Ted Johnson

MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

HEADQUARTERS OFFICE
180 HOWARD STREET
SAN FRANCISCO, CALIFORNIA U.S.A. 94105
TELEX: (WUI) 677058, (ITT) 470040, (RCA) 278362, (WUD) 34376
PHONE: (415) 442-7300

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16 July 1985

Mr. John D'Antonio
Department of Energy
c/o Jacobs Engineering Group, Inc.
5301 Central Avenue N.E., Suite 1700
Albuquerque, New Mexico 87108

Subject: UMTRA PROJECT - GEN
Review Comments on Documents for Working Group 1 - Erosion Protection

Dear Mr. D'Antonio:

I am enclosing marked copies of the following draft documents distributed to Working Group 1 at the 2 July 1985 meeting of the DOE, NRC, TAC and RAC at NRC Headquarters in Silver Springs:

1. NRC, "Standard Review Plan on Surface Water Hydrology and Erosion Protection."

2. NRC, "Regulatory Guide on Design of Long Term Erosion Protection Covers."

3. Jacobs-Weston, "Procedures for the Design of a Protective Cover System over Radon Barriers for Uranium Mill Tailings Piles."

4. Jacobs-Weston, "Surface Water Hydrology."

5. Jacobs-Weston, "Embankment Design Considerations."

My marks include the following key comments:

1. In the Draft Standard Review Plan the PMP is specified as the design storm. It is possible that the consequence of damage due to exceedance of the PMP do not justify adoption of this storm for design. The DOE and the NRC may wish to set the design storms as that for which the probability of exceedance in 200 and 1000 years is 10%. This gives 90% assurance of non-exceedance. In this case the choice of designing for 200 or 1000 years would be based on practicality, on a case-by-case basis.

2. In the Draft Regulatory Guide a "no routine maintenance" design is prescribed. It is possible that the consequences of damage due to distress of the erosion protection do not justify a "no routine maintenance" design.

3. In the Draft Regulatory Guide a 99% confidence level design is postulated. It is possible that the consequences of damage due to malfunction of the erosion protection do not justify providing a 99% sure design. A reliability of 90% may be satisfactory for this element.

4. Adjusting the design storm on a case-by-case basis as recommended in the Draft Regulatory Guide may be more cumbersome and time consuming than justified.

In conjunction with my comments on Documents 3 and 4 above I am also enclosing Chapters 4 and 5 of the UMTRA Design Procedures Manual.

In accordance with your discussion with T. R. Wathen, on 15 July 1985 I am forwarding copies of this letter and our comments, and Chapters 4 and 5 of our manual to Berg Keshian of the TAC and Ted Johnson of the NRC.

Sincerely,

G. R. Thiers

G. R. Thiers
Principal Engineer

GRT:kfb

Enclosures:
1. NRC, "Standard Review Plan on Surface Water and Erosion Protection
2. NRC, "Regulatory Guide on Design of Long Term Erosion Protection Covers."
3. Jacobs-Weston, "Procedures for the Design of a Protective Cover System over Radon Barriers for Uraniuum Mill Tailings Piles."
4. Jacobs-Weston, "Surface Water Hydrology."
5. Jacobs-Weston, "Embankment Design Considerations."
6. Chapter 4, "Site Drainage," from MKE UMTRA Design Proceudres, Document No. 4005-GEN-Q-01-00571-00.
7. Chapter 5, "Erosion Protection," from MKE UMTRA Design Procedures, Document No. 4005-GEN-Q-01-00571-00.

cc: (with enclosures)
Berg Kershian
Jim Oldham
Ted Johnson ✓

Marked Copy
Marked by
G.R.Thiers,
Morrison Knudsen Engineers,
Inc. 7/10/85

SRP/TJ/85/06/13/0

DRAFT

STANDARD REVIEW PLAN
SURFACE WATER HYDROLOGY
AND EROSION PROTECTION

I. HYDROLOGIC DESCRIPTION OF SITE *Must agree with SRP titled "Surface Water Hydrology."

A. Areas of Review

The areas of review under this plan include

(1) identification of the relationships of the site to surface water features in the site area, and

(2) identification of mechanisms such as floods and dam failures that may require special design features to be implemented.

The review requires identification of the hydrologic characteristics of streams, lakes (e.g., location, size, shape, drainage area, etc.) and existing or proposed water control structures influencing flooding which may adversely affect the site design.

B. Acceptance Criteria

Acceptance of the information presented is based on a qualitative evaluation of the completeness and quality of information, data, and maps. The description and elevations of structures, facilities, and erosion protection designs should be sufficiently complete to allow independent evaluation of the impact of flooding and intense rainfall. Site topographic maps should be of good quality and of sufficient scale to allow independent analysis of pre- and post-construction drainage patterns.

The information presented forms the basis for subsequent hydrologic engineering analysis. Therefore, completeness and clarity of data are very important. Maps must be legible and adequate in coverage to substantiate applicable data. The descriptions of the hydrologic characteristics of surface water features should be detailed and correspond to those of the United States Geologic Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), Soil Conservation Service (SCS), Corps of Engineers, or appropriate state and river basin agencies. Descriptions of all existing or proposed reservoirs and dams (both upstream and downstream) that could influence conditions at the site should be provided. Descriptions may be obtained from reports of the

USGS, United States Bureau of Reclamation (USBR), Corps of Engineers, and others. (Generally, reservoir descriptions of a quality similar to those contained in pertinent data sheets of a standard Corps of Engineers Hydrology Design Memorandum are adequate). Tabulations of drainage areas, types of structures, appurtenances, ownership, seismic and spillway design criteria, elevation-storage relationships, and short- and long-term storage allocations should be provided.

C. Review Procedures

The information normally presented is not generally amenable to independent verification, except through cross-checks with available publications relating to hydrologic characteristics of the site region and by site visits. The review procedure consists of evaluating the completeness of the information and data by sequential comparison with information available from references. Based on the description of the hydrosphere (e.g., geographic location and regional hydrologic features), potential site flood mechanisms are identified.

D. References

Because of the geographic diversity of sites and the large number of hydrologic references, no specific tabulation is given here. In general, maps and charts by the USGS, NOAA, Army Map Service (AMS), and Federal Aviation Administration (FAA); water-supply papers of the USGS; River Basin Reports of the Corps of Engineers; and other publications of state, federal, and other regulatory bodies, describing hydrologic characteristics in the site vicinity and region, are used. Other specific review areas, as given below, contain references that are to be used in evaluating the specific hydrologic features of the site.

II. FLOODING DETERMINATIONS

A. Areas of Review

The flooding potential in the site area is reviewed to determine the extent of flood protection required to meet EPA standards. The area of review include the precipitation potential, precipitation losses, the runoff response characteristics of the watershed, the accumulation of flood runoff through river channels and reservoirs, the estimate of the probable maximum flood (PMF)* and other lesser floods at the site, and the determination of critical water levels and velocity conditions at the site. Included is a review of site drainage and a review of the probable maximum precipitation (PMP)* potential and resulting runoff for site

*See next page.

designing for 200 years or 1000 years should be based on practicality on a case-by-case basis. Should substitute "design flood" for "PMF."

drainage and for drainage areas adjacent to the site. The analyses involve modeling of physical rainfall and runoff processes to estimate the upper level of possible flood conditions adjacent to and onsite.

B. Acceptance Criteria

The probable maximum flood as defined in ANSI N 170 (Ref. 4) has been adopted* as one of the conditions to be evaluated in establishing the applicable stream and river flooding design basis. The criteria for accepting the PMF* estimates depend on the relative significance of the flood to the site design. PMF* estimates are needed for all adjacent streams, rivers, and site drainage channels. One of two conditions may exist at the site under review, as follows:

1. The elevation attained by the PMF* on a large adjacent stream establishes a required protection level and the necessary flood protection.

2. The elevation attained by the PMF* onsite and in onsite drainage channels establishes the design basis flood protection.

The staff will estimate the flood level as described below. The estimate may be made independently from basic data, by detailed review and checking of the applicant's analyses, or by comparison with estimates made by others which have been reviewed in detail. Acceptance is based on general agreement of the staff and applicant estimates of static flood level and peak discharges. The evaluation of the adequacy of the flood estimates is generally a matter of engineering judgement, and is based on the confidence in the flood level estimate and the degree of conservatism in each parameter used in the estimate.

C. Review Procedures

The evaluation of flooding potential is, for review purposes, separated into two parts; PMF* on large adjacent streams, and PMF* on local drainage channels and protective features. The basis for the selection of the PMF* as the design flood event is presented in Reference 3. The review procedure for evaluating a PMF* on a large stream is outlined in Reference 4. The review procedure for evaluating a local PMP/PMF* event is outlined in Part IV, below. PMF* estimates approved by the Chief Engineers, Corps of Engineers, and contained in published or unpublished reports of that agency, or generalized estimates may be used in lieu of staff-developed estimates. In the absence of such estimates, the staff will use both large and small basin techniques of the World Meteorological Organization

*In my opinion the consequences of damage due to exceedance of the design flood do not justify adoption of the PMF as the design flood. The design floods should be those floods for which the probability of exceedance in 200 and 100 years is 10%. This gives 90% assurance of non-exceedance. The choice of

in conjunction with Corps of Engineers' runoff, impoundment, and river routing models to estimate PMF* discharge and water levels at the site. When detailed independent estimates are necessary, the applicant will be requested to provide any necessary basic data.

2. Hydrometeorological Reports of the U.S. Weather Bureau (now U.S. Weather service, NOAA), Hydrometeorological Branch: Nos 43, 49, 55

3. Johnson, T.L., "Design of Rock Covers for Reclaimed Uranium Mill Tailings Impondments: A Regulatory Perspective" Proceedings of Seventh Symposium on Management of Mill Tailings, Low-Level Waste and Hazardous Waste, February 6-8, 1985.

4. American National Standard Institute, Standards for Determining Design Basis Flooding at Power Reactor Sites, ANSI N 170, November, 1976.

5. Bureau of Reclamation, "Design of Small Dams," Second Edition, U.S. Department of the Interior (1973).

6. Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants."

III. DAM FAILURES

A Areas of Review

Peak water levels, arrival times and velocities are reviewed to determine potential hazards due to the failure of upstream water control structures from either seismic or hydrologic causes. When data are provided to show that seismic events will not cause failures of upstream dams that could produce the governing flood at the site, the areas of review will include items necessary to justify such conclusions. Where analyses are provided in support of either a conclusion that a dam failure flood* due to a PMP* is the design basis flood for a stream, or that a postulated or arbitrarily assumed seismically-induced flood is the design basis flood for a stream, the areas of review consist of the following:

1. Conservatism of modes of assumed dam failure.

2. Consideration of storage capacity flood control reservoirs.

3. Conservatism of downstream flow rates and levels.

*See Footnote added to Pg. 3.

break superimposed on local 10-year storm as a third. Full reservoir should be assumed as initial condition for each case.

4. Flood wave attenuation to downstream dams, or to the site.

5. Potential for multiple upstream dam failures and resultant flood wave effects.

6. Shape of breach. 7. Duration of breach process.

B. Acceptance Criteria

The staff will review the applicant's analyses or independently estimate the coincident river flows at the site and at the dams being analyzed. The acceptable "worst conditions" to be postualted for analysis of upstream failures in lieu of substantiation of seismic resistance capability are: (1) a 25-year flood in a full reservoir coincident with the dam-site equivalent of the maximum credible earthquake (MCE)*, (2) a standard project flood (a flood about half the severity of PMF) on a full reservoir coincident with the dam site equivalent of the ~~½ of the~~ MCE,* and (3) a PMF* on a reservoir which is not designed to safely store or pass such a flood.

The location of dams and potentially "likely" or severe modes of failure should be identified. The potential for multiple dam failures (of closely-spaced dams) and the domino failure of a series of dams, should be discussed. Analytical hydraulic failure models will require complete model description and documentation. A determination of the peak flow rate and water level at the site for the worst ~~possible combination of dam failures~~ and a summary analysis (that substantiates the condition as the critical permutation) should be presented, along with a description of all coefficients and methods used. Computations, coefficients, and methods used to establish the water level at the site for the most critical dam failures should be summarized. Comparison with steady or unsteady flow models with adequate site-related coefficients, serves as a basis for acceptance.

conditions assumed for design

C. Review Procedures

In general, the conservatism of the applicant's estimate of flood potential and water levels from dam failures is analyzed and when required, an analysis is performed using simplified, conservative procedures (such as instantaneous failure, minimal flood wave attenuation, and extrapolated site discharge-rating curves). Techniques for such analyses are identified in standard hydraulic design references and text books. If the simplified analysis indicates a potential flooding problem, the analysis may be repeated using more refined techniques, and additional information and data are requested from the applicant, if necessary. Detailed failure models, such as those of the Corps of Engineers, Nat~~ural~~ long

* The consequences of damage due to failure of an upstream dam do not justify designing for the PMF or the "worst conditions" postulated. The design flood should be that defined in the footnote added to page 3. Worst conditions should include 1) design flood ~~and~~ one condition, & 2) 10-yr. flood superimposed on dam break as another, and 3) dam

Weather Service, and the Tennessee Valley Authority, are utilized to identify the outflows and various failure modes and resultant water level at the site

IV. EROSION PROTECTION DESIGN

A. Areas of Review

In this section, the following erosion protection designs are reviewed:

1. Erosion protection to ~~placed to~~ provide protection against the effects of ~~due to~~ flooding from nearby large streams.
2. Erosion protection to protect drainage channels.
3. Erosion protection to protect the top and side slopes of the remediated pile.
4. Durability of the erosion protection to be provided.

The staff review assesses the peak discharge rates, water levels, water velocities, and associated riprap requirements needed to provide protection to meet EPA long-term stability criteria.

B. Acceptance Criteria

The erosion protection designs must be capable of meeting the long-term stability requirements of 40 CFR 192. In general, erosion protection that is designed to resist on occurrence of the PMP* or PMF* provides an acceptable design. Additional details and acceptable methods of analysis may be found in Regulatory Guide 4.xx(Ref)

C. Review Procedures

The staff will check applicant analyses ~~on~~ or perform independent analyses in accordance with the guidelines provided in Regulatory Guide 4.xx. If the design assumptions and calculations are reasonable, accurate, and/or compare favorable with independent staff estimates, the designs are found acceptable.

~~D. References~~

*See footnote added to Page 3.

References

In addition to the following specific references, Design Memoranda, Civil Works Investigations and research and development reports of the Corps of Engineers and reports of other federal and state agencies relevant to flood estimates at a specific site will be used on an "as available" basis.

1. Reports of Corps of Engineers, Department of the Army:

a. EM 1110-2-1411, "Standard Project Flood Determinations", 26 March 1952 (rev. March 1965).

b. EC 1110-2-27, "Policies and Procedures Pertaining to Determination of Spillway Capacities and Freeboard Allowances for Dams," 19 February 1968.

c. EM 1110-2-1405, "Flood Hydrograph Analysis and Computations," 31 August 1959.

d. EM 1110-2-1408, "Routing of Floods Through River Channels," 1 March 1960.

e. EM 1110-2-1406, "Runoff From Snowmelt," 5 January 1980.

f. EM 1110-2-1603, "Hydraulic Design of Spillways," 31 March 1965.

g. EM 1110-2-1409, "Backwater Curves in River Channels," 7 December 1959.

h. EM 1110-2-1601, "Hydraulic Design of Flood Control Channels," 1 July 1970.

i. CE 1308, "Stone Protection," January 1948.

j. EM 1110-2-1410, "Interior Drainage of Leveed Urban Areas: Hydrology," 3 May 1965.

k. Waterways Experiment Station, "Hydraulic Design Criteria," continuously updated.

l. ETL 1110-2-120, "Additional Guidance for Riprap Channel Protection," May 1971.

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V References

7. "Flood Hydrograph Package," HEC-1, Corps of Engineers Hydrologic Engineering Center. Davis, California, October 1970.

8. "Water Surface Profiles," HEC-2, Corps of Engineers Hydrologic Engineering Center, Davis, California, May 1973.

9. "Reservoir System Operation for Flood Control," HEC-5, Corps of Engineers Hydrologic Engineering Center, Davis, California, May 1973.

10. "Routing of Floods Through River Channels," EM 1110-2-1408, Corps of Engineers, March 1960.

11. Hunter Rouse, ed., "Engineering Hydraulics," John Wiley & Sons, Inc., New York (1950).

12. Ven Te Chow, "Open-Channel Hydraulics," McGraw-Hill Book Co., New York (1964).

13. J.M. Garrison, J.P. Granju, and J.T. Price, "Unsteady Flow Simulation in Rivers and Reservoirs," Jour. Hydraulics Division, Proc. Am. Soc. of Civil Engineers Vol. 95, No. HY5, pp. 1559-1576 (1969).

14. "Gradually Varied Unsteady Flow Profiles," 723-62-L2450, Corps of Engineers Hydrologic Engineering Center, Davis, California, March 1969.

15. R.A. Baltzer and C. Lai, "Computer Simulation of Unsteady Flows in Waterways," Hydraulics Division, Proc. Am. Soc. of Civil Engineers, Vol. 94, No. HY4, pp. 1083-1117 (1968).

16. J.J. Stoker, "Numerical Solution of Flood Prediction and River Regulation Problems," Reports I and II, New York Univ. (1953-54).

17. V.L. Streeter and E.B. Wylie, "Hydraulic Transients," McGraw-Hill Book Co., New York, pp. 239-259 (1967).

18. W.A. Thomas, "A Method for Analyzing Effects of Dam Failures in Design Studies," Corps of Engineers Hydrologic Engineering Center, Davis, California, (for presentation at the ASCE Hydraulics Division Specialty Conference, Cornell University, August 1972).

19. "Flow Through a Breached Dam," Military Hydrology Bulletin No. 9, Corps of Engineers (1957).

20. "Floods Resulting from Suddenly Breached Dams, Conditions of High Resistance," Mics. Paper No. 2-374, Report 2, Corps of Engineers (1961).

21. Bureau of Reclamation, "Flood Routing," Chapter 6/0 in "Flood Hydrology," Part 6 in "Water Studies," Volume IV, U.S. Department of the Interior (1947).

22. Natural Weather Services - Dambreak

23. Regulatory Guide 4.XX, Design of Long-Term Erosion Protection Covers for Reclamaton of Uranium Mill Sites.

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