

Stephens & Associates

10424 Windfall Court, Damascus, MD 20872 (301) 253-5576

December 23, 1987

Mr. K.C. Chang
623-SS
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Chang:

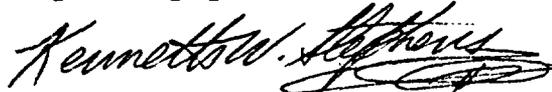
VOUCHER FOR PROFESSIONAL SERVICES

Attached are the original and required two copies of the voucher for my services December 14-23, 1987.

My activities covered by the voucher are described in the attached Progress Report.

I have now worked 87 days in this consulting year.

Very truly yours,



Kenneth W. Stephens

Attachments
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WM Record File: A-4165

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PROGRESS REPORT

Kenneth W. Stephens

December 14-23, 1987

Introduction

During this reporting period, my activities included further work on the tuff engineered barriers, preparation of a briefing to be given to NRC, and work associated with comments on the CONVO user's manual.

Engineered Barriers

As mentioned in my previous Progress Report, I had extensive discussions at the recent Materials Research Society meeting in Boston relating to information helpful in our work with engineered barriers. Nava Garisto and David LeNeveu, who are instrumental in the Canadian performance assessment work sent me some more material that is quite interesting.

For the analysis of tuff engineered barriers, it has been necessary for us to choose release and transport models that are both accurate enough for NRC purposes and simple enough to be modeled without undue expenditure of computer time. In recent work, the Canadians have compared the results from simple models with those from more detailed finite-element and finite-difference models. The results are encouraging.

For diffusive mass transport (as is relevant for our tuff purposes), detailed three-dimensional finite-element models show that the concentration profiles tend to become parallel with the ground surface. That is, the concentrations from the collection of waste packages are very similar to those that would be calculated using simple slab geometry. Moreover, the researchers have found one-dimensional models to be quite good in predicting the release profiles a few meters away from the waste packages.

I will pursue this tack for the moment to see whether it meets our short-term needs.

Briefing

Preparation of the briefing is proceeding nicely.

Comments on CONVO User's Manual

I have reviewed draft comments from the NBS support team relating to the manual. My response is attached.

Response to NBS Draft Comments on
CONVO Users' Manual

Summary

I have reviewed the December 14, 1987 draft comments from the NBS team providing technical assistance to NRC under FIN-A-4171-7, Evaluation and Compilation of DOE Waste Package Test Data.

I appreciate the obvious time the NBS people put into formulating their thoughts and articulating the comments. It appears that the comments cover three main items:

- o The overall NRC performance assessment program.
- o Items associated with the nature of CONVO itself.
- o Specifics related to CONVO User's Manual.

Unfortunately, the comments concentrate on the first two and include almost no guidance on the third item. Specific suggestions related to the manual are sorely needed if we are to improve its usefulness to the user. Because we have been associated with the subject matter for so long, we cannot read the manual as a new user might. However, the NBS people can.

I have separated my responses into the above three categories.

Comments Relating to the Overall
Performance Assessment Program

Many of the NBS comments fall into this category. They are concerned with the overall state of knowledge for performance assessment and the role CONVO should play. The comments include the following:

...the basic problem with CONVO is that the end product or output obtained (from this or any other model that is unproven, uses sparse data, and contains so many uncertainties) is questionable....Hence, the CONVO program should not be released in its present form because it could provide misleading information to those who might use it inappropriately in making performance assessments of a nuclear waste package.

This philosophy has been expressed by the NBS team for some time. In essence, they feel the overall state of knowledge to support performance assessment (by any models--not just CONVO) is so bad that no performance assessment should be

done until such time as the state-of-the-art improves. Although I understand why the NBS researchers feel that way, I cannot agree with such an overall strategy for NRC purposes.

The NRC people recognize that the state-of-the-art is not perfect and that neither DOE, NRC, nor their supporting organizations have solved all the problems. Nevertheless, it is essential that NRC proceed to develop performance assessment tools NOW so that they can be refined by the time they are needed for licensing. Although there always a potential that an uninformed user will misuse a tool, that possibility is not sufficient justification to suppress documentation that contains proper caveats.

I am confident that NRC is capable of deciding when is the proper time to release CONVO and its documentation for external consumption.

Another comment is:

Adequate models can be developed only after uncertainties related to the degradation of a waste package are understood. It was not possible for these uncertainties to have been carefully addressed in the CONVO program. The rate-limiting processes, or the weakest links, or critical paths for all potential degradation processes involved in the assessment of performance of a waste package must be understood before any framework developed for the prediction of performance can be regarded as adequate.

We make no pretense that CONVO (or any of DOE's work for that matter) is now adequate for licensing needs in the future. However, there is essentially a consensus that corrosion will be the weakest link in the chain for most container materials. Thus, it is appropriate to base current failure models on strawman corrosion models until such time as better models are developed for corrosion, as well as degradation modes such as stress-corrosion cracking.

Comments Associated with the Nature of CONVO Itself

The comments include:

Ultimately, after process models have been developed, appropriate data have been obtained, and interactive processes are understood, a more totally inclusive code may be needed to make a lifetime assessment for a nuclear waste package. The approach to the calculation that may be suggested at that time could

be quite different from that taken in the data vacuum under which CONVO was developed.

Such comments imply that the CONVO code and the performance assessment philosophy it embodies are inadequate for NRC purposes and perhaps should be scrapped. I disagree for the following reasons:

- o The code is designed with a generic mathematical framework that can accommodate a wide variety of process models representing factors that affect package lifetime and radionuclide release and transport (including models that are not yet available).
- o The generic framework is similar to that being used by other performance assessment groups within and outside the United States.
- o NRC must have performance assessment tools NOW in order to direct the research program that ultimately will support licensing, and in order to provide guidance to DOE regarding areas of concern. Nothing prevents NRC from using improved modeling when it is available.

The NBS comments include a list of important processes not accounted for in CONVO, such as stress-corrosion cracking, hydrogen embrittlement, and interactions that would lead to enhanced degradation, and surface diffusion. We agree that CONVO does not include them, but we observe that the code could incorporate such considerations if process models were available for these processes. We have maintained close touch with research programs around the world and can say with confidence that sufficient models are not currently available.

Internal corrosion was mentioned in the NBS comments. The NRC essentially ruled out the significance of internal corrosion during work at Battelle Columbus over the past several years. If necessary, however, our methodology can easily incorporate inside-out corrosion, as was stated in our Methodology Report, Demonstration Report, and other communications from time to time.

The NBS comments also include:

The corrosion models do not account for material type, material-stability characteristics, and environmental effects relating to corrosion and/or pit initiation and corrosion rate. Electrochemical data relating to electrode potential, environmental pH, and other environmental factors must be

considered in relation to surface films, corrosion products, and corrosion protection.

We have never considered the strawman corrosion models used in CONVO demonstrations to be perfect. Whenever, corrosion specialists such as the NBS researchers are able to produce models that include the above considerations, we will be happy to apply them in performance assessment.

On the subject of surface films, Dr. Marsh of Harwell recently expressed to me his concern that it will be very difficult to defend corrosion models based on the presence of surface films. His work apparently shows that such films can be removed by a variety of mechanisms and that if the films are removed, corrosion can proceed at an accelerated rate.

Attachment 1 of the NBS comments lists parameters and uncertainties in prediction of container life. Those are appropriate items to consider, and we have done so over the past five years. Such items and their impact have been thoroughly discussed in our methodology work and the work by Oak Ridge for NRC.

Comments on the User's Manual

The NBS comments concentrate on the overall NRC performance assessment strategy and items related to CONVO itself. The only direct reference to the user's manual is a brief reference to Attachment 2. The NBS comment is:

Guidance for use in the development of understandable codes is given in Attachment 2. Further work on this question [adequacy of documentation for first-time users] should be based on these guidelines, and this would require a significant effort.

Does this mean that the persons who reviewed the user's manual feel it is inadequate in relation to the guidelines of Attachment 2? If so, they should say so and should provide specific suggestions for change. The guidelines seem reasonable. Based on my personal knowledge of CONVO and the lengthy process that led up to its development, I am confident that it can deal adequately with items discussed in the guidelines.

If the user's manual does not convey that message sufficiently for the new user, then the manual should be refined.

Suggested Changes to the
User's Manual

When the final comments are sent by NBS, they should concentrate on specific suggestions for improving the user's manual. The basic characteristics of NRC performance assessment philosophy and the CONVO methodology were laboriously established over the past five years and are not likely to change in the near-term. The user's manual, however, is still in draft form and can be enhanced if we get good suggestions from people outside our team.

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