SAI Report No. 186-028-12

LACROSSE NUCLEAR POWER STATION

INSERVICE INSPECTION PROGRAM
TECHNICAL EVALUATION REPORT

Submitted to:

U.S. Nuclear Regulatory Commission
Contract No. 03-82-096

Science Applications, Inc.
McLean, Virginia 22102

June 10, 1982

CONTENTS

LACROSSE BOILING WATER REACTOR (LACBWR)

INSERVICE INSPECTION PROGRAM
EVALUATION OF RELIEF REQUESTS

INTRODUCTION

The revision to 10 CFR 50.55a, published in February 1976, required that Inservice Inspection (ISI) Programs be updated to meet the requirements (to the extent practical) of the Edition and Addenda of Section XI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code* incorporated in the Regulation by reference in paragraph (b). This updating of the programs was required to be done every forty months to reflect the new requirements of the later editions of Section XI.

As specified in the February 1976 revision, for plants with Operating Licenses issued prior to March 1, 1976, the Regulations became effective after September 1, 1976 at the start of the next regular 40-month inspection period. The initial inservice examinations conducted during the first 40-month period were to comply with the requirements in editions of Section XI and addenda in effect no more than six months prior to the date of start of facility commercial operation.

The Regulation recognized that the requirements of the later editions and addenda of the Section XI might not be practical to implement at facilities because of limitations of design, geometry, and materials of construction of components and systems. It therefore permitted determinations of impractical examination or testing requirements to be evaluated. Relief from these requirements could be granted provided health and safety of the public were not endangered giving due consideration of the burden placed on the licensee if the requirements were imposed. This report provides evaluations of the various requests for relief by the licensee of the LACBWR. It deals only with the inservice examinations of components and with system pressure tests. Inservice tests of pumps and valves (IST programs) are being evaluated separately.

The revision to 10 CFR 50.55a, effective November 1, 1979, modified the time interval for updating ISI programs and incorporated by reference a later edition and addenda of Section XI. The updating intervals were extended from 40 months to 120 months in order to be consistent with intervals as defined in Section XI.

---

*Hereinafter referred to as Section XI, or the Code.

For plants with Operating Licenses issued prior to March 1, 1976 the provisions of the November 1, 1979 revision are effective after September 1, 1976 at the start of the next one-third of the 120-month interval. During the one-third of an interval and throughout the remainder of the interval, inservice examinations shall comply with the latest edition and addenda of Section XI, incorporated by reference in the Regulation on the date 12 months prior to the start of that one-third of an interval. For LACBWR, the ISI program, and the relief requests evaluated in this report, cover the entire current 120-month inspection interval; i.e., from November 1, 1979 to October 31, 1989. This program was based upon the 1974 Edition of Section XI of the ASME Boiler and Pressure Vessel Code with Addenda through the Summer of 1975.

The November 1979 revision of the Regulation also provides that ISI programs may meet the requirements of subsequent code editions and addenda, incorporated by reference in Paragraph (b) and subject to U.S. Nuclear Regulatory Commission (NRC) approval. Portions of such editions or addenda may be used provided that all related requirements of the respective editions or addenda are met. These instances are addressed on a case-by-case basis in the body of this report.

References (1) to (10) listed at the end of this report pertain to previous information transmittals on ISE between the licensee, Dairyland Power Cooperative, and the NRC. By letters of April 22 and November 17, 1976[1,3], the Commission provided general ISI guidance to all licensees. Submittals in response to that guidance were made by the licensee on October 13, 1976[2], May 11, 1979[4], and July 27, 1979[5]. A revision was made on July 14, 1980.[8]. By information transmittal[6] and by letter of March 8, 1982[9], the NRC requested additional information to complete this review. This information was furnished by the licensee on January 24, 1980[7], and March 24, 1982[10].

From these submittals, a total of 27 requests for relief from code requirements or for updating to a later code were identified. These requests are evaluated in the following sections of this report.

I. CLASS 1 COMPONENTS

A. Reactor Vessel

1. Request for Relief; Reactor Vessel Pressure Retaining Welds, Categories B-A and B-B, Items B1.1 and B1.2

Code Requirement

Category B-A: Volumetric examination of the shell longitudinal and circumferential welds may be performed at or near the end of each inspection interval and shall cover at least 10% of the length of each longitudinal weld, and 5% of the length of each circumferential weld, with the minimum length of weld examined equal to one wall thickness.

Category B-B: The volumetric examinations performed during each inspection interval shall cover at least 10% of the length of each longitudinal shell weld and meridional head weld and 5% of the length of each circumferential shell weld and head weld.

Code Relief Request

Relief is requested from the volumetric examination of the following reactor pressure vessel welds:

Category B-A: Circumferential welds: 13, 15, 17; longitudinal welds: 12, 14, 16, 18.

Category B-B: Circumferential welds: 7, 9, 11, 19, 21; longitudinal welds: 6, 8, 10, 20.

Proposed Alternative Examination

None

Licensee Basis for Requesting Relief

No part of the seven welds identified under Category B-A is accessible for any kind of an examination from inside or outside of the reactor vessel.

The only penetration through the concrete shield wall in the core region is for the intermediate liquid level indicating pipe, and is not a direct line penetration. There are no access ports.

Further restricting the access to all the welds in the core region is the external thermal shield. This is a metal cylindrical container filled with lead shot and cooled by the shield cooling system. It is 4-inches thick by 120-inches high, surrounding the reactor vessel in the core region. It was placed there to attenuate the gamma heating of the solid concrete structure. There is a 4-inch annulus between the inside of the external thermal shield and the outside of the vessel. There is a 2-inch thick fiberglass insulation blanket in this annulus.

Evaluation

Imposition of the Code requirements would necessitate the removal of portions of the concrete biological shield and the permanently installed insulation to perform the required examination of the welds listed from the vessel exterior. The vessel internals preclude volumetric examination of the beltline weld volume from the vessel interior.

The reactor vessel is presently being monitored for radiation damage in the beltline region by a surveillance program which was initiated prior to the issuance of Appendix H, 10 CFR 50. The program, therefore, does not completely meet all the Appendix H requirements, but exceeds them in many areas[11]. The LaCrosse reactor vessel surveillance program conforms to the intent of Appendix H. Test results so far have shown upper shelf energy values for fracture toughness, obtained from sample material are well above the requirements of Appendix G, 10 CFR 50. It is expected[11] that the LaCrosse reactor vessel fracture toughness will be maintained at acceptable leve's during its service lifetime.

No relief has been requested on three of the Category B-B welds in the vessel shell. Also, no relief from inspections on the vessel head is requested. The vessel shell-to-flange weld can be examined by manual or semi-mechanized ultrasonic (volumetric) techniques. The circumferential weld of the upper shell course, just below the vessel upper nozzles, is accessible on the vessel outer surface for manual volumetric and visual examination. The longitudinal weld in this course is also fully inspectable. These three welds contain the most highly stressed regions of the vessel although they are not subject to the radiation degradation of the beltline welds. All vessel head welds are fully accessible and can be examined by manual or semi-mechanized ultrasonic (UT) techniques.

The licensee has scheduled to perform 100% of the required examinations in each of the three accessible welds and the head welds each inspection interval.

Adhering to all Category B-A and B-B Code requirements is impractical due to existing plant design and geometry. To maintain the extent of examination, however, an augmented inservice inspection program of both volumetric and visual examination should be required. The volumetric examination of accessible Category B-B welds should be increased to achieve (1) an examination sample whose total weld

length is equal to that required for the Category B-A and B-B welds for which relief was requested, or (2) 100% of the length of each accessible Category B-B weld, whichever is less. In addition, visual examination for gross leakage as proposed by the licensee should be required during each system pressure test in accordance with IWB-1220(c).

Conclusions and Recommendations

Based on the above evaluation, it is concluded that for the welds discussed above, the code requirements are impractical. It is further concluded that the alternative examination discussed above will provide necessary added assurance of structural reliability. Therefore, the following is recommended:

Relief should be granted from volumetric examination of the identified welds for the 10-year inspection interval, provided that:

(a) The examination of the accessible Category B-B welds should be increased to achieve (1) an examination sample whose total weld length is equal to that required for the Category B-A and B-B welds for which relief was requested, or (2) 100% of the length of each accessible Category B-B weld, whichever is less.

(b) General visual examinations per IWB-1220(c) should be made during each system pressure test for evidence of leakage in the areas of the lower head and the shield annulus below the vessel.

References

References 5, 8, 10 and 11.

2. Reactor Vessel Recirculation Nozzles and Blowdown Nozzle, Category B-D, Item B1.4

Code Requirement

The extent of volumetric examination of each nozzle shall cover 100% of the volume to be inspected as shown in Figure IWB-2500D of the code. All nozzles shall be examined during each inspection interval.

Code Relief Request

Relief is requested from the volumetric examinations required by the code on the following nozzles (includes examination of the nozzle-vessel welds, and nozzle-inside-radius sections for each nozzle):

Outlet recirculation nozzles 1 and 2,
Inlet recirculation nozzles 5 and 6,
Blowdown nozzle in lower head.

Proposed Alternative Examination

None

Licensee Basis for Requesting Relief

For the recirculation nozzles, radiation levels of 1100 to 1200 mr/hr on the surface would cause excessive personnel exposures. These four nozzles are subjected to the same thermal/hydraulic conditions as the four reactor vessel recirculation nozzles in the inspection program.

There is no access to the blowdown nozzle in the bottom head, due to interference from the CRD nozzles. Also, this nozzle has been capped, which eliminated the dissimilar metal weld.

Evaluation

Permanent tracks are installed on two outlets and two inlets (#3,4,7 and 8) such that remote volumetric (ultrasonic) examinations may be conducted on these four nozzles. This setup is capable of examining the nozzle-to-pipe, and two pipe-to-pipe welds on each of the outlets (#3 and 4), and the nozzle-to-pipe and one pipe-to-pipe weld on each of the inlets (#7 and 8). Also, the nozzle-inside-radius sections on these four nozzles are accessible. 100% of all code-required examinations were performed on these four nozzles in the last interval, and are scheduled to be repeated this interval.

All the recirculation nozzles are subject to the same environmental conditions. The code examination of each of the above nozzles and a visual examination of all nozzles per IWB-1220(c)

should provide adequate information as to the integrity of all the recirculation nozzles. Examining the remaining nozzles would result in unnecessary exposure to personnel.

The blowdown nozzle on the bottom head of the reactor vessel is capped and no longer used. In addition, the nozzle is physically inaccessible being surrounded by control rod drive nozzles. Therefore, due to design of the reactor vessel, examination of the blowdown nozzle is impractical.

Conclusions and Recommendations

Based on the above evaluation, it is concluded that for the welds discussed above, the code requirements are impractical. It is further concluded that the alternative examination discussed above will provide necessary added assurance of structural reliability. Therefore, the following is recommended:

Relief should be granted from the code-required examinations of recirculation nozzles 1, 2, 5 and 6, and of the capped blowdown nozzle in the lower head. General visual examinations per IWB-1220(c) should be made, however, during each system pressure test for evidence of leakage in the areas of the lower head and the shield annulus below the vessel.

References

References 5, 8 and 10.

3. Partial Penetration Welds, CRD, Liquid Level, and Purification, Category B-E, Item B1.5

Code Requirement

The visual examination during system pressure test (IWA-5000) performed during each inspection interval shall cumulatively cover at least 25% of each group of penetrations of comparable size and function.

Code Relief Request

Relief is requested from the visual inspection during system pressure testing per IWA-5000 of the following partial penetration welds:

(a) CRD penetrations to reactor vessel,

(b) Intermediate liquid level penetration-to-reactor vessel,

(c) Lower liquid level penetration-to-reactor vessel,

(d) Primary purification penetration in lower head.

Proposed Alternative Examination

None.

Licensee Basis for Requesting Relief

There is no access to individually examine each of these partial penetration welds because they are inside the reactor vessel. Earlier requests also cited outside access problems due to concrete block shield wall and vessel support ring interference.

Evaluation

The code examination procedure to visually check for leaks at each penetration during system pressure tests requires only that there be external access to visually examine the penetration. The current relief request basis does not address external access. However, external interference does preclude individual access to each penetration in question. The lower vessel cavity has a leak detection system that operates 20 out of 24 hours and enables the licensee to detect any gross leakage that occurs from the penetrations. Also, visual examination can be made during system pressure tests.

Conclusions and Recommendations

Based on the above evaluation, it is concluded that for the welds discussed above, the code requirements are impractical. It is further concluded that the alternative examination discussed above will provide necessary added assurance of structural reliability. Therefore, the following is recommended:

Relief should be granted from the requirement to visually examine each individual penetration in question. General visual examinations per IWB-1220(c) should be made, however, during each system pressure test for evidence of leakage in the areas of the lower head and the shield annulus below the vessel.

References

References 5, 7 and 8.

4. Integrally Welded Reactor Vessel Supports; Category B-H, Item D1.12

Code Requirement

In the case of vessel support skirts, the volumetric examination performed during each inspection interval shall cover, at least, 10% of the circumference of the weld to the vessel. In the case of support lug attachments, 100% of the welding to the vessel shall be volumetrically examined.

Code Relief Request

Request relief from volumetric examination of the integrally welded reactor vessel supports.

Proposed Alternative Examination

Examine subject welds using surface non-destructive examination (NDE) methods.

Licensee Basis for Requesting Relief

High radiation, greater than 1 R/hr.

Evaluation

Access to the reactor vessel integrally-welded supports is impeded by the reactor vessel insulation, structural support components, and the biological shield. Performing volumetric examinations on the welds which are at all accessible requires much more set-up and examination time in a radiation field than does surface NDE. The resulting personnel exposure would be excessive. The licensee has committed to subject these welds to surface examination. Based on the loading conditions of these types of welds, flaws would most likely be generated at the weld surface and thus be detectable by surface examination.

Conclusions and Recommendations

Based on the above evaluation, it is concluded that for the welds discussed above, the code requirements are impractical. It is further concluded that the alternative examination discussed above will provide necessary added assurance of structural reliability. Therefore, the following is recommended:

Relief should be granted from the code requirement to volumetrically examine the integrally-welded reactor vessel supports, provided that all of these welds which are accessible are examined by surface NDE techniques.

References

References 5, 7 and 8.

5. Reactor Vessel Cladding, Category B-I-1, Item B1.14

Code Requirement

The examinations performed during each inspection interval shall cover 100% of the patch areas. The areas shall include at least six patches (each 36 sq. in.) evenly distributed, in the closure head, and six patches (each 36 sq. in.) evenly distributed in accessible sections of vessel shell. The examination shall be (1) visual and surface, or (2) volumetric for the closure head cladding, and visual for the vessel cladding.

Code Relief Requested

Request relief from performing code-required examinations of vessel cladding.

Proposed Alternative Examination

None.

Licensee Basis for Requesting Relief

Access is not justified because of high radiation levels.

Evaluation

The 1977 Edition of Section XI has been referenced in 10 CFR 50.55a and inservice examinations may meet the requirements of this edition in lieu of those from previous editions with the following provisions:

(a) Commission approval is required to update to the more recent edition (pursuant to 10 CFR 50.55a(g)(4)(iv));
(b) When applying the 1977 edition, all of the addenda through Summer 1978 Addenda must be used;
(c) Any requirement of the more recent edition which is related to the one(s) under consideration must also be met.

The requirements for examining closure-head cladding and vessel cladding are deleted from the 1977 Edition with addenda through Summer 1978.

Recommendations

Pursuant to 10 CFR 50.55a(g)(4)(iv), approval should be granted to update to the requirements of the Summer 1978 Addenda for Category B-I-1 items. This approval would delete the requirement to examine these items.

References

References 5 and 8.

B. Pressurizer (No relief requests)

C. Heat Exchangers and Steam Generators (No relief requests)

D. Piping Pressure Boundary

1. Dissimilar Metal Socket Welds, Forced Circulation Piping, Category B-F, Item B4.1

Code Requirement

The volumetric and surface examinations performed during each inspection interval shall cover the circumference of 100% of the welds.

Code Relief Request

Requests relief from the volumetric examination requirements for the following 2-inch dissimilar metal socket welds:

Forced circulation suction, Loop 1B: Weld 22BC,
Forced circulation bypass, Loop 1A: Welds 90A, 91A,
Forced circulation bypass, Loop 1B: Welds 92A, 93A.

Proposed Alternative Examination

Licensee proposes to perform only the prescribed surface NDE on these welds.

Licensee Basis for Requesting Relief

The configuration of a socket weld precludes meaningful results from a UT examination.

Evaluation

Ultrasonic examination of these socket welds is impractical because the socket weld configuration does not allow the return of useful UT results. A surface NDE is the only practical method of examining these welds.

Conclusions and Recommendations

Based on the above evaluation, it is concluded that for the welds discussed above, the code requirements are impractical. It is further concluded that the alternative examination discussed above will provide necessary added assurance of structural reliability. Therefore, the following is recommended:

Relief should be granted from the volumetric examination requirement for the above welds. The surface NDE prescribed in the code should be performed as proposed.

References

References 5, 8 and 10.

2. Penetration to Extension Pipe Welds, Intermediate and Lower Liquid Level and Purification (lower head), Category B-J, Item B4.5

Code Requirement

The volumetric examinations performed during each inspection interval shall cover all of the area of 25% of the circumferential joints including the adjoining 1-foot sections of longitudinal joints and 25% of the pipe branch connection joints.

Code Relief Request

Relief is requested from the code requirement to volumetrically examine the following welds:

Intermediate liquid level penetration-to-pipe weld,

Lower liquid level penetration-to-pipe weld,

Primary purification penetration in lower head-to-extension pipe.

Proposed Alternative Examination

None.

Licensee Basis for Requesting Relief

No access due to concrete shield wall and reactor vessel support ring.

Evaluation

All the welds in question are located inside a thermal sleeve which penetrates the concrete biological shield or is behind the vessel support ring. Imposition of the code would require the licensee to remove portions of the biological shield and a thermal sleeve. This procedure would result in excessive personnel exposure and therefore be impractical. Visually examining the general area during pressure testing will help detect leakage problems.

Conclusions and Recommendations

Based on the above evaluation, it is concluded that for the welds discussed above, the code requirements are impractical. It is further concluded that the alternative examination discussed above will provide necessary added assurance of structural reliability. Therefore, the following is recommended:

Relief should be granted from the examination requirements for these welds. General visual examinations per IWB-1220(c), however, should be made during each system pressure test for evidence of leakage in the areas of the lower head and the shield annulus below the vessel.

References

References 5 and 8.

3. Piping Welds, 10-Inch Main Steam Line, Category B-J, Item B4.5

Code Requirement

The volumetric examinations performed during each inspection interval shall cover all of the area of 25% of the circumferential joints, including the adjoining 1-foot sections of longitudinal joints and 25% of the pipe branch connection joints.

Code Relief Request

Requests relief from the code requirement to volumetrically examine the 10-inch mainsteam line pipe-to-pipe welds 19, 20, 21, and 22.

Proposed Alternative Examination

None

Licensee Basis for Requesting Relief

There is no personnel access to these welds as they are inside a pipe chase cavity 2-feet square. Also, the general area radiation levels are 1.1 to 1.5 R/hr.

Evaluation

The identified welds are completely inaccessible for either volumetric or surface examination. Also, the number of welds involved compared to the total number of welds in the system is relatively small. The welds should be examined for evidence of leakage during system pressure tests. Also, whenever one of these welds becomes accessible because of needed maintenance on a piping run, the weld should be code-examined.

Conclusions and Recommendations

Based on the above evaluation, it is concluded that for the welds discussed above, the code requirements are impractical. It is further concluded that the alternative examination discussed above will provide necessary added assurance of structural reliability. Therefore, the following is recommended:

Relief should be granted from the code-required examinations on these welds. Alternatively, a weld should be examined whenever it is made accessible by maintenance. Also, the welds should be examined for evidence of leakage during system pressure tests.

References

References 5, 7 and 8.

4. Integrally-Welded Attachment, Main Steam Line; Category B-K-1, Item B4.9

Code Requirement

The volumetric examinations performed during each inspection interval shall cover 25% of the integrally-welded supports.

Code Relief Request

Requests relief from the code requirement to volumetrically examine the integrally-welded pipe attachment (MS-102) in the main steam line.

Proposed Alternative Examination

There is no personnel access to this weld as it is inside a pipe chase cavity 2-feet square. Also, the general area radiation levels are 1.1 to 1.5 R/hr.

Evaluation

Same as for I.D.3 of this report.

Recommendations

Same as for I.D.3 of this report.

References

References 5, 7 and 8.

5. Miscellaneous Areas Containing Integrally-Welded Attachments, Category B-K-1, Item B4.9

Code Requirement

The volumetric examinations performed during each inspection interval shall cover 25% of the integrally-welded supports.

Code Relief Request

Relief is requested from the code requirement to volumetrically examine integrally-welded pipe attachments for pipe hangers in the Class 1 portions of the following systems:

Main Steam,
Feedwater & Condenser Condensate,
Alternate Core Spray,
Decay Heat Suction and Discharge,
Forced circulation suction & discharge headers, and
Forced circulation suction & discharge and piping.

Proposed Alternative Examination

Perform surface NDE on the integral attachment welds of the above systems.

Licensee Basis for Requesting Relief

Weld configurations preclude reliable UT results.

Evaluation

The volumetric examinations required by the code are impractical because these welds are the fillet-type rather than full penetration. As an alternative, the licensee has proposed to subject these welds to surface NDE. Based on the loading conditions of these types of welds, any flaws would most likely be generated at the weld surface and thus be detectable by surface examination.

Conclusions and Recommendations

Based on the above evaluation, it is concluded that for the welds discussed above, the code requirements are impractical. It is further concluded that the alternative examination discussed above will provide necessary added assurance of structural reliability. Therefore, the following is recommended:

Relief should be granted from the volumetric examination of the above integrally-welded attachments. Alternatively, these welds should be examined by surface NDE methods according to the prescribed schedule.

References

References 5 and 8.

II. CLASS 2 COMPONENTS

No relief requests

III. CLASS 3 COMPONENTS

No relief requests

IV. PRESSURE TESTS

1. Sodium Pentaborate Tank 60-19-001

Code Requirement

IWD-1410(b): 100% of the components shall have been pressure-tested and visually examined in accordance with IWA-5000, IWD-5000, and IWD-2600 by the expiration of each inspection interval.

IWD-5200(b): In the case of storage tanks, the nominal hydrostatic pressure developed with the tank filled to its design capacity shall be acceptable as the system test pressure.

Code Relief Request

Requests relief from performing the prescribed hydrostatic test with the tank at design level.

Proposed Alternative Examination

System inservice test will be substituted at the scheduled intervals.

Licensee Basis for Requesting Relief

In order to fill the tank to capacity, it would be necessary to mix a quantity of dry boric acid and dry borax in 120°F water equal to approximately 25% of the tank's capacity. Then, at the completion of the inspection, drain tank to normal level and dispose of the sodium pentaborate solution.

Evaluation

Filling this tank to design capacity for test purposes would increase the static head a modest amount. However, the excessive chemical waste generated when draining the tank back to normal levels would unnecessarily add to the environmental burden. Visual inspection of this tank while at normal operating level is adequate to determine the tank's integrity.

Conclusions and Recommendations

Based on the above evaluation, it is concluded that for this tank, the code requirements are environmentally impractical. It is further concluded that the alternative examination discussed

above will provide necessary added assurance of structural reliability. Therefore, the following is recommended:

Relief should be granted from the requirement to fill the sodium pentaborate tank to its design level for pressure test. Alternatively, visual examination with the tank filled to the maximum level of its normal operating range should be substituted according to the prescribed schedule.

References

References 5 and 8.

V. GENERAL

(No relief requests)

REFERENCES:

1. R. W. Reid (NRC) to J. P. Madgett (DPC), April 22, 1976.

2. LAC-4271, J. P. Madgett (DPC) to R. W. Reid (NRC), October 13, 1976.

3. R. W. Reid (NRC) to J. P. Madgett (DPC), November 17, 1976.

4. LAC-6280, F. Linder (DPC) to D. L. Ziemann (NRC), Application for Amendment to License, May 11, 1979.

5. LAC-6429, F. Linder (DPC) to D. L. Ziemann (NRC), ISI Program Document, July 27, 1979.

6. Informal Request for Additional Information, NRC to DPC, undated.

7. LAC-6752, F. Linder (DPC) to D. L. Ziemann (NRC), Response to NRC Request for Additional Information, January 24, 1980.

8. LAC-7025, F. Linder (DPC) to D. M. Crutchfield (NRC), Revisions to ISI Program, July 14, 1980.

9. D. M. Crutchfield (NRC) to F. Linder (DPC), LSO5-82-041, ISI Review - LaCrosse BWR, March 8, 1982.

10. LAC-8173, F. Linder (DPC) to D. M. Crutchfield (NRC), Responses to RAI, March 24, 1982.

11. NUREG-0569, Evaluation of the Integrity of SEP Reactor Vessels, K. G. Hoge, December 1979.