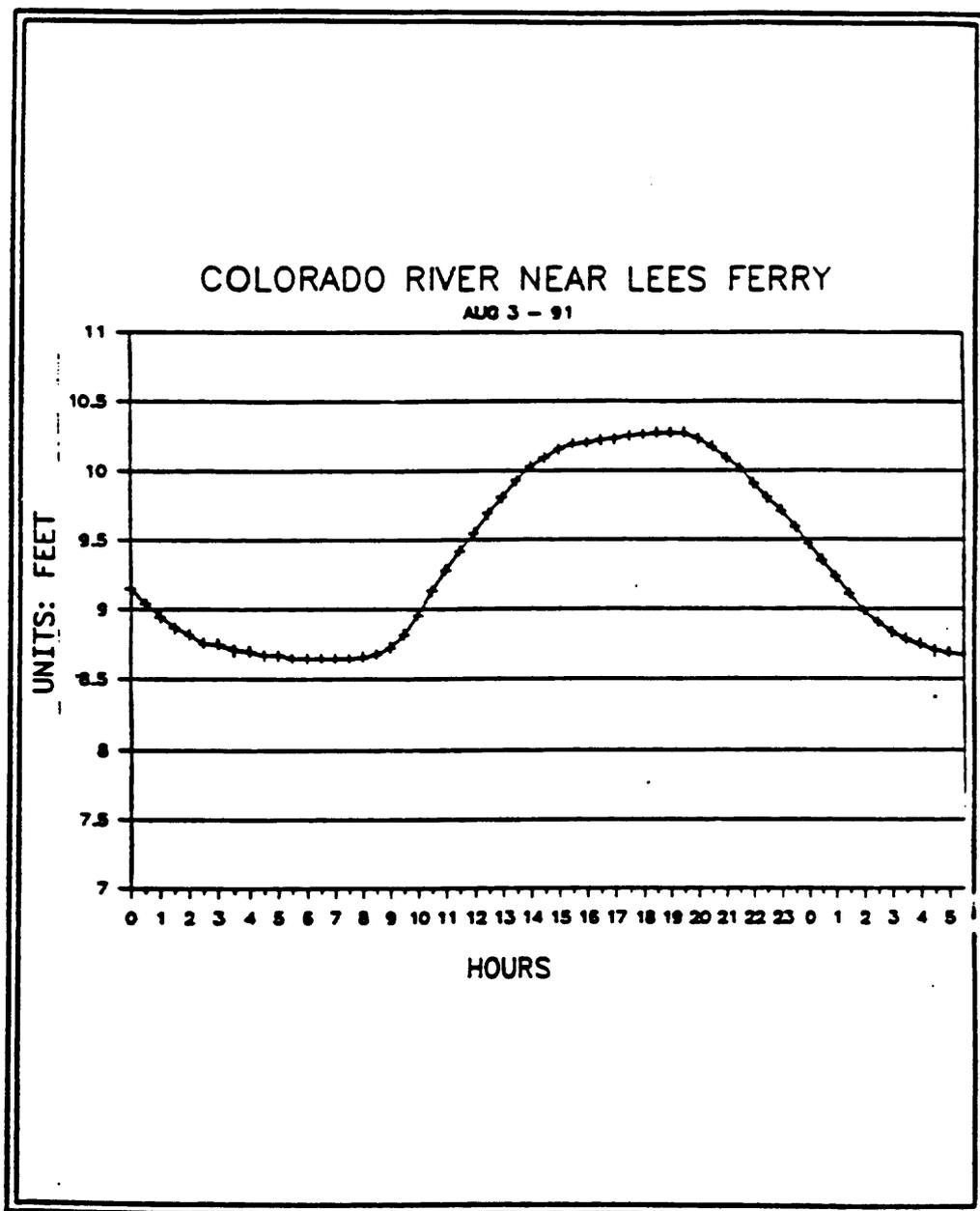
SCHEDULED RAMP MW (CFS): -56 (-1505)

EXPLANATION: CONTROL AREA REGULATION

Control area regulation required by CUEA for system regulation.

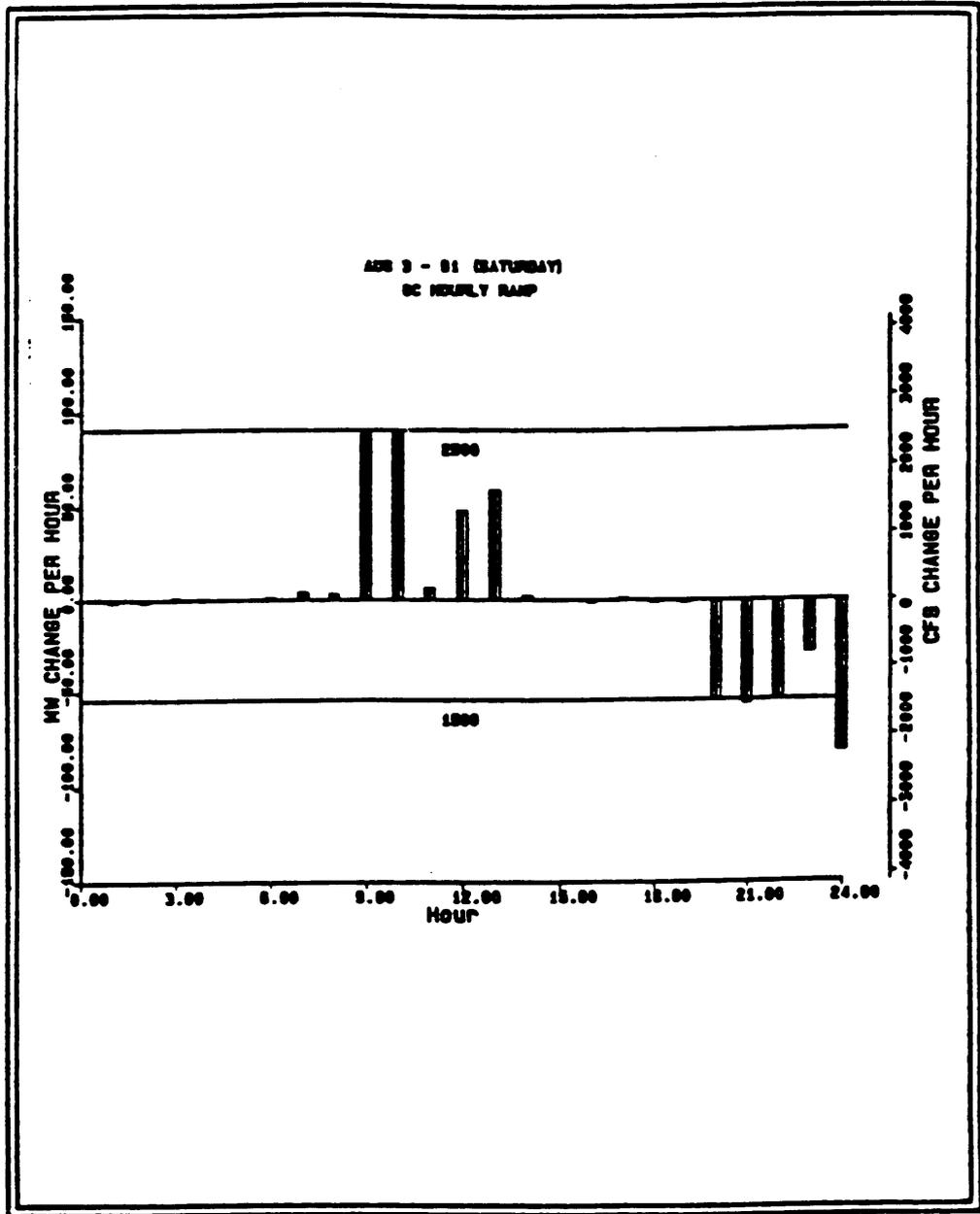
AUGUST 3, 1991

USGS/LEE'S FERRY RIVER ELEVATION



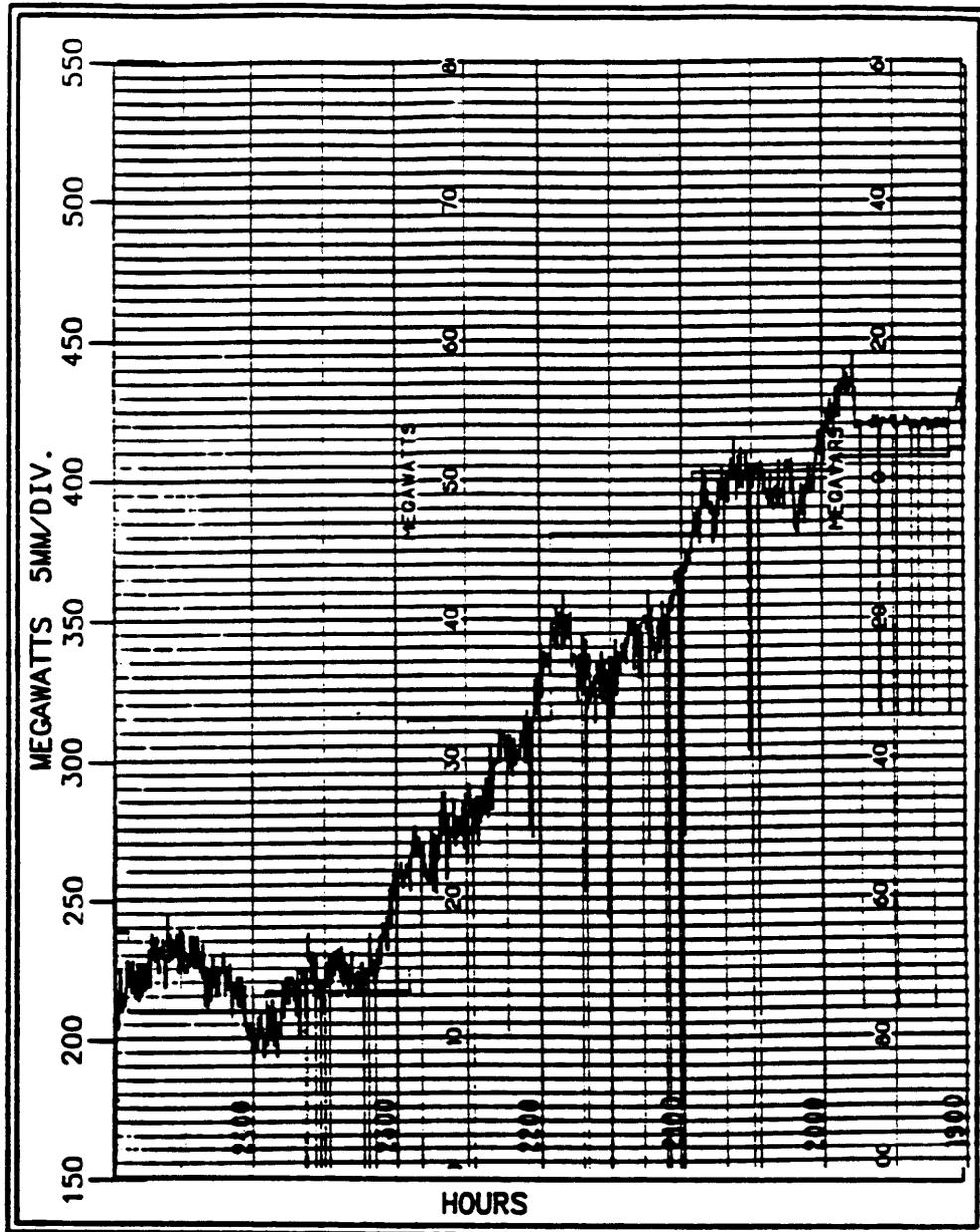
AUGUST 3, 1991

GLEN CANYON HOURLY RAMP



OCTOBER 16, 1991

GLEN CANYON GENERATION



**TIME:** HE 2400

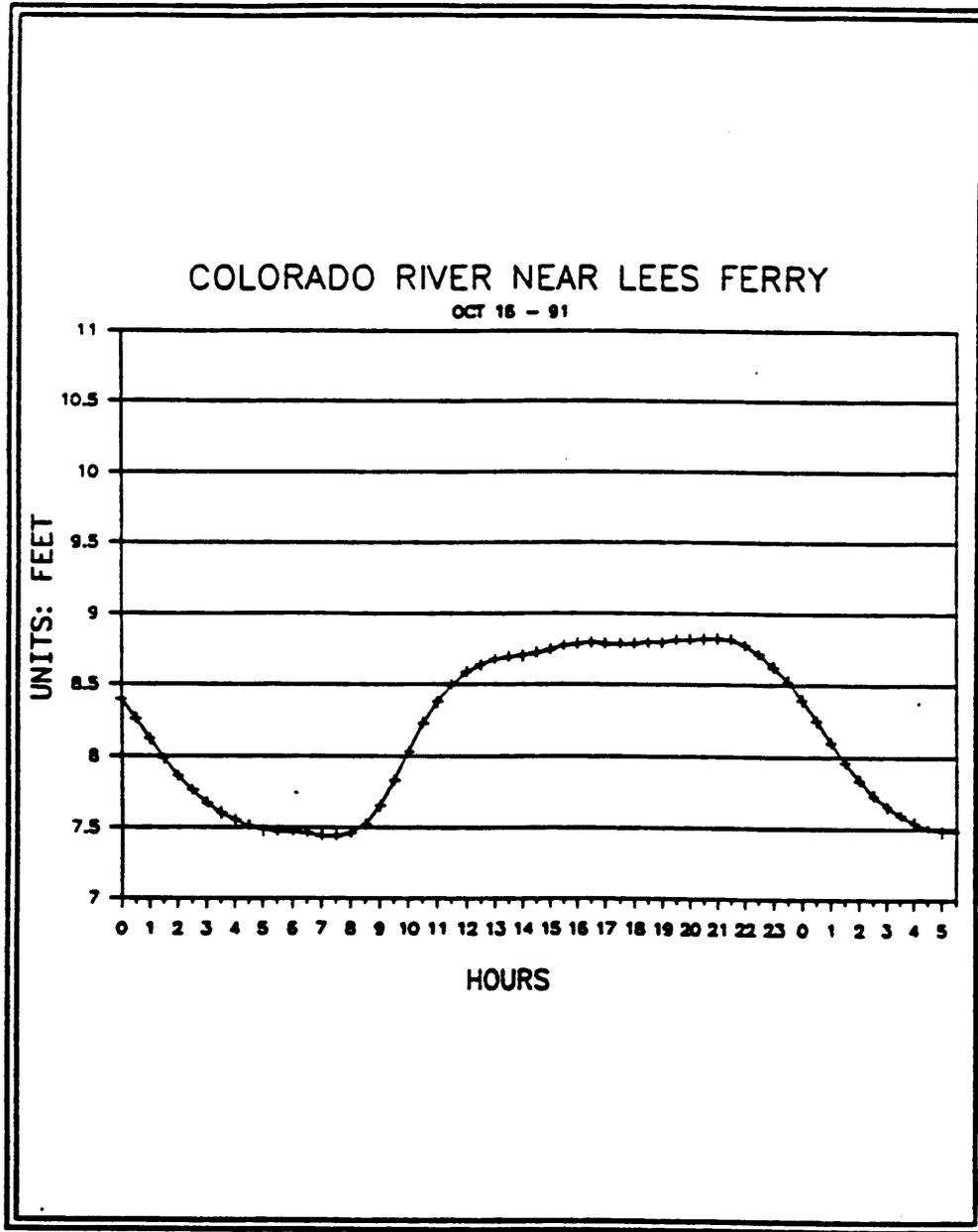
**ACTUAL RAMP MW (CFS):** -61 (-1639)

**SCHEDULED RAMP MW (CFS):** -54 (-1451)

**EXPLANATION:** CRSP RESOURCE AVAILABILITY

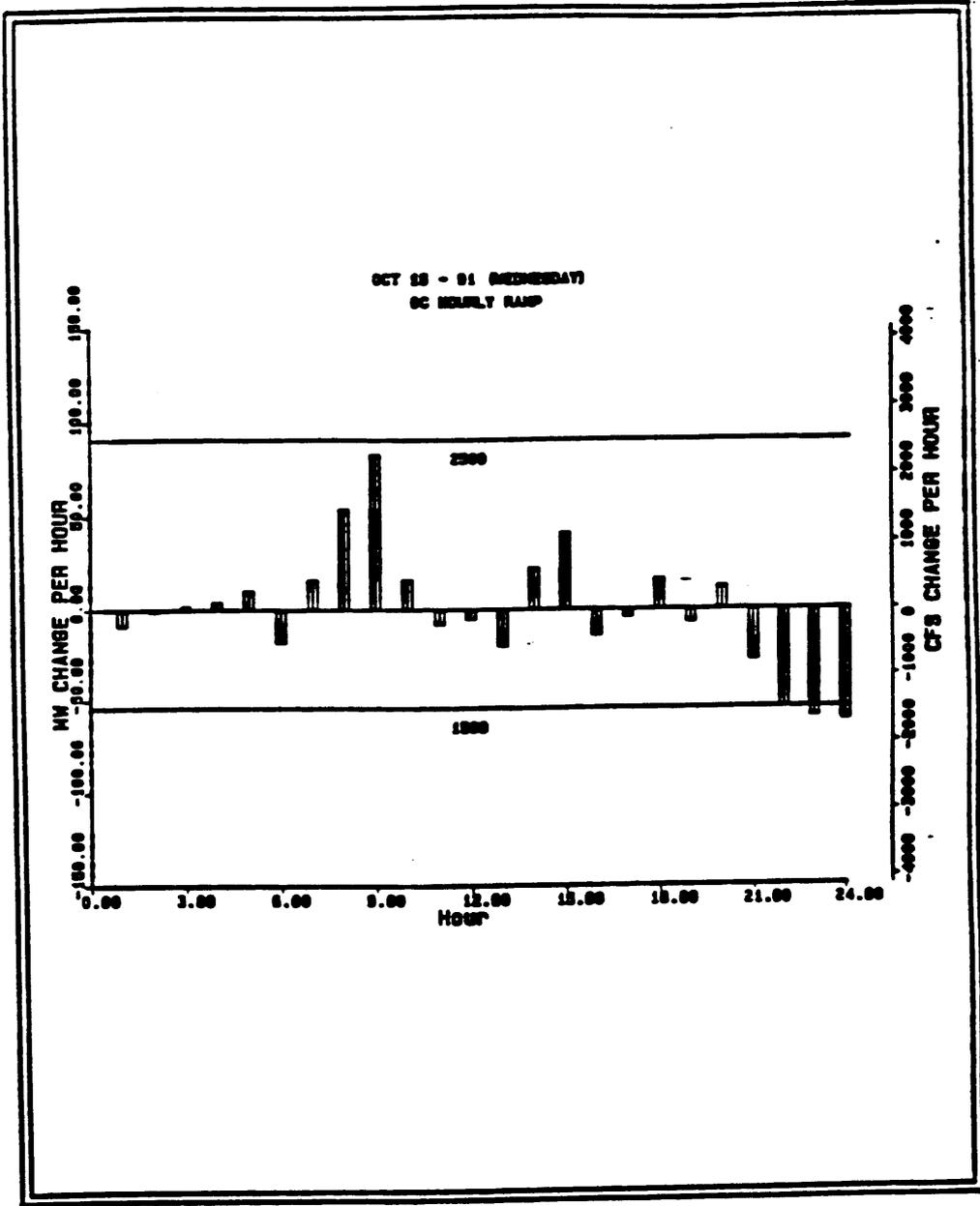
Morrow Point generation at minimum. Reserving minimal generation at Flaming Gorge and Blue Mesa to moderate down ramps for upcoming hours.

OCTOBER 16, 1991  
USGS/LEE'S FERRY RIVER ELEVATION



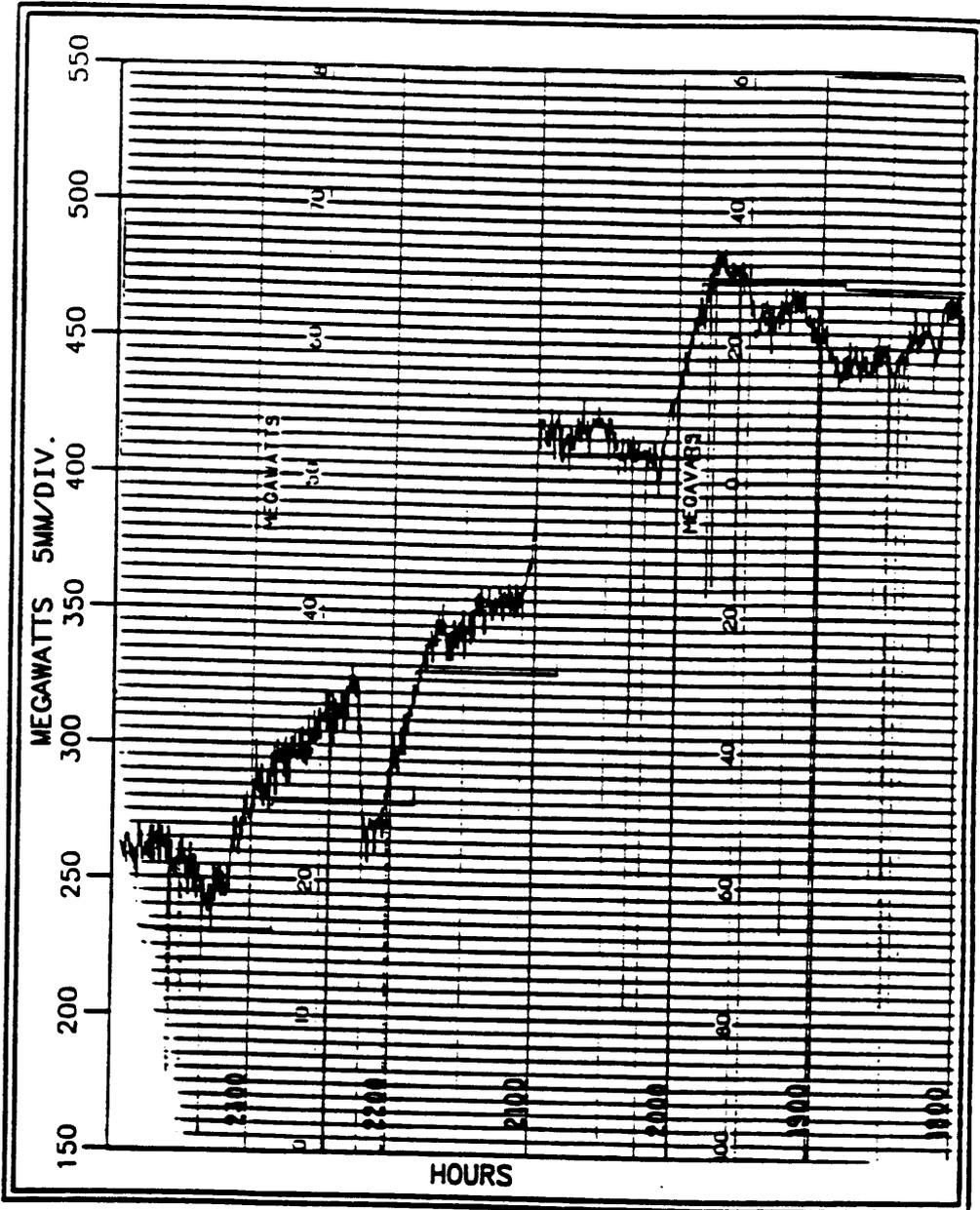
OCTOBER 16, 1991

GLEN CANYON HOURLY RAMP



NOVEMBER 8, 1991

GLEN CANYON GENERATION



TIME: HE 2200

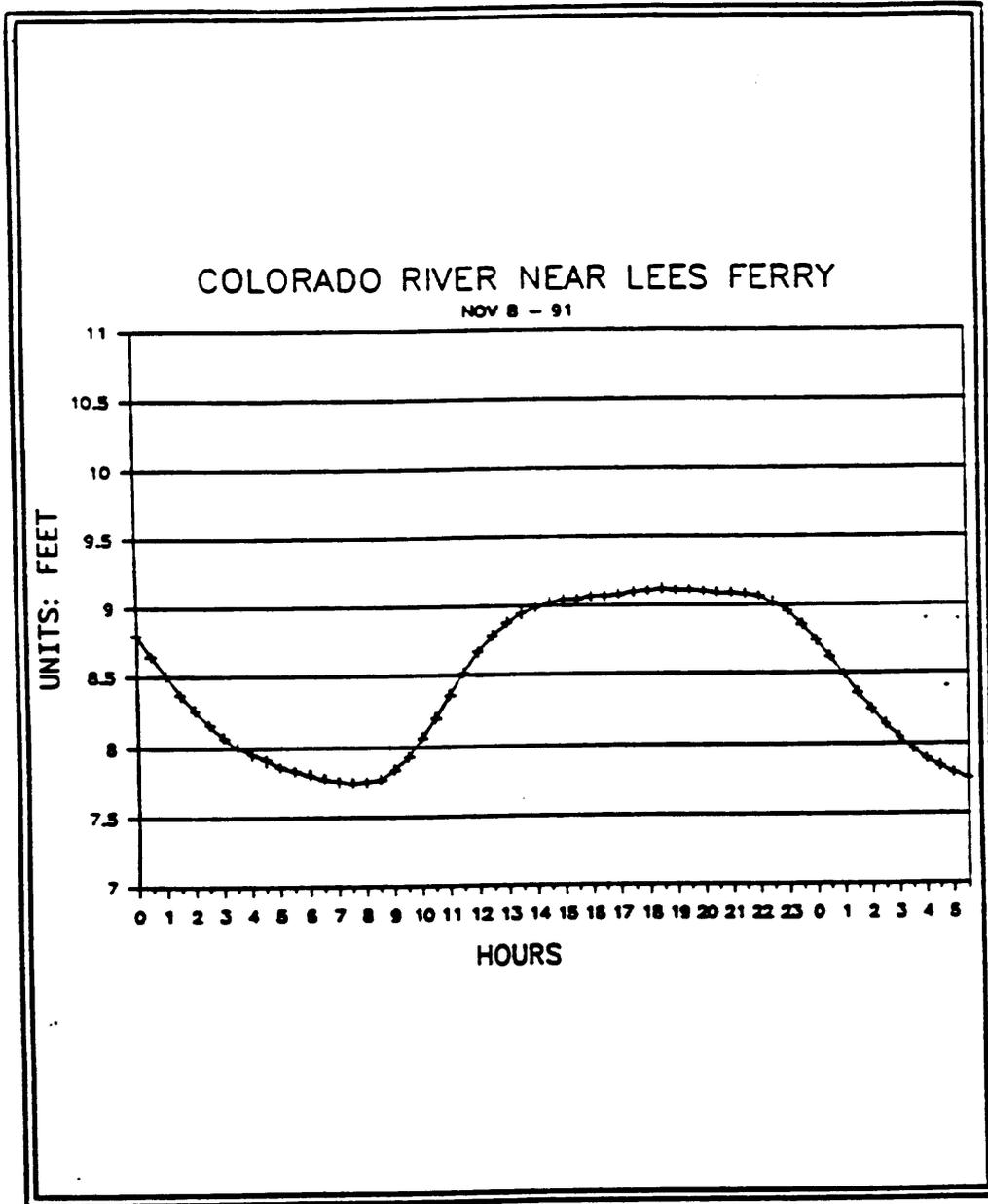
ACTUAL RAMP MW (CFS): -69 (-1854)

SCHEDULED RAMP MW (CFS): -54 (-1451)

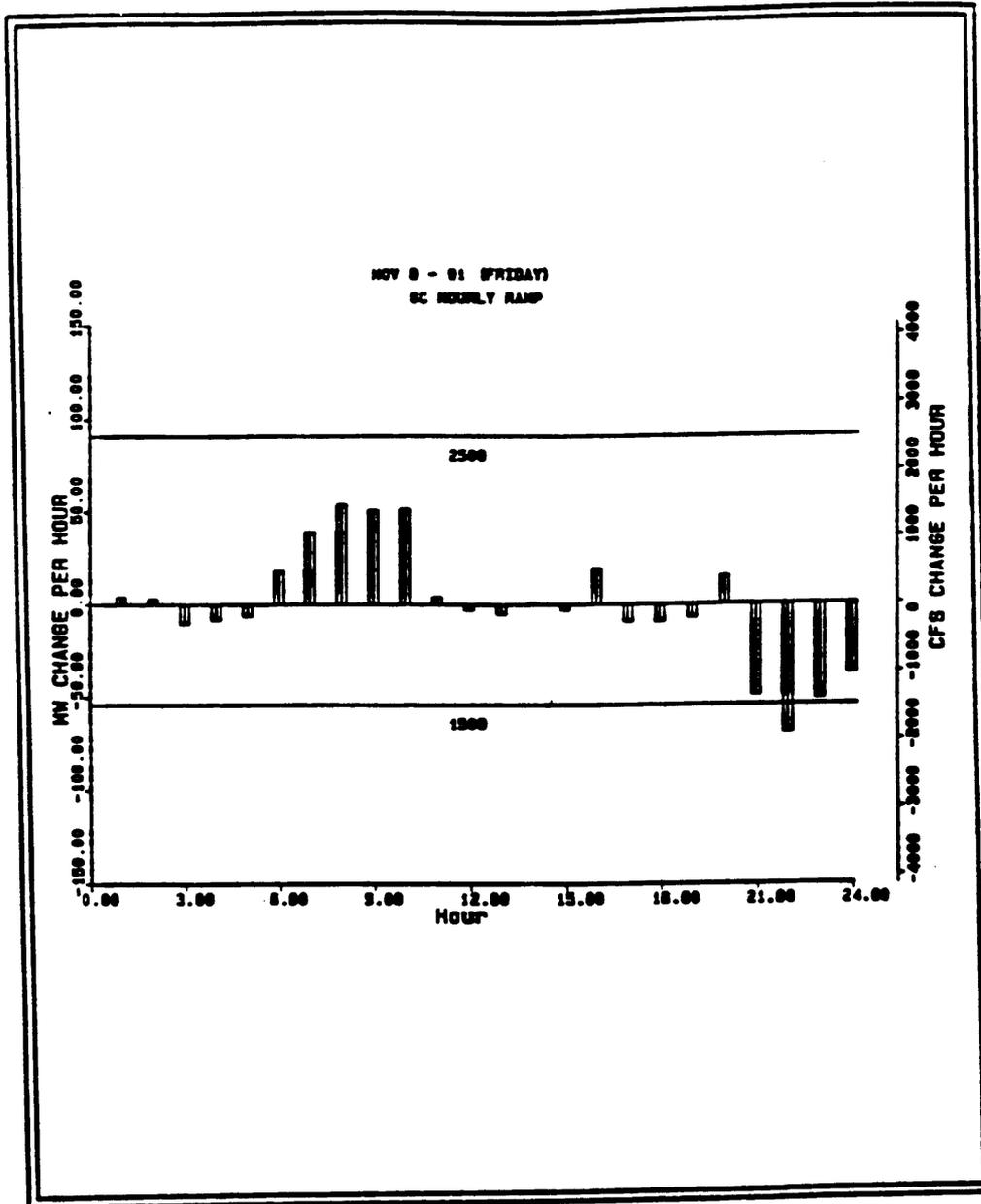
EXPLANATION: CONTROL AREA REGULATION, CRSP  
RESOURCE AVAILABILITY

Reserving generation at Flaming Gorge, and the  
Aspinal units to moderate down ramps for  
upcoming hours.

NOVEMBER 8, 1991  
USGS/LEE'S FERRY RIVER ELEVATION

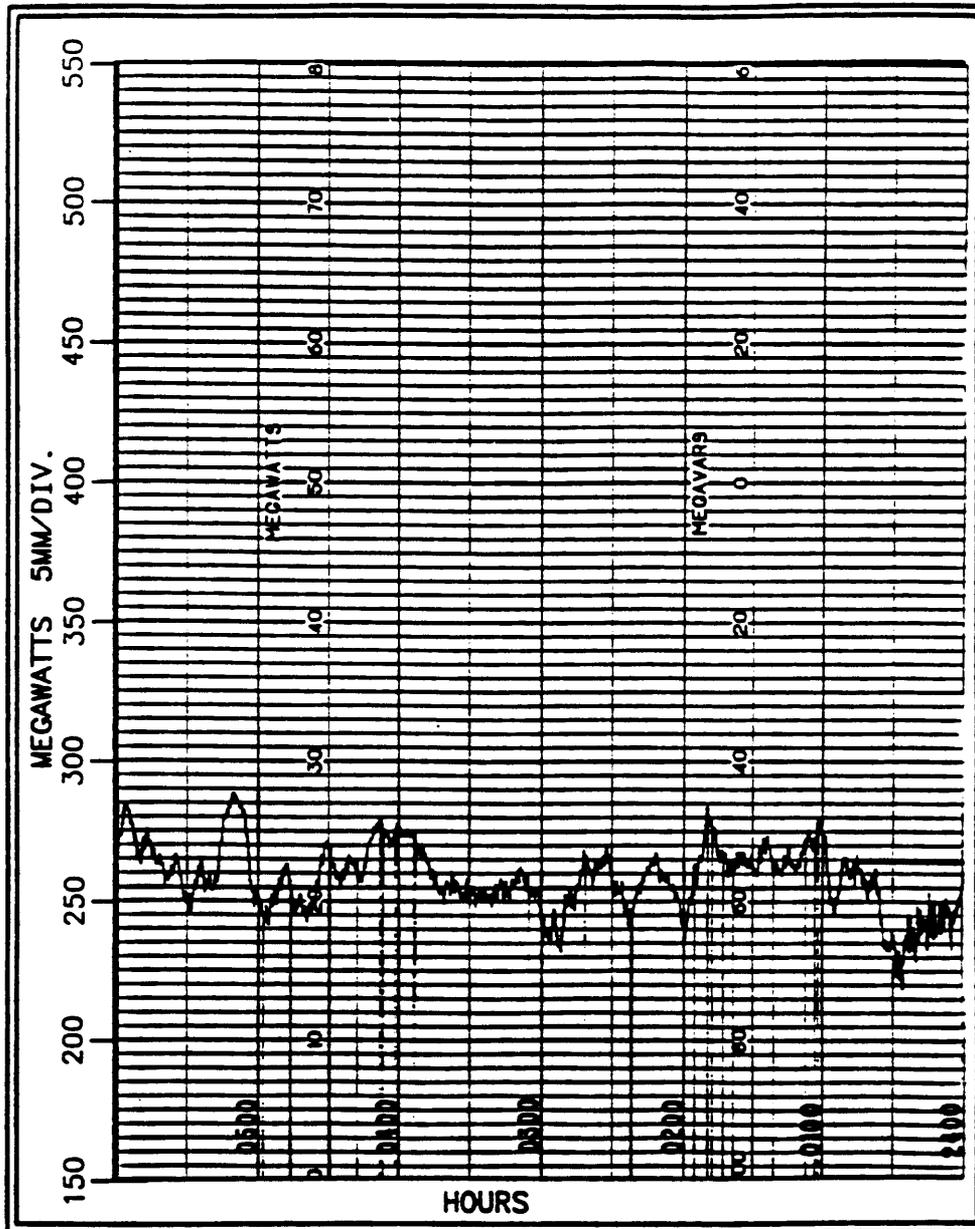


NOVEMBER 8, 1991  
GLEN CANYON HOURLY RAMP



NOVEMBER 19, 1991

GLEN CANYON GENERATION



TIME: HE 0100

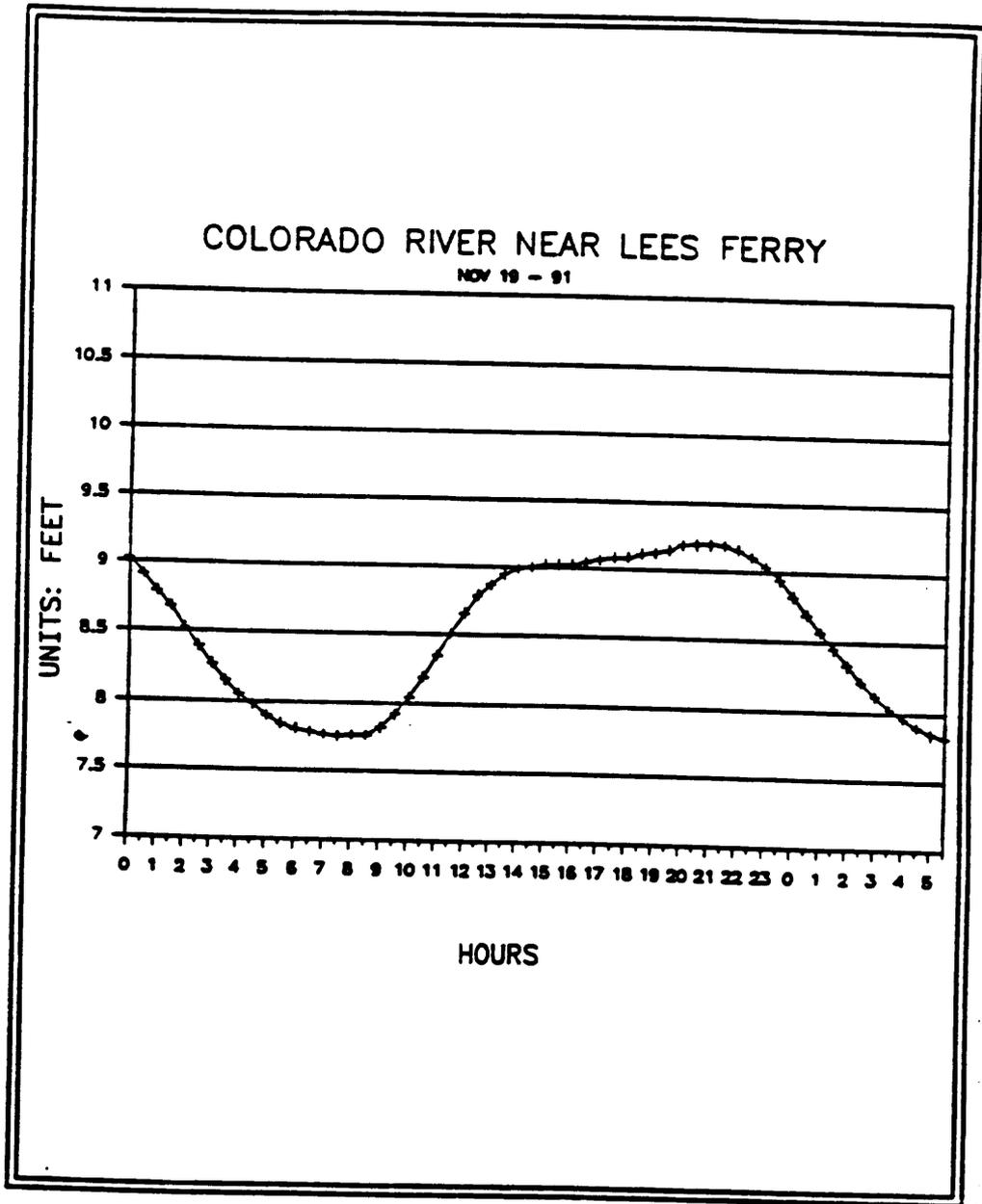
ACTUAL RAMP MW (CFS): -59 (-1585)

SCHEDULED RAMP MW (CFS): 0 (0)

EXPLANATION: INTERCHANGE SCHEDULING

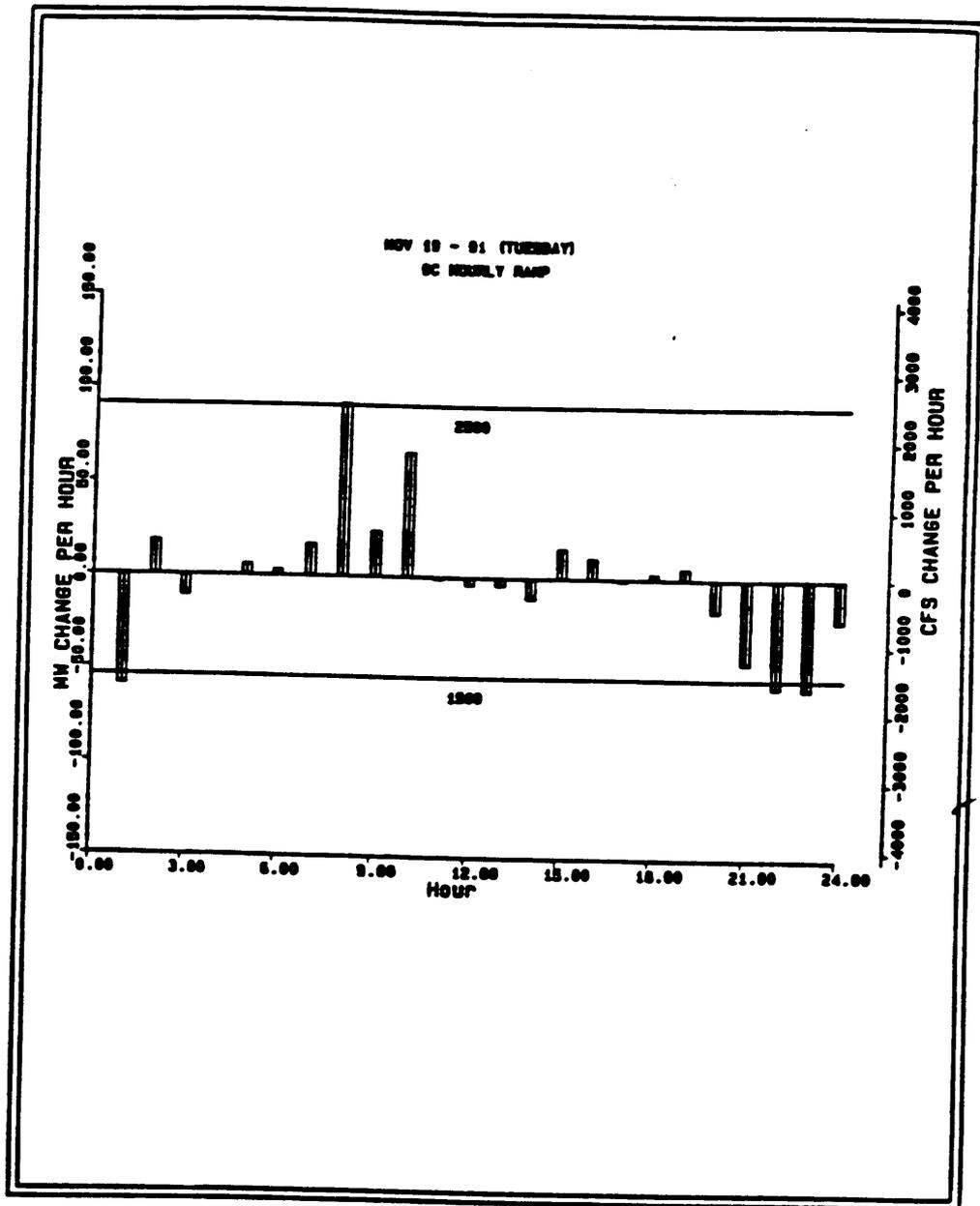
Crystal off-line for annual maintenance. This was not accounted for in the preschedule.

NOVEMBER 19, 1991  
USGS/LEE'S FERRY RIVER ELEVATION



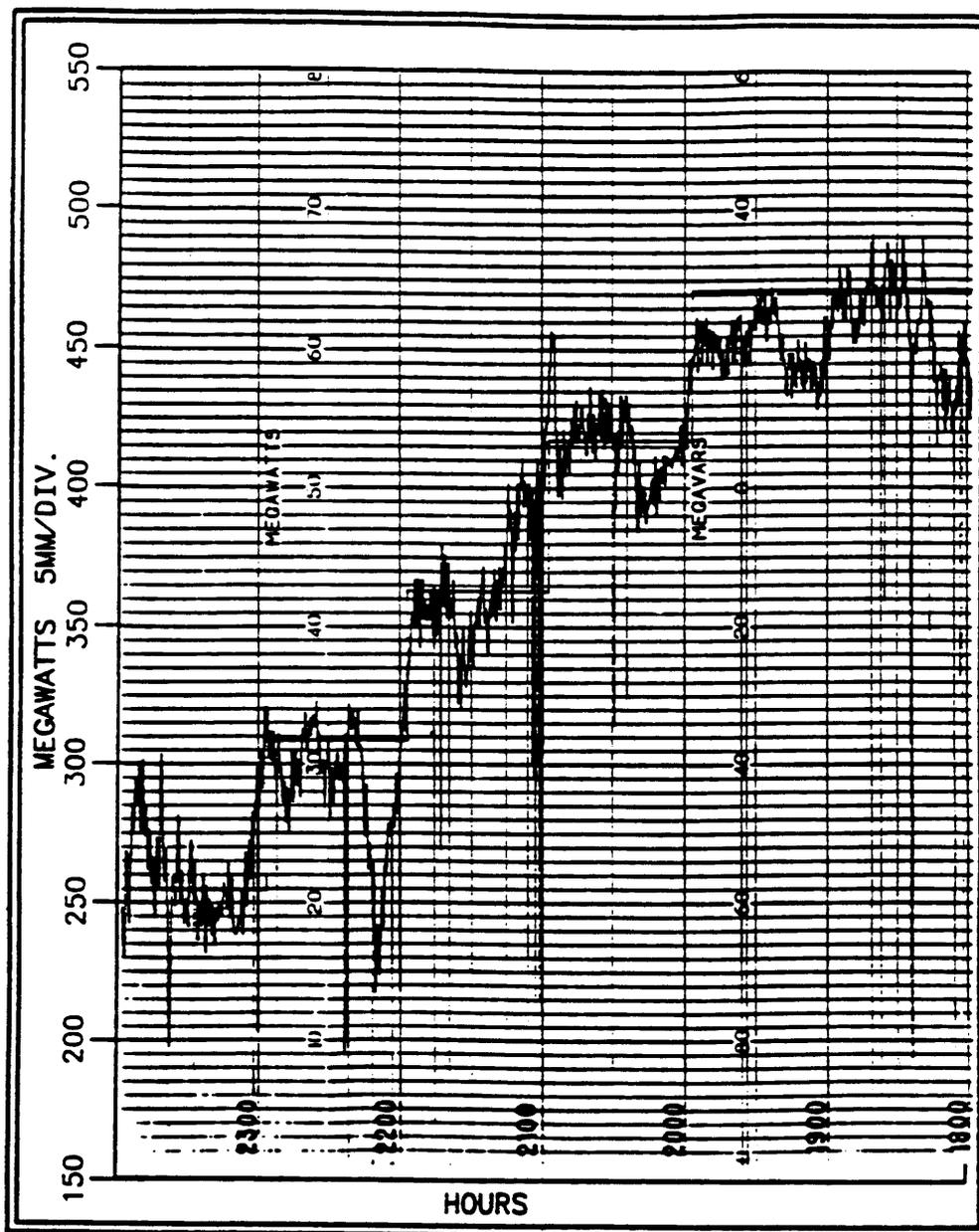
NOVEMBER 19, 1991

GLEN CANYON HOURLY RAMP



NOVEMBER 21, 1991

GLEN CANYON GENERATION



TIME: HE 2200

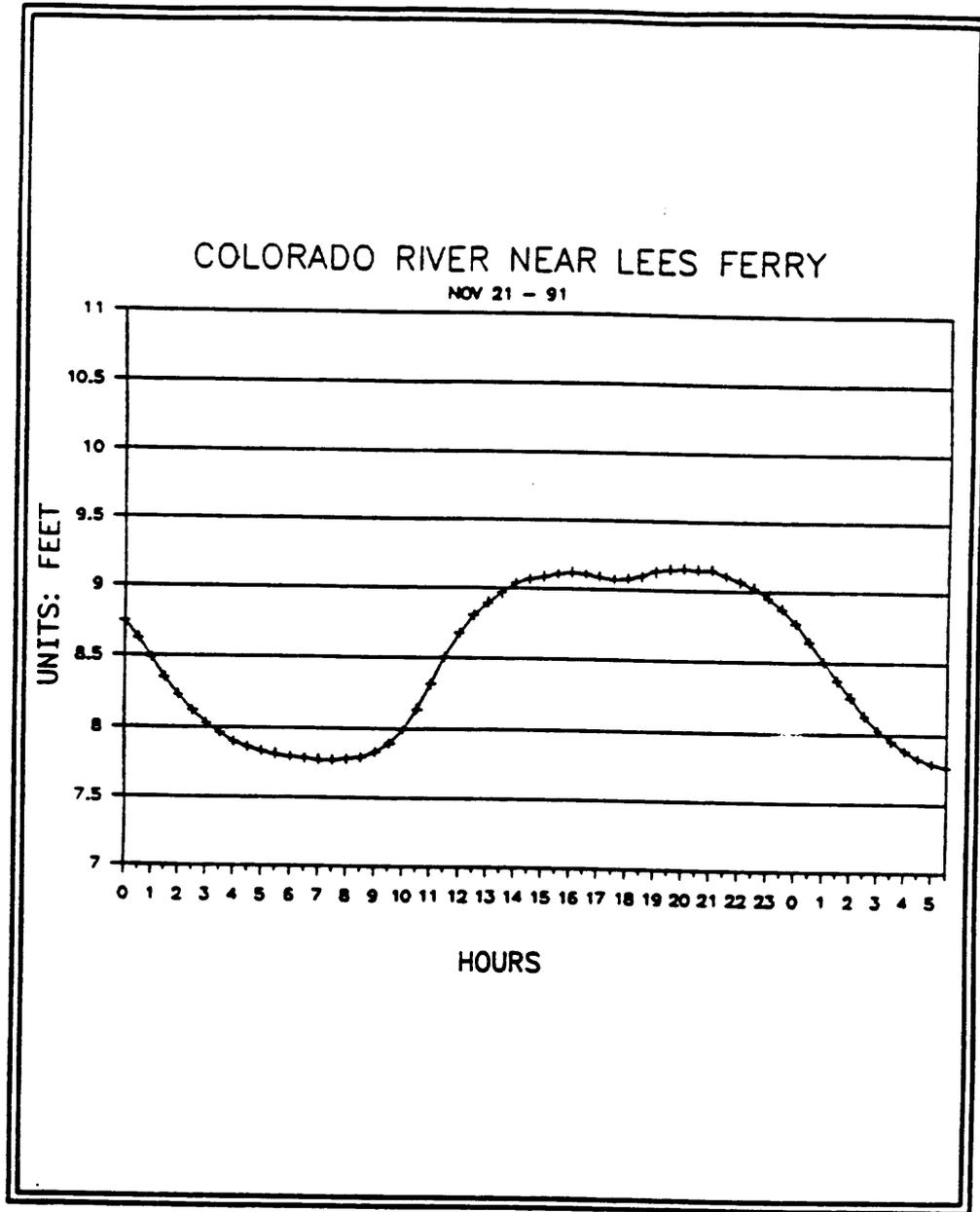
ACTUAL RAMP MW (CFS): -61 (-1639)

SCHEDULED RAMP MW (CFS): -54 (-1451)

EXPLANATION: INTERCHANGE SCHEDULING

Crystal coming on line following annual maintenance, not accounted for in preschedules.

NOVEMBER 21, 1991  
USGS/LEE'S FERRY RIVER ELEVATION



TIME: HE 2300

ACTUAL RAMP MW (CFS): -61 (-1639)

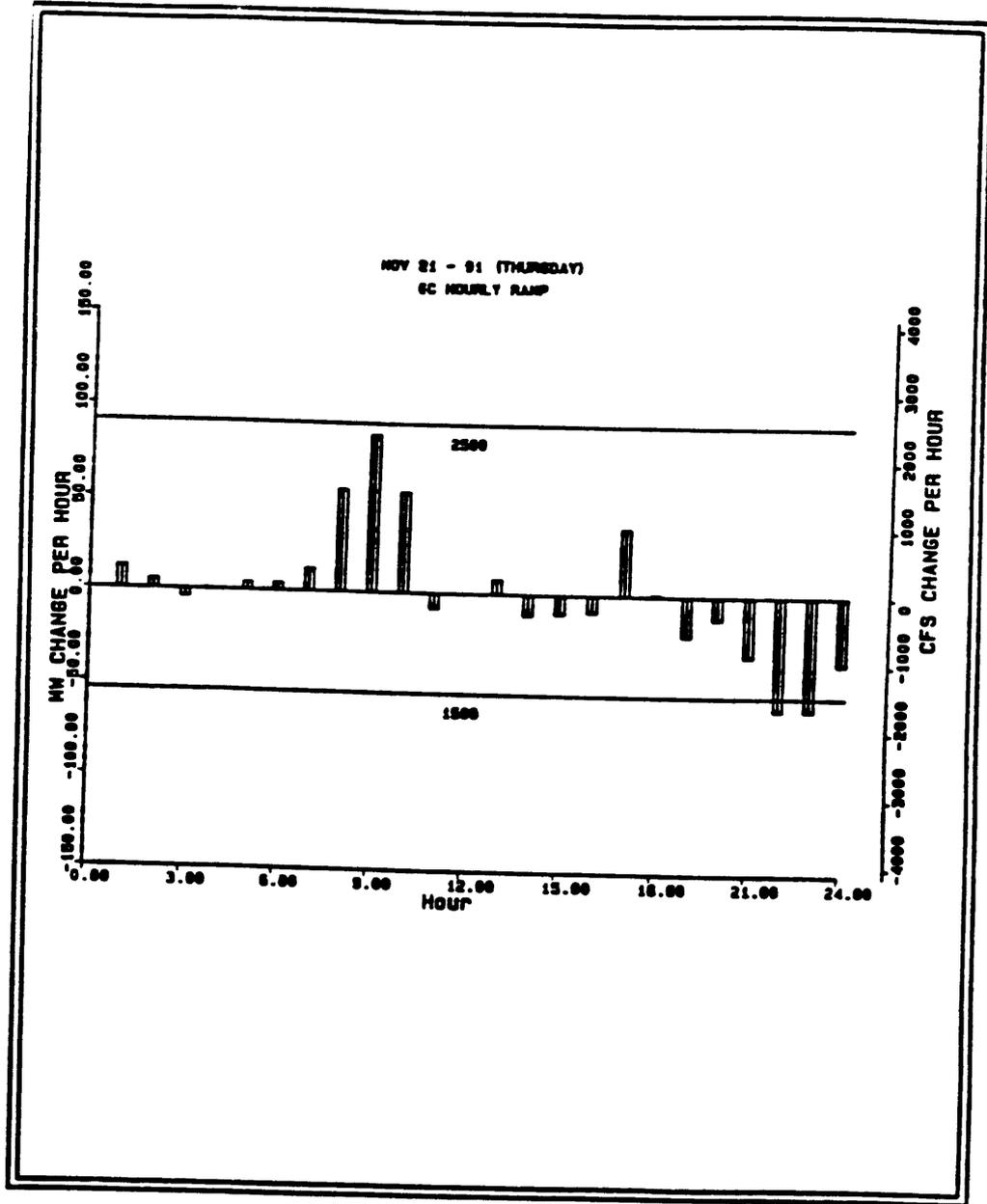
SCHEDULED RAMP MW (CFS): -54 (-1451)

EXPLANATION: CONTROL AREA REGULATION, CRSP RESOURCE AVAILABILITY

Control area regulation required by CUEA and DG&T for system operation. Control area internal load dropped more than prescheduled. Minimal generation available at the Flaming Gorge and Aspinall units to moderate the ramp.

NOVEMBER 21, 1991

GLEN CANYON HOURLY RAMP



**APPENDIX VII**  
**Monitoring of Resources**  
**Response to**  
**Interim Operations**

APPENDIX VII  
MONITORING OF RESOURCES RESPONSE TO INTERIM OPERATIONS

The monitoring to date by primary categories of the GCES program are listed below.

A. Sediment and Hydrology (7 river trips-data collection)

1. The USGS gaging stations have continued to collect information on the stage and flow levels at the five mainstem gages.

2. The USGS and GCES water quality monitoring devices have continued to collect values on the temperature, conductivity, pH, and Dissolved Oxygen levels.

3. No beach surveying or photogrammetry has occurred.

4. No sediment transport has occurred.

5. Monthly video records of the entire river corridor have been collected but the information has not been analyzed.

6. Remote cameras have been periodically maintained.

7. Flow/stage data has been collected from the R-200 network.

B. Biological (11 trips, endangered species and food base)

1. Monthly endangered fish work has been occurring in the mainstem Colorado through Bio/West and quarterly through the Arizona Game and Fish Department. These studies are part of the ongoing endangered fish work and should not be construed to be focused towards the interim flows.

2. Ad hoc surveys (non-supported) counts of eagles and other avifauna have been accomplished by National Park Service and GCES personnel on our own time.

3. Quarterly electrofishing has occurred in the Lee's Ferry reach by AGF and GCES personnel. This is part of the ongoing Trout studies and is not specifically focused towards the interim flows.

4. Informal discussions with the Lee's Ferry fishing guides has occurred.

5. AGF analysis of the productivity of the Lee's Ferry reach has occurred under existing research studies.

6. One aquatic food base (diptera) survey occurred in November.

C. Cultural Resources (1 geomorphology trip)

1. Cameras were placed at selected sites in March 1992.
2. Continual discourse with the tribal leaders and advisory teams has been conducted.
3. Evaluation of the geomorphology of the cultural resources at Unkar occurred. Part of ongoing section 106 work.

D. Economics

1. Continual check on the interim flows and monthly discussion with Western on the exception criteria and the costs of the interim flows.
2. Initiation of the non-use economic discussions.
3. Initiation of the power modeling efforts.