QUESTIONS AND ANSWERS

FOR A HEARING ON

THE FAILURE OF TETON DAM

CONDUCTED BY

UNITED STATES SENATE COMMITTEE
ON
INTERIOR AND INSULAR AFFAIRS
SUBCOMMITTEE ON
ENERGY RESEARCH AND WATER RESOURCES

PREPARED BY

BUREAU OF RECLAMATION

ON

JANUARY 20, 1977

January 24, 1977
Question No. 1

The Panel report states that:

"The design followed USBR practices, developed over a period of many years from experience with other Bureau projects, but without sufficient consideration of the effects of differing and unusually difficult geological conditions at the Teton Dam site. Every embankment can be said to have its own personality requiring individual design consideration and construction treatment. Treatment of such individualities produces most of the continuing advances in dam design and construction technology."

In view of this statement, please indicate the policy, if any, maintained by the Bureau for continually reviewing and updating its design criteria for dams. How frequently are design standards modified?

To what extent is the design of a dam uniquely devised on the basis of its site characteristics?

Has there been a tendency to perpetuate previous design practices without adequate consideration of their suitability for locations having significantly different physical characteristics?
Question No. 1 (Cont)

Is the engineering for a particular dam innovative and based on current technology or is it a transfer of traditional designs to new sites?

Answer to Question No. 1

The Office of Design and Construction constantly modifies its design criteria and standards as appropriate in order to stay as close to the state-of-the-art as practicable. In general, design standards are maintained in the design section responsible for the specific type of structure. Major changes in design philosophy or techniques are approved by the Design branch chief; the Chief, Division of Design; and/or the Director of Design and Construction, as appropriate. These standards are modified when a more appropriate method of design is developed. Approval of the Commissioner's Office is not required.

Many design standards are published in Bureau Manuals, Engineering Monographs, Research Reports, Technical Records of Design and Construction, and in Journals of Professional Societies. These documents are used throughout the world. When a sufficient number
of changes have been accumulated, the publications are revised. The following examples reflect recent practice:

Design of Gravity Dams, 1976
Design of Arch Dams (in preparation, with tentative publication date of August 1977)
The Dynamic Analysis of Embankment Dams (completed and scheduled for 1977 publication by the International Congress of Large Dams)

Each dam is designed to satisfy the site conditions at a particular location and geological setting. Designers take advantage of the experience gained by previous designs and incorporate new technologies in the design of the next project.
Question No. 2

The Panel stated the following in its report:

"The volcanic rocks at the Teton damsite are highly permeable and moderately to intensely jointed. Water was therefore free to move with almost equal ease in most directions except locally where the joints had been effectively grouted. Thus during reservoir filling water was able to move rapidly to the foundation of the dam. Open joints existed in the upstream and downstream faces of the right abutment key trench providing potential conduits for ingress or egress of water."

Did designers consider the possibility of rapid water movement to the foundation of the dam? If so, why wasn't the design and/or choice of construction materials and procedures modified accordingly?

If it was assumed that rapid water movement to the foundation would not occur or was precluded by grouting and/or other procedures, what field tests or analytic methods were used to arrive at this conclusion?

What are the Bureau's procedures for evaluating design integrity during construction?
Answer to Question 2

It is normal design practice to assume that the reservoir will have access to the upstream foundation of the dam, and in this case, the upstream face of the key trench as well. Rapid water movement to the foundation of the dam was recognized. As a result of the pilot grouting program in 1969, the decision was made to replace grouting from the ground surface on the abutments with the impervious soil filled key trench, and the three-row grout curtain in the bottom of the key trench.

In order to provide a dense, well-bonded material against the rock surface, specially compacted zone 1 material was specified. Earthwork construction control tests and close inspection of the specially compacted material were documented. The Panel's report states:

"The embankment foundation contact in the key trench was excellent and well bonded where observed at many locations in the side wall, transverse invert trenches, and the longitudinal trenches extending to the top of the grout cap. Foundation cleanup was excellent **. No dry, pervious, or low density layers or lenses were found. A few localized, saturated pockets of Zone 1 material were encountered along the upstream wall of the key trench **"
The Panel excavations did not reveal any locations where reservoir water had penetrated the fill beyond the face of the trench, except for the localized pockets.

Grouting techniques required by the Bureau provide a reliable check on the adequacy of foundation grouting.

The Bureau continually evaluates the design integrity during construction. Weekly and/or monthly progress reports are prepared by each Construction Engineer. Design engineers monitor each construction contract through construction liaison engineers stationed in Denver. Design engineers visit the jobsite at selected times such as when the foundation is exposed or a problem related to the design arises. Designs are modified by the original design group when field conditions dictate.
Question No. 3

Relative to the material used in zone 1 (the core), the Panel commented as follows:

"The wind-deposited nonplastic to slightly plastic clayey silts used for the core and key trench fill are highly erodible. The Panel considers that the use of this material adjacent to the heavily jointed rock of the abutment was a major factor contributing to the failure."

It is assumed that Bureau of Reclamation engineers employ state-of-the-art technology in the design and construction of earthfill dams. Considering the Panel's comment that the manner of use of the selected zone 1 material was a major factor contributing to failure, why weren't provisions made in the dam's design to circumvent this problem?

It is documented that the Bureau noted the highly erosive character of the core fill. This factor combined with the difficult geologic conditions at the damsite would suggest the exercise of great caution and special design accommodations. What options for design and choice of construction materials were explored?
Question No. 3 (Cont)

What were the alternatives to the use of the selected zone 1 material?

Answer to Question No. 3

This soil was used within a deep abutment key trench to create an impermeable barrier. The Bureau assumed that this trench in combination with the grout curtain would provide a sufficiently impermeable barrier to the water. Provisions were made to make sure the barrier was impermeable. Although the Bureau is just beginning to evaluate the data collected by the Independent Panel, our preliminary evaluations indicate that the major problem occurred because of the configuration of the deep key trenches.

Initially the Bureau planned to design a rockfill dam at the site of Teton Dam. This type of design is highly resistant to earthquake effects and to erosion by flowing water. This design was revised due to the environmental consideration of defacing the upstream reservoir abutment area. Following this, a homogeneous type design embankment constructed of the wind-deposited silt was considered for the site. This design was rejected due to the erodible
Answer to Question No. 3 (Cont)

Characteristics of the wind-deposited silt and possible earthquake effects at the site. Finally the present design wherein the silt material would be contained within sand gravel shells and within the key trench was decided upon. The choice of material for the core was limited to the wind-blown loessial material which covers the uplands adjacent to the damsite. This material is commonly used in the construction of earth dams and was selected here because it was strong, impermeable, and readily available.
Question No 4

The rate of filling of the reservoir was affected in part by the delay in completion of the river outlet works. To what extent, if any, could this have impacted on the extent and timing of the failure and the opportunity to provide more advanced warning of the breach of the dam?

Answer to Question No. 4

In the Panel's view, as stated by Mr. Chadwick at the January 6, 1977 press conference, with which the Bureau agrees,

"* * * we did not believe that the rapid filling rate was a fundamental cause of the failure of the dam. It might have changed the timing, but we don't think that it would have saved the structure if it had been able to fill the reservoir at its lower rate."

The effect of any change in timing is speculative.
Question No. 5

Regarding the grout curtain, the Independent Review Panel stated the following:

"The records show that great effort was devoted to constructing a grout curtain of high quality and the Panel considers that the resulting curtain was not inferior to many that have been considered acceptable on other projects. Nevertheless, the Panel’s on-site tests and other field investigations showed that the rock immediately under the grout cap at least in the vicinity of stas. 13+00 to 15+00 was not adequately sealed and that additional unsealed openings may have existed at depth in the same locality. The leakage beneath the grout cap was capable of initiating piping in the key trench fill leading to the formation of an erosion tunnel across the base of the fill. The Panel considers that too much was expected of the grout curtain and that the design should have provided measures to render the inevitable leakage harmless."

To what extent was an effort made to determine the degree to which the rock below the grout cap was adequately sealed? Could a better determination have been made?
In view of the fact that leakage beneath the grout cap could significantly affect the integrity of the dam, why weren't more adequate measures taken to eliminate this hazard?

Answer to Question No. 5

The foundation grouting in the reach between stations 13+00 and 15+00 consisted of two outer rows of grout holes on 20-foot centers and a centerline curtain through a grout cap on 10-foot centers with closure holes on 5-foot centers as necessary. Centerline holes were grouted to refusal under established standards. Final closure holes had negligible grout take under pressure. The grouting techniques employed furnished a good check on the adequacy of the grout curtain so there was no reason to doubt the quality of the grout curtain in this area.

Foundation conditions in the reach after failure, when additional drilling and water testing were done, were quite different than during construction. Approximately 300,000 cubic yards of rock and considerable grout cap were eroded during the failure which produced vibrations in the area. The tremendous force of water which was directed against the abutment may have affected previously filled
Answer to Question No. 5 (Cont)

cracks and stress relief resulting from the removal of the rock may have contributed to post failure open joints that did not exist immediately after grouting. This may have contributed to the amount of leakage beneath the grout cap indicated by the tests performed after failure.
Question No. 6

The Review Panel noted that the key trench design created some problems. It stated that:

"The geometry of the key trenches, with their steep sides, was influential in causing transverse arching that reduced the stresses in the fill near the base of the trenches and favored the development of cracks that would open channels through the erodible fill. Arching in the longitudinal direction due to irregularities in the base of the key trenches and arching adjacent to minor irregularities and overhangs undoubtedly added to the reduction of stress."

The arching condition referred to is well understood and yet a questionable design was chosen with knowledge beforehand of the difficult geology and less-than-optimal zone 1 material. Why was this selection made? What other options, if any, were evaluated?

Answer to Question No. 6

The following options were evaluated for providing an impervious barrier in the abutments:
1. Constructing a grout barrier from the ground surface

2. Excavating the highly fractured and jointed rock to form a key trench, constructing a grout curtain from its bottom, and replacing the highly fractured and jointed rock with compacted impervious soil

Option No. 2, the key trench in combination with the grout curtain, was selected because it was felt that it would provide a more reliable cutoff in the highly fractured zone.

The imperviousness of the material is stated in the Panel's report, "* * * the coefficient of permeability of the in situ zone 1 fill varies from about 0.1 x 10^{-6} to 5 x 10^{-6} cm/sec," which is a very satisfactory impermeability.

The phenomenon of arching with potential for hydraulic fracturing was not well understood at the time of design and construction of the dam and in particular with reference to the key trench situation. The Panel in their report also made the statement, "* * * the phenomenon (hydraulic fracturing) is not yet fully understood and deserves research * * *. When a better physical understanding of
Answer to Question No. 6 (Cont)

the creation and propagation of cracks by water pressure has been achieved, the criteria for initiation of hydraulic fracturing utilized herein may require modification."
Question No. 7

Stress calculations made at the request of the Independent Panel by the finite element method indicated that at the base of the key trench near stations 14+00 and 15+00 the arching was great enough that the water pressure could have exceeded the sum of the lateral stresses in the impervious fill and the tensile strength of the fill material. Thus cracking by hydraulic fracturing was a theoretical possibility and may have led to flow of water in the base of the key trench between stations 14+00 and 15+00, and erosion of the key trench fill.

To what extent was the hazard of hydraulic fracturing considered in the design of the Teton Dam?

Does the Bureau routinely use analytic tools such as the finite element method to evaluate prospective designs?

What analytic procedures are required as part of the Bureau's design and analysis methodology?

To what extent are studies conducted to identify potential hazardous conditions in proposed structures?
Answer to Question No. 7

The hazard of hydraulic fracturing was not considered in the design of Teton Dam. At the time Teton Dam was designed the analytical methods which were capable of indicating the possibility of hydraulic fracturing were not a generally accepted design tool for embankment design. However, the Bureau has used the finite element analysis in the design of concrete structures for many years, and does not disagree with the panels theory with regard to hydraulic fracturing at Teton being related to the key trench design.

At the present time the Bureau uses both static and dynamic finite element analyses in the design of both concrete and embankment dams. Additional analytical procedures used in the design of a dam include laboratory analyses, geological assessment, seepage analyses, and conventional limit equilibrium analyses.

Where the safety of a dam is involved, the Bureau goes to great lengths in field, laboratory, and analytic investigations to identify a potentially hazardous condition. This is illustrated by the fact that at Teton Dam the Bureau had drilled 102 preconstruction drill holes which totaled 17,864 feet of core. In addition, a test grouting program was accomplished, and seismic monitoring stations established to verify the seismicity of the area.
However, the hazard now related to the hydraulic fracturing of material in the key trench was not recognized.
Question No. 8

The Review Panel stated that:

"The dam and its foundations were not instrumented sufficiently to enable the Project Construction Engineer and his forces to be informed fully of the changing conditions in the embankment and its abutments."

Why was the instrumentation insufficient?

Was the extent of monitoring at Teton consistent with that used at other damsites?

What procedures are used to determine the degree and nature of monitoring required?

Is the monitoring program for a dam standardized or designed specifically based on the properties of the site?

Answer to Question No. 8

The minimum instrumentation provided at Bureau earth dams consists of surface measurement points for measuring settlement or heave.
and deflection upstream and downstream, plus seepage monitoring features as required, such as toe drains, weirs, collection facilities, and observation wells. Additional instrumentation is used to monitor some particular condition for which more information is desired or to help evaluate the overall performance of the structure. Palisades Dam and other Bureau dams of similar material and height were well instrumented and the data therefrom showed what the material behavior was like. It was therefore felt that instrumentation at Teton to reaffirm previously established performance was not necessary.

The monitoring program for a dam is only standardized from the standpoint of minimum instrumentation and observation. Additional instrumentation is designed specifically for each site. The Bureau has pioneered the design and application of many types of instruments for monitoring embankment behavior. These are used worldwide.

Instrumentation, however, is not a foolproof means for detecting all internal happenings; it has to be at the right place, at the right time. While additional instrumentation data might have been helpful, the Panel states in their report:

"The paucity of instrumentation and the decision to allow an increased rate of filling had no demonstrable influence
on the failure. The short time within which the chain of events occurred that culminated in the catastrophe suggests that there would have been insufficient reaction time to take advantage of instrumental warnings * * *.

Nevertheless, Reclamation intends to intensify its instrumentation research and design requirements.
In summarizing its views on the causes of failure of the Teton Dam, the Independent Review Panel stated the following:

"The fundamental cause of failure may be regarded as a combination of geological factors and design decisions that, taken together, permitted the failure to develop. The principal geologic factors were (1) the numerous open joints in the abutment rocks, and (2) the scarcity of more suitable materials for the impervious zone of the dam than the highly erodible and brittle windblown soils. The design decisions included among others (1) complete dependence for seepage control on a combination of deep key trenches filled with windblown soils and a grout curtain; (2) selection of a geometrical configuration for the key trench that encouraged arching, cracking, and hydraulic fracturing in the brittle and erodible backfill; (3) reliance on special compaction of the impervious materials as the only protection against piping and erosion of the material along and into the open joints, except some of the widest joints on the face of the abutments downstream of the key trench where concrete infilling was used; and (4) inadequate provisions for
Question No. 9 (Cont)

collection and safe discharge of seepage or leakage which inevitably would occur through the foundation rock and cutoff system."

Please comment appropriately on each of the four statements related to design decisions. In particular, how do you justify the design of the key trench in view of the Panel's comment that this design encouraged arching, cracking, and hydraulic fracturing?

Answer to Question No. 9

Control of seepage in the abutments by using the combination of a key trench filled with impervious soil and a grout curtain was considered at the time of the design to be a completely satisfactory solution. It now appears that because of arching and high reservoir heads, the key trench was conducive to hydraulic fracturing.

The Bureau has relied on special compaction in a large number of dams in which no problems have been experienced. At Teton, the bonding of the zone 1 material to the floor and walls of the key
trench was found by the Panel to be satisfactory. The Bureau has supporting evidence that the cracks in the floor were sealed with grout as were the larger cracks in the walls. The design contemplated that the key trench would be sealed. This was described on page 16 of the Design Considerations.

The entire (downstream portion) of the zone 2 embankment served as a filter and a drainage blanket. Tests indicated that the zone 2 material ranged from 100 to 1,000 times as pervious as the zone 1 material and was considered to be adequate for the anticipated seepage. This material is in excess of 1,000,000 cubic yards and was purposely extended up both the left and right abutments beneath the zone 3 material providing for abutment drainage.

The design did not contemplate that massive seepage would develop through zone 1 material, including the key trench. Therefore a requirement for additional foundation treatment or special filter design was not considered necessary.
Question No. 10

At 8:30 a.m. on June 5, 1976, it was recorded that a muddy flow was issuing from the right downstream toe of the dam. According to the Independent Panel's report, the Project Construction Engineer believed the situation to be critical but felt it could be remedied and elected not to alert residents downstream at that time.

What criterion does the Bureau employ to prescribe under what conditions citizens should be alerted to a potential hazard?

Would an alert at 8:30 a.m. rather than 10:30 a.m. have decreased the loss of life or property?

Answer to Question No. 10

The Bureau prepares a manual called "Standard Operating Procedures" and a supporting document "Communications Directory" for each dam. The manual and directory include the names, addresses, telephone numbers, and radio calls of persons to be contacted in various situations, unusual conditions, and emergencies. Such documents are prepared for use of operating personnel. During construction similar emergency procedures are employed by the Construction Engineer. The person in charge must use his best judgment in deciding on the specific conditions which require alerting the
public. It is speculative whether an earlier alert would have decreased the loss of life or property. Consider the facts that Idaho Falls had some 24 hours advance warning and Blackfoot 36 hours, and yet there was property damage in these two areas because some people elected not to remove mobile property and livestock from the flood plain to higher ground.
Question No. 11

The zone 2 material was intended to form "a blanket and chimney drain in the downstream shell." Test results on this material appear to indicate that it is not adequately permeable.

In view of this, why was this material used?

Was adequate consideration given to the implications of this material not having properties required to permit appropriate drainage?

Answer to Question No. 11

The material for the zone 2 embankment fill was used because it was judged to be adequately permeable to handle the small volume of seepage anticipated in the design. It was available in large quantities in the upstream borrow area. In addition, it is a strong statically and dynamically stable material of a type used in many Bureau dams. The Bureau feels that adequate consideration was given to the use of this material. Seepage quantities through the embankment which the zone 2 was to accommodate were not envisioned to be large, concentrated flows.

As stated in reply to question 9, tests showed zone 2 material to be 100 to 1,000 times as pervious as zone 1.
Question No. 12

According to the Review Panel:

"Large open joints or cracks in the bottom of the key trenches and cutoff trench were to be treated by (1) clearing out the crack with air and/or water jets, (2) setting grout pipe nipples in the crack, (3) sealing the surface by caulking and/or grout, (4) drilling, if required, and (5) low-pressure grouting through the nipples. Evidently little of this treatment was actually done, at least in the part of the key trench exposed by the Panel's investigations."

What is the explanation for this?

Was the contractor at fault?

Why wasn't this determined through routine inspection and construction supervision?

Answer to Question No. 12

Only limited areas of this treatment were required in the bottom of the key trench because the technique used to form the grout curtain
Answer to Question No. 1? (Cont)

automatically sealed the majority of the open joints and cracks. Those large joints that remained did receive the prescribed treatment. The contractor performed the work in a competent and workmanlike manner under the Bureau's direction. Close inspection insured that the treatment intended was provided.
Question No. 13

The Review Panel stated that in view of the maze of open joints under all of the zone 1 material, it would not have concurred with the decision to limit blanket grouting essentially to the bottoms of the key and cutoff trenches. Please explain the rationale for the extent of blanket grouting actually employed.

Answer to Question No. 13

Blanket grouting is required in areas which contain open joints not treated in any other manner. Specifications required that the foundation beneath the zone 1 material be cleaned of all loose, soft, and disintegrated materials. Thus, the Bureau felt that a suitable zone 1 contact was being created without the use of blanket grouting. The positive cut-off expected to be provided by the key trench eliminated the need for extensive blanket grouting.

Again, in retrospect, the configuration of the key trench appears to have permitted a series of unrealized developments which led to internal erosion and eventual failure.
Question No. 14

In 1967, a magnetometer survey was made along the line of the proposed cutoff trench, to determine if any large cavities were present in the left abutment. Results were reported to be unconclusive.

Why weren't gravity surveys conducted in addition to this?

Answer to Question No. 14

The statement in the Independent Panel's Report, page 4-8, lines 20, 21, and 22 is incorrect. In a memorandum to the Geology Files dated November 6, 1967, Noel Bivens, Geologist for the USBR who conducted the 1967 magnetometer survey, states: "The purpose of the survey was to delimit an intracanyon basalt flow." Near the end of the report he states further, "The magnetometric survey was successful, in combination with drill hole control, in delimiting an intracanyon basalt flow along the grout cap - cutoff trench." The survey was not intended to define voids in the left abutment bedrock.
Question No. 15

Interflow zones between basalt flows were being studied in the late 1960's and early 1970's with new bore hole geophysical surveying equipment. Because the Bureau knew of the leakage significance of such interbeds, was there any attempt to include such investigations as part of the study of the Teton damsite?

Answer to Question No. 15

The deposit of interflow sediments between the intracanyon basalt and the underlying rhyolite was investigated as to its seepage potential. Inasmuch as this deposit accepted grout during the pilot grouting program, the decision was made that this deposit could be effectively grouted to control seepage and that the overlying basalt would not have to be excavated in order to remove this alluvial deposit. No borehole geophysical surveys were made of this deposit nor were borehole television camera surveys made of this section. The Bureau's borehole television camera, which had been operated in many differing circumstances by Bureau geologists for 8 years prior to the Teton examinations, was used to examine open and grout-filled joints in the rhyolite bedrock at the damsite.
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Honororable Leo J. Ryan  
Chairman, Subcommittee on Conservation, 
Energy, and Natural Resources  
Committee on Government Operations  
House of Representatives  
Washington, D.C.

Dear Mr. Ryan:

This is in response to your letter of September 10, transmitting 
for grammatical corrections a copy of the transcript of the testimony 
given at the August 31, 1976, hearing on the Teton Dam 
Disaster before your subcommittee along with questions for 
Messrs. Stamm and Arthur.

Messrs. Stamm and Arthur have made corrections to the testimony 
and the marked transcript is enclosed. Also, their respective 
answers to your questions have been prepared and two copies are 
enclosed.

Sincerely yours,

(Sgd) G. G. Stamm

G. G. Stamm  
Commissioner

Enclosures

bcc:  
Director of Design and Construction, E&R Center, Denver, Colorado  
Regional Director, Boise, Idaho  
Project Construction Engineer, Newdale, Idaho  
(w/c of answers to ea.)  
A/S - LW  
A/S - CL  
(W/C of incom. to ea.)  
W/C Code 100, 1600 (w/c of incom. and answers to Code 1600)

LBR: JW Pepple:ghh 9/22/76
QUESTIONS FOR COMMISSIONER STAMM

1. What was your responsibility for the safety of the Teton Dam?

Based on delegations from the Secretary of the Interior, I, as Commissioner of Reclamation since May 1973, am responsible for the direction of all activities of the Bureau of Reclamation. This would include the safety of the project and the safety of those involved in its construction. As is done on all Bureau projects, that direction in regard to Teton Dam was accomplished through delegation of design and construction supervision responsibility to the Director of Design and Construction, Engineering and Research Center, Denver, Colorado.

2. How does that responsibility differ from Mr. Arthur's?

Mr. Arthur, since becoming Director of Design and Construction in July 1972, has had primary responsibility for supervision and coordination of activities relating to the Bureau's design and construction of water resource developments, including:

- development and recommendation of related policies, standards, and procedures;
- technical supervision of design and construction activities Bureau-wide; and
- administering or supervising contracts for major construction jobs as contracting officer.

My responsibility as Commissioner is not relieved through delegation of authority to the Director of Design and Construction, but the amount of personal involvement on my part is somewhat diminished to permit time for direction of all Bureau activities. In other words, my primary responsibilities are in the policy areas; Mr. Arthur's, in the technical.
3. Did you have authority to call a halt to the continued construction of the Teton Dam?

Yes, I could halt the construction of a dam at least temporarily. If such action were for technical reasons, I would depend heavily on the recommendation of the Director of Design and Construction if he were to determine that onsite conditions warranted abandonment of a project. If I were to accept his recommendation, after thorough review of all the facts presented, I would then inform the Secretary of the Interior and the Congress of the decision and the reasons therefor. Anything I would do, however, could be overruled by the Secretary of the Interior or the Congress of the United States.

4. Does Mr. Arthur also have authority to halt construction of a dam project?

Yes, if emergency conditions were to develop Mr. Arthur or his authorized representative could immediately suspend construction activities. Reclamation construction work is accomplished primarily through competitively bid contracts. These contracts contain provisions to allow the contracting officer to temporarily suspend construction activities to consider differing site conditions, to require the contractor to correct unacceptable or unsafe operating procedures, and to consider other impacts of an economical, safety, or political nature. This has occurred on many construction projects in the past. After the deficiencies were corrected, construction was then resumed. The duration of such suspensions has usually been in terms of hours or days.
5. Under what circumstances do you believe construction of a project should be halted?

Construction would be suspended when a safety hazard appears to exist that could be minimized or eliminated by such suspension; construction would be terminated when a confirmed safety hazard exists that jeopardizes the safety of onsite personnel or the public; or when existing conditions would make it technically infeasible or uneconomical to proceed, and when a suitable remedy cannot be found.

6. Do you have procedures in the Bureau to call a halt to construction of a dam when safety hazards appear?

   a. What are they?
   b. Where are they promulgated?
   c. Will you summarize them?

The Director of Design and Construction or his authorized representative can direct the contractor to suspend his operations if safety hazards appear or other circumstances warrant.

When questions of safety of the site arise, there are no specific procedures in Reclamation Instructions for halting construction of a dam. Each major structure requires the application of sound engineering principles to recognize specific site conditions and to accommodate those conditions in a safe, economical design. No set-down procedures
in themselves will substitute for scientific and engineering judgments in evaluating unexpected or differing site conditions. When such conditions cannot be evaluated and corrected economically and safely, then, we will halt construction on an ongoing project. However, once construction on a project begins, the work would not be permanently terminated, and the site abandoned, without systematic processing through the Commissioner's office, the Department, and the Congress.

Procedures for suspending or terminating a construction contract are contained in the specifications for each specific project.

7. Has construction on any Bureau dam ever been stopped once construction has commenced?

Conditions have not existed that have resulted in total or final termination of construction of a dam once construction began. However, construction on many Bureau dams has been temporarily suspended for a wide variety of reasons, including contract disputes, safety of personnel, and construction problems.

8. Did you ever warn Mr. Arthur, or the construction engineer, Mr. Robison, to take extra precautions at the Teton Dam?

I did not. However, safety precautions are axiomatic both currently and historically.
9. Did you ever call for a halt on the construction of Teton Dam because of safety hazards?

I did not, nor was I ever supplied with data which called for such a decision.

10. Didn't you receive warnings from a number of sources as to safety hazards at the Teton Dam site?

Not personally; however, responsible Reclamation officials received such communications. The warnings raised were speculative in nature. Each was fully considered and, when warranted, appropriate action was taken, such as in the case of the fault postulated by the USGS at the damsite. Mostly, concerns were expressed by opponents of the project that the site would not hold water. Those concerns were not related to the safety of the dam.

USGS geologists became concerned that the seismicity of the site was not fully described in the Bureau environmental impact statement. They informed the Bureau about the possibilities of earthquakes and the presence of young faults in the general vicinity. The dam had been designed to withstand a sizable earthquake. The Bureau joined with USGS to perform additional seismic studies to advance the knowledge of earthquake activities at Teton damsite.
11. It seems to me that you, as the official responsible, should have called a halt to construction until all those hazards had been resolved.

Item 11 is a statement rather than a question. My response to question 10 above sheds light on your implied question. In addition, I would volunteer that warnings of a speculative nature are not sufficient grounds upon which to delay construction. No actual hazards were identified beyond the conditions recognized in the design or encountered during construction, evaluated, and found to be correctable.

12. Did you consider the Teton Dam site to be a favorable site?

No two sites are identical. Almost all have some deficiencies. Geologically the axis of Teton Dam had competent rock on both abutments and was away from all known faults. Initial investigations showed the site to have competent rock on both the surface and at depth, but indicated that reservoir seepage could be a problem. In the area of the damsite, this problem was recognized and accommodated by special design considerations.

Other sites considered were apparently as feasible geologically as the site chosen; none apparently was geologically superior. For storage capacity, flood control, ease of diversion of water, and
power potential, all others were inferior to the location used. Also, the selected location would have materially benefited the residents of southeastern Idaho more than the other sites.

13. The site had a number of significant problems, didn't it, including known and suspected faults, location in a seismically active zone and the abundance of heavily fractured rock, to name some of which we have heard testimony?

No known active faults occur at or near the damsite. Faults were mapped by the Bureau and the USGS in the reservoir, the closest being about 9 miles away from the damsite. No evidence of faulting was found in any excavation for the dam or appurtenant structures. While the site is located in a Seismic Risk Zone 3 (Algermissen), due to its association with mountain ranges to the north, east, and south, maximum ground accelerations which would be anticipated from a severe earthquake originating in these ranges would not be large enough to cause concern. Many dams are constructed in areas of seismic activity.

The surface rock was highly fractured. The Rhyolite on the abutments was excavated to depths of 70 feet above elevation 5100 to avoid large grout takes. This procedure was primarily an economic consideration.

Both seismicity and rock conditions were taken into consideration when the dam was designed.
14. Didn't the problems of the site oblige the Bureau to take special design precautions such as the triple grout curtain, and the pilot grout program?

The design for Teton Dam, as is the case in all Reclamation engineering projects, included precautions to accommodate the conditions revealed during site investigations. The pilot program was recommended and conducted because of the known or suspected foundation conditions. The pilot grout program disclosed that the foundation materials could be adequately grouted. Although a triple grout curtain was used at the Teton site, it is not unusual to construct a dam with more than one grout curtain. Since 1940, the Bureau of Reclamation has constructed 12 other dams with more than one grout curtain.

15. So you knew that the site required special attention and close observation?

Yes, the nature of the foundation rock did require special attention with respect to seepage control from both design and construction standpoints. Our preconstruction investigations indicated the fractured rock condition as well as the strength of the rock. The pilot grouting was performed to determine that the fractured rock could be adequately grouted. The drilling and grouting operations were no different than on some of our other projects, including large grout takes in some areas.
16. Nevertheless, when new problems emerged during construction you never felt it desirable to halt construction?

Because solutions appeared to be adequate, the problems were not referred to me. The problems that occurred during construction were of such a nature that they were determined to be correctable without suspending construction or significantly delaying the contractor. The construction of the dam embankment lagged behind the grouting of abutments by 1-1/2 to 3 years on the right and left abutments, respectively. When fissures were encountered, there was ample time to explore fully the extent of each fissure and to take remedial measures. This is explained more fully in my statement of August 31, 1976, under the heading "Fissures and Fissure Treatment."

When the fault was postulated by the USGS, measures taken to check for faults in the damsite produced negative results.

17. And despite the problems of the site, you waived the design requirements and authorized the very rapid filling of the reservoir—Why?

The Director of Design and Construction, who was responsible for the design, waived the original reservoir filling criterion after reviewing the structure's performance and after consultation, I understand, with members of the design-unit team which had recommended initially the criterion for filling of the Teton reservoir concurred. All concurred in the waiver.
Deviation from the filling criterion was not unusual. As I indicated in my formal statement, initial filling rates were increased in the initial filling of 36 Bureau reservoirs. In eight instances, the reservoir filling rates experienced exceeded the maximum rate of 4.3 feet which occurred during filling of Teton reservoir. No problems were encountered in any of those instances.

18. Have you learned anything from this disaster?

Essentially for lack of time and incomplete investigations, new technical information arising from the disaster has been very limited. Hopefully, precise information as to the cause of failure will result from the investigations underway. Whatever we learn that will further improve our methods and procedures and further the cause of safety will be adopted, and also will be made available to others who can benefit.

19. You were quoted as saying that you never considered not constructing. Do you feel the same way today?

You are asking for hindsight. Certainly, any conscientious person who could foresee tragedy would take any steps possible to avoid it. Every project is faced with its own peculiar problems. As these are revealed and considered, sound engineering solutions based on specific and related experiences are applied. Obviously, if no solutions were
considered to be available; construction would not proceed. For 74 years the cautious conservative judgment of experts in their fields has met all deficiencies of nature without a Teton episode. That is why I insist on learning the "why" of Teton, if at all possible.

20. Do you feel that there is a problem of momentum to build a project once commenced in the face of any problems or hazards?

No sir, not when fundamental safety is involved. Except for that, it obviously is desirable to continue to construct a project once commenced. Deficiencies are intended to be dealt with before construction starts. The Bureau has a long history of taking whatever measures are required properly to construct and operate its projects regardless of external pressures.

21. How do you believe the problem of "momentum" can be dealt with?

The question assumes a situation with which I do not agree. I have already expressed my position with regard to fundamental safety of structures.
QUESTIONS FOR COMMISSIONER STAMM
BASED ON PREPARED STATEMENT

1. In your statement you say that you do not agree that the Bureau suffers from the pressure of momentum. You then recount projects which were halted during the planning stage and you describe changes that were made during construction of other projects. The fact remains that NO PROJECT HAS EVER BEEN HALTED ONCE CONSTRUCTION HAS COMMENCED. What is your comment?

We believe this confirms that adequate planning procedures and progressive stages of exploration in the process of preparing definite plan reports and the field data obtained for preparation of construction specifications should eliminate unacceptable sites prior to actual initiation of construction.

2. You state on page 2 of your statement; "I assure you that we would not hesitate to make changes even after construction has begun if questions of safety or competence of a major dam should arise." You say nothing about halting construction or calling for a halt of construction. Why not?

Certainly some circumstances could warrant stopping work on a project. This responsibility should rest with the Commissioner, based on analyses and recommendation of the Director of Design and Construction. As explained in number 1 above, such decisions should not be necessary.
Except for structures eliminated before construction starts, we have not encountered any circumstances in advance involving dam safety which we did not feel could be accommodated by changes in design or in construction specifications. Others apparently share this view as evidenced by the testimony of Brigadier General Drake Wilson, Deputy Director of Civil Works, Office of the Chief of Engineers, Department of the Army, who testified before you on August 31, 1976. He stated that when the Corps finds something unforeseen that requires modification, it would study what the modification involves and that if it was still economically feasible and if the project still met project needs, the Corps would simply modify it and go on. You will recall the Corps could not recall halting construction on any project and concluded that it is more common to change a design than to abandon a project.

a. --Don't you believe you have a responsibility to call for a halt to construction under some circumstances?

Yes, as I have heretofore stated, if there is no reasonable nor acceptable solution for a hazard not recognized in an earlier phase of project processing.

b. --Is it your opinion that all questions of safety can be resolved by changes in construction and more construction?

No sir. However, our intention is to delay the construction phase until the questions of safety, if any, have been resolved. Specific hazards which would endanger the safety of Teton Dam relating to geology, design, or construction methods had not been identified nor reported to me.
3. On page 3 of your statement you say Congress can stop construction. Do you mean to say that only Congress can halt construction?

No sir. The Director of Design and Construction or the Commissioner can suspend construction activities immediately if the need arises. Only Congress can totally abandon or deauthorize a project.

   a. Have you ever asked to halt construction of a dam already under construction?

      To delay, yes; to halt permanently, no.

   b. In your annual justification for the continued funding of the Teton project to Congress, did you warn the Congress of the safety hazards associated with the dam?

      No. No specific hazards which would endanger the safety of the dam had been identified to me. This means all were considered by my staff to be correctable by technology.

4. On page 4 of your statement you indicate that the Bureau spent 12 years examining the Teton damsite and had a dozen geologists on the job. Yet, when the Geological Survey mapping team happened to come on the scene they thought the site raised fundamental questions as to suitability and safety. Why didn't your dozen geologists raise these issues?
I believe your question is misleading and therefore cannot be answered directly. Bureau designers and geologists had considered the seismic risks prior to the time that geologists from the USGS raised questions, not by happenstance, about the seismic design. Our standard procedures include use of the expertise of qualified sister agencies in the Department of the Interior, such as USGS. Bureau geologists were aware of the area geology and were more aware of the damsite geology conditions through the exploration program. Based upon Bureau experience in constructing earth dams throughout the western United States, our geologists concluded that there were no unusual seismic conditions and that the geology at the damsite did not present a safety concern. There is no difference of official opinion to my knowledge between USGS and USBR.

a. --Why weren't they identified and called to the attention of the Congress?

The project was authorized in 1964. As brought out in the testimony of August 31, 1976, the Congress is not an engineering body and must look to the Federal agencies in dam construction to identify hazards and take appropriate action. In the case of the Teton site, no unusual seismic conditions or other geologic conditions presenting a safety hazard were identified. The facts discovered in Reclamation's preproject-authorization investigations were made available to the Congress. All who had an interest in the project had the opportunity to testify before the Congressional committees, which is the standard procedure.
5. Mr. Stamm, no one is suggesting that any person in the Bureau of Reclamation deliberately and with malice aforethought took any action knowing in advance what was going to happen at Teton. But let me ask you this: Don't you think it would be helpful to the decision-makers on those projects—including Congress—to make certain they are clearly aware of all the arguments against a project as well as those favoring it? I think every study on site selection, design, engineering, and construction as well as the presentation made to Congress should contain a section with all of the "cons" clearly set forth.

I agree. The procedure including hearings of all interested witnesses is intended to do this. We believe that it is most appropriate that the Congress be made fully aware of the total project costs and benefits, and that the costs reflect the expense of constructing safe, adequate structures. In addition, we feel that the Congress should be made aware of all the "pros" as well as the "cons." Our process of project authorization accomplishes this through the use of environmental impact statements and appraisal, feasibility, and definite plan reports, all in addition to Congressional hearings, which include outside witnesses and frequently include field hearings in addition to those held in Washington, D.C.

6. Mr. Stamm, you say that what happened at Teton should not have happened. But the fact remains it did despite your contention that every precaution was taken. Now if using your words every precaution was taken, just exactly what are you going to do in the way of something new and additional?
Any specific answer to your question would be premature. As you are aware, two teams are currently trying to determine the precise cause of the failure. In addition, the Bureau organization, in the decision-making process for dam design, is currently being reviewed by a team from the Department of the Interior. There are also plans to engage an engineering firm to make a technical review of the methods and procedures used by the Bureau in designing dams. Outside consultants are being utilized on current dam projects that have recognized problem areas. This is all in line with the practice Reclamation has followed throughout its long history of constantly improving and perfecting its procedures for the benefit of all. To a large extent its procedures have been adopted worldwide.

We sincerely hope that the review groups will discover the technical deficiencies which may have occurred during the design or construction of Teton Dam so that existing procedures may be modified to prevent a recurrence.

Recognizing that your subcommittee has a sincere interest in benefiting humanity by pursuing the Teton Dam failure, you can be sure that Reclamation has an even greater interest, ranging from the individual in Idaho to worldwide society, and from local life, prosperity and safety to national economics, gross national product, balance of trade, and perpetuation of United States' supremacy in development of its perpetually renewable resources for the benefit of mankind now and in the future.
For this reason we are eager to cooperate fully with all who have similar objectives. If your subcommittee can be of further service to society or we can be of further service to you in these laudible objectives, please let us know.
QUESTIONS FOR MR. ARTHUR
re Auburn Dam

1. Mr. Arthur, on April 22 of this year the Association of Engineering Geologists sent to Commissioner Stamm a report by their Seismic Hazards Committee concerning the safety of the proposed Auburn Dam project near Sacramento.

Have you read this report?

Yes, I have read the report. The report from the Seismic Hazards Committee is somewhat misleading in that the inference is made that the Bureau has not considered earthquakes originating in (1) the Sierra Nevada fault zone 60-70 miles northeast of Auburn and (2) the San Andreas fault zone 80-90 miles southwest of Auburn. The Bureau of Reclamation report "Method for Estimating Design Earthquake Rock Motions" dated April 1972 (rev. November 1972) addresses itself to both of these geologic provinces.

The report concludes that "The Auburn Dam, as presently designed, would be unsafe in even a moderate earthquake." Are you satisfied that the present design is adequate?

The dam is presently designed for major earthquakes occurring on the above mentioned two fault zones and for a lesser earthquake occurring in the general vicinity of the dam. After the Oroville seismic event of August 1, 1975, the Bureau began a reevaluation of the seismicity of the Foothills Fault System in the vicinity of Auburn Dam. New data generated from this study will be incorporated into Auburn Dam designs if necessary to ensure a safe structure.
2. The Engineering Geologists report concludes that the earthquake safety factor designed for the Auburn Dam is "far too low." Don't you feel it is important to, if anything, err on the side of caution in developing a design for this dam?

Auburn Dam has been designed for an extreme loading combination of reservoir load, temperature load, dead load, etc., and a maximum credible earthquake (MCE). By definition, the MCE is the most severe seismic event associated with active faults that can be hypothesized for a given damsite. Auburn Dam has been designed for a safety factor of 1.5 for this extreme condition. For seismic events of lesser magnitudes, the safety factors increase. No damage to the structure will occur during the operating basis earthquake and only minor repairable damage during the design basis earthquake. For the usual loading conditions of reservoir load, dead load, temperature load, etc., Auburn Dam has a safety factor of 4. These safety factors are adequately conservative.

3. This very thin and extremely wide concrete arch dam would, if constructed, be the largest project of its type in the world. It has been shown by your own studies that it will crack all the way through, as a result of a single, moderate earthquake. What proof do you have that the dam would withstand a series of seismic accidents?

The seismic design for Auburn Dam is based upon the most severe seismic event that can occur—not a "moderate" earthquake. The dam was found to be stable during and after that event. Consequently, it would be stable for another seismic event of similar magnitude.
4. Dr. George C. Rouse, a former dam designer for the Bureau of Reclamation, last year warned the California Division of Dam Safety that "The results of my investigations indicate that a thin double-curvature arch dam is not a suitable structure for the site," and "that the cracked dam could fail." Why do you feel that your own former expert feels the dam design is not adequate?

Dr. Rouse's analysis of Auburn Dam appears to be based upon the method of free arches. Prior to the advent of digital computers, this method was used by some designers to roughly size an arch dam. The final designs were then based upon the more rigorous trial load method. The method of free arches is not used by the Bureau because it does not take into account the full three-dimensional structural capability of the dam. Dr. Rouse has been unwilling to discuss in detail his report and the methods that he used.

During his Bureau career, Dr. Rouse specialized in building and testing scale models of concrete dams and in instrumenting and measuring the behavior of concrete dams. He was not involved in the actual design and analysis of concrete arch dams. Although I do not consider him an expert in the field of dam design, his concerns have been considered and we disagree with his conclusions.

5. In a report sent by Dr. Rouse to the California Division of Dam Safety this past June, Dr. Rouse reiterated his concerns, and stated that "The engineer's knowledge is limited, however, in the design of arch dams for combined static and seismic loads, and in the design of high arch dams for wide valleys." If this statement is true, how can I feel assured that the Bureau has enough information at this time to begin construction of this project?
Arch dams have been designed all over the world for combined static and seismic loads. Several of these dams have been constructed in wide valleys. As a comparison, Auburn Dam has a crest-to-height ratio of 6.1 to 1. Pieve di Cadore in Italy has a ratio of 7.4 to 1; Hendrik Verwoerd in South Africa has a ratio of 10.3 to 1; and Kariba Dam in Rhodesia has a ratio of 4.8 to 1 which is somewhat comparable to Auburn Dam. Thus, the configuration of Auburn Dam is not without precedent.

Furthermore, there is no recorded instance of failure of a modern concrete arch dam due to earthquake. Several arch dams have been subjected to severe earthquake intensities and sustained little or no distress. These include Kariba Dam, a number of arch dams in northern Italy that sustained a Richter magnitude 6.5 earthquake (May 1976), and Pacoima Dam in California which sustained a richter magnitude of 6.5 (San Fernando earthquake of February 9, 1971).

6. When do you now plan to begin construction at Auburn? What is the status of work at the project at this time?

The invitation for bids for the prime contract for Auburn Dam and Powerplant is currently scheduled for July 1977. The actual date will depend upon the outcome of the seismic investigations that are currently underway. The contract for the foundation excavation and treatment for the dam and powerplant is approximately 70 percent complete. The expected completion date is November 1977.
7. California Secretary of Natural Resources Claire Dedrick has requested that the Interior Department establish a cooperative Federal/State dam safety and inspection program for Bureau of Reclamation dams in California. Do you have any reason to oppose the establishment of such a program?

No, I look forward to continuing our cooperative effort with the State of California if such a program is established.

8. Last week I wrote you suggesting "Perhaps the Auburn project is an appropriate place to begin implementing such a program." Do you have any objection to having the California Division of Dam Safety review your final decision on the design of the Auburn Dam?

I have no objection to the California Division of Dam Safety or any other organization reviewing our final decision on the design of Auburn Dam. I expect the final decision on the design of Auburn Dam will be the subject of professional papers which will have international exposure.
IN REPLY
REFER TO:

Honorable Leo J. Ryan
Chairman, Subcommittee on
Conservation, Energy and
Natural Resources
Committee on Government Operations
House of Representatives
Washington, D.C.

Dear Mr. Ryan:

I have read the report of the Committee on Government Operations concerning the failure of Teton Dam. I do not intend to comment on the report's conclusions and recommendations in this letter because I feel any such comments before the completion of the several investigations underway into the causes of the failure would be premature.

However, there are many questions in my mind concerning the body of the report.

For example, I am particularly disturbed by a quotation attributed to me, to the effect that I was not losing any sleep over the loss of Teton Dam. I am disturbed, first, to find in a hearing report a statement that was allegedly overheard in a private conversation before the start of the hearings. Second, I object because neither the statement nor the quotation is true.

There are other aspects of the report that bother me.

On page 3 the report states:

"Shortly after the disaster, the Bureau prepared and widely circulated a question and answer paper about the Teton Dam disaster. One of their questions was: 'With the benefit of hindsight, is there anything that Reclamation might have done to prevent this disaster?' And their answer was: 'Nothing.'"

I cannot understand why only one word from the six-paragraph answer we actually made to the question was used in the report. The connotation is misleading to say the least. Our complete reply was:
"Based on the information available to Reclamation today, nothing.

"Reclamation took extraordinary measures to assure that water seepage would not damage the dam embankment.

"Those measures were based upon Reclamation's 74 years of experience, its knowledge of the experiences of other dam building organizations all over the world, a pilot testing program.

"The specifications prepared by Reclamation appear to have been followed scrupulously by the contractor, under the supervision and inspection of Reclamation engineers.

"On the basis of the information now available, there is no discernable reason why the dam should have failed.

"However, Reclamation is determined to learn the cause and will work closely with the review panel appointed by the Secretary of the Interior and the Governor of Idaho to discover the cause and devise a sure cure."

The report states on page 24:

"The overconfidence of the Bureau is regarded by some critics as an attitude bordering on arrogance. To this day, the official position of the Bureau is that what happened at Teton was 'impossible.' The report cites neither the names of the 'critics' nor the source of Reclamation's alleged 'official position.'

I do not know who was being quoted in that passage, but I have never used that word in any such context, nor have I ever taken a position akin to it. Words I have used are in verbatim transcripts and are available.

For example, I stated in my oral testimony before the Subcommittee on August 31, 1976, that: "... based on the past experience and history of dam building, what happened at Teton should not have happened. But the fact remains that it did, and the Bureau is more eager and anxious than anyone to find out why."

The report states on page 21:

"The Committee cannot emphasize too strongly its conclusion that brakes on construction must be applied when a warning of hazard appears. There could hardly have been a clearer warning of a safety hazard for a dam, than a warning from the United States Geological Survey that the geology of the damsite presented problems of safety."

2
But the report omits any reference to the letter from the Director of the Geological Survey, V. E. McKelvey, to Senator Henry M. Jackson on June 11, 1976, in which he said:

"In summary, I believe that all the concerns expressed by the Geological Survey geologists were transmitted to the Bureau of Reclamation and that the Bureau took appropriate action in arranging for the seismic network. We have no information on the cause of the failure (of Teton), but we are quite confident it was not caused by an earthquake. At no time did the Geological Survey issue a prediction that the dam would fail."

The discussion of Orme Dam and the Arizona Bureau of Mines in the report was replete with errors. This is what appeared in the report on pages 30 and 31:

"Prompted by the Teton Dam collapse (1), the Arizona Bureau of Mines geologists undertook an examination of the geology of the Orme Dam site (2) which was planned at the confluence of the Salt and Verde Rivers on the Fort McDowell Indian Reservation northeast of Phoenix. To their dismay they found (3) that at least seven possible fracture trends were present on or near the site. Unfortunately, none of these faults were mentioned or discussed in the Bureau of Reclamation's environmental impact statement for the Orme Dam (4), which coincidentally was the subject of public hearings in Phoenix the day the Arizona Bureau of Mines findings were released. As a result of the Arizona Bureau of Mines findings, the Bureau of Reclamation has announced that it intends to temporarily abandon plans to build Orme Dam at the original site (5) and will consider alternative sites (6). If the Bureau had not been prevented from beginning construction on this dam because of lawsuits concerning the adequacy of the Environmental Impact Statement (7), it is possible that construction would have begun on the site and continued for several years (8) without benefit of this new geological information."

These are the facts:

It was the release of a draft environmental statement, not the failure of Teton Dam, which prompted action by the Arizona Bureau of Mines (1). Bureau of Mines geologists did not undertake an examination of the dam site (2); they merely referred to standard geological maps of the area (3). They noted that there were fractures in the area and
suggested that the final EIS should contain a more detailed discussion of the geology of the site. Reclamation has agreed to expand its discussion of the geological data it has gathered in the final EIS (4). Reclamation has not announced that it intends to temporarily abandon plans to build Orme Dam (5). Its investigation of alternative sites had been started long before comments from the Bureau of Mines were received (6). Those sites were discussed in the EIS which prompted the comments from the Bureau of Mines. No lawsuits of any kind have been filed to halt construction of Orme Dam (7). The earliest possible start of construction on Orme is two years away (8).

The report also states on page 31:

"The Bureau is apparently reluctant to cooperate with States which have dam safety programs. Mr. Robert James, Deputy Director of the California Department of Water Resources told the Committee that letters were addressed to the Secretary of the Interior and the Chief of the Corps of Engineers suggesting that they enter a cooperative program of dam safety with the State of California, but that no replies had yet been received."

The report does not mention that I told the Subcommittee, "We have expressed to the State of California and others our willingness to participate in cooperative programs as an added precaution to ensure the safety of all structures, both ours and theirs," and that we have done so.

These are some examples of what appears to be a pattern of omission and wholesale editing of Reclamation's testimony and its replies to the testimony of others. The report contains other discrepancies and omissions, all of which combine to make it extremely difficult for those reading it to make an objective judgment of the validity of its conclusions and recommendations.

One final example:

On September 24, the date specified by the Subcommittee, we delivered to the Subcommittee the answers to 35 questions put to us by the Subcommittee. On that same date, the Los Angeles Times carried a
story on the Committee's report. Obviously our answers to those questions could not possibly have been considered by whoever wrote the report or developed its conclusions and recommendations.

Sincerely yours,

G. G. Stamm
Commissioner

cc: Members, Committee on Government Operations
House of Representatives

bcc: Regional Director, PN, MP, LC, UC, SW, UM, LM
Director of Design and Construction, E&R Center
W.O. Code 100, 105, 110, 115, 120, 1600 (2)

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Committee on Government Operations, House of Representatives