GENERAL ATOMICS

April 30, 2003

Chief, Rules Review and Directives Branch
U.S. Nuclear Regulatory Commission
Mail Stop T-6-D-59
Washington, DC 20555-0001

2/21/03
68 FR 8530
(37)

Subject: General Atomics Comments on NUREG -1768,
"Draft Package Performance Study Test Protocols"

Dear Mr. Lesar:

General Atomics is very encouraged to see that the US program to build and operate the Yucca Repository is starting. We consider this a pivotal milestone in the future of nuclear power in our country, and are providing support wherever possible.

An integral part of the Yucca program is the transport of spent nuclear fuel from current storage locations to the Repository. General Atomics was very active in the DOE's cask design and development program in the early 1990s, and produced designs for legal weight truck spent nuclear fuel (SNF) casks (the GA-4 and GA-9) as well as a Defense High Level Waste cask. When the DOE stopped the SNF cask development program, General Atomics completed the engineering with additional proprietary features and obtained in 1998 a NRC Certificate of Compliance (71-9226) for the GA-4 cask at its own expense. Due to delays in the repository program, the production engineering and licensing of the GA-9 and DHLW casks has not been completed.

The current Yucca program is appropriately concentrating on the surface facility design for licensing due to a lack of sufficient funding to pursue the transportation effort on an equivalent basis. Initial planning for the transportation program has started using available funds. A basic part of the early Government activity for the program has been the NRC Package Performance Study (PPS) that is investigating the adequacy of analytical models used to determine cask behavior due to very low probability events. The PPS is planning tests of full size transportation casks to benchmark analytical modeling and to increase public confidence in spent nuclear fuel transportation.

The PPS has released a draft test protocol document presenting the NRC's tentative plan for the testing (structural and thermal tests of both rail and truck casks), initial SNL analytical results, and requesting comments from the public. The NRC proposes extra-regulatory tests to impact both casks at 75 mph onto an unyielding surface and then expose them to an extended fire test. The probability of such a sequence of events occurring is extremely incredible, especially for the truck cask. The impact test proposed for the GA-4 truck cask will impose very high strains on the cask body and the shielding material, and will reduce the capability of the cask to survive the fire test. General Atomics believes that these incredible test conditions are not necessary to

Template - ADM-013

E-RIDS=ADM-03
Cod - A. Snyder (AMS3)
H. Murphy (AJM1)

3550 GENERAL ATOMICS COURT, SAN DIEGO, CA 92121-1194 PO BOX 85608, SAN DIEGO, CA 92186-5608 (619) 455-3000

increase the adequacy of the analytical models for extra-regulatory events, and that the conditions being imposed will not contribute to public confidence in credible events.

General Atomics has supported both the NRC and SNL in the early stages of this effort by providing details of our proprietary cask design and the analytical models used for the license analyses, and by commenting on the SNL analysis of the cask. General Atomics comments on the proposed test protocol are now provided. Overall comments and recommendations, answers to questions requested by the NRC, and specific comments are provided below for your consideration.

Overall Comments / Recommendations

General Atomics believes that appropriate tests can be defined to increase the adequacy of the analytical models to predict the effects of incredible events, and that testing to provide added public confidence can be performed, but that these two goals probably require separate tests. We also believe that a public confidence test is more valuable to the SNF transportation program than improving the ability to analyze the effects of incredible events.

Clearly the test protocol presumes the conduct of tests to provide data to improve the analytical models. The following comments / recommendations are presented based on that NRC assumption.

1. We recommend that the analytical model data tests be conducted separately from the public confidence test. Combining the two test goals is inappropriate since the analytical model data needs are very different from the public confidence needs. The model data criterion is plastic deformation of the cask which requires an incredible event to inflict the damage. The public confidence test criterion is containment of any damage to the fuel inside the cask during a credible event. Results from a single test trying to satisfy both criteria may not be meaningful or correct.

2. We recommend that the full-scale cask testing be clearly focused on providing data for the modeling of extra-regulatory events, and that the testing program be clearly defined as a parallel effort to the NRC transport cask certification activity (similar to the loss of coolant activity for reactors).

3. We recommend separation of the truck cask "back-breaker" and extended fire tests. This sequence of events is impossible and damage from the impact test (see comment 5) will affect the ability of the cask to perform properly during the fire test. In addition, the ability to provide fire pretest analytical predictions will be severely limited by undefined impact test damage to the structure. In addition, less data may be available from the fire test due to instrumentation damage during the impact test.

4. We recommend that the duration for the truck cask fire test be carefully considered based on credible conditions, and that the duration be appropriately decreased compared to the rail cask fire duration based on availability of fuel for the fire.

5. We recommend that a lower speed be used for the truck cask "back-breaker" impact test. A speed less than 50 mph onto a rigid body is probably sufficient for plastic deformation to provide data for the analytical model. We also recommend that a clearer statement be made of the purpose for the analytical model. The model is being generated to allow determination of the effect of very low probability events. We also recommend a clearer statement of the analytical model data needs and the means by which the test results will be used to improve the models for the investigation of the effects of incredible events.

   Statements have been made that the analytical model will be used to predict the test results, and then the results will be compared to the model to determine the adequacy of the model. We do not believe that this is a reasonable expectation for extra-regulatory conditions. Analyses cannot be precise because of the effects of multiple variables. Design analyses use appropriate margins on capabilities to ensure elastic performance. Extra-regulatory analyses apply excessive loads/strains to ensure plastic deformation, and can identify the areas of highest stresses and probable modes of failure. Due to the effects of multiple variables, the exact point of failure in a real situation cannot be defined precisely. We therefore question that the exact damage from a given set of extra-regulatory conditions (an actual test) can be defined by an analytical model, especially in the plastic regime, and be used to determine the acceptability of the model by direct comparison to test results.

6. We recommend that acceptance criteria for the tests be the production of high quality data for the refinement of extra-regulatory analytical models. Adequate risk informed performance of transport casks is ensured by the NRC certification requirements. The primary purpose of extra-regulatory testing is to provide data to improve the analytical models used to predict the effects of incredible events. There are no "pass / fail" criteria associated with the testing of incredible events.

B. Answers to NRC Questions:

1. How many casks and what types of cask designs should be used in the tests?

   Testing both truck and rail casks is appropriate. GA believes that the cask from the proposed back-breaker test should not be used for the proposed fire test. If the test data from the proposed tests are sufficient to determine the adequacy of the extra-regulatory analytical models, testing of other designs is not necessary. GA recommends that the NRC consider the option of a) multiple casks to separate the

truck tests, b) retesting if results are not as expected, and / or c) conducting a public confidence demonstration test of a credible event.

2. At what scale should the cask impact tests be conducted (e.g., full-scale or partial-scale)?

   Tests of full-scale casks will increase the public confidence in the analytical models for extra-regulatory events.

3. Should the impact tests be conducted as drops from a tower, as proposed in this report, or along a horizontal track using a rocket sled?

   The tower drop test onto an unyielding surface will provide the best controlled data for analytical model adequacy evaluation purposes. If having adequate models for extra-regulatory event analysis is not sufficient to satisfy the public confidence criterion, a horizontal impact test is probably more effective as a public confidence demonstration test.

4. What should the impact speed and orientation be for the rail cask impact test?

   The impact speed selected (75 mph?) for the unyielding surface model related test must be converted to reality to counteract the automatic public assumption that the test speed is representative of a credible event speed (Reference NUREG CR6672). The use of the center of gravity over corner orientation is appropriate for the rail cask test.

5. Is 96 to 144 kph (60 to 90 mph) a reasonable speed range for the rail cask impact test given that the frequency for a rail cask impacting a hard rock surface within this speed range is 10^{-6} to 10^{-8} per year?

   GA believes that it is inappropriate to mix incredible probability events with "real" speed numbers. It may be appropriate to test onto an unyielding surface for analytical model related data at any speed, but if a credible speed demonstration is to be conducted, the impact object must be changed or an equivalent credible speed must be used.

6. Is the 120 kph (75 Mph) rail cask impact speed proposed by the NRC staff appropriate?

   Please see responses above. A 75 mph speed onto an unyielding surface for analytical model related data may be appropriate, but it is not appropriate for a credible event demonstration.

7. What should the impact speed be for the back breaker truck cask impact test? An impact speed of less than 50 mph onto an unyielding surface is probably sufficient to product plastic deformation of the cask for comparison to the

analytical model. The proposed 75 mph speed is not necessary for model related data. For a credible public demonstration test, the speed should be selected consistent with the event.

8. What should be the duration and size of the cask fire tests?

   For analytical model related heat transfer data, the most severe fire should be used (the optically dense, fully engulfing fire standard at regulatory temperature). The duration of the fire should be sufficient to achieve equilibrium conditions, or limited by the available fuel source for a truck cask event. A credible duration should be used for a public demonstration test.

9. What should be the cask position relative to the fire?

   The cask orientation should be horizontal since this is the most likely position after an event.

10. How many and what types (real or surrogate, PWR or BWR) of fuel assemblies should be in the casks during the tests?

    Surrogate PWR spent fuel should be used for these tests. Correlation between the surrogate and actual spent fuel can be established in the related NRC fuel failure test program.

11. Will the proposed tests be able to yield the insights consistent with the NRC risk-informed regulatory initiatives?

    The proposed testing is outside the risk-informed regulatory initiatives. The testing will aid in predicting the effects of incredible events, and add confidence in the analytical modeling for these events. Credible scenarios and tests should be clearly separated from the proposed tests, and performed separately if appropriate.

C. Specific Comments:

NUREG 1768 Page	Comment
ix	In the description of the PPS, the purpose of generating test data to improve structural and thermal analytical models which are used to investigate the effects of incredible events should be clearly stated. It should also be stated that the tests will increase confidence in the NRC's ability to evaluate incredible extra-regulatory transportation events.
xi	The purpose of comparing test results to pre-test predictions should be clearly stated.

	Rigid targets are appropriate for analytical model data only. Note 2 is misleading - a bridge column or abutment yields and absorbs energy. The discussion of proposed speed for the rail cask impact test mixes credible and incredible event criteria. The criteria should be clearly separated.
xii	There is no discussion of the proposed speed for the truck cask impact test. Conducting the proposed fire test using the cask damaged by the proposed incredible impact test is not appropriate for the truck cask.
2	The first conclusion of the previous SNL investigation indicates that a separate public confidence test may be necessary. NRC may want to consider defining only an acceptable public confidence test and using available data from such a test for analytical model adequacy purposes.
8	The last sentence in the top paragraph implies that if test results do not match the pre-test prediction, the use of the model for design basis conditions is in question. GA believes that this is mixing apples and oranges. The design basis analysis model is for well established, large safety margin, elastic material performance. The tests being proposed are for events beyond the elastic regime, and detail prediction of effects of these events is much less precise. Establishing the adequacy of plastic performance analytical models is not required or necessary for design to elastic conditions. The discussion in the second paragraph relating to cask closure region damage applies only to the proposed rail cask test. Impact testing of the truck cask without the impact limiters is not representative, as suggested in the second paragraph on page 9. The impact limiters must clearly be in place for any thermal test, although they could be damaged from the drop event.
22	Any discussion of flange separation should estimate the leakage gap expected. Paragraph 2 of page 16 states that the analytical model will conservatively ignore head bolt preload. This effect and the seal compliance capability should be estimated and stated so that the impression left for the reader is not one of a 0.76mm gap.
38	The basis for a rigid 4 ft diameter surface is not stated. If similarity to a bridge column is intended (page xi), it should

	probably be larger.
41	A discussion of engineering strain and true strain capability of the material would be appropriate here and on page 46.
49	The last sentence 4th paragraph is confusing. Why is it acceptable for measurements to be outside the uncertainty range?
52	Suggest rewording line 8 to say "Next, a fire test using an actual rail cask...."
54	As previously mentioned, it is not clear how the truck cask damaged by the impact test can be modeled accurately for thermal test predictions.
56	It appears that casks were analyzed without impact limiters. The impact limiters should be included.
70	Last paragraph – the lack of rail cask containment verification due to the extra-regulatory test conditions is inconsistent with the leak test planned for the truck cask after the extra-regulatory impact test.
73	4th paragraph – Suggest using the word "impact and fire test" rather than "collision". These test conditions are not credible. Also, it is not clear how a fully engulfing fire will produce data on heat transfer from the cask to the ground.
Appendix A	The appendix only addresses rail casks, and in some cases disagrees with the proposed truck cask test. Suggest that a truck cask discussion be added.
A-2	The mixing of "reasonable speeds" and incredible test conditions is inappropriate. The goal of confident analysis of incredible events is appropriate.
A-3	The meaning of the last sentence is unclear.
A-4	The third bullet states that at speeds greater than 75mph, the closure seal begins to leak. Such statements should clearly be qualified with respect to the uncertainties and conservatisms used in the calculation.

Respectfully submitted:

Louis. D. Johnson

Cc: Andrew Murphy NRC
David Zabransky DOE

GA:
Al Zimmer
Maria Koploy
Richard Meyer
Nile Johanson
Bill Davison