ENTERGY

Entergy Operations, Inc.
P.O. Box 756
Port Gibson, MS 39150
Tel 601 437 2800

C. R. Hutchinson
Vice President
Operations
Grand Gulf Nuclear Station

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U.S. Nuclear Regulatory Commission
Mail Station P1-37
Washington, D.C. 20555

Attention: Document Control Desk

Subject: Grand Gulf Nuclear Station
Docket No. 50-416
License No. NPF-29
Partial Response to Containment Systems and Severe Accident Branch Request for Additional Information Concerning Request for Exemption from 10CFR Part 50, Appendix J

GNRO-94/ 00077

Gentlemen:

Additional information concerning our request for an exemption to the requirements of 10CFR50 Appendix J was requested by letter dated April 6, 1994. The information provided here is the final response to that request. A partial response was forwarded for your review by letter dated April 15, 1994.

We appreciate your efforts to review the submittal on a timely basis and will be glad to assist in that effort in any way possible. If you have any questions or require additional information, please contact this office.

Yours truly,

C. R. Hutchinson

CRH/WBB/amb
attachment: Final Response to Questions Regarding the GGNS Application for Exemption from 10CFR50, Appendix J
cc: (See Next Page)

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cc: Mr. R. H. Bernhard (w/a)
Mr. H. W. Keiser (w/a)
Mr. R. B. McGehee (w/a)
Mr. N. S. Reynolds (w/a)
Mr. H. L. Thomas (w/o)

Mr. Stewart D. Ebneter (w/a)
Regional Administrator
U.S. Nuclear Regulatory Commission
Region II
101 Marietta St., N.W., Suite 2900
Atlanta, Georgia 30323

Mr. P. W. O'Connor, Project Manager (w/2)
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Mail Stop 13H3
Washington, D.C. 20555

FINAL RESPONSE TO CONTAINMENT SYSTEMS AND SEVERE ACCIDENT BRANCH REQUEST FOR ADDITIONAL INFORMATION CONCERNING REQUEST FOR EXEMPTION FROM 10CFR PART 50, APPENDIX J GRAND GULF NUCLEAR STATION DOCKET NO. 50-416

1. **The application provides, in a number of areas of the document, justification that proposed methods for conducting Type B and C tests would meet performance goals based on IPE results and be safety neutral. The following are areas where this discussion is provided in the document:**

   - **Equation on p. 7 and following discussion, and Figures 2-1 and 2-2.**
   - **Page 25, Section on Internal Valve Leakage**
   - **Pages 30 and 31, Section on Containment Isolation**
   - **Pages 31 and 32, Section on Containment Bypass**

   These discussions are related; however, they appear in different parts of the document and the links between the discussions are not clear. A logical integrated discussion regarding the goals and assessment methods for the proposed Type B and C test scheme is necessary in order to assess its merit.

   The overall performance goal of the Appendix J testing program is to ensure that the reactor containment integrity is maintained with high reliability following accidents. Performance goals establish the bases for any performance-based testing program including the program proposed by GGNS. To achieve this goal containment leakage must be maintained at an acceptable level. Currently this level is specified in the GGNS Technical Specifications as 0.437 wt percentage of the containment air per day at a pressure of 11.5 psig. The overall performance goal is then used to determine performance criteria, that if met would provide reasonable assurance that the overall goal has been achieved. Component specific acceptance criteria are then established to demonstrate that acceptable performance has been achieved.

   The GGNS proposal attempts to do two things. First, an assessment of risk based on the IPE and shutdown PRA was done to support the conclusion that the impacts on risk of the proposed changes are small and "safety neutral." Second, a performance basis for containment leak rate testing was developed which provides reasonable assurance that the overall goal has been met.

RISK ASSESSMENT

The overall performance goal is based on an assessment of risk impact and is supported by the GGNS IPE as well as by the evaluations documented in Draft NUREG-1493. Draft NUREG-1493 assesses the dependence of reactor risks on containment leaktightness for several reactor/containment types. The study reviewed previous work on risk impacts of containment leak rate and updated the results based on more recent probabilistic risk results. The study went on to evaluate the risk impact of several alternatives to Appendix J requirements. The present study and the previous studies generally support the GGNS proposal as do the evaluations of the alternatives that are similar to the GGNS proposal.

NUREG/CR-4330 examined the risk impacts associated with increasing the allowable containment leakage using two different methods. The first method used existing PRAs to calculate the incremental risk due to increasing the allowable containment leakage rate. The study concluded that overall plant risk is not very sensitive to changes in containment leakage rate. The study further concluded that accident risk for BWRs is relatively insensitive to the containment leakage rate because the risk is dominated by accident sequences that result in failure or bypass of containment.

The second approach in NUREG/CR-4330 examined selected accident sequences and considered several additional measures, including individual radiation exposure and early health effects. This approach analyzed two specific BWR scenarios (and two PWR scenarios), as well as a hypothetical scenario related to the Three Mile Island (TMI) accident, to indicate the impacts of various assumed containment leakage rates for the selected accident scenarios. The conclusions show that the two BWR scenarios would not be risk significant even at an assumed 100 percent per day leak rate. The TMI scenario conclusion indicated that the risk impact of the assumed 1 or 10 percent per day leakage rates were not large and that no early fatalities would result from leakages of up to 100 percent per day. Even in the latter case, the risk of early injuries is small.

Draft NUREG-1493 updated the results of NUREG/CR-4330 based on NUREG-1150. Grand Gulf is included in both studies. An analysis of the dependence of reactor accident risks on containment leaktightness for each of the five reactor/containment types analyzed in NUREG-1150 was then presented as the results of the study. The results for Grand Gulf indicated that even if leakage is increased to 50 percent per day, the total population exposure is increased by only about 3 percent.

The comparison of the present work to those given in NUREG/CR-4330 noted several points related to risk for GGNS. The overall levels of risk for GGNS are lower than those calculated for previous studies. The present work shows less sensitivity of risk to containment leakage for GGNS. Uncertainties were also evaluated and it was determined that the uncertainties associated with containment leakage are insignificant when compared to other uncertainties in the quantification of accident risks.

The Draft NUREG then evaluated the risk associated with several alternatives to the requirements of Appendix J including alternatives similar to those proposed in our application. Although the evaluations of risk impacts for the alternatives were based on an analysis of Surry, it was recognized in the study that the contribution of leakage to reactor accident risk for Grand Gulf is enveloped by the Surry results. The evaluation of the alternative that is similar to the GGNS proposal indicated that the change in ILRT frequency coupled with the reduced LLRTs leads to an increase of only 0.2 to 4.7 percent in overall accident risk. It is important to note that the Draft NUREG did not consider the risk reduction achieved during shutdown conditions due to greater availability of systems such as RHR when employing the GGNS proposal. Crediting these and other risk reduction effects allowed us to conclude that the GGNS approach is essentially risk-neutral.

The Draft NUREG, in its appraisal of the GGNS proposal concluded that the proposed performance based approach to containment leak testing is projected to lead to considerable savings in resources with minimal impact on public risk. The Draft NUREG went on to say that a qualitative assessment of the GGNS proposal supports the general concept that containment leak testing frequency can be decreased with only minimal impact on public risk.

The Bayesian analysis discussed in the application supports the conclusions reached in the Draft NUREG. As the discussions in the application indicate, the GGNS IPE results demonstrate that the maximum probability for isolation failure is less than 1.0E-3. This is dominated by failure of containment isolation valves to close on demand. Although the probability for leakage may be increased by the proposal, several factors support the GGNS application and the Draft NUREG conclusions that leakage sequences have very little risk significance. For GGNS, as with all the BWRs included in the NRC study, scrubbing of the fission products in the suppression pool reduces risk for many leakage scenarios. The source term in leakage scenarios is further reduced by the restricted flow path through a leaking valve which results in higher decontamination factors. Because releases due to containment isolation failure are expected to be dominated by failure of valves to close on demand, the proposal is consistent with the conclusions of the GGNS IPE and with those of the Draft NUREG.

Containment bypass scenarios are similarly dominated by probabilities of failure to close on demand. In this case the changes in estimated bypass probability due to the proposed changes were estimated and compared to the probabilities assumed under the current test program in the IPE. These changes are documented in the application in Table 3-6. An increase in bypass failure probability from slightly less than 1E-3 to about 1.2E-2 was estimated as a result of the proposed changes. If the contribution from the MSIV leakage is negated (since these valves are expected to remain on a two year test frequency), the incremental increase in bypass failure probability is approximately 1.2E-4. Given the low frequency for containment challenges, the bypass sequences would still be below the screening criteria for the IPE.

The discussions in the text of the GGNS proposal are intended to support the concept of a variable test schedule based on past performance and that the variable test schedule will not have an adverse impact on overall plant safety. Again, as recognized in the Draft NUREG, the proposal does not explicitly consider component leak rates to project the expected containment performance. Rather, each component is assigned an allowable leak rate. This leak rate is assigned to each component to provide a conservative indication of the potential onset of valve degradation.

PERFORMANCE BASIS

The GGNS proposal uses the IPE results coupled with the Bayesian analysis to support the concept of a variable testing schedule based on performance histories for individual components. A general level of performance for containment isolation can then be set such that the conclusions of the IPE remain valid. This is consistent with the stated Regulatory/Safety objective of Draft NUREG-1493 which says that the "Risk impact, as measured by expected population exposure derived from probabilistic risk assessment, is the yardstick by which various alternatives are measured."

The GGNS proposal developed performance criteria to provide the quantitative basis for the proposed testing program. The performance criteria for the LLRT program at Grand Gulf included the establishment of acceptance criteria for the tests and the establishment of quantitative criteria for testing intervals. Demonstrating acceptable performance necessarily includes meeting the acceptance criteria for the test at the established test intervals.

The test intervals proposed by GGNS are based on demonstrated component performance. Qualitative performance factors were considered in the development of the performance criteria. These factors include the nominal pipe size of each component, past performance of the component, component design, component service, safety impact and alternative testing programs.

The acceptance criteria are conservatively established without taking credit for the effects of multiple penetration barriers. The Draft NUREG recognizes the conservatism of the GGNS methodology for establishing these acceptance criteria. First, the Draft NUREG recognizes that by using the owners allowable leakage for each component, each component "can be considered failed even though the overall containment leak rate is within acceptable limits." Additionally, the report states that "considering a penetration consisting of two valves in series, the GGNS method assumes that if both valves leak at a rate greater than their allowed leakage rate, containment leakage is greater than allowed. This is conservative as many such leaks are less than the allowable containment leakage rate."

The overall performance goal of the proposed testing program is to ensure that containment integrity is maintained with high reliability following an accident. The methods proposed by Grand Gulf to assess the performance of the containment do not include the use of Bayesian analysis. Rather, containment isolation valve leakage in comparison to component-specific acceptance criteria is relied upon to ensure that the overall performance goal is met. This in turn, will ensure that an adequate level of safety is preserved.

2. **The application proposes a containment system performance goal, based on the plant's IPE, for assessing the adequacy of the proposed Type B and C test scheme. However, a discussion of how this performance goal would be used to track the performance of the Type B and C tests at each outage is not provided. Does Grand Gulf intend to implement such a tracking system? If so, details of the performance monitoring need to be provided.**

   As discussed in the response to question 1 above, the application does not propose an alternative containment system performance goal based on the plant's IPE. Rather, the IPE is only used to support the proposed testing program by showing that the impacts of the proposed changes are small and "safety neutral". The proposed program (along with the current program) tracks the leak rate performance of individual valves. The proposed program will extend this by tracking the past performance of individual valves and using this past performance information to determine the valves' testing schedules. The program will also include an assessment step to determine whether, or not, an observed valve failure may be relevant to other similar valves which are not scheduled for testing.

3. **Baysian statistics are used to evaluate component reliability based on generic data and component performance history. Baysian analysis normally deals with both the means and standard deviations of the prior, conditional, and posterior distributions. The equation of page 6 is the basic form of Bayes equation. However, no information or supporting equations are provided to illustrate the actual use of the basic concept for this particular application. The handling of the standard deviation is not described. Provide the missing information.**

   The Bayesian analysis described in Section 2.4 is intended to support the concept of a variable testing schedule based on past performance. The analysis assumes a log normal distribution for the prior distribution with the median failure rate and error factor derived from the generic data cited in the IPE.

$$P_{prior}(\lambda) = \frac{1}{\lambda\sigma\sqrt{2\pi}} \exp\left[-(\ln(\lambda) - \mu)^2 / (2\sigma^2)\right]$$

The error factor reported in the IPE is assumed to represent the ratio of the 95th percentile to the median value.

$$Error\ Factor = \frac{\lambda_{95\%}}{\lambda_{med}} = \frac{\exp(\mu + 1.645\sigma)}{\exp(\mu)}$$

where μ is the logarithm of the median failure rate.

The mean value of the prior distribution is reported in the IPE. The relationship between the mean and the median failure rates is

$$\text{Mean Failure Rate} = \exp(\mu + \frac{\sigma^2}{2})$$

The mean failure rates are taken from the GGNS IPE. The error factors are taken from the NREP database for motor-operated valves and check valves. There is no AOV leakage rate given in the NREP database, so the error factor was assumed to be the same as for MOVs. The values for the parameters σ and μ are derived from the above equations. The following table presents the results.

Prior Distribution Parameters

Valve Type	Mean Failure Rate (hr-1)	Error Factor	μ	Median Failure Rate (hr-1)	σ
Check Valve	5.0E-07	100	-18.43	9.95E-09	2.799
Air-Operated Valve	1.00E-06	100	-17.73	1.99E-08	2.799
Motor-Operated Valve	1.00E-07	100	-20.04	1.99E-09	2.799

The results shown in Figure 2-1 of the application are for a hypothetical component put into service at time zero that experiences no failures in time. The probability of no failures up to time t given a failure rate λ is given by the following.

$$P'(0|\lambda) = \exp(-\lambda t)$$

The posterior distribution function from the Bayesian analysis is therefore calculated as:

$$P(\lambda|0) = P_{prior}(\lambda)P'(0|\lambda)$$

$$P(\lambda|0) = \frac{\exp(-\lambda t)}{\sigma\lambda\sqrt{2\pi}} \exp[-(\ln(\lambda) - \mu)^2 / (2\sigma^2)]$$

The posterior is further multiplied by a normalization constant, such that the integral from zero to infinity is unity.

The mean value of the posterior distribution is calculated as:

$$\bar{\lambda} = \int_0^\infty \lambda P \cdot (\lambda) d\lambda$$

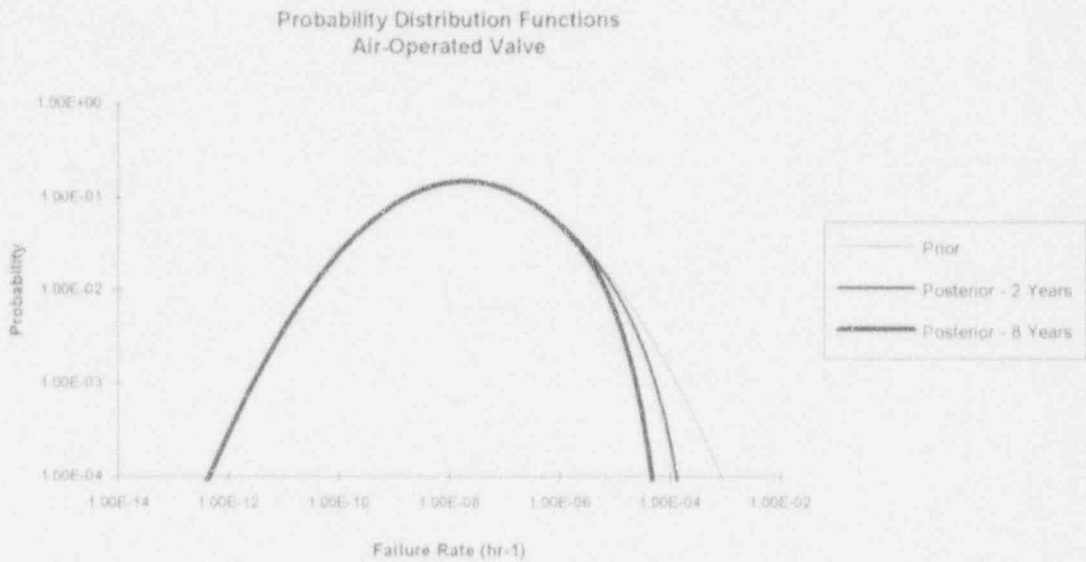
The above integration is performed numerically with the failure rate axis divided into 1000 discrete intervals.

The probability for penetration leakage is based on two like components in a single penetration (a typical arrangement). The Bayesian analysis therefore assumes zero failures for two like components over time t (i.e., zero failures in 2t component-years). The leakage probability is calculated using the square of the mean failure rate, i.e.

$$P_{leakage} = \frac{(\bar{\lambda} t)^2}{4}$$

This effectively assumes no correlation between the two posterior distributions. If a strong correlation exists, the resulting mean failure probabilities would be somewhat lower than reported.

Figure 2-1 of the application shows only the calculated mean values of the failure rates as functions of time. The following figure shows the prior and posterior distributions after 2 years and after 8 years for one valve type. The qualitative result is that the mean value decreases with time and that the spread in the distribution becomes narrower. The low failure rate end of the distribution is essentially unchanged. The high end of the distribution becomes cut off as time increases. This has the effect of pushing the mean to lower values. Since the principal use of the Bayesian analysis is to support the concept of a variable testing schedule based on component performance, the spreads in the prior and posterior distributions were not included in the application.



4. In generating Figure 2-1, Isolation Valve Failure Rate Estimates, generic component failure rates are again used. The decreasing component failure rate over time is based on no observed failures of the component over time. The calculation ignores any component failures which may have occurred prior to the time "0". It appears that once a component undergoes maintenance, it is assumed to be "as good as new". The reliability of a component would be expected to be both a function of the nature of the component as well as its environment. The environmental aspect as measured by the component performance history does not appear to be considered. If a specific component fails frequently, a higher rather than a decreasing failure rate for the particular component is expected. This should be reflected in the Baysian analysis.

The curves shown in Figure 2-1 are indeed for hypothetical components put into service at time zero that experience no subsequent failures with time. The figures are not intended to encompass every case. They do not include every valve combination, nor do they include combinations of valves which may have experienced failures at some point during their service life.

A Bayesian analysis of valves which experience failures (either due to environmental effects or due to other causes) would potentially result in higher calculated failure rates. Entergy does not propose to establish testing schedules based on Bayesian analysis of individual valves or penetrations, however. The proposed testing program incorporates a more straightforward algorithm to determine the testing schedule. The program will identify potential poor performers and retain them on the current two-year testing schedule.

Again, the intention of the Bayesian analysis is only to illustrate that the concept of a variable testing schedule is consistent with demonstrated past good performance.

5. **The application for exemption from the existing requirements focuses largely on the Baysian analysis, but the description of this analysis is poor, and its application inconsistent. Results which should fall out of the Baysian analysis, such as the need to maintain the current testing intervals for components with historically high failure rates, are handled as "special cases". Given this, it is not clear that the Baysian analysis really adds much to the proposal. Assuming that component failure rates are not increasing with time, extending the test interval for all components from 2 to 10 years increases the probability of containment leakage by at most a factor of 5. This should correspond to an approximate factor of 5 increase in the incremental risk due to containment leakage, assuming no bias toward very large leakages. The purpose of the Baysian analysis and its relationship to other justifications presented in the application should be clarified.**

   The application for exemption should not focus on the Bayesian analysis, since the intent of this analysis is to support the concept of a variable testing schedule. In fact the subsequent demonstration that the proposed changes are "safety neutral" does not take into account any decrease in failure rates due to past good performance. The focus of the application should be on:

   - the overall safety impact is small and neutral;
   - the overall cost savings are substantial;
   - the reduction in worker doses is significant.

   With regard to the containment leakage probability, the potential impact of extending the testing interval for all components from 2 to 10 years is a factor of 25 (not 5), if the failures are modeled as independent failures (see discussion for comment #6).

   Components with historically high failure rates are not "special cases", but will naturally remain under the current testing requirements if poor performance persists. Consistently poor performance is not, and will not, be tolerated, however. Entergy has programs in place to address and correct equipment performance problems. These programs should identify the root causes for poor performance and corrective actions should be implemented. Only after such corrective actions are shown to be effective (by continued good performance) will the component's testing schedule be extended.

6. **The equation for the probability of penetration leakage (p. 7) assumes independent failures of the components in the penetration. For the low failure rates considered, common mode failures of the components in a penetration would likely dominate the independent failure probability. While common mode failures are ignored in the analysis, they are apparently addressed in the proposal by basing the test schedule for all components in a penetration on the performance of**

the worst component. A discussion of common mode failures should be included in the application.

The equation on p. 7, as well as the analysis in Section 3.5 does not include a contribution due to common mode failures. This is due to the following:

- The analysis uses the GGNS IPE as a basis, wherever possible. Common mode valve leakage failures were not included in the IPE. Inclusion of the failures here would therefore introduce an inconsistency with the baseline analysis which we are comparing. Since we are primarily interested in relative impacts (vs. absolute results) consistency was deemed more important.

- The analysis of common mode failure rates is very difficult and not well established. The common mode failure presumes that the two (or more) failures occur at the same time, or within a fairly narrow window in time. Potential common mode failure mechanisms for leakage (e.g., harsh environment) do not necessarily cause the leakage to occur in two components within a fairly narrow time window. These are generally treated by assigning higher failure rates to such components on an individual basis. A major industry study of common mode failures (EPRI NP-3967/NUREG/CR-4780) considers valve leakage for MOVs, but does not identify any events considered to be applicable to parameters modeling. Other published PRAs also have not included this failure mode (e.g., NUREG-1150).

- Inclusion of a common mode failure element would potentially reduce the relative impact of the proposed changes. With independent failures, the penetration failure probability increases as the testing interval squared. If this is dominated by a common mode failure mechanism, the increase is linear with the testing interval.

9. **§3.2, p 11.(a). A stronger link between the Maintenance Program and isolation valve performance would be helpful. For example, would changes in the Maintenance Program change isolation valve failure rates and thus the database upon which the exemption rests? If so, how would such changes be monitored and evaluated? (b) If a valve has had a good leak rate performance, does Entergy plan to reduce preventive maintenance on that valve? If preventive maintenance is reduced, what assurance is there that the valves' good performance will continue?**

Changes to a containment component through design modifications or a change to maintenance practices could have an effect on the performance of the component. All modifications to containment components are reviewed by the department responsible for implementation of the Appendix J program. Preventative maintenance of a component is controlled through repetitive tasks. The process that controls these tasks will be modified to require the approval of any task addition or change to a containment component by the department responsible for the Appendix J program.

These reviews allow the engineer to become part of the process in which changes to a containment component would take place. The engineer would review the changes and evaluate how the change would affect performance of the component. If the change has the potential of affecting performance, the components test interval would be adjusted.

17. **Does Entergy currently conduct a full battery of Type B and C tests prior to initiating a Type A test at Grand Gulf? Does Entergy propose to do so if its exemption request is granted?**

    Entergy currently conducts a full battery of Type B and C tests prior to initiating a Type A test a Grand Gulf. With the exemption, Grand Gulf would utilize the leakage information obtained from the last Type B & C test performed and would not perform a full battery of Type B and C test prior to initiating a Type A test.

18. **In the proposed Type B and C testing program it is stated (p. 12), "All components located in a penetration of a failed component will be evaluated for placement in the same interval as the failed component." What will be the basis for making such a determination? Should all components in a penetration of a failed component be automatically placed in the same interval as the failed component?**

    All components in a penetration of a component that fails a LLRT will be evaluated for placement in the same interval as the failed component. The components in the penetration would not however automatically be placed in the same interval as the failed component. Rather, the determination of the interval would be based on the results of the evaluation. The evaluation will consider the amount of leakage from the failed component, the failure mechanism, any generic implications, the possibility for a repeat failure, component application, the performance history and the amount of radiation and cost that would be expended to test the other components in the penetration.

    Not all components in a penetration of a failed component will be considered relevant in the evaluation. Several penetrations have multiple inboard and outboard components. The only components considered relevant would be the opposite boundary valves. For example, if the penetration consisted of three outboard valves and two inboard valves and one of the outboard valves failed, the two inboard valves would be evaluated.

21. **The IPE assessment of containment failure to isolate is based on "random independent failures of two valves" (p. 31). An earlier question noted that neglect of common cause failures is nonconservative. A more fundamental problem is the implication that the probabilities of containment isolation failure and excessive leakage are the same; they are not. Failure to isolate would typically require the failure of two valves within a penetration to close; such an occurrence should have**

a low probability. Excessive leakage, on the other hand, can take place even if the valves close but fail to seal tightly. The latter could be a relatively frequent occurrence, as evidenced by the leak rate test experience discussed in draft NUREG-1493.

Justify the use of a criterion in terms of failure to isolate to judge acceptable performance in terms of leakage.

As discussed previously, common cause failures of valves due to leakage is not included in the present assessment due to two reasons:

a. It was not included in the IPE submittal. Since this assessment uses the IPE as a baseline, this assessment was performed in a manner consistent with the IPE. We are interested in relative changes.

b. It is not clear that valve leakage is amenable to traditional common cause modeling and there is little data to support this modeling.

With regard to the "fundamental problem" referred to, the assessment of "isolation failure" includes two failure modes (if applicable) - valve fails to close on demand and valve leaks after closing. Isolation failure for an individual valve is defined to occur if either of these failure modes occurs. Indeed, the leakage portion can dominate. Figures 3-1 and 3-2 illustrate how both failure modes are handled for two specific penetrations.

22. **It is the staff's understanding that Grand Gulf performed a Type A test late in 1993. Are the results of this test together with the associated Type B and C tests available? If so, provide the results (reference to previously docketed materials is acceptable). If not, provide a short summary. If the Type A test failed, discuss the reasons for the failure and the impact this may have on the basis for Entergy's exemption request (in other words, would not failure of two out of the three periodic Type A tests performed in the plant's lifetime suggest that reduced test frequency is not justified?).**

The results of the Type A test performed in November of 1993 were reported by letter dated April 28, 1993. The report found the leakage rates to be acceptable and concluded that the ILRT had demonstrated that the containment had maintained acceptable leaktight integrity at the end of the operating cycle. The test results have no effect on the requested exemption.

25. **The basic premise behind the exemption request is that testing frequency should be based on the performance of the component, rather than being set at an "arbitrary" fixed frequency by a regulation. If good performance justifies reduced frequency, then conversely poor performance calls for increased**

frequency, logically. However, the proposed program has no provision for increasing frequency beyond the regulation's once-in-two-years for Type B and C testing. The proposal is that components that have passed one test, or failed one test, will be tested once in two years. Should not a component that has failed two consecutive tests be tested more often, say, once a year, and a component that failed three times be tested even more often, say, twice a year? An earlier answer to this question (given at a meeting), that Appendix J says once in two years is good enough so that will be the maximum frequency, is not acceptable to the staff. If frequency is to be "cut loose" from the Appendix J number, then it should move in either direction, based on performance. Provide justification for the assumption, implied by the requested exemption, that performance-based frequency is good, but only in the decreasing direction (compared to Appendix J's required frequency).

We agree that in some cases increased testing frequencies may be appropriate. We do not think however, that an automatic increase in testing frequencies is justifiable or necessary. Current Appendix J leak rate testing frequencies are based for the most part on refueling outage cycles. Type B testing frequencies (air lock testing for example) may have more restrictive intervals. The minimum frequencies proposed by GGNS are consistent with current practice. This is due to several reasons including the following:

- Current testing frequencies have already been determined to be safe enough and therefore should provide a reasonable minimum. It should be remembered that for local leak rate testing, it is the aggregate of the leakages of each component that provides the overall protection sought by Appendix J. This implies that currently the worst performers are being tested on an adequate frequency, but good performers are being tested at a frequency determined by the poor performers. The vast majority of leaks (on the order of 97%) that exceed the allowable leak rate are detected by type C testing. The GGNS proposal recognizes the dependency of valve failure probabilities on previous failure history. The minimum frequencies are set accordingly.

- The operability of any component that suffers repetitive failures will be considered for the full operating cycle. If the operability of any component is considered to be at risk during the cycle, a shorter testing interval would be necessary. This shorter interval would be based on the qualitative performance factors specified in the application.

- Corrective action in accordance with ASME section XI rules will be taken for any component that fails an LLRT. This would include a repair, replacement or an evaluation. Any corrective action that is considered an interim fix would be evaluated to ensure that it will last until a permanent fix can be completed or at least until the next opportunity for testing.

- Usage of the owners allowable leakage rate for each component adds conservatism in that each component can be considered failed even though the overall containment leak rate is within acceptable limits.

- Other programs (i.e., the Maintenance Rule and the Maintenance Monitoring Program) will monitor the effectiveness of any corrective action and will evaluate repetitive failures.

26. **Explain the choices of 5 and 10 years for intervals for Type B and C components that pass 2 and 3 consecutive tests, rather than something shorter (for example, 2 refuelings and 3 refuelings). Ten years is a large increase in interval, five- or six-fold (for 18-month fuel cycle). The staff has never more than doubled the interval, even on a one-time basis, and permanent exemptions have not increased interval beyond 30 months.**

The 5 and 10 year intervals were chosen by GGNS based on the past testing history of the components and the risk assessment outlined in the application. The review of the history indicated that establishment of 5 and 10 year frequencies can be achieved on many of the components without experiencing a failure of the owners allowable leakage rate and on most of the components without experiencing catastrophic failure. Even in cases where a component had failed, the overall leak rate for the containment has generally remained within acceptable limits. This is because components in a penetration are normally redundant. The 5 and 10 year intervals were evaluated for risk impact and it was concluded that the risk impacts resulting from the proposed changes are small and well within the uncertainty bands of the present risk analyses.

Even though past testing history supports testing on 5 and 10 year intervals strictly based on performance, the GGNS submittal has gone a step further to evaluate the potential of failure. The program requires the responsible engineer to evaluate any passed test to determine if the leakage was high, erratic or indicative of a degrading trend. The engineer will then consider the appropriateness of the interval based on the evaluation. In addition, with the experience gained through past years of testing, it becomes more obvious which components will have a high risk of failure. The GGNS proposal has placed those components on a fixed 2 year interval.

Other conservative items are built into the program to ensure leak tightness which are outlined on page 12 of the submittal:

- All components in a penetration of a failed component will be evaluated for placement in the same interval as the failed component.

- Review of industry operating experience to identify generic problems associated with containment components.

- Review each failure to determine if the failure was generic or isolated.

- A portion of the components on 5 & 10 year frequencies will be tested every outage to monitor the effectiveness of the program and to identify any common mode failures.

The 5 and 10 year intervals are justified based on the implementation of the program outlined in the submittal, the risk assessment based on GGNS PRA data and GGNS testing history. The intervals are also supported by Draft NUREG -1493. Reducing the intervals to every 2nd or 3rd outage would be unnecessarily restrictive and would not take full advantage of a performance based/risk based approach to containment testing.

27. **The practice at Grand Gulf, as the staff understands it, is to not require as-found Type B and C testing except during outages when Type A tests are conducted. However, only as-found data are valid as indicators of component performance. How much of the Grand Gulf data, used in the analyses supporting the exemption request, are not as-found data, and what effect does this have on the validity of the analyses?**

GGNS only requires as-found testing during outages when a Type A test is performed. This does not mean that most components are not as found tested. During the past outage only 12% of the valves tested in the LLRT test program were scheduled for maintenance which means 88% of the components were as-found tested. The 12% figure is unusually high and was due for the most part to MOV testing done in response to GL 89-10.

Realistically the type of maintenance activities generally performed, packing replacement and MOV testing (usually requires reduction of torque switch settings which would increase leakage), would not destroy conditions that generally cause failures associated with seat leakage. The type of maintenance that would destroy as-found conditions for seat leakage generally involves complete disassembly of the valve. Based on the previous outage, very few valves are scheduled for complete disassembly. However, with the proposed program, valves would be as-found tested prior to any maintenance or modification activity that could affect the valve's leaktightness.

28. **The submitted analyses seem to be tied to class 9 accidents rather than design basis accidents, and yet Appendix J addresses and accounts for only design basis accidents. Explain the appropriateness of the analyses in light of this observation.**

The GGNS IPE submittal was used as a basis for estimating the risk impact of the proposed modifications. This provides a well-documented baseline against which positive and negative impacts of the proposed changes can be evaluated. The IPE, however, only assesses releases from accident sequences which ultimately result in core damage. Design basis events which do not result in core damage are not evaluated.

The justification for this is that most of the risk results from core damage events. The frequency of a design basis LOCA is relatively low. Coupled with an estimated low conditional probability of containment failure, the frequency of accidents resulting in significant releases from a design basis LOCA is fairly small. To illustrate the order of magnitude of such events, consider the following:

frequency of large LOCA	~10^{-4}/year
containment failure probability (leakage --- estimate)	~10^{-2} to 10^{-3}
large LOCA with release	~10^{-6} to 10^{-7}/year

The frequency of core damage events resulting in releases from containment is greater than the above estimate for a design basis LOCA. Also, the source term for the design basis LOCA will be much smaller than for the core damage event. Therefore, it is concluded that the IPE has captured the most significant potential accidents resulting in release of radionuclides from containment. Using the IPE as a basis for estimating the risk impact of the proposed changes is therefore appropriate.

While the IPE does not address containment isolation failure for design basis accidents not resulting in core damage, the qualitative effects of the proposed changes, discussed in section 3.5.3.2 item 4, apply. That is:

- The proposed changes would not affect the fail-to-close-on-demand portion of the isolation failure probability.
- The proposed changes would increase the leakage-after-closure portion of the isolation failure probability.
- Flow through leaking valves will be restricted, relative to fully open leakage paths, and will therefore have higher decontamination factors and result in a lower source term.

29. It has been suggested that RCM/PRA methods (reliability-centered maintenance/ probabilistic risk assessment) would provide a better analysis of Type B and C component performance and test frequency than the Baysian analysis used in the submittal, and would account for aging and cycling of components. Provide an assessment of this seemingly superior method and compare it to the Baysian method.

The proposed testing frequency is not being determined by Bayesian analysis. The purpose of the Bayesian analysis is only to support the *concept* of performance-based testing, as applied to the Appendix J testing program. The actual proposed testing frequency is based upon an empirical assessment of past failure patterns.

RCM is a tool for developing a comprehensive maintenance program or optimizing an existing maintenance program. The goal of the RCM process is to improve or maintain a high level of system reliability. This is accomplished by analyzing a system to determine the components that are critical to its function. PRA data can be used to aid in the component criticality determination. After a component is determined to be critical, testing and maintenance tasks are recommended to predict, prevent, mitigate the effects of, or detect component failures. These recommendations are made to optimize the use of predictive maintenance testing and preventive maintenance resources. By focusing maintenance on failures that can cause loss of function, catastrophic failures are prevented and corrective maintenance is reduced. As a result of optimization of predictive and preventive maintenance and reductions in corrective maintenance, system reliability is increased. The RCM process may use component failure probability data to help establish component failure criticality or to establish performance frequencies for recommended tasks. However, the data used in the RCM process is collected from other sources and is not generated by the RCM process.

The program proposed by GGNS uses essentially the same criteria that RCM methodologies would use to determine testing frequencies. Risk considerations as well as sound engineering judgment are used in both cases to establish the optimal frequency to perform a task (in this case testing frequency). Given that each of the isolation valves would probably be identified as critical (to perform the containment function) using RCM methods, the analysis done would be very similar to the analysis described in the proposal. In either case relevant reference data such as industry operating experience, maintenance histories, design limitations, NPRDS data, etc., would be considered. Therefore, there is no advantage to using RCM/PRA methods over the proposed methods.

31. **Discuss the effects of aging on possible valve leakage mechanisms and explain, in terms of these effects, why it is acceptable to not leak test a valve for up to 10 years. Also, in terms of Type B testing, it has been said that ANO, Trojan, and possibly Davis-Besse are having (or have had) electrical penetration leakage problems; ANO reportedly had 16 fail at once. Heretofore, the conventional wisdom has been that electrical penetrations never leak significantly. Similarly, piping penetration expansion bellows in some older plants have recently exhibited Type B testing problems and excessive leak rates (see NRC Information Notice 92-20), whereas before they were also thought to be stable, leaktight boundaries. How will the proposed program detect or prevent these kinds of problems, which seem to be related to aging or wear?**

Valve leakage mechanisms that are affected by age related problems are generally associated with parts that will deteriorate through time such as resilient seats and valve packing.

Valves with resilient seats could deteriorate through time which could lead to failures that range from minute leakage through the seat to a complete rupture that could cause the seat to leak excessively. The containment isolation valves at GGNS with resilient seats are the containment Purge Valves and the Feedwater Check Valves. The containment purge valves are tested every 92 days per GGNS Technical Specification 4.6.1.9.2 and are not presently in the performance based program. The Feedwater check valve seats have a limited life time and are currently replaced every outage and are assigned a 2 year fixed frequency. Type B components with resilient seals with limited lifetimes are in the repeti ive task program for replacement. The intervals for testing these components would be controlled by the performance of the component or the life time of the seal, which ever is less.

Valve packing could deteriorate through time and cause containment leakage if the packing was within the containment boundary. This deterioration would be driven by many factors such as valve usage, component application/usage factor, system function and operating medium. These conditions are required to evaluated by the engineer prior to assignment of the testing interval per Section 3.2 of exemption. Packing is evaluated and replaced on a periodic basis to maintain the valve leak tightness and performance. Valve packing leakage is continuously monitored through operations walk downs, monitoring of drywell and steam tunnel temperatures and leakage, the ASME Section XI Pressure Test Program and NUREG 0737 Leakage Reduction Program. Packing failures characteristically start with a small leak that can increase over time. This monitoring is generally during system operation when the systems are at a much higher pressure than those specified for containment testing and would identify deterioration of valve packing without performing a LLRT. In addition, very few LLRT failures at GGNS were caused by packing leakage.

Other possible age related problems such as faulty actuators, corrosion, leaking gaskets, etc., associated with valve leakage mechanisms are monitored by testing a portion of the valves on 5 & 10 year intervals each outage, the MOV GL 89-10 Program, ASME Section XI Pump & Valve Program, INPO's SOER 86-03 Check Valve Program, System Surveillances, Preventative Maintenance Program, ASME Section XI Pressure Testing Program, NUREG 0737 Leakage Reduction Program, and by the Maintenance Rule as outlined in Section 3.3 and 3.4 of the exemption.

The 16 electrical penetration failures reported by ANO would have been identified by the program requirements established in the GGNS application. The GGNS application requires a portion of the components that are on 5 and 10 year intervals to be tested each outage to assist in identifying common mode failures. This staggered testing will help ensure that problems associated with components of similar design, age or usage are identified. Failure of a component would prompt a review of generic implications. If the GGNS program was in place at ANO, a portion of the electrical penetrations would have been tested which would have identified a failure. The failure would have prompted a review of generic implications resulting in a high probability of finding all 16 failures. In addition, the maintenance rule program, maintenance monitoring programs along with the EQ program ensure aging problems are being monitored.

Age related problems would be effectively monitored and identified with the testing requirements and engineering evaluations for interval assignments required by the application. This coupled with GGNS testing and preventive maintenance programs should effectively monitor aging problems and allow the test frequencies to be extended for up to 10 years without performing a LLRT.

32. Name the manufacturer of Grand Gulf's electrical penetration assemblies. The staff believes that certain CONAX electrical penetrations have a failure mechanism (a plug that could be missing) that would not be picked up by Type B testing.

The manufacturer of Grand Gulf's electrical penetration assemblies is Westinghouse. A review of the appropriate Westinghouse drawing did not indicate any plugs that could be missing nor did the drawing indicate any failure mechanism that would not be picked up by a Type B test. Therefore, the concerns with the CONAX electrical penetrations do not appear to be applicable to GGNS.

33. If the requested exemption is granted, how will ASME Section XI inservice (IST) leak rate testing requirements be satisfied? They currently require tests at no more than 2 year intervals. Will Grand Gulf need relief from Section XI?

GGNS currently has a generic relief request applicable to containment isolation valves. The relief request specifies that leak testing of containment isolation valves be performed in accordance with GGNS Technical Specifications. The relief request also requires that individual valve leakage shall be analyzed and corrective action taken in accordance with paragraphs IWV-3426 and IWV-3427(a) in addition to the requirements of GGNS Technical Specifications. We do not plan to revise the alternative testing requirement as it is currently written in the relief request. We do plan on revising part 1) of the basis for relief based on NRC approval of this exemption request. Part 1) will be revised to read:

1) In accordance with GGNS Technical Specifications 4.6.1.2 (d), (g), (h), (i), and (j) and 4.6.1.9.2, containment isolation valves are required to be leak rate tested in accordance with 10 CFR 50, Appendix J, using the methods and provisions of ANSI N45.4-1972. The test intervals specified in the Technical Specifications are based on NRC staff review and approval of the Application for Exemption from 10 CFR 50 Appendix J and the associated Proposed Amendment to the Operating License. The requirements and methods contained in Appendix J and ANSI N45.4 meet the intent

of Section XI although the frequencies, requirements, and test methods are somewhat different. In addition Appendix J specifies the test medium for each valve.

A copy of the generic relief request as currently written is included to assist you in your review.

35. Do generic MOV failure rates apply to Grand Gulf? To be applicable, would a good MOV maintenance program be required? Substantiate the efficacy of the Grand Gulf program.

Overall, the performance of containment isolation valves at GGNS is generally consistent with generic data for valve leakage, given the relatively large error factors in the generic data. Plant specific maintenance programs and practices are one factor influencing valve performance. The GGNS MOV program has been demonstrated to be effective in meeting the objectives of Generic Letter 89-10. We believe that significant problems associated with MOVs were detected and corrected as a result of the effort. The application does in fact rely on the MOV testing program, as well as other practices and programs, to ensure adequate containment performance. The MOV program is relied on to assist in predicting potential failures that could contribute to valve leakage. A good MOV testing program is obviously beneficial in the overall effort to ensure containment performance.

GGNS conducted a sensitivity study utilizing the GGNS IPE to demonstrate the effectiveness of the GGNS MOV program. The results of this effort indicated that little increase in core damage frequency or dose consequences can be obtained by reducing MOV failure rates much below 7/1000. For GGNS, CDF improvements for failure rates below 7/1000 are on the order of 2 E-06. As the implementation of the GGNS MOV program is expected to result in failure rates from 3-7 per 1000 demands, it is reasonable to conclude that the GGNS program is effective. MOV failure rates at GGNS, as evidenced by a recent review of NPRDS failures of safety related MOVs at GGNS, have shown improvement since 1985 which we believe further demonstrates the positive impact the MOV program has had on valve reliability. A more complete discussion of the effectiveness of the GGNS program in meeting the objectives of Generic Letter 89-10 as well as a discussion of MOV failure trends has previously been shared with the NRC in a meeting on April 20, 1993, and transmitted to the NRC by letter dated July 23, 1993.

36. In Section 3.3 of the submittal, the causes of failure are not addressed, nor is the definition of failure nor the physical problems that caused the failures. Provide this information.

Section 3.3 of the exemption list the total number of Type B & C test failures at GGNS from RFO1 to RFO5. As stated in Section 3.3 sentence 2, a Type B & C test is considered a failure once the owners allowable leakage rate is exceeded. The following provides a list of the failed components referred to in Section 3.3 along with the physical problem that caused the failure.

TYPE B TEST
RFO1

Component	Cause of failure
E12D003C	O Rings
B21N420A	Loose Bolts
B21N420B	Loose Bolts
B21N420C	Loose Bolts
B21N420D	Loose Bolts
B21N421A	Loose Bolts
B21N421B	Loose Bolts
B21N421C	Loose Bolts
N21N421D	Loose Bolts
B21N422A	Loose Bolts
B21N422B	Loose Bolts
B21N423A	Loose Bolts
B21N423B	Loose Bolts
E51N411	Loose Bolts
E51N412	Loose Bolts
B21N426	Loose Bolts
B21N427	Loose Bolts

TYPE B TEST
RFO3

Component	Cause of failure
E12D003C	O Rings
E51N411	Loose Bolts

TYPE B TEST
RFO4

Component	Cause of failure
B21N422A	Loose Bolts and Bad Gasket
E51N411	Loose Bolts and Bad Gaskets
E51N412	Loose Bolts and Bad Gaskets
B21N426	Loose Bolts and Bad Gaskets
B21N427	Loose Bolts and Bad Gasket

TYPE C TEST
RFO1

Component	Cause of failure
B21F010B	Deterioration of resilient seat
B21F028D	Eroded seating surface

B21F065A	Erosion of valve seating surface
B33F126	Erosion of valve seating surface
C11F122	Erosion of valve seating surface and scoring on stem
E22F005	Erosion of valve seating surface
G36F101	Erosion of valve seating surface
P42F035	Erosion of valve seating surface
P45F067	Stroke length
P52F105	Misadjusted valve-stem-to actuator coupling
E12F064C	Torque switch setting
P72F165	Erosion and pitting of valve seating surface

TYPE C TEST
RFO2

Component	Cause of failure
B21F022A	Air actuator piston seals worn
B21F022C	Eroded seating surfaces on valve and pilot and Air actuator piston seals worn
E12F023	Packing binding
E21F006	Valve is binding
E51F072	Packing leak
G41F040	Eroded valve/disk seating surface
G36F101	Erosion of valve seating surface
P53F002	Erosion of valve seating surface

TYPE C TEST
RFO3

Component	Cause of failure
B21F010A	Resilient seal deteriorated
B21F010B	Resilient seal deteriorated
B21F022A	Valve was not fast stroked closed
B21F022B	Valve was not fast stroked closed
B21F022C	Valve was not fast stroked closed
B21F022D	Valve was not fast stroked closed
B21F032A	Resilient seal deteriorated
B21F032B	Resilient seal deteriorated
E12F041C	Valve stuck partially open
P11F004	Valve seat dirty
E22F014	Valve seat erosion
P53F001	Valve seat erosion
P53F002	Valve seat erosion
B21F067A	Steam erosion of disk and seat
B21F067B	Steam erosion of disk and seat
B21F067C	Steam erosion of disk and seat

TYPE C TEST
RFO4

Component	Cause of failure
B21F022C	Valve was not fast stroked closed
B21F022D	Valve was not fast stroked closed
E12F041C	Valve disk sticking open
E22F004	Valve would not close properly
G33F001	Valve packing
P60F010	Valve packing
B21F067A	Steam erosion of disk and seat
B21F067B	Steam erosion of disk and seat
B21F067C	Steam erosion of disk and seat

TYPE C TEST
RFO5

Component	Cause of failure
B21F028D	Dirty seat and poppet
G36F101	Disc erosion
M23Y001CKV	Dirt on valve seat
P52F105	Valve seat wear
P53F006	Valve seat wear
P60F010	Packing leak

37. **In Section 4.5, the first bullet states that "other testing programs will effectively detect containment leakage." This is vague; describe the other testing programs.**

The Type B and C program, the air lock testing program, the Technical Specification leakage reduction program and ASME Section XI pressure testing program are other testing programs that will effectively detect containment leakage. The Type B and C testing program will detect individual containment penetration leakage (i.e., valve seat leakage and electrical penetration leakage). The majority of Type A failures are through Type B and C penetrations and are detectable by type B and C testing.

Each valve that is Type C tested is pressure tested and inspected for leakage in accordance with ASME Code Section XI, Paragraph IWA-5211. Class 1 components are pressure tested every refueling outage per Table IWB-2500 and Class 2 components are pressure tested per Table IWC-2500 every 40 months. These inspections detect any external leakage from components, such as through-wall pressure boundary leaks, leaks from mechanical joints including bonnet to body leaks, and packing leaks. External leakage could be an indicator of containment isolation component leakage.

Each valve that is Type C tested and is in a system that could contain highly radioactive fluid during an accident is also included in the Leakage Reduction Program, which is required by NUREG 0737. This program requires a walkdown to identify leakage at least once a refueling cycle with the respective system in operation or otherwise pressurized. These walkdowns detect any external leakage from components, such as through-wall pressure boundary leaks and leaks from mechanical joints, including bonnet to body leaks and packing leaks.

Accessible containment isolation valves that are not capable of being closed by operable automatic containment isolation valves and are required to be closed during accident conditions are verified to be secured in the closed position monthly during power operation. The verification also includes accessible blind flanges in the containment isolation boundary. Manual containment isolation valves and other containment isolation barriers which are not accessible during power operation are verified to be secured in their isolation positions before reactor startup. These verifications will help to identify any containment penetration abnormalities that could indicate a containment leakage path.

Relief valves are set-pressure tested and seat-leakage tested in accordance with ASME Code Section XI. The valves are tested at least once every 5 years. This program would confirm relief valve operational readiness and/or identify relief valve seat leakage. Seat leakage would be a direct indicator of containment penetration leakage.

40. The proposed change to Technical Specification 4.6.1.3.a. is at least confusing and possibly in error. Currently, it requires air lock door seal leak rate testing within 72 hours after each closing, except when the air lock is being used for multiple entries, in which case the test would be required once every 72 hours. The proposal would change only the latter occurrence of "72 hours" to "30 days". Explain what would happen when the two parts of this requirement conflict. For example, if an air lock is opened (and closed) and then not opened again until 5 days later, would a test be required within 72 hours of the first closing? Within 72 hours of the second closing? Since there are now multiple entries in a 30 day period, would one wait until the end of the 30 day period to test? If 72 hours pass after a closing and the time until the next air lock use is unknown, does one wait to see if it gets used in the next 27 days? If it doesn't, isn't that then a violation of the 72-hour interval? Considering the frequent use made of the air locks at Grand Gulf, would the 72-hour limit ever come into play?

As a practical matter, any air lock at GGNS can be classified into one of two categories. Some air locks are considered to be used every day while others are only used under certain conditions. For example the airlocks on the containment are used on a routine basis and would be tested as a multiple entry airlock. The drywell airlock on the other hand, is not normally used during power operations. The drywell airlock is normally locked and deenergized except during outages. This airlock would not be considered a multiple entry airlock. In certain unusual cases a containment airlock may temporarily change status due to maintenance problems. In this case, the airlock would no longer be used as a multiple entry airlock until repairs could be affected. In these cases the airlock would be tested, locked and deenergized.

GENERIC RELIEF REQUEST 4

SYSTEMS: As Applicable

VALVES: Containment Isolation Valves

CATEGORY: A or A, C

CLASS: 1 or 2

FUNCTION: As Applicable

TEST REQUIREMENTS: 1) Subarticle IWV-3420 requires that Category A valves be leak tested and that such tests shall be conducted at least once every 2 years. Methods for measuring the amount of seat leakage are specified. The test medium shall be specified by the owner.

2) Paragraph IWV-3427(b) specifies additional requirements on increased test frequencies for valve sizes of six inches and larger and repairs or replacement over the requirements of IWV-3427(a).

BASIS FOR RELIEF: 1) In accordance with GGNS Technical Specifications 4.6.1.2(d), (f), (g), (h), (i), and (j) and 4.6.1.9.2, containment isolation valves are required to be leak rate tested in accordance with 10 CFR 50, Appendix J, using the methods and provisions of ANSI N45.4-1972. The requirements and methods contained in Appendix J and ANSI N45.4 meet the intent of Section XI although the frequencies, requirements, and test methods are somewhat different. In addition, Appendix J specifies the test medium for each valve.

GENERIC RELIEF REQUEST 4

2) Generic Letter 89-04 states that "Based on input from many utilities and (NRC) staff review of testing data at some plants, the usefulness of IWV-3427(b) does not justify the burden of complying with this requirement."

ALTERNATIVE TESTING: Leak testing of containment isolation valves shall be performed in accordance with GGNS Technical Specifications. Individual valve leakage shall be analyzed and corrective action taken in accordance with paragraphs IWV-3426 and IWV-3427(a) in addition to the requirements of GGNS Technical Specifications.

NRC DISCUSSION: Generic Letter 89-04 provides approval of Code deviations that are consistent with the NRC positions of the Generic Letter Attachment 1. This relief request meets the guidelines of Position 10 of the Generic Letter.