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DESIGN NOTE NO. 20

Subject: Guide to Organization and Operation of Independent Review Boards

Introduction

Independent reviews are examinations made by experts to evaluate the adequacy of operating procedures. These reviews can be either broad in scope or very limited. Regardless of the scope initially identified, however, examination of very small details may be done, as needed, to provide confidence in the end result. Independent reviews are used in engineering to examine procedures in comparison with current engineering practice and to evaluate judgments.

Reviews are a part of the engineering design process. Special reviews may, in addition, be made of critical structures by technical experts not routinely involved in the design-review process. These special reviews, which are independent, may be used when structure malfunction or distress and failure would adversely impact on public health and safety or cause extensive property damage. In addition, independent reviews are used in areas of new technological applications or when existing conditions being analyzed are variable and require the best judgment available.

Review Board Organization

Review boards may consist of one or more people, as needed, to adequately evaluate the technical considerations involved. The people assigned to make the review must have technical training and experience sufficient to be familiar with the current state-of-the-art. A person with an identifiable expertise should be a board member for each major area of technical consideration. The board should have a person who has general knowledge to provide overall guidance and balance in the board deliberations. The person with general knowledge may also provide the special expertise in one facet, as appropriate. One of the board members must be designated chairman.

Review Board Operations

The purpose and function of a review board are to evaluate procedures used and assumptions made in terms of appropriateness and adequacy. The board is not required to perform design functions or determine alternatives. In order to satisfy the board inquiries, it may turn out that alternate evaluations will be required to verify all the anticipated performance conditions. However, the burden is upon the designer or design group to demonstrate adequacy in terms of anticipated performance. This demonstration is by means of a clear application of principles and procedures based upon substantiated physical laws of nature. Also

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included is evidence of data that substantiates the assumptions made and alternatives selected. Each and every item of consideration identified by the board will need to be resolved by means of rational analysis. The basis for procedures and data used needs to be substantiated. A properly prepared design will have satisfied all of these considerations. (See NEM Part 511.04 and 511.05(c).)

The review board should not be expected to and does not provide technical expertise to prepare or complete a design. If special expertise is required to prepare a design or resolve a construction problem, arrangements should be made for that purpose.

The review board should report upon the activities of each review made with the designer(s). This report will summarize the scope and procedure used during the review and list those portions of design that have been examined and determined adequate. In addition, those items of data, procedures, and assumptions that are not sufficiently substantiated or erroneously applied will be listed along with the justification of inadequacy. The report will not project design treatments nor alternative considerations other than alternate considerations needed to fully substantiate the rationale of anticipated performance. Details regarding procedures will not be provided.

The board will normally participate through the whole process of preliminary and final design and construction. In addition, the extent and frequency of the reviews will be largely at the will of the board. The board will generally meet as a body with the designer(s) at critical times during the design and construction. These meetings will be on-site at either the field site or in the design office, as appropriate. The information to be reviewed at each meeting will normally be supplied in some detail in advance of the meeting, as the board may request. During the on-site review, the presentation will be made in an organized manner by the designer(s) with opportunity to examine and substantiate any and all questions raised. The detail of examination is at the will of the board and sufficient to satisfy their inquiry. Through this process, an evaluation of adequacy is made. The quality of the independent review is directly related to the expertise of the board.

References

Enclosed are copies of documents that discuss the need for an independent review board for purposes of dam safety. Some of the discussion may give added guidance to the composition and activities of such a board.

Enc. 1 "Review of Safety of Dams for the United States Department of Agriculture," Woodward-Clyde Consultants, August 1977, p. A-42-44.

Enc. 2 "Improving Federal Dam Safety," a report of the Federal Coordinating Council for Science, Engineering and Technology, November 15, 1977, p. 6 and SID-6 and 7.

Enc. 3 "Federal Dam Safety, Report of the OSTP Independent Review Panel," Executive Office of the President, Office of Science and Technology Policy, December 6, 1978, p. 16-19.

Enc. 4 "Federal Guidelines for Dam Safety," a revised issue of Appendix B in item 2 above, June 25, 1979, p. 15-17.

Enclosure 1

Excerpt from "Review of Safety of Dams" for the U.S. Department of Agriculture by Woodward-Clyde Consultants
August 1977

A 6.1 Internal-External Panel Reviews

The SCS has extensive internal review procedures. These are primarily of an administrative nature but do involve program and technical matters. Specific reviews of dam designs are accomplished at the EWP unit level but EWP personnel may also be involved in the design. These appear to be normal reviews of technical aspects with each expert reviewing the work in his discipline. There are no provisions for independent panel or "board" type reviews. The SCS does make use of private consultants both in design, where the results are reviewed and approved by the SCS, and in specific problem areas. We found no policy or procedure that suggest the requirement for an independent "board of consultants" for SCS projects. The SCS has substantial contacts with other governmental agencies. Some projects require review by the Forest Service. The requirements of these reviews are documented in agreements between the two agencies. In general, SCS retains the responsibility for safety and the FS review is primarily to evaluate effects on forest resources. Contacts with other governmental agencies involved in dam building, such as the Corps of Engineers and the Bureau of Reclamation, are primarily for exchange of information which only indirectly impacts on dam safety. From the standpoint of safety, we favor a board or panel type of review for important dams as quite frequently the potentially unsafe aspect may involve two or more disciplines. Review by a board or panel will normally provide the breadth of view necessary to recognize and analyze the problem. Consequently, we recommend that the SCS establish a policy to require review of design and construction for certain important dams as defined below by a board consisting, as a minimum, of a qualified engineering geologist, geotechnical engineer, and hydrologist or hydraulic engineer. Additional members would be added depending upon the type and complexity of the dam. The board could be made up of qualified SCS personnel or consultants; but, it must have a special charge that safety is as important as economy.

We would define important structures as those having "significant" or "high" hazard potential according to the hazard classification given in Table 2 of the Recommended Guidelines for the Safety Inspection of Dams prepared by the Office of the Chief of Engineers, Department of the Army in fulfillment of the National Dam Inspection Act, Public Law 72-367.

Enclosure 2

Excerpt from "Improving Federal Dam Safety," a Report of the Federal Coordinating Council for Science, Engineering and Technology
November 15, 1977

1. Independent Reviews

An independent review of a dam project at critical stages in its development, by experts not directly involved, is essential for all dams where existing or anticipated downstream life and/or property would be threatened in event of failure.

It is recommended that each agency responsible for any aspect of dam development or regulation establish a policy to provide for independent reviews of dam project development. Reviews may be made by teams within the agency, or by outside consultants, or by combinations of these two sources.

D. Reviews

1. Extent. All factors affecting the safety of a dam during design, construction, and operation should be reviewed on a systematic basis at appropriate levels of authority.

2. Internal. Management policy should provide for automatic review of all decisions, methods, and procedures. Review should be at a level of authority above the design section or designer-supervisor relation. Uniformity of criteria and design technique, as well as methods to ensure that specific experience is exchanged and used to advance the agency's ability to design, construct, and operate safe dams, should be implemented.

3. External. The need for review of a project by independent experts outside the agency should be based on the degree of public hazard, size of the project, complexity of the site, and complexity of the design. Agency flexibility should be allowed in determining the need for such review. The independent reviews should provide appropriate evaluations of exploration, design, and construction. Detailed assistance in performing calculations, etc., if needed, should not be the responsibility of the reviewer but should be supplied under separate contracts.

When appropriate, meetings should include a site visit. Agency representation at each meeting should include pertinent design and construction staff. The agency should formally document all aspects of the continued development of the project for presentation at each meeting. The reviewer should formally document findings and recommendations after each meeting.

Enclosure 3

Excerpt from "Federal Dam Safety Report of the Office of Science and Technology Policy Independent Review Panel," December 6, 1978

3.3.2 Independent Review

It is incumbent on any engineering organization to establish comprehensive and effective peer review procedures which address both the technical accuracy and soundness of judgment of the work performed. This is particularly true in dam design and operation where the consequences of failure may involve massive destruction and loss of life.

All factors affecting the safety of a dam during design, construction, and operation should be subjected to comprehensive technical review by an independent review body either internal to the agency but outside of the line organization or external involving expertise from the private sector. Indeed, depending on the degree of public hazard, the size of the project and the complexity of the site or design, both avenues for independent review may be utilized. This concept of the need for independent safety evaluation holds true both for dams in the process of design or construction and for the re-evaluation of existing dams although the process may differ in each case.

Procedures for review across functional or organizational lines, which may be independent by definition, may not serve the purpose of a comprehensive technical review for safety unless the reviewing body has this responsibility as one of its prime charges. This function is perhaps best served by an organizational unit having as its sole purpose that of dam safety, specifically including independent review, for dams both existing and under design, and having authority commensurate with the responsibility assigned. Elsewhere in this report (see Section 3.2) the Panel has, in fact, made a specific recommendation for creation of a dam safety office in each appropriate agency. The Panel recognizes that such an office may neither fit the particular role of every Federal agency having involvement in dam safety nor be practical in the case of each organization. However, through interagency cooperation and agreements, the expertise available for internal independent review for dam safety within one or more Federal agencies might serve the needs of agencies lacking such review processes.

The ad hoc Committee has acknowledged the importance of independent reviews and has recommended that each agency "establish a policy to provide for independent reviews of dam project development." (FCCSET report p. 6, Recommendation No. 1). The Panel supports this recommendation but feels that a clearer distinction needs to be made between the concepts of internal and external independent reviews. The following comments are offered in this regard.

Review programs may encompass a broad spectrum ranging from routine checking performed within the organizational unit responsible for the work to independent evaluation by an external panel of consultants or an engineering firm. However, those procedures involving multi-level in-line review through the line organization, while they may be essential to the conduct of the work of that organization, are not properly classed as independent review elements. The rare practice of one Federal agency acting in the role of technical reviewer across interagency lines could perhaps be categorized as a form of external independent review. Likewise, technical review of Federal dams by state agencies having such capabilities, if such reviews were to be conducted on more than an informal basis, could also be so categorized. However, the terminology used herein in speaking of external independent review refers solely to the role of consultants or consulting engineering firms from the private sector.

Even this distinction is not sufficient, however, since the expertise of private consultants may be used in various ways by Federal agencies. Only when the private consultant's primary function is peer review and is independent can the term external independent review be applied. Thus, the use of engineers in the private sector to accomplish tasks for which manpower or specific expertise is not available in the Federal agency does not fall within the meaning of external independent review. The same is also true of the role of the consultant called in to solve a specific problem. For example, inspections currently being conducted under P.L. 92-367 should not be considered a form of external independent review, rather they constitute a specific engineering task which itself could be subject to independent review.

External independent reviews can be conducted by either boards of consultants or consulting firms. Boards of consultants are comprised of individuals having the experience and recognized qualifications in the various technical specialities such that, collectively, they can provide the broadly based experience and high degree of expertise needed to provide an overview for the entire spectrum encompassing dam safety. For dams in the design stage, the board should be formed before the project moves from the planning stage to design, and the same panel should ideally continue at least until the project is operational. Because of the long time spans involved, continuity of board membership is not always feasible; thus, provisions for rotation and replacement of board members are essential.

Boards of consultants are usually formed to serve on specific projects, although sometimes they are retained as more or less permanent panels which serve on a continuous basis. Also, falling into this category are advisory groups of eminent specialists which some agencies form to furnish advice in particular fields and which may also play a role in independent review. The use of individual experts providing technical consultation and review in specific areas of expertise and who operate outside the forum of a formalized board of consultants is, also, an effective procedure for these special cases.

Consultant firms can also perform the function of external independent review. In practice, this is normally undertaken as the result of a contractual agreement established when the design is finished but before the Invitation for Bids is issued for the construction contract. The review entails both study of the project records, field data and design calculations, evaluation of the adequacy of the structure, and very likely independent calculations and checks in specific instances.

In the case of dams in a design-construction stage the use of a board of consultants or a consulting firm for independent review can be effective in ensuring that the advantages of a continual overview are realized. In either case it must be recognized that it is inappropriate to expect a board of consultants or a consulting firm engaged in external independent review to perform the detailed calculations and analyses necessary to assure that all possible safety problems have been resolved. The employment of consultants for external independent review does not relieve an agency of its responsibility for project safety.

The Panel supports the general concept of independent reviews and feels strongly that external independent reviews should be an integral part of every agency's normal practice. The panel senses that this view is not universally shared equally by all Federal agencies and, therefore, recommends that:

The ad hoc Committee's recommendation calling for independent reviews of dam project development should be expanded to call for:

a. external independent reviews on all dams which constitute a significant hazard potential, or involve unusual and difficult design or construction problems; and

b. the establishment of mechanisms whereby external independent review of an agency's procedures can be periodically conducted.

Enclosure 4

Excerpt from "Federal Guidelines for Dam Safety," a revised issue of Appendix B in "Improving Federal Dam Safety." June 25, 1979

6. Reviews

a. Extent

All factors affecting the safety of a dam during design, construction, and operation should be reviewed on a systematic basis at appropriate levels of authority. Reviews include those internal to the agency, and those external to the agency by individuals or boards (consultants) with recognized expertise in dam planning, design, and construction.

b. Internal

Provision should be made for automatic internal review of all design decisions, methods, and procedures related to dam safety. Review should be at levels of authority above the design section or designer-supervisor relation. Uniformity of criteria and design technique should be maintained, as well as methods to ensure that specific experience is exchanged and used to advance the agency's ability to design, construct, and operate safe dams.

Management technical personnel should review the construction periodically. Reviewing personnel should include geologists, geotechnical engineers, and embankment and/or structural engineers who have had experience in responsible positions relating to similar structures. When appropriate, the review should include mechanical and/or electrical equipment engineers. Preconstruction inspection should be made after geologic mapping is done and prior to ground surface disturbance. On large projects, construction reviews would normally be at critical construction periods such as start and completion of foundation preparation and grouting, dam construction at several stages, and completion of the dam. Visits by appropriate personnel are recommended every 6 months, and to accompany the consultants during scheduled reviews. The final construction inspection should cover inspection of completed structures and equipment, the adjacent valley floor and abutments, and the reservoir rim.

On smaller projects, the frequency of construction review and the disciplines represented in the review would vary with the size and complexity of the project. However, management should make certain that construction reviews are sufficient to cover the requirements for dam safety.

Reviews should be made of the agency's procedures for post-construction operation and periodic inspections. These would include the responsibilities for collection and evaluation of data from any dam instrumented.

Reviews should be made to ensure that the project emergency preparedness plan is periodically updated.

Formal documentation should be made of all significant findings from reviews and inspections.

c. External

The need for review of a dam by independent experts (consultant board or firm) from outside the agency should be determined on a case-by-case basis, depending on the degree of hazard, size of the dam, complexity of the site geology and geotechnology, complexity of the design, or a specific need perceived by the public. Consultant reviews should provide appropriate overview evalutions of site investigation, design, and construction.

Consultant reviews of operation and maintenance practices, and of alterations and improvements should be conducted when the agency considers such reviews advisable.

The following text deals first with design and construction reviews. Applicable portions apply also to post-construction reviews; specifics for post-construction reviews are in the last paragraph of the section.

The agency should be represented at each consultant meeting by appropriate design and construction staff. When appropriate, meetings should include a site visit. At each meeting the agency should formally document all aspects of the continued development of the project for presentation in a meeting-opening briefing to the consultants. The consultants should formally document findings and recommendations and present them at a closing conference with the agency staff.

The consultant board members should be chosen to assure coverage of all areas of expertise needed to assess the dam design, construction, and safety. The board should contain at least three, but normally not more than five, permanent members. The board should always contain a general civil engineer, a geologist and/or geotechnical engineer, as appropriate a concrete and/or embankment dam engineer; and usually a member for the electrical and mechanical features, especially necessary if a power plant is part of the project. Additional specialists covering specific aspects such as structural integrity, earthquake response, or three-dimensional analysis should be assigned for short intervals as recommended by the board. The board should be formed during the design stage and consulted (if possible) on site selection, on type of structure, and for input to the feasibility study. The board should be kept active throughout design and construction, in order to keep the board completely familiar with all aspects of the project so they are in a position to respond rapidly if problems arise.

During design and construction of large projects, the board should meet every 6 to 12 months, depending upon activities and duration of the work. Meetings should be scheduled to review at specific phases of construction. These phases might include, but not be limited to, review during the early stages of foundation cleanup and treatment, on completion of foundation cleanup, and during the early stages of embankment and/or concrete placement. All board members should attend every meeting even

though some meetings may not apply to all members. This would ensure that the entire board is fully aware of the complete work status before being asked for their input on specific points.

The briefing to the board by agency personnel at the start of a meeting should include exploration data, structural adequacy and seepage characteristics of the foundation, proposed foundation treatment, grouting programs, quarry test data, test fill data, embankment requirements for zones and material for those zones, sources of materials, compaction requirements, inspection requirements, instrumentation program, type of spillway (gated or ungated), proposed water release control systems, diversion requirements and care and diversion of water, power generation anticipated, and surge tank design. For concrete dams, the review would include concrete design and placement requirements in lieu of the embankment information.

On a smaller project, the use of consultants should be commensurate with the dam size and complexity, and with the degree of associated hazard. If there is significant hazard, the agency should obtain consultant reviews adequate to assure independent assessment of the dam safety.

Consultants should be engaged during agency evaluations of existing dams if considered necessary to provide independent support for agency assessment of dam safety. This might be in connection with studies for alterations or improvements for potential criticality of dam stability resulting from structure deterioration, or from increased reservoir levels due to possible flood inflows larger than design floods and consequent inadequate spillway capacity. It might involve consultation on seismic design; and in the case of old dams, especially embankment dams, with inadequate records of materials properties. It might include consultation on the advisability and procedures for new materials investigations. Consultants on features of existing dams may be individuals rather than formal boards.