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MEMORANDUM FOR: R. John Starmer, Section Leader
Technical Branch
Division of Low-Level Waste Management
and Decommissioning, NMSS

FROM: Seth Coplan, Section Leader
Operations Branch
Compliance Demostration Section
Division of High-Level Waste
Management, NMSS

SUBJECT: TECHNICAL ASSISTANCE FOR RIPRAP DESIGN REPORT

At your request, Richard Codell of the Compliance Demonstration Section has reviewed the draft report "Development of Riprap Design Criteria by Riprap Testing in Flumes: Phase II" by S. Abt and others. Comments from this review are attached. The report is generally well-written. The most serious problem with it is the specification of parameters to be used in the riprap design methodology in Chapter 7. The report gives no references for the parameters chosen, and it appears that their values are speculative. If so, this should be stated up front, and justification given for choosing those values. Please address any questions to Dick Codell at X2-0408.

/S/

Seth Coplan, Section Leader
Operations Branch
Compliance Demonstration Section
Division of High-Level Waste
Management, NMSS

Attachment: As stated

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Review of "Development of Riprap Design Criteria by Riprap Testing in Flumes" by S. Abt et.al., Colorado State University

Reviewed by Richard Codell, Compliance Demonstration Section, HLOB, DHLWM

1. General - This report is in much better shape than the Phase I report when it first came in. The authors have done a much better job this time.

2. General (minor) - The authors have used "affects" when they meant "effects" several places in text. See abstract for example.

3. Page 42 - Equation 4.1 - This equation gives a good fit to the angular rock data, but it is dimensionally inconsistent. I would not suggest changing it at this point in time, since it would involve many other changes to the text.

4. Page 74 - Section 5.2 - I don't necessarily agree with the authors' statement that "The data indicate that the measured and calculated velocities favorable (sic) compare over the wide range of slopes, rock sizes and rock layer thicknesses tested". It appears that the straight line drawn through the data in Fig 5.2 would be less than 45 degrees, indicating some sort of correlation between velocity and other variables as well as porosity. I covered this point in NUREG-1263 "Hydrologic Design for Riprap on Embankment Slopes", suggesting that there might be an "effective porosity" different from the measured porosity. I suggest that the present report contain words to the effect that, although there is a generally good fit in Fig 5.1, it appears that the velocity is not strictly proportional to the inverse of porosity, and that other factors may be important. This would be a good lead in for the next section on correlation of velocity with D_{10}.

5. Page 84, top of page - The first sentence of Comment 1 seems out of place, because at this point in the section experiments with clayey soils had not yet been discussed. I think that it would be better to move this comment about clay content to a point following the discussion of other experiments.

6. Page 86 - I think it would be useful to add another column to Table 6.2, giving the estimated values of q_f from equations such as 4.5.

7. Page 89, line 2 - "intact" for "in tact"

8. Page 89, Section 6.6 - It seems that one of the things that Experiment 52 did not test was the gradual erosion by lesser storms and runoff over a period of time. It would be possible that over a few tens or hundreds of years, soil would be removed in such a manner that there would be channelization, leading to a situation that is worse than no cover at all. If this were to be the case, the conclusion in this section would be misleading. Another factor with a soil-filled matrix is that any runoff and storage that the unfilled matrix allowed would be lost. This did not, and could not, come out of the flume experiments, since storage in the steady-state flow tests is not a factor. It <u>is</u> a factor, however, in the

calculation of runoff from storms falling directly onto the embankment, and soil-filled riprap would lead to increased runoff. This is demonstrated by example in NUREG-1263. It would be appropriate to point out these factors in the use of a soil-filled riprap layer, and conclude that no clear conclusions on its aptness should be drawn on the basis of the flume tests.

9. Page 92, Section 7.1, Step 1 - The use of "tributary" is confusing. I thought the report dealt primarily with runoff of water from rain falling directly on the embankment. If this is the case, the report should give some indication of how the user should go about calculating q from rainfall.

10. Page 92, Step 1 - Where did the concentration factor C_f come from? Do the factors for channelized flow come from Section 4.6, "Stone movement and channelization"? I have the feeling that these factors are for the most part unsubstantiated. If so, the speculative nature of the factors should be discussed openly and justification given for their use. This is the most serious problem I found in the report.

11. Section 7 - General (minor) Equations are misnumbered. They should have started with "7".

12. Page 94, bottom of page - Eq. 4.1 should be Eq. 1.1. Also, Eq. 6.6 is dimensionally inconsistent. The width of the flume should in the equation or else q should be expressed as a flow per unit width of the flume.

13. Page 96 - Step 5 - The report should mention that the procedure to reduce the estimate of overtopping flow would not make sense for a soil-filled matrix, since the riprap layer would not conduct an appreciable amount of water. This would be important in estimating the runoff from severe storms of short duration (see comment 8 above). Also, when applying the procedure for bare riprap, some consideration should be given to the infilling of the rock by wind-borne or water-borne sediments and the gradual disintegration of the rock by weathering.