July 2, 1984

Docket Nos.: 352/353

MEMORANDUM FOR: Richard W. Starostecki, Director
Division of Project and Resident Programs
Region I

FROM: Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation

SUBJECT: MAIN STEAM ISOLATION VALVE LEAKAGE CONTROL SYSTEM (MSIVLCS) DESIGN - BWRs

Your June 18, 1984, memorandum identified a concern related to the design of the MSIVLCS at the Limerick Unit 1 and Shoreham nuclear plants which under historic worst case assumptions could impair reactor building assessibility upon actuation of this system following a DBA LOCA.

We have been aware of this as a generic BWR concern and it is the subject of a Task Action Plan related to MSIV Leakage and LCS Failures (Generic Issue C-8), Task 7, Review of Compartment Contamination. A copy of this Task Action Plan is enclosed. The scheduled completion date for this project is December 1986. Note, particularly the last page of the enclosure which addresses the bases for continued operations and licensing pending final resolution of this concern.

Since the MSIVLCS for Limerick and Shoreham, and the other BWRs currently being licensed are in conformance with the requirements of the General Design Criteria, Regulatory Guides and the applicable criteria of SRP 6.7 we have deferred re-evaluation of this aspect of this MSIVLCS until resolution of Task 7 of Generic Issue C-8 is completed. At that time the MSIVLCS designs of all the BWR plants will be evaluated and considered for backfit, if appropriate.

If you have further questions, please call Byron Siegel at 492-8344.

Original signed by
Darrell G. Eisenhut

Darrell G. Eisenhut, Director
Division of Licensing
Office of Nuclear Reactor Regulation

Enclosure: As Stated

CONTACT: Byron Siegel
492-8344

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*See previous concurrence

Enclosure

TASK ACTION PLAN

MSIV LEAKAGE AND LCS FAILURES (GENERIC ISSUE C-8)

Lead Organization:	Division of Systems Integration Auxiliary Systems Branch
Task Manager:	John N. Ridgely
Lead Supervisor:	Jerry Wilson, Section Leader
NRR Principal Reviewers:	1. John Ridgely Auxiliary Systems Branch Division of Systems Integration 2. Millard Wohl Accident Evaluation Branch Division of Systems Integration 3. Robert Kirkwood Mechanical Engineering Branch Division of Engineering 4. C. P. Tan Structural Engineering Branch Division of Engineering 5. Donald Hoffman Standardization and Special Projects Branch Division of Licensing
Applicability:	Boiling Water Reactors
Project Completion:	December 1986

Revision 1, May 25, 1984

Description of Problem

Statement of Issue:

Generic Issue C-8, "MSIV Leakage and LCS Failure" (Item 16 of NUREG-0933, Revision 1) deals with the inability of some Main Steam Isolation Valves (MSIVs) in BWRs to meet the Technical Specification leakage rate limit which is typically 11.5 SCFH. This leakage rate was based on a large LOCA, a specified design basis source term (TID 14844) from the core, the worst single active failure and giving no credit for any nonseismic Category I equipment, components, and structures (design basis LOCA). In order to limit offsite doses, a leakage control system (LCS) has been installed on most BWRs to direct any leakage past the MSIV during the design basis LOCA to an area served by the Standby Gas Treatment System (SGTS). If the leakage rate through the MSIV is greatly in excess of the Technical Specification value, the LCS may not be effective due to limitations in its design

The three main manufacturers of BWR MSIVs are Crane, Rockwell, and Atwood and Morrill. A typical Y-globe MSIV is shown in Figure 1. Initial surveys of excessive leakage through the MSIVs do not appear to show a high correlation to the valve manufacturer, or to other obvious parameters.

Initially we contracted with Pacific Northwest Laboratory (PNL) to perform a literature search and to analyze the information gathered to develop a correlation to the high leakage rates being observed. Then the BWR Owners Group (BWROG) formed a committee, the MSIV Leakage Control Committee, to determine the cause of the high leakage rates associated with many of the MSIVs and to develop recommendations to reduce the leakage rate, hopefully below the Technical Specification limit. The BWROG committee has completed their effort and has provided a copy of their recommendations to the NRC. As part ofthe resolution of this Generic Issue, we will review the BWROG recommendations and provide, as a minimum, a summary of their effort. Since the BWROG has initiated this effort independent of any suggestion from the NRC and the participating utilities have documents which they would be reluctant to provide the NRC, it is our opinion that the data base from which the BWROG formed their conclusions is better than we could generate by ourselves. This not withstanding, we intend to use the information that is readily available to us as the basis for auditing the BWROG committee's effort.

The BWROG data base was provided to the NRC during a meeting between the NRC and the BWROG on February 23, 1984. During the meeting, the Staff requested that the BWROG propose a follow-on effort to provide assurance that the recommendations provided by the BWROG Committee will be adopted by the BWR owners and will indeed reduce the leakage rate through the MSIVs to an acceptable value. The BWROG has responded with a proposal dated April 9, 1984 which is currently being reviewed by the Staff. A modification to their proposal is

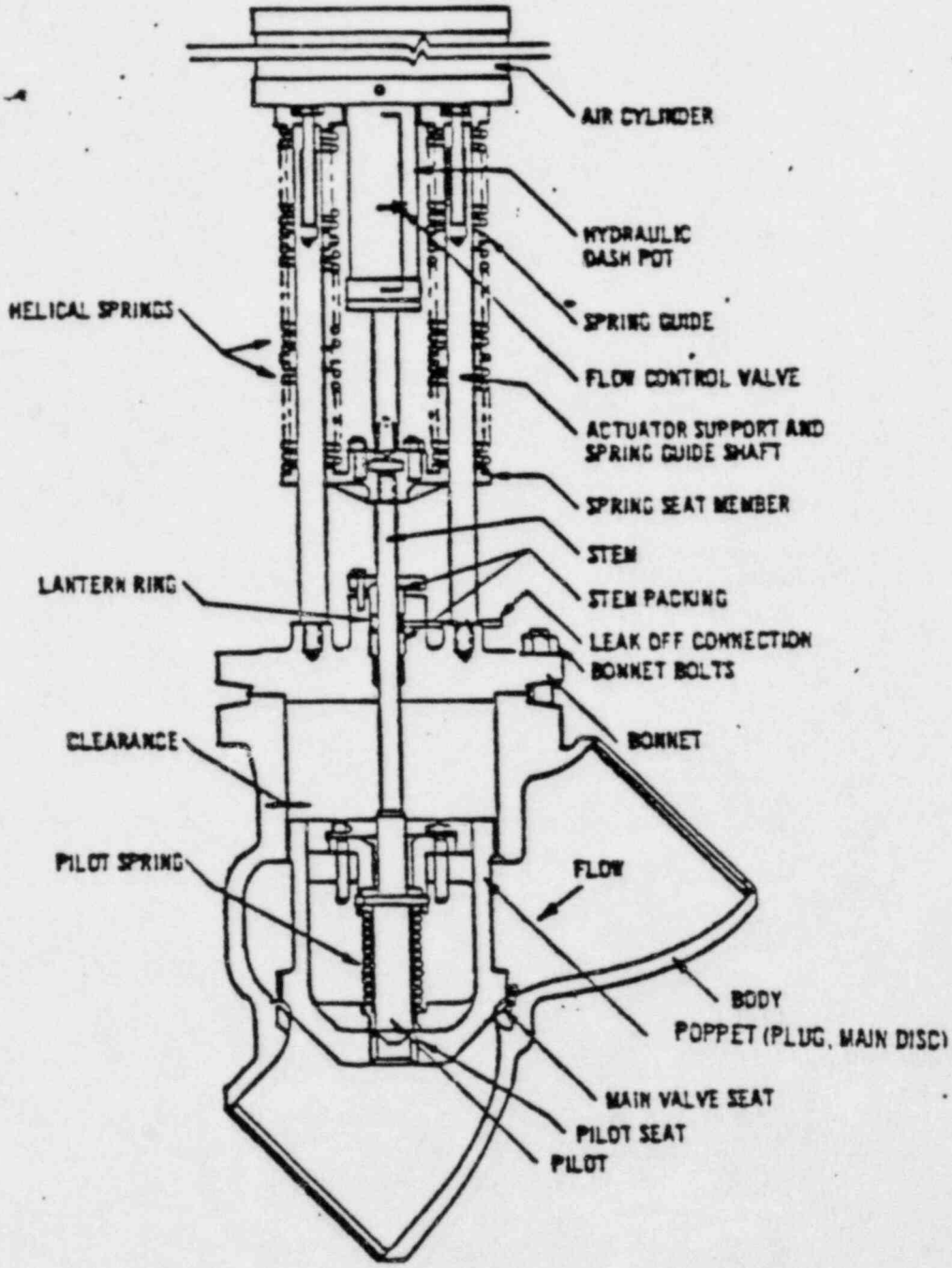
AIR CYLINDER
HYDRAULIC DASH POT
SPRING GUIDE
FLOW CONTROL VALVE
ACTUATOR SUPPORT AND SPRING GUIDE SHAFT
SPRING SEAT MEMBER
STEM
STEM PACKING
LEAK OFF CONNECTION
BONNET BOLTS
BONNET
HELICAL SPRINGS
LANTERN RING
CLEARANCE
PILOT SPRING
FLOW
BODY
POPPET (PLUG, MAIN DISC)
MAIN VALVE SEAT
PILOT SEAT
PILOT

FIGURE 1

expected to be issued shortly by the NRC for adoption by the BWROG. If our review of the BWROG material and follow on effort indicates that the BWROG recommendations are acceptable, then this portion of Generic Issue C-8 associated with the MSIV leakage rate will be complete.

The remaining portion of Generic Issue C-8 concerns identifying the optimum handling of MSIV leakage under credible LOCA conditions, and the steps the NRC should take, if any, to revise the standard BWR-LOCA scenario. Regulatory Guides, Standard Review Plan sections, and Technical Specifications will be modified, as appropriate. For this Generic Issue, a LOCA is considered to be the large pipe break LOCA with the existing TID source term or the source term currently being developed by the RES Accident Source Term Program Office (ASTPO). The worst single active failure is assumed and the availability of various components, systems, and structures will be considered. The effects of the loss of and recovery of offsite power will be incorporated into the resolution of this generic issue. The results of the resolution of Unresolved Safety Issue (USI) A-44, "Station Blackout", will be the basis for the time until offsite power is restored. The effects of the various aspects of a LOCA will be analyzed in terms of the offsite dose rates. The results of this analysis will be used to adjust the maximum allowable MSIV leakage rate of the Standard Technical Specifications, as appropriate. The effects of discharging the LCS effluent into a compartment served by the SGTS will be reviewed, if the current LCS design proves to be the optimum method of handling the leakage through the MSIVs.

Background :

A survey of the leakage rates of 400 MSIV's has shown that 46 valves exceeded the allowable leakage rate limit and required refurbishing in order to be brought within the allowable limit (R.W. Tedesco memorandum to S.H. Hanauer, dated February 14, 1977). As an example, leakage rates as high as 3795 SCFH have been reported (R.W. Woodruff memorandum to R.L. Baer dated February 4, 1982). At Brown's Ferry, some valves consistantly have a test leak rate well in excess of 11.5 SCFH; some consistantly above 1000 SCFH. Region II has been working with TVA at Brown's Ferry where major valve modifications are being made in order to reduce the MSIV leakage rate. This effort will be monitored by this generic issue. In order to return the valves to within the allowable leakage rate limits, different methods of refurbishment have been used. Most utilities grind or lap the valves. Brown's Ferry has ground the valves on Unit 1 and has instituted a major refurbishment. This new approach includes increasing the actuator stem diameter, adding more guide rails for the valve plug, and increasing the force of the operator.

As a result of these concerns and the potential consequences following a LOCA, the Division of Safety Technology (DST) has prioritized the MSIV leakage and LCS failures as a high priority item, as indicated

in their reprioritization on January 20, 1983. The NRR operating plan for FY 83 included this item as Generic Issue C-8, "MSIV Leakage and LCS Failures", and authorized work in FY 83.

There are a number of other areas in which work is presently being conducted by the BWROG which includes manufacturers and utilities that is pertinent to the present task. These other activities will be considered in the resolution of this generic issue.

One of the problems at Three Mile Island (TMI) was the operation and the inaccessibility of equipment due to the release of radioactive fluid into compartments. There has been a concern that the discharge from the LCS into one or more compartments may result is contamination of the equipment and compartment walls, inhibiting equipment maintenance and could have adverse effects of the capability of a plant for long term cooling. Therefore, the realistic effects of discharging the LCS effluent into a compartment in the generic plant will be reviewed as part of this generic issue, if the LCS is verified to be the optimum method for handling the leakage through the MSIVs. The extrapolation to specific plants is outside the scope of this effort.

Purpose :

The purpose of this generic issue is to evaluate the BWROG recommendations associated with reducing the leakage through the MSIVs, to evaluate the need for a safety related LCS, and to propose changes, as appropriate, to the current licensing requirements. The result of the resolution of this generic issue will be to provide assurance that MSIV leakage will not be a significant contributor to offsite doses following a LOCA using realistic assumptions concerning the equipment available to mitigate the effects of a LOCA.

As part of the evaluation of the need for a safety related LCS, the use of alternate methods using existing equipment, potential modifications to the existing systems, and addition of new components will be considered. The intent is to assure that the alternate methods, which use existing equipment to handle the leakage through the MSIVs, will not contribute an appreciable increase in plant risks. The effects of MSIV leakage following other postulated scenarios resulting in significant core damage will not be evaluated in that the design basis accident is considered to be bounding due to the extremely conservative assumptions. Furthermore, during the presentation by the BWROG committee, the chairman stated that during the design basis LOCA, the LCS would be the last system to be used for controlling the material leaked through the MSIV's.

The analysis of the offsite doses will be performed using the TID source term and the CRAC2 computer code. This is a realistic calculation. After determining the optimum method(s) for handling leakage through the MSIV's, comparison calculations will be performed using the ASTPO source term, if available, and the traditional calculational

method (TACT III computer code).

Our current requirement for evaluating the offsite doses after a LOCA is to assume a concurrent safe shutdown earthquake (SSE) by not giving credit for nonseismic Category I components and to assume the worst single active failure. This is essentially taking two low probability events concurrently and may be excessively conservative. Furthermore, the difference between seismic Category I and nonseismic Category I can be as little as not having 100% traceability or not being Q-listed and may not reflect the actual ability of the equipment to withstand an SSE. Therefore, part of the resolution of this generic issue is to evaluate which nonseismic Category I components, systems, and structures could reasonably be expected to be available to mitigate the consequences of a LOCA with the worst single active failure and the probability of that equipment being available. Based on preliminary calculations by the Pacific Northwest Laboratory (PNL), the use of other available alternate equipment may result in a significant reduction in the offsite dose consequences as compared to using the LCS. One of the purposes of this generic issue, then, is to determine if the LCS is the best approach for mitigating the effects of leakage past the MSIVs. Based in what equipment is assumed to be available, the LCS may not be the optimum method of mitigating the effects of MSIV leakage following a LOCA.

The current Standard Technical Specifications specify a maximum MSIV leakage rate of 11.5 SCFH per MSIV. This leakage rate is considered in sizing the MSIV leakage control system (LCS). In the event of a high leakage rate, such as the aforementioned leakage rate of 3795 SCFH, the LCS may not be operative due to an excessive flow rate through the system which would cause the system to shutdown. If the LCS is not operative due to a high flow rate and such a function is determined to be necessary, an alternative method of mitigating the effects of the MSIV leakage would be necessary. Alternate methods would either 1) require new equipment or 2) be able to use existing equipment based on current state-of-the-art calculational methods and current regulatory practices. Therefore, part of the resolution of this generic issue is to evaluate the Technical Specification leakage rate limit with respect to the utility's ability to meet this limit and the need for this limit considering the state-of-the-art calculational methods for determining the offsite dose release limit. In addition, the combined benefits of alternate mitigation techniques and the improved calculational methods may result in an increase in the MSIV leakage rate limit being acceptable.

Plan for Resolution of the Generic Issue

Approach :

We will review the BWROG committee recommendations concerning leakage reduction through the MSIVs and will incorporate their recommendations, as appropriate, as part of the final documentation of the resolution of this generic issue. The information which has been gathered as part of an initial literature search will be used in the audit of the BWROG recommendations.

The LOCA sequence will be realistically reviewed to determine what components, systems, and structures could reasonably be expected to be available. The results of the Unresolved Safety Issue (USI) A-44, "Station Blackout", will be factored into the determination of the availability of electrically operated equipment which can only be powered from offsite power sources. Based on the available equipment, accident consequence calculations will be performed using the existing source term and the source term being developed by ASTPO, as appropriate, to determine the optimum method of mitigating the effects of a LOCA with the worst single active failure and the relative effect of the ASTPO source term on the offsite dose calculations. The acceptance criteria for the method of mitigation will be the 10 CFR 100 dose guidelines and no appreciable increase in accident risks. One of the varying parameters will be the maximum allowable leakage rate. This parameter will be used in a sensitivity study to evaluate the potential for increasing the MSIV leakage rate Technical Specification limit in order to determine if a relaxation in the allowable leakage rate is acceptable. If this analysis indicates that the available alternate method of mitigating the effects of a LOCA is a reasonable and viable approach, the need for the LCS will be evaluated.

Based on the findings, modifications to the Standard Review Plan, Regulatory Guides, General Design Criteria, and the Standard Technical Specifications may be made. One of the Standard Review Plan Section which would considered for revision is Section 6.7 which requires that the LCS be seismic Category I and redundant. Part of the resolution of this generic issue is to review these requirements in light of the results of the aformentioned evaluations. Upon completion of the technical evaluations, a NUREG report documenting the resolution of this generic issue will be published and a regulatory position will be developed for review and implementation.

Tasks for Resolution of MSIV Leakage and LCS Failure Issue

Task 1 - Literature Search :

Primary Responsibility: ASB

Secondary Responsibility: None

This task is to collect information concerning the high leakage rates through MSIVs. Various sources will be reviewed such as Licensee Event Reports (LER's), the generic plant Final Safety Analysis Report (FSAR), and procedures. This information will be used as audit material for Task 2 and will primarily be gathered and used by the contractor, Pacific Northwest Laboratory (PNL).

Task 2 - Review of BWROG Committee Recommendations :

Primary Responsibility: ASB

Secondary Responsibility: None

The BWROG Committee on MSIV Leakage made a presentation to the NRC on February 23, 1984. At this meeting, the BWROG Committee provided the Staff with the data base and recommendations of the Committee. Peach Bottom Atomic Power Station (PBAPS) Unit 2 had consistantly found MSIV leakage rates in excess of 1000 SCFH. They have been following the Committee's recommendations and as a result, during the latest testing of the leak tightness of the MSIVs (1st quarter 1984), seven of the eight MSIVs had a leakage rate of less than 11.5 SCFH and the eighth MSIV had a leakage rate of 14 SCFH.

This task is to review the BWROG Committee recommendations and to use the information gathered in Task 1 to audit the data base for completeness. The recommendations and the review of these recommendations will be incorporated into the final documentation of this generic issue. In order to provide assurance that the Committee recommendations will indeed resolve the problem of excessive MSIV leakage, a follow up effort has been identified to the BWROG and will be tracked by Task 3.

Task 3 - Effectiveness of BWROG Recommendations :

Primary Responsibility: ASB

Secondary Responsibility: None

During the same meeting identified in Task 2, the Staff requested that the BWROG recommend a method for the BWROG, and ultimately the Staff, to monitor the effectiveness of the recommendations made by the BWROG Committee to provide assurance that the leakage problems associated with the MSIVs have indeed been resolved.

This Task is to review the reports/documentation which will be provided by the utilities to the NRC concerning the testing of the leakage rate of the MSIVs. It is not clear at this time whether the individual utilities or whether the BWROG will be providing this information. The end of this task is not fixed, but is on-going. The final product which discusses the technical resolution of this generic issue will be a NUREG. This Task will end on the last day that information can be incorporated into the NUREG in order for the NUREG to be as complete as possible.

Task 4 - Realistic Alternate LOCA Mitigation Equipment Availability:

Primary Responsibility: ASB

Secondary Responsibility: SGEB, MEB

This Task is to realistically review the design basis LOCA senario to determine the components, systems, and structures which can reasonably be expected to be available after the LOCA. This is a step by step consideration of the various components of the LOCA, namely the pipe break (recirculation line), worst single active failure (one inboard MSIV fails to close), and the loss of offsite power. The probability of this event sequence will be incorporated into the review. The loss of offsite power information will be obtained from the resolution of the Unresolved Safety Issue A-44, "Station Blackout".

This Task will identify the systems or areas where systems would be expected to be available following a LOCA and when those systems which require offsite power could be expected to be available, i.e. when offsite power could be expected to be regained. This Task is complete.

Task 5 - Offsite Dose Calculations :

Primary Responsibility: ASB

Secondary Responsibility: AEB

The information obtained from Task 4 will be used to determine the various methods of inhibiting the release of radioactivity that leaks through the MSIVs from entering the environment. The offsite dose calculations will be performed for each method identified for mitigating the effects of a LOCA with consideration being given to plate-out and other mechanisms which tend to collect radioactive material and prevent it from being transported offsite. Natural decay and dispersion will also be considered. The results will be evaluated against the current method of calculating offsite doses due to a design basis LOCA. For the most favorable alternate method, a sensitivity study will be performed to determine the leakage rate

which yields offsite doses equal to the 10 CFR 100 guidelines. Included will be consideration of the accident source term expected to be available through the ASTPO. The effects of grid stability (time to recovery of offsite power) will also be considered by performing a sensitivity study using several times for recovery of offsite power, if equipment powered by offsite power was identified in Task 4.

Subtask 5.1 - Baseline Calculations :

This subtask is to set up the computer model and to perform the dose calculations for the design basis LOCA to determine the baseline offsite dose rates. This will be the benchmark for the other calculations and meet the requirements of 10 CFR 100. Ultimately six cases will be calculated. Four cases will use CRAC2 (TID, WASH 1400 Mod 4 and Mod 5 and ASTPO Source Terms), one case with TACT III, and one case with CRAC1. AEB will perform the CRAC1 analysis.

Subtask 5.2 - Thermal Hydraulic Modeling :

This subtask will provide the analytical representation of the components used in the alternate methods for mitigating the effects of MSIV leakage following a LOCA. These components include, but are not limited to the steam piping, valves, condenser, turbine, and off-gas system.

Subtask 5.3 - Alternate Calculations :

This subtask will calculate the offsite doses for the alternate methods for mitigating the effects of MSIV leakage following a LOCA. All related sensitivity studies will be performed under this subtask. The CRAC2 computer code using the TID source term will be used to determine the relative merits of the various alternatives. The alternative which uses only the passive features of the plant and results in the least offsite release will be analyzed with TACT III. The alternative with the least offsite release using both passive and active plant features will be analyzed for sensitivity to recovery time of offsite power. The optimum passive and passive and active alternatives will be analyzed for sensitivity to the MSIV leakage rates.

Task 6 - PRA Study of Different Alternatives :

Primary Responsibility: SPEB

Secondary Responsibility: ASB

This task will evaluate the reliability and relative risks associated with the different methods of mitigating the effects of a LOCA. The reliability of the existing method of using the LCS for a design basis LOCA will be compared with the alternate methods identified

in Task 4 for mitigating the effects of a LOCA and for contributing to the plant risk. This task will be performed under an existing contract between SPEB and Pacific Northwest Laboratory.

Task 7 - Review of Compartment Contamination :

Primary Responsibility: ASB

Secondary Responsibility: AEB

If the results of Tasks 4, 5, and 6 indicate that the optimum method of processing the leakage through the MSIV's is to use the LCS, then this Task will evaluate the effects of discharging the effluent of the LCS into a compartment serviced by the SGTS. All doors to the compartment will be considered to be open. This evaluation will consider such aspects as initial radioactivity concentration, natural decay, delution, partition factors, plate-out, dispersion, and air flow. The features of the generic plant will be used.

Task 8 - Information Collation :

Primary Responsibility: ASB

Secondary Responsibility: SGEB, MEB, AEB, SSPB

All of the information produced by Tasks 1 through 7 will be collated and evaluated. This Task will formulate the recommendations for operating reactors and operating license applicants as well as prepare the revisions to the Standard Review Plan, Regulatory Guides, and Standard Technical Specifications, as determined to be necessary. These recommendations will include the use of alternate equipment to mitigate the effects of a LOCA, the changes to the MSIV allowable leakage rate limit in the technical specifications, and the need for a leakage control system.

Assistance Required from NRR Divisions

The Auxiliary Systems Branch (ASB) will provide the overall management of this generic issue. Except as noted below, a contractor, PNL, will perform all of the aforementioned tasks. ASB with assistance from SGEB and MEB will determine the realistic alternate LOCA mitigation equipment availability (Task 4). This work has already been completed and the information transmitted to the contractor. AEB will run the CRAC1 computer code for the benchmark case, which is part of Task 5.1. In addition, AEB will review various documents on an as requested basis to provide assurance of the dose rate calculation methods and consistence with the current practices for the benchmark cases. The PRA, Task 6, will be performed by PNL but under a contract with DST. Each branch will revise the Standard Review Plan sections, Regulatory Guides, and other related documents for which they have the primary responsibility, as appropriate. The estimated manpower required to resolve this generic issue is as follows:

Branch	Staff Years FY 83	FY 84	FY 85		Total
ASB	.05	.95	.60		1.60
SGEB	0	.15	.10		.25
MEB	0	.15	.05		.20
SSPB	0	0	.10		.10
AEB	0	.15	.15		.30
				Total:	2.45

Basis for Continued Plant Operation and Licensing Pending Resolution of Generic Issue C - 8

The concern addressed in this generic issueis whether, and by what means, 1) the experienced high leakage rates can be reduced, 2) the LCS is the best method of treating the leakage that could reasonably be expected to be available following a LOCA and 3) operation of the LCS could have adverse effects on plant safety. The purpose of this generic issue is to evaluate the operating experience of the MSIV's and to determine if any changes should be made to the current licensing requirements. Currently, the utilities refurbish the MSIV's as necessary and /or are following the BWROG Committee recommendations to bring the leakage rate within the Technical Specification limits prior to restarting the plant after an MSIV leakage rate test, which normally occurs during a refueling outage. The design basis analysis which serves as the basis for determining the acceptable MSIV leakage rate is based on extremely conservative assumptions which go beyond the normal accident scenarios. In addition, the design basis LOCA has an extremely low probability of occurrence. Most BWRs currently have an LCS to process the post LOCA MSIV leakage.

For these reasons, we consider interim operation of all BWR's, until resolution of this generic issue and implementation of appropriate recommendations, to be acceptable.