Acceptance Criteria for Polyethylene High Integrity Containers

Polyethylene high integrity containers are subjected to loadings during three types of operations: handling, transport, and storage and burial. During transport the containers are housed inside a primary containment, while there is no outside containment during storage and burial. The container is subjected to handling and transport loads both while it is in the primary containment and when it is not. General guidance for polyethylene high integrity containers is currently prescribed in the "Final Waste Classification and Waste Form Technical Position Paper" (page 8 paragraph 4 item d). To assure an acceptable licensing basis for approving proposed designs a more quantitative acceptance criteria is required.

The need for a detailed acceptance criteria became clear during a review of topical reports recently performed by BNL and at a meeting between P. Soo, M. Reich, C. Miller and the NRC staff at Silver Springs, MD on January 30, 1986. The objective of the program outlined in this proposal is to develop such acceptance criteria and to develop analytical/computational tools that may be used by NRC in evaluating licensee applications for polyethylene high integrity container. The proposed program is designed so that NRC will have sufficient data to evaluate the topical reports within six months. It is anticipated that additional work will be required after this six month study to provide a firmer base for the acceptance criteria. The following tasks are proposed for this initial study.

Task I - Develop Acceptance Criteria

The objective of this task is to develop detailed design criteria for the polyethylene containers. In performing this task, the current criteria and existing standards used by various vendors will be identified and reviewed. These in term will be correlated with the requirements for other

(steel) shipping and storage containers. Furthermore related requirements for plastic culverts, conduits, buried pipes and fuel tanks will be assessed for applicability to high integrity polyethylene containers. In developing these criteria following loads will be considered. It is expected that visits to both Hanford and Barnwell will be made to assess the methods used to place and store the containers.

- 0 Handling
  - Lifting
  - Placement in trench
  - Compaction in trench
- 0 Storage/burial
  - Above ground effects
  - Soil pressures
  - Time effects
  - Seismic considerations
  - Water pressure

It is assumed that transport loadings are not at issue since the containers are housed in a cask during transport and damage to the containers would not present a hazard to public safety.

For the above loads acceptance criteria such as stress/strain allowable etc. will be developed and prescribed. In performing this task, consideration will be given to:

- As-built conditions
- Radiation embrittlement
- Multi-dimensional creep effects

It appears that the radiation embrittlement and creep data are not complete for the plastic regime. Engineering judgement will be used to fill in these gaps. Additional material studies will be recommended and these will be performed during later phases of the project.

Task II - Preparation of Container Response Computer Codes

A computer code will be prepared which can be used by NRC staff to perform evaluations of proposed AIC designs. It is anticipated that this code will be capable of computing the response of axially symmetric shell and plate structures to arbitrary loadings (i.e., the criteria loadings developed during Task I). Elastic and creep material response characteristics will be included in the code. Shell buckling will either be treated within the computer code or will be treated by specifying buckling stresses against which the code generated stresses can be compared.

Output from the code will consist of stress strain information at critical locations in the containers. These data can then be compared with the allowable criteria developed during Task I.

It is anticipated that the code will be developed by modifying existing codes which are available at BNL. The SAP, and older versions of NFAP codes contain finite element formations that treat all of the problems of interest except for creep. Subroutines handling creep are available in the NFAP and old BNL concrete creep codes. Creep response computations will be incorporated into the newly put together SAP/NFAP series based on data that is available in the other codes.

A user's manual will be prepared and training session in the use of the code will be conducted for NRC personnel. The above two tasks will be completed in six months. They require a minimum of 9 man-months of staff effort and $7,000 of computer usage time.

As mentioned during the discussions at Silver Springs, MD, in order to provide a firmer basis for the developed criteria, it is expected that the following further tasks will be performed to complete the project. These of course can be carried out after the first two tasks are completed.

Task III - Supplementary Material Data

It is expected the several areas will require additional work to support the newly developed acceptance criteria. At this time it is judged that certain issues such as radiation embrittlement of the plastic and creep effects will need to be analyzed in greater detail by refined finite element methods. Other specific issues to be addressed in greater detail will be identified during Tasks I and II.

Task IV - Sensitivity Studies

Parametric studies will be performed to assess the suitability of the criteria developed during Task I for general use. In performing these studies six typical designs will be evaluated using the criteria. Furthermore, investigations will be made to assess the safety impact involved in relaxing various aspects of the developed criteria.