PDR

71-6698

Nuclear Assurance Corporation
24 Executive Park West
Atlanta, Georgia 30329
(404) 325-4200
Telex: 549567, 542703

715 Horizon Drive
Grand Junction, Colorado 81501
(303) 245-4320
TWX: 9109296334

Weinbergstrasse 9
8001 Zurich, Switzerland
(01) 470844
Telex: 57275

October 6, 1980

CRJ/80/161/ETS

Mr. Charles E. MacDonald, Chief
Transportation Certification Branch
Division of Fuel Cycle and Material Safety
United States Nuclear Regulatory Commission
Washington, D. C. 20555

Re: Docket No. 71-6698
NFS-4 (NAC-1) Spent Fuel Shipping Cask

Dear Mr. MacDonald:

In the interest of clarity and to provide a more quantitative criteria for assessing the stability of the NAC-1 spent fuel shipping cask inner cavity, we request Paragraph 14 of Certificate of Compliance No. 6698, Revision 11 be changed to:

"14. Before inactive casks are returned to service and for active casks at nominal intervals of six (6) months but no later than seven (7) months following the first shipment of irradiated fuel under Revision 9 and later revisions to Certificate of Compliance No. 6698, the licensee shall perform physical measurements of the inner shell of each cask at comparable locations to those documented in Appendix C to NAC letter dated June 8, 1979. These measurements are to be compared with the Reference dimensions of each cask as determined by the average of at least three measurement replications, without intervening use of the cask, using separate equipment setups for each replication.

The measured values for cavity dimensions shall agree within a 95/95 tolerance limit with the Reference dimensions, and deviations from the Reference dimensions shall be random. Additional replications of cavity measurements may be made providing values from each replication are used to compute average dimensions for comparison with Reference dimensions and to verify randomness of deviations.

17575

8011070338

C

To verify that individual measurements differing from the Reference dimensions are part of the inherent variability of the measuring system and do not represent localized dimensional changes in the cavity, a 'chi-square test' as described in the attached appendix shall be performed. This shall consist of comparing the frequency of indiviual changes in measured values in each of five axial segments of the cask with the frequency of individual changes in measured values observed between the sets of measurements used to establish the Reference dimensions of the cask. The probability quantity p resulting from the chi-square test shall lie between 0.1 and 0.9. Should the probability quantity p lie outside of this range, the cask shall be removed from service."

This requested change supersedes the change requested in our letter of September 12, 1980.

Should you have any questions or if further information is desired, please contact me.

Very truly yours,

NUCLEAR ASSURANCE CORPORATION

Charles R. Johnson
Vice President
Engineering & Transportation Services

CRJ:bam

Attachment

THE CHI-SQUARE TEST FOR DIMENSIONAL CHANGES IN CASK CAVITIES

In establishing Reference dimensions of the inner cavities of the NAC-1 casks, at least three (3) replications of measurements as documented in Appendix C to NAC's letter to NRC dated June 8, 1979 shall be made without intervening use of the cask. The purpose of the replications is twofold: first, to provide values from which average dimensions can be established and, second, to provide data from which the variance inherent in the measuring system can be determined. A normal distribution of differences between individual measurements at comparable locations should result if there is no change in the measuring system.

Differences in measured values from comparable locations after the cask has seen service will represent a change in the cavity dimensions unless they can be shown to be a part of the same population as that established by the replicated measurements used for the Reference dimensions. Local differences in cavity dimensions might still be masked by a general statistical comparison of measured values. For this reason, the chi-square test shall be performed over five axial segments of the cask.

The test consists of comparing the frequency of individual changes in measured values in a segment of the cask with the frequency of individual changes in measured values observed between the sets of measurements used to establish the Reference dimensions of the cask cavity. In equation form, the test is expressed as:

$$\chi^2 = \sum_{i=1}^{n} \frac{[f(x_i,\Delta x) - p(x_i,\Delta x)]^2}{p(x_i,\Delta x)}$$

where χ^2 is the chi-square value

$f(x_i,\Delta x)$ is the number of diametral differences in the range between x_i and $x_i + \Delta x$

$p(x_i,\Delta x)$ is the number of diametral differences in the range between x_i and $x_i + \Delta x$ predicted by the normal distribution representing the differences noted in establisning the Reference dimensions

n is the number of measurement locations

Acceptance of the results of the chi-square test is based upon the determination of a quanity p which is defined as "the probability that, on repeating the series of measurements, larger deviations from the expected values would be observed." Reference 1 also states that if p lies between 0.1 and 0.9, "the assumed distribution very probably corresponds to the observed one; while if p is less than 0.02 or greater than 0.98, the assumed distribution is extremely unlikely and is to be questioned seriously."

Figure 2.1 on page 776 of Reference 1 (attached) presents p as a function of χ^2 and F. F is the number of degrees of freedom, which in this case is two less than the number of different values of the diametral differences. Thus, the acceptable chi-square must result in a probability between 0.9 and 0.1 for the diametral differences to be considered as measurement error and not real dimensional changes. Satisfaction of this criteria provides confidence that there are no diametral changes which could reflect a change in the cavity configuration.

References

1. Evans, Robley D., The Atomic Nucleus, McGraw-Hill Book Company, Inc., 1955.

2. Parratt, Lyman G., Probability and Experimental Errors in Science, Dover Publications, Inc., 1961.

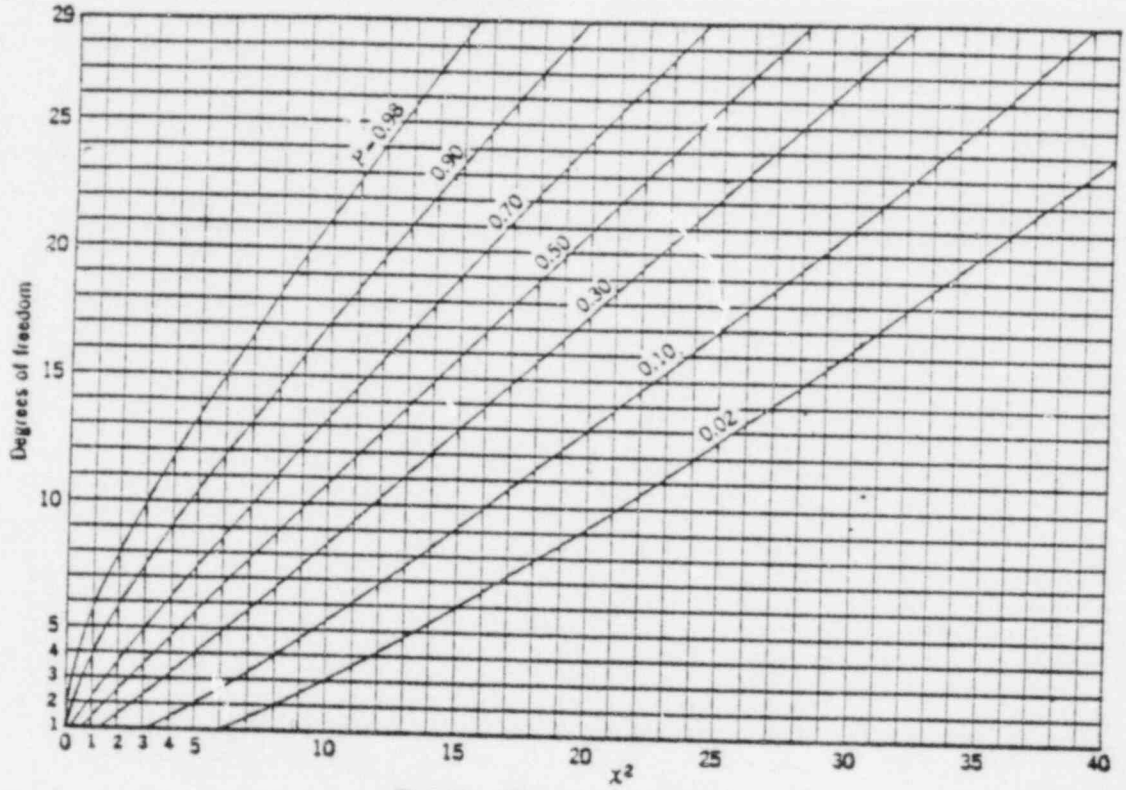

Fig. 2.1 The chi-square test.