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MEMORANDUM FOR: William Ott, Section Leader  
Waste Management Branch  
Division of Radiation Programs  
and Earth Sciences, RES

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FROM: Michael B. McNeil  
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SUBJECT: JULY 23-24 TUFF WASTE PACKAGE MEETING

The subject meeting took place at Lawrence Livermore National Laboratory. The NNWSI waste package corrosion program was explained by Dr. Dan McCright, Dr. R. S. Glass, and Mrs. M. Juhas. The NNWSI spent-fuel testing program, which involved both corrosion and leaching, was explained by Dr. Virginia Oversby. The meeting was attended by a number of DOE staff and contractors, including Mark Frei (DOE waste) and Danny van Rooyen (now working for DOE waste through Dr. Schweitzer, BNL).

Mr. Frei shows increased awareness of the relevance of ongoing work in other parts of DOE (especially in the Office of Energy Research) to the DOE waste program. He now attends meetings of the Energy Materials Coordinating Committee and is taking steps to ensure that the projects are aware of at least part of the research being done elsewhere in DOE. Furthermore, Dr. Van Rooyen's involvement means that DOE waste now has a recognized corrosion expert involved in their planning.

The presentation by Dr. McCright, Mrs. Juhas, and Dr. Glass indicated several possible problems in their corrosion testing program:

- a) Although Mrs. Juhas acknowledged that inhomogeneity in stainless steels and nickel alloys could well be expected (in a discussion of sigma phase information), LLNL nowhere shows evidence of doing multiple analyses to ascertain the range of inhomogeneity to be expected within a given lot of alloy. This is a matter of concern because alloy samples often show nontrivial inhomogeneity.

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b) Metal Samples, Inc. provides corrosion samples. They do not generally provide data on how the steels are made, though they have expressed the view that the extra-clean 316LNF steel is produced by an argon-oxygen decarburization furnace, continuously cast, and given no further purification. Dr. Glass has discussed the (dirtier) 316LN with colleagues and is of the impression that it has been electroslag remelted. Superficial reasoning would suggest that the electroslag remelted alloy should be cleaner. I think that this is an area where NNWSI would benefit from having a consultant with expertise in process metallurgy.

c) Inclusion counts are done in duplicate or triplicate for each lot of material. I am not sure this represents adequate sampling unless the materials are very homogeneous. Dr. Glass thinks that the surfaces being photographed are in all cases normal to the rolling directions of the plate from which the sample was made. In at least one case there appear to be slag "stringers" (elongated inclusions) oriented normal to the purported rolling direction. This makes one wonder about the reliability of the records. Dr. Glass has informed me that he now realizes the importance of retaining very careful documentation of orientations, especially when the metallographs contain indications which are contrary to conventional expectations.

d) Many of the reported corrosion results were collected using a black-box automated scheme. Some of these results show very strange behavior (e.g., more than 100 mv shifts in the cathodic part of a potentiodynamic scan) which seems to me to be more likely to be due to experimental problems than to some unusual physical phenomenon, such as the experiment itself significantly changing the sample surface or some solution species which dominates the cathodic reaction. These data should be confirmed by other techniques.

The LLNL was questioned in detail on their emphasis on austenitic stainless steels rather than nickel alloys. There was considerable discussion but Dr. McCright agreed with me that we could imagine no situation relevant to NNWSI in which austenitic stainless steels would be preferable to Mo-containing high Ni alloys, whereas there are at least some situations not qualitatively different from repository conditions where the Ni alloys would have advantages. Another exchange touched upon the assertion by Dr. Interrante (NBS) that a steel which LLNL designated as "clean" on the basis of very limited metallography had an analysis which would not lead one to expect that it be much different from a relatively "dirty" steel on which parallel testing was being done. I pointed out that no analysis had been done for oxygen and was assured that the alloys were never analyzed for oxygen because there was so little. Professor King (MIT) advises me that 100 ppm total oxygen would be

expected for 316 or 316L from an argon-oxygen decarburization furnace given careful production practice but that poor practice could easily multiply this by a factor of 5. He added that oxygen content correlates closely with inclusion count, and I believe this may account for the apparent discrepancies. Professor King is the world's leading expert on the chemical metallurgy of stainless steels.

It is clear that as DOE/NNWSI go to more corrosion-resistant alloys, sigma phase is becoming more and more important. We may want to consider expanding our activity in this area in the future.

The presentation by Dr. Oversby on spent fuel testing seemed clear to me. Points that I would make are the following:

- a) The present LLNL model predicts escape of less than  $10^{-5}$  of the inventory of each significant radionuclide in each year after emplacement. However, the model makes two significant assumptions,
  - i) There will not be a major infant mortality problem for waste containers, and
  - ii) Seriously damaged fuel elements can be kept track of for special consideration where appropriate.
- b) The experimental data base on spent fuel represents only two sets of fuel rods. I think that it is important to secure data on more rods. The other NRC staff present agree with this position and it will be communicated to DOE.

A DOE contractor from Argonne (Bates) proposed a new test for leaching behavior in a porous medium. It seemed reasonable though I expressed reservations at plunging ahead with a test on which we have no data base at all as a major component for a licensing action; I believe that this has been communicated to DOE and that they plan to develop a data base for this test.

One point that disturbs me is that information being passed on by NRC for use at the sites is not getting to the people who need it. For example, we have repeatedly provided information relating to salt radiolysis, which NMSS

has forwarded through appropriate channels. Sam Basham of ONWI (the ONWI manager responsible for work in this area) was completely unaware that we had any concerns in this area.

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