UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

ENCLOSURE 1

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO THE INSERVICE TESTING PROGRAM'S THIRD TEN-YEAR INTERVAL

COMMONWEALTH EDISON COMPANY

ZION NUCLEAR POWER STATION, UNITS 1 AND 2

DOCKET NOS. 50-295 AND 50-304

1.0 INTRODUCTION

The Code of Federal Regulations, 10 CFR 50.55a, requires that inservice testing (IST) of certain Ameraican Society of Mechanical Engineers (ASME) Code Class 1, 2, and 3 pumps and valves be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel Code (the Code) and applicable addenda, except where alternatives have been authorized or relief has been requested by the licensee and granted by the Commission pursuant to Sections (a)(3)(i), (a)(3)(ii), or (f)(6)(i) of 10 CFR 50.55a. In proposing alternatives or requesting relief, the licensee must demonstrate that: (1) the proposed alternatives provide an acceptable level of quality and safety; (2) compliance would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety; or (3) conformance is impractical for its facility. NRC guidance contained in Generic Letter (GL) 89-04, *Guidance on Developing Acceptable Inservice Testing Programs*, provides alternatives to the Code requirements determined acceptable to the staff. Alternatives that conform with the guidance in GL 89-04 may be implemented without additional NRC approval. Relief requests that conform with GL 89-04 are not evaluated in the Technical Evaluation Report (TER), though they have been reviewed to determine conformance and any concerns identified by such reviews are discussed in Section 5.0, "IST Program Recommended Action Items." Relief Requests PR-03 and VR-04 are approved pursuant to GL 89-04 as they conform to the guidance for Position 9 and Position 2, respectively, of Attachment 1 of GL 89-04.

Section 10 CFR 50.55a authorizes the Commission to approve alternatives and to grant relief from ASME Code requirements upon making the necessary findings. The staff's findings with respect to authorizing alternatives and granting or not granting the relief requested as part of the licensee's IST program are contained in this Safety Evaluation (SE).

The 1989 Edition of the Code, Section XI, Subsections IWP and IWV, provide that the rules for IST of pumps and valves shall meet the requirements set forth in ASME *Operations and Maintenance Standards* Part 6 (OM-6), "Inservice Testing of Pumps in Light-Water Reactor Power Plants," and Part 10 (OM-10), "Inservice Testing of Valves in Light-Water Reactor Power Plants." The Zion Nuclear Power Station IST Program is based on the requirements in the 1989 Edition of the Code.

The Zion Nuclear Power Station IST program covers the third ten-year IST interval for the Zion Nuclear Power Station, Units 1 and 2. The third ten-year interval for Unit 1 began on December 31, 1993, and ends on December 30, 2003. For Unit 2, the third ten-year interval begins on September 14, 1994, and ends on September 13, 2004.

2.0 EVALUATION

The staff, with technical assistance from Brookhaven National Laboratory (BNL), has reviewed the information concerning inservice testing (IST) program submitted for the third ten-year intervals for the Zion Nuclear Power Station, Units 1 and 2, in a Commonwealth Edison Company (CECo or the licensee) request for relief dated August 31, 1993. The staff adopts the evaluations and recommendations for granting relief or authorizing alternatives contained in the attached Technical Evaluation Report (TER), prepared by BNL. Table 1 lists each relief request and the status of approval. The test deferrals of valves, as allowed by OM-10, were also reviewed. Results of the review are provided in Tables 4.1 and 4.2 of the TER with recommendations for further review by the licensee for specific deferrals.

For the Zion Nuclear Power Station, Units 1 and 2 IST program, relief is granted from, or alternatives are authorized to, the testing requirements which have been determined to be impractical to perform, where an alternative provides an acceptable level of quality and safety, or where compliance would result in a hardship or unusual difficulty without a compensating increase in quality or safety. Nine relief requests were granted provisionally or on an interim basis and require additional action by the licensee as discussed in Section 5.0 of the TER. Three relief requests were denied: (1) Relief Request VR-01 was denied because the proposed alternate testing of the safety injection accumulator tank discharge check valves did not appear to conform with the guidance provided in Generic Letter (GL) 89-04, Position 1, for testing with design basis flow rate or verifying obtuator full stroke by a positive means; (2) Relief Request VR-03 was denied because the proposed alternative to full stroke exercise the cold leg injection pressure isolation check valves by measuring total flow through multiple parallel lines may not identify a problem with an individual check valve; and (3) Relief Request VR-09 was denied because the proposed alternative did not provide a means to determine degradation in the containment spray pump cooling water solenoid valves. The licensee should take action prior to performing the next regularly scheduled IST, or within 90 days for tests performed quarterly, to ensure that the testing of these components complies with the Code or to develop additional justification for not complying with the Code (reference GL 91-18 for guidance on nonconforming conditions).

The authorization of the alternative requested in Relief Request PR-02 for using root-mean-square for monitoring the vibration of pumps is based on discussions and the approval of a Code Inquiry at the Operations and Maintenance meeting held March 8, 1994, in San Antonio, Texas. The Code Inquiry has not yet been published; however the ASME file number is OM94-2, as noted in Section 2.1 of the TER, and a copy may be obtained from ASME by referencing this number.

BNL, using the Zion Nuclear Power Station Updated Final Safety Analysis Report, conducted a scope review for the following Unit 1 systems against the requirements of Section XI and the regulations: auxiliary feedwater, main steam, reactor vessel head venting, containment spray, and service water. The review revealed seven items that did not appear to be in compliance with the Code requirements (see Section 5.2 of the TER). The licensee should review these items, as well as other systems that might contain similar problems, and revise the program as appropriate.

The IST program relief requests which are granted or authorized are acceptable for implementation provided the action items identified in Section 5.0 of the TER are addressed within one year of the date of the SE or by the end of the next refueling outage, whichever is later. Additionally, the granting of relief is based upon the fulfillment of any commitments made by the licensee in its basis for each relief request and the alternatives proposed.

Program changes involving new or revised relief requests should be submitted to the staff for review. New or revised relief requests that meet the positions stated in GL 89-04, Attachment 1, should be submitted to the staff but may be implemented provided the guidance in GL 89-04, Section D, is followed. Program changes that add or delete components from the IST program should also be periodically provided to the staff.

3.0 CONCLUSION

The Zion Nuclear Power Station requests for relief from the Code requirements have been reviewed by the staff with the assistance of its contractor, BNL. The TER provides BNL's evaluation of these relief requests. The staff has reviewed the TER and concurs with the evaluations and recommendations for granting relief or authorizing alternatives. A summary of the relief request determinations is presented in Table 1. The authorizing of alternatives or granting of relief is based upon the fulfillment of any commitments made by the licensee in its basis for each relief request and the alternatives proposed. The implementation of the IST program and relief requests is subject to inspection by the staff.

The staff has identified a number of generic deficiencies that affect plant safety and have frequently appeared as IST programmatic weaknesses. These are addressed by Generic Letter 89-04. In that letter, the staff delineated positions that describe deficiencies and explained alternatives to the ASME Code that the it considers acceptable. If alternatives are implemented in accordance with the relevant position in the generic letter, the staff has determined that relief should be granted pursuant to 10 CFR 50.55a(g)(6)(i) (now (f)(6)(i)) on the grounds that it is authorized by law, will not endanger life or property or the common defense and security, and is otherwise in the public interest. In making this determination, the staff has considered the public interest. In making this determination, the staff has considered the burden on the licensee that would result if the requirements were imposed.

For any relief granted pursuant to GL 89-04 the staff (with technical assistance from BNL) has reviewed the information submitted by the licensee to determine whether the proposed alternative follows the relevant position in the generic letter. If an alternative conforms to a position of the generic letter, it is listed as having been approved pursuant to GL 89-04 in Table 1 of the SE. Any anomalies in the relief request are addressed in the TER and identified in Table 1.

The licensee should refer to the TER, Section 5.0, for a discussion of recommendations identified during the review. The licensee should address each recommendation in accordance with the guidance therein. The IST program relief requests are acceptable for implementation provided the action items identified in Section 5.0 of the TER are addressed within one year of the date of this SE or by the end of the next refueling outage, whichever is later. The licensee should inform the staff within one year of the date of this SE of the actions taken, actions in progress, or actions to be taken, to address each of these items.

The staff concludes that the relief requests as evaluated and modified by this SE will provide reasonable assurance of the operational readiness of the pumps and valves to perform their safety-related functions. The staff has determined that granting relief pursuant to 10 CFR 50.55a (f)(6)(i) and authorizing alternatives pursuant to 10 CFR 50.55a (a)(3)(i) or (a)(3)(ii) is authorized by law and will not endanger life or property, or the common defense and security and is otherwise in the public interest. In making this determination, the staff has considered the impracticality of performing the required testing and the burden on the licensee if the requirements were imposed.

Attachment:
Table 1

Principal Contributors: Patricia Campbell and Joseph Colaccino

Date: May 6, 1994

SE Table 1 - Summary of Relief Requests
Zion Generating Station, Units 1 and 2

Relief Request No.	TER Sect.	Section XI Requirement	Equipment Identification	Proposed Alternate Method of Testing	NRC Action
PR-01	2.2.1	OM Part 6, ¶5.1, test frequency	Unit 1 and 2 Service Water Pumps	Perform tests during refueling outages and during scheduled cold shutdowns.	Relief granted in accordance with §50.55a(f)(6)(i) with provisions.
PR-02	2.1.1	OM Part 6, ¶5.2(d) and Table 2, vibration measurement	Unit 1 and 2 Safety Injection, Containment Spray, Component Cooling, AFW, RHR, SW, and Charging Pumps	Use RMS in lieu of peak measurements. Multiply the acceptance criteria by .707.	Alternative authorized in accordance with §50.55a(a)(3)(i).
PR-03		OM Part 6, ¶4.6.1.2(a), application of flowrate acceptance criteria quarterly.	Unit 1 and 2 RHR Pumps	Use only a minimum acceptance criteria for quarterly test using the minimum flow line. Comply with the Code acceptance criteria during cold shutdown "substantial test."	Relief granted in accordance with GL 89-04, Position 9.
PR-04	2.3.1	OM Part 6, Table 3a and ¶6.1, vibration acceptance criteria	Unit 1 and 2 Containment Spray Pumps	Delete required alert and required action absolute vibration limits. Perform maintenance on flexible coupling and vibration spectrum analysis.	Alternative authorized in accordance with §50.55a(a)(3)(ii).
PR-05	2.2.2	Part 6, ¶ 4.4, measurement of flowrate following maintenance	Unit 1 and 2 Service Water Pumps	Use brake horsepower as required test quantity following pump maintenance. Perform flow test during scheduled cold shutdown.	Relief granted in accordance with §50.55a(f)(6)(i), with provisions.
PR-06	2.4.1	OM Part 6, ¶5.2, measurement of parameters at a fixed reference value	Unit 1 and 2 AFW Pumps	Set the reference flowrate with a ±2.17% tolerance.	Alternative authorized in accordance with §50.55a(a)(3)(ii).
PR-07	2.5.1	OM Part 6, ¶5.2, measurement of parameters at a fixed reference value	Unit 1 and 2 Safety Injection Pumps	Set the reference flowrate with a ±10% tolerance.	Relief granted in accordance with §50.55a(f)(6)(i), for an interim period.

Attachment

SE Table 1 - Summary of Relief Requests
Zion Generating Station, Units 1 and 2

Relief Request No.	TER Sect.	Section XI Requirement	Equipment Identification	Proposed Alternate Method of Testing	NRC Action
PR-08	2.6.1	OM Part 6, ¶5.2, measurement of parameters at a fixed reference value	Unit 1 and 2 Component Cooling Water Pumps	Set the reference flowrate with a ±2.63% tolerance.	Alternative authorized in accordance with §50.55a(a)(3)(ii).
PR-09	2.7.1	OM Part 6, ¶5.2, measurement of parameters at a fixed reference value	Unit 1 and 2 Charging Pumps	Set the reference flowrate with a ±5.56% tolerance.	Alternative authorized in accordance with §50.55a(a)(3)(ii).
PR-10	2.2.3	OM Part 6, ¶5.2(b), measurement of parameters at a fixed reference value	Unit 1 and 2 Service Water Pumps	Set the reference flowrate with a ±5% tolerance.	Relief granted in accordance with §50.55a(f)(6)(i), for an interim period.
VR-01	3.1.1	OM Part 10, ¶4.3.2, test frequency	SI Accumulator Tank Discharge Check Valves, 1(2)SI8948A, B, C, D and 1(2)SI8956A , B, C, D	Test one valve each refueling outage using a reduced pressure test.	Relief denied.
VR-02	3.2.1	OM Part 10, ¶4.3.2, full-flow test method	Charging Pumps Minimum Flow Valves, 1(2)VC8542 A and B	Use pump curve to determine flow through valves.	Relief granted in accordance with §50.55a(f)(6)(i), for an interim period.
VR-03	3.1.2	OM Part 10, ¶4.3.2, full-flow test method	RHR Cold Leg Injection PIVs, 1(2)SI9001A, B, C, D and 1(2)SI9002A, B, C, D	Full flow exercise by ensuring total flowrate does not change during refueling outages. Partial-stroke exercise during cold shutdowns.	Relief denied.
VR-04		OM Part 10, ¶ 4.3.2.1, test frequency	Miscellaneous Check Valves	Sample disassembly and inspection of valves during refueling outages.	Relief granted in accordance with Generic Letter 89-04, Position2.
VR-05	3.3.1	OM Part 10, ¶ 4.3.2, Verification of closure capability quarterly	Steam Supply to AFW Pump Turbine Check Valves, 1(2)MS 0006 and 7	Pursue acoustic monitoring at refueling outages.	Relief granted in accordance with §50.55a(f)(6)(i), for an interim period.
VR-06	3.1.3	OM Part 10, ¶4.1, remote valve position indication verification frequency	Containment Recirculation Sump Isolation Valves, 1(2)MOV-SI8811A and B	Verify one valve each refueling outage (every 18 months).	Alternative authorized in accordance with §50.55a(a)(3)(ii), with provisions.
VR-07	3.1.4	OM Part 10, ¶4.3.2.4(a), individual valve obturator movement verification	High Head SI Header RCS Isolation Valves, 1(2)SI8900A, B, C, D and 1(2)SI9032.	Verify pairs of valves are closed by monitoring upstream pressure.	Relief granted in accordance with §50.55a(f)(6)(i), with provisions.

SE Table 1 - Summary of Relief Requests
Zion Generating Station, Units 1 and 2

Relief Request No.	TER Sect.	Section XI Requirement	Equipment Identification	Proposed Alternate Method of Testing	NRC Action
VR-08	3.2.2	OM Part 10, ¶4.3.2.4(a), individual valve obturator movement verification	RCP Seal Injection Check Valves, 1(2)VC8367A, B, C; 1(2)VC836D, 1(2)VC8375A, B, C, D	Leak test pairs of valves in series during refueling outages.	Relief granted in accordance with §50.55a(f)(6)(i), with provisions.
VR-09	3.4.1	OM Part 10, ¶4.2.1.2, quarterly measurement of valve stroke times.	CS Pumps' Cooling Water Solenoid Valves, 1(2)SOV-SW0153	Verify flowrate through valves is within a certain range.	Relief denied.

TECHNICAL EVALUATION REPORT

Zion Nuclear Generating Station Units 1 and 2
Commonwealth Edison Company
Pump and Valve Inservice Testing Program
Revision 6/93, Third Ten-Year Interval

Docket Number: 50-295 and 304
TAC Number: M87550 and 87551

Prepared by:
A. Fresco, E.J. Grove and A. M. DiBiasio
Engineering Technology Division
Department of Advanced Technology
Brookhaven National Laboratory
Upton, New York 11973

Prepared for:
P. L. Campbell, NRC Lead Engineer
Division of Engineering
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, DC 20555

FIN L-2301, Task Assignment 8

March 16, 1994

ABSTRACT

This report presents the results of Brookhaven National Laboratory's evaluation of the relief requests, deferred testing justifications and, for selected systems, a review of the scope of the Zion Nuclear Generating Station Units 1 and 2's ASME Section XI Pump and Valve Inservice Testing Program.

CONTENTS

Technical Evaluation Report
Pump and Valve Inservice Testing Program
Zion Station Units 1 and 2

1.0 INTRODUCTION

Contained herein is a technical evaluation of ASME Section XI pump and valve inservice testing (IST) program submitted by Commonwealth Edison Company for its Zion Nuclear Generating Station Units 1 and 2. The Zion Plants are Westinghouse Pressurized Water Reactors (PWR) that began commercial operation in December 1973 (Unit 1) and September 1974 (Unit 2).

Commonwealth Edison Company submitted Revision 6/93 of the Third Ten-Year Interval Inservice Testing Program on August 31, 1993. This program revision supersedes all previous submittals. The third ten year interval will commence June 1994, as allowed by Section XI, IWA-2430(d). The licensee states that this program is based on the requirements of the 1989 Edition of the ASME Section XI Code.

Title 10 of the Code of Federal Regulations, §50.55a ¶(f) requires that inservice testing of ASME Code Class 1, 2, and 3 pumps and valves be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel Code and applicable addenda, except where specific relief has been requested by the licensee and granted by the commission pursuant to §50.55a ¶(a)(3)(i), (a)(3)(ii), or (f)(6)(i). Section 50.55a ¶(f)(4)(iv) provides that inservice testing of pumps and valves may meet the requirements set forth in subsequent editions and addenda that are incorporated by reference in paragraph (b) of §50.55a, subject to the limitations and modifications listed, and subject to Commission approval. In rulemaking to 10CFR50.55a, effective September 8, 1992 (see Federal Register, Vol. 57, No. 152, page 34666), the 1989 Edition of ASME Section XI was incorporated into paragraph (b) of § 50.55a. The 1989 Edition provides that the rules for inservice testing of pumps and valves are as specified in ASME/ANSI OMa-1988 Part 6 and 10, respectively.

The review of the relief requests was performed utilizing the Standard Review Plan, Section 3.9.6, "Inservice Testing of Pumps and Valves"; Generic Letter No. 89-04, "Guidance on Developing Acceptable Inservice Testing Programs;" the Minutes of the Public Meeting on Generic Letter 89-04, dated October 25, 1989; and Draft NUREG-1482, "Guidelines for Inservice Testing at Nuclear Power Plants." The IST Program requirements apply only to component (i.e., pump and valve) testing and are not intended to provide a basis to change the licensee's current Technical Specifications for system test requirements.

Section 2 of this report presents the nine pump relief requests and Brookhaven National Laboratory's (BNL) evaluation. Similar information is presented in Section 3 for eight relief requests for the valve testing program. The two relief requests that are authorized by Generic Letter 89-04 are not specifically evaluated in this Technical Evaluation Report. However, any anomalies associated with the relief requests are addressed in Section 5 of the report.

Section 4 contains the evaluation of Commonwealth Edison Company's justifications to defer valve testing to cold shutdowns and refueling outages. Section 5 summarizes the recommended actions for the licensee, resulting from these evaluations herein, and the review of the IST Program scope for selected systems. BNL recommends that the licensee resolve these items in accordance with the evaluations, conclusions, and guidelines presented in this report.

2.0 PUMP IST PROGRAM RELIEF REQUESTS

In accordance with §50.55a, Commonwealth Edison Company has submitted ten relief requests for pumps at the Zion Station, Unit 1 and 2 which are subject to inservice testing under the requirements of ASME Section XI. One pump relief request (PR-03) was authorized by Generic Letter 89-04, and is not included in this Section. The relief requests not authorized by Generic Letter 89-04 have been reviewed to verify their technical basis and determine their acceptability. These nine relief requests, along with the technical evaluation by BNL, are summarized below.

2.1 Generic Pump Relief Requests

2.1.1 Relief Request Number: PR-02

Relief Request: The licensee requests relief from OM Part 6, ¶ 5.2(d) and Table 2, "Inservice Test Parameters," which states that for vibration measurements, if velocity measurements are used, they shall be peak for the Component Cooling (0CC003 through 7), Containment Spray (1(2)CS001 through 3), Auxiliary Feedwater (1(2)FW004 through 6), Residual Heat Removal (1(2)RH001 and 2), Safety Injection (1(2)SI003 and 4), Service Water (1(2)SW001 through 3), and Charging (1(2)VC006 and 7) pumps.

Proposed Alternate Testing: Vibration measurements will be taken in Root Mean Square (RMS) in lieu of peak. Ranges for all centrifugal and vertical line shaft pumps, except for 1(2)CS003 which are explained in Relief Request PR-04, with pump speed greater than or equal to 600 rpm will be as follows:

Acceptable Range: ≤2.5 Vr
Alert Range: 2.5 Vr to 6 Vr or .23 in/sec RMS
Required Action Range: > 6 Vr or .49 in/sec RMS

Vr is the vibration reference value in in/sec RMS.

Licensee's Basis for Relief: The licensee states: "Zion Station proposes to take vibration velocity measurements in Root Mean Square (RMS), as an alternative to measurements being taken in peak. The European standard of reporting vibration measurements is in RMS. The North American standard of measuring vibration is in peak. Experts have written that RMS is a quantity most representative of component condition. Zion has had a long history of monitoring pump vibrations and these past measurements have been in RMS. Zion has found RMS to be an appropriate means for monitoring pump vibration. With RMS, Zion has been able to identify vibration-induced problems with pumps and has taken appropriate corrective actions prior to failure.

There are several attributes to taking vibration measurements in RMS. RMS is a measure of the effective energy used to produce the vibration of the machine. RMS has a direct relationship to the power content of the vibrations. RMS provides a better indication of overall vibration severity since RMS measurements take all vibration peaks into account over a given time period.

Peak measurements are useful for pure harmonic vibration. For other types of vibration, peak measurements may not be as effective because they are based only on the highest instantaneous peak vibration amplitude. Zion's pumps do not experience pure harmonic vibration the majority of the time.

The IST pumps are a small subset of Zion's overall rotating equipment currently monitored as part of Zion's Vibration Program. The Vibration Program currently uses RMS values as the standard measurement parameter for all machines measured.

Conducting future vibration measurements in peak instead of RMS would result in establishing and maintaining 2 different vibration standards. Zion would be required to perform the arduous tasks of administration and implementation of procedure changes (>50); to retrain vibration test personnel to recognize which equipment required RMS and peak; and to monitor through analysis and evaluation 2 sets of data in either RMS or peak for the entire pump/motor combination.

Zion has developed alert and action limits in in/sec RMS calculated with the .707 multiplier. This would provide for the absolute limiting values of the Alert Range >0.23 in/sec RMS in lieu of the >.325 in/sec of Part 6 and the Required Action Range 0.49 in/sec RMS in lieu of the 0.70 in/sec peak. The reference value multipliers of 2.5 and 6 for Alert and Required Action would remain unchanged. Zion Station meets the other requirements for vibration measurements contained in the Code (except for pumps 1(2)CS003 which have the exceptions explained in Relief Request PR-04)."

Evaluation: As the licensee has stated, the United States standards generally use vibration measurements in peak or peak-to-peak, while European standards use RMS. OM Part 6, ¶5.2(d) requires vibration velocity measurements to be broad band (unfiltered) and peak. The licensee has stated that "Experts have written that RMS is a quantity most representative of component condition," without reference to the "experts." The root-mean-square measurement is the total area beneath the vibratory curve, i.e.,

$$RMS = \sqrt{\frac{1}{T}\int_{o}^{T} v\ (t)^2 dt}\ .$$

It is calculated by a circuit which square the instantaneous amplitude, sums it over time, averages the result, and then computes the square root of that value. The peak measurement is the absolute highest amplitude reading over a given period of time. The issue between using peak or RMS vibration measurements is whether the measurement "should be responsive to non-sinusoidal, high frequency impact excitation (true peak) or to low frequency energy (RMS)." Based on our literature review, there does not appear to be an industry consensus that RMS readings provide a better indicator of pump condition.

RMS is the unit in which electronic instruments measure amplitude of sine waves. The RMS is a measure of the energy content of the sine wave and is equal to 0.707 (sine of 45°) multiplied by the peak (for pure sine waves). Besides sine waves, which are pure tones, there are two other types of vibrations: (1) random, such as tones caused by friction, and (2) shock pulses, such as tones caused by impacts. True peak values may be far greater than 1.414 (1/sine 45°) times RMS. The recently published ASME Guide titled "Vibration Monitoring of Rotating Equipment in Nuclear Power Plants," Part 14 (Reference 13), states that RMS amplitudes "are useful for varying amplitudes but tend to mask impact signals." Vibration consultant James Berry, of Technical Associates of Charlotte, Inc. (Reference 14) states, "The real disparity between true peak and true RMS readings occurs when problems such as rolling element bearing wear, a worn or broken gear tooth, cavitation, rub, or other problems which may involve impact are present. In these cases, the time waveform can show pronounced spikes which tend to smooth out and then reoccur when the impact event takes place. In essence, RMS measurements tend to average the "energy under the curve" whereas true peak or true peak-to-peak measurements will measure the total height travelled." Bentley Nevada, a supplier of peak-to-peak vibration instruments, in a paper titled "Understanding Vibration Measurement" (Reference 15), "strongly recommends use of the zero-peak measurement...zero-to-peak is synonymous with true peak....Diagnostic instruments need a broadband high speed response to capture as much information from the signal as possible, to provide a machinery diagnostic engineer with the data necessary to diagnose machinery and instrumentation faults."

One source (Reference 16) recommended using both RMS and peak measurements to assess pump condition. "The rule of thumb then is to use either RMS measurements or RMS measurements multiplied by a conversion factor at low frequencies at which damage is largely a function of the energy being put into the system. Use true peak measurements at high frequencies to detect defects that indicate impacts and potential problems". A number of sources (References 14, 16, and 17) state that when most analyzers measure vibration, the readings are in RMS and are simply multiplied by 1.414 for converting to peak measurements.

The ASME Operation and Maintenance Code Committees have recently considered the use of RMS in lieu of peak. Section XI, prior to the 1988 Addenda, required that vibration be 'read' in peak-to-peak. This could be interpreted to mean that it is acceptable to measure RMS, convert it to peak-to-peak, and read it as peak-to-peak. OM Part 6 removed this ambiguity and requires vibration to be measured in peak or peak-to-peak. Newer digital equipment now measures directly in peak. The ten-year update required by 10CFR 50.55a of the ISI and IST programs reflects the need for licensees to incorporate new technologies incorporated into the Codes. However, there is continuing debate within the Code committees on whether the use of RMS measurements is acceptable for determining the operational readiness of pumps. A Code inquiry has been submitted (ASME file #OMI94-2). The Code committees have recently clarified the intent of the Code, which is to allow the use of a calculated peak (based on a mathematical conversion of RMS).

Based on the ASME Code interpretation, the use of RMS is considered equivalent to the use of the Code required peak measurements. Therefore, it is recommended that the alternative be authorized in accordance with 10CFR50.55a(a)(3)(i).

2.2 Service Water Pumps, 1(2)SW001, 2, 3

2.2.1 Relief Request Number: PR-01

Relief Request: The licensee requests relief from OM Part 6, ¶5.1, which requires that an inservice test be run nominally every 3 months during normal plant operation.

Proposed Alternate Testing: "Inservice testing on the SW pumps can be performed during refueling outages and during scheduled cold shutdowns. The testing need not be performed more often than once every 3 months if conditions permit. This alternative will provide reasonable assurance of continued operational readiness."

Licensee's Basis for Relief: The licensee states: "Permanent flow instrumentation is installed on the common discharge headers for the Service Water (SW) pumps on both units. Flow instrumentation could not be installed on the individual discharge lines because the plant design did not provide a sufficient length of straight pipe needed to obtain accurate flow measurements. In order to test the pumps individually, two of the SW pumps on the Unit being tested must be secured and the cross-tie valves between units must be closed.

Additionally, pressure switches located on the common unit supply headers will auto start an idle pump if the header pressure drops below the setpoint. The low pressure needed to cause an auto start occurs when both units are at power, cross-tie valves closed, and only one pump supplying a unit. Auto start of the idle pump will then result in the flow from both units being monitored by the common flow instrument. The auto start function is designed to maintain header pressure above the minimum design for service water during a Design Basis Event.

Individually flow testing the SW pumps at normal plant operation would jeopardize safety. Per UFSAR Section 9.2.1, two SW pumps per Unit are required during normal plant operations to provide adequate cooling. During normal plant operations, operating the system as required for individual quarterly testing of the SW pumps would violate the SW system design requirements described in the UFSAR and place the plant in an unsafe operating condition."

Evaluation: At Zion, service water is provided by six vertical turbine pumps which feed two separate main supply headers (one header per unit, three pumps per header). The headers are crosstied so any combination of pumps can serve both units under normal operating conditions. As stated in UFSAR Section 9.2.1, normal operation requires two pumps for each unit, with the third pump serving as stand-by. During emergency shutdown and accident conditions, one pump is required for each unit.

The licensee states that permanent flow instrumentation is installed on the common discharge headers, but not on the individual pump discharge lines, due to the lack of sufficient length of straight pipe needed to obtain accurate flow measurements. A review of P&ID M-32 Sheets 1 and 4, Diagram of Service Water Zion Station Unit 1 and 2, confirms the absence of individual pump discharge flow meters. The licensee states that individual pump flow testing would jeopardize plant safety, and would require that 2 of the 3 pumps be secured, and the cross-tie valves between units closed.

In lieu of the quarterly flow testing as required by OM Part 6 ¶ 5.1, the licensee has proposed testing the pumps during refueling outages and cold shutdowns, but not more frequently than once every three months if conditions permit. As stated in Table 3.1-1 Units 1 and 2 Pumps Inservice Testing Plan Listing, the licensee intends to take differential pressure, flow, and vibration measurements during these tests. The NRC has previously provided guidance (Generic Letter 89-04, Position 9) that an increased interval for measuring flow may be an acceptable alternative to the Code requirements, provided that pump differential pressure, flow rate, and bearing vibration measurements are taken during this deferred testing, and that quarterly testing including measuring at least pump differential pressure and vibration is continued. The licensee has not discussed measuring pump differential pressure and vibration quarterly in accordance with the Code. Deferring all measurements to the cold shutdown or refueling outage frequency provides no means to assure pump operability quarterly. However, based upon relief request PR-05, it appears that brake horsepower, differential pressure, and vibration will be measured quarterly.

Meeting the Code requirements to measure flow quarterly would present a burden to the licensee necessitating extensive plant modifications and an extended outage to install individual pump flow meters. Based on the impracticality of meeting Code requirements given the existing plant configuration, and the alternative providing an acceptable level of quality and safety, it is recommended that relief to measure flow during refuelings or cold shutdowns be granted in accordance with §50.55a ¶(f)(6)(i), provided that the licensee measures vibration and differential pressure quarterly in accordance with the Code.

2.2.2 Relief Request Number: PR-05

Relief Request: The licensee requests relief from measuring individual pump flow rates following maintenance as required by OM Part 6, ¶ 4.4, "Effect of Pump Replacement, Repair, and Routine Servicing on Reference Values."

Proposed Alternate Testing: "The proposed alternative would only be necessary during power operation after a SW pump has been replaced, repaired, or serviced where reference value(s) may have been affected. Zion considers this maintenance to be infrequent during power operation. Therefore, this test methodology may be performed only on those rare occasions.

When a pump has been serviced offsite where reference values may have been affected, the OEM or equivalent test facility will test the pump. Pump head, flow, and brake horsepower will be measured to establish a new combination pump and motor characteristic curve. As part of this test, data will be taken at the previous IST flow reference value. The corresponding head and brake horsepower will be considered the "previous" (Subarticle 4.4) reference test quantities to be used with the first inservice test at Zion Station.

When a pump has been serviced on site where reference values may have been affected, the corresponding head and brake horsepower at the previous IST reference values from the latest combination pump and motor characteristic curve will be considered the "previous" (Subarticle 4.4) reference test quantities to be used with the first inservice test at Zion Station.

Following installation of a replaced, repaired, or serviced pump off-site or on-site where reference values may have been affected, Zion will perform an inservice test at power. Zion will use brake horsepower as a required test quantity. Flow will be manipulated until the brake horsepower corresponding to the reference flow is achieved. When stable, the pump head and vibration will be measured. These values will be the new reference values for subsequent IST.

As required by Subarticle 4.4, deviations between the previous and new set of reference values shall be identified. Zion will compare the previous head with the new values. The most recent inservice test vibration reference values will be compared with the new values. The previous flow rate will be reconfirmed by varying the system resistance to the corresponding brake horsepower value. Verification that the new values represent acceptable pump operation shall be placed in the record of tests.

In addition, during the next inservice test, performed during a scheduled cold shutdown, Zion will perform this alternative testing described above. This test will be analyzed for satisfactory operation. If satisfactory, Zion may establish an additional set of reference values from a second test, as allowed by Subarticle 4.5, where flow rate will be measured. This will enable Zion to conduct subsequent IST in accordance with OM, Part 6 at the frequency discussed in PR-01."

Licensee's Basis for Relief: The licensee states: "Permanent flow instrumentation is installed on the common discharge headers for the Service Water (SW) pumps on both units. Flow instrumentation could not be installed on the individual discharge lines because the plant design did not provide a sufficient length of straight pipe needed for accurate flow measurements. In order to test the pumps individually, two of the SW pumps on the Unit being tested must be secured and the cross-tie valves between units must be closed.

Additionally, pressure switches located on the common unit supply headers will auto start an idle pump if the header pressure drops below the setpoint. The low pressure needed to cause an auto start occurs when both units are at power, cross-tie valves closed, and only one pump supplying a unit. Auto start of the idle pump(s) will then result in the flow from all pumps being monitored by the common flow instrument. The auto start function is designed to maintain header pressure above the minimum design for service water during a Design Basis Event.

Individually flow testing the SW pumps during normal plant operation would jeopardize safety. Per UFSAR Section 9.2.1, two SW pumps per Unit are required during normal plant operations to provide adequate cooling. During normal plant operations, operating the system as required for inservice testing would violate the SW system design requirements described in the UFSAR and place the plant in an unsafe operating condition.

Zion proposes an alternative to the requirements in Subarticle 4.3, 4.4 and 5.2. During normal plant operation the alternative test would be performed without measurement of flow rate following maintenance where reference values may have been affected. This alternative provides an acceptable method to test the SW pump/motor combination because for each unique flow and head point on the pump performance curve there is a corresponding brake horsepower."

Evaluation: OM Part 6 ¶1.3 defines reference values as "one or more values of test parameters measured or determined when the equipment is known to be operating acceptably." For pumps, test parameters include speed, differential pressure, discharge pressure, flow rate, and vibration (displacement or velocity) (OM Part 6 ¶5.2). When a reference value(s) may have been affected by pump replacement, repair, or routine servicing, new reference value(s) shall be determined, or the previous value(s) reconfirmed prior to declaring the pump operable (OM Part 6 ¶4.4).

Due to plant design limitations, individual SW pump discharge flow rate cannot be accurately measured with the plant at power. In order to test the pumps individually, two of the SW pumps would need to be secured, and the cross-tie valves between the units closed. To accomplish this safely, the plant would need to be shutdown, or the power significantly reduced. This would be unnecessarily burdensome if an acceptable alternative is available for the period between restoration following maintenance, and the next scheduled cold shutdown, when testing with flow measurement could be performed.

The licensee proposes to use brake horsepower, instead of flow rate as the set reference parameter when performing the retest to verify pump operability following onsite or offsite maintenance. Brake horsepower is the actual power developed by the pump as measured by an absorption dynamometer applied to the shaft. Brake horsepower is calculated from output flow (varies with the cube of the flow) (References 22 and 23) and inlet and outlet pressures, and provides a reasonable alternative to the pump test methodology described in OM Part 6 ¶5.2 which sets either flow or differential pressure.

Following offsite maintenance, pump head, flow, and brake horsepower will be measured at the repair facility to establish a new combination pump and motor characteristic curve. Included in this test will be data taken at the previous IST flow reference value. The corresponding head and brake horsepower will be considered the previous reference test quantities to be used with the first IST test at the plant as stated in OM Part 6 ¶4.4. Following onsite maintenance, the corresponding head and brake horsepower at the previous IST reference values from the latest combination pump and motor characteristic curve will be considered the reference test quantities.

Following this maintenance (onsite or offsite), the licensee will perform an IST test at power using brake horsepower as the required test quantity. Flow will be manipulated until the brake horsepower corresponds to the reference value. When stable conditions have been reached, pump head and vibration will be measured. These values will serve as the new reference values for subsequent IST tests. Any deviations between these values and the previous reference values shall be identified, and documentation shall be placed in the record of tests that these new values represent acceptable pump operation.

During the next inservice test, performed at scheduled cold shutdowns, the licensee will perform an additional test where flow rate is measured. This will enable Zion to conduct subsequent IST during cold shutdowns, as described in PR-01. The licensee should perform this test during the next cold shutdown of suitable length to allow testing, regardless of whether it is "scheduled".

The licensees proposed alternative to test the pumps measuring brake horse power in lieu of flow following maintenance, coupled with flow rate measurements during the next cold shutdown, provides an adequate means to monitor the pumps for degradation. In addition, a quarterly pump test, measuring pump vibration and differential pressure, will provide information on any significant pump degradation. This test methodology provides reasonable assurance of the operational readiness of the SW pumps following maintenance, and is an acceptable interim test until an inservice test, with flow measuring, in accordance with OM Part 6 ¶4.4, can be performed at the next cold shutdown.

Meeting the Code requirements would present a burden to the licensee by necessitating extensive plant modifications and an extended outage to install individual pump flow meters. Based on the impracticality and the burden on the licensee, and the alternative providing an acceptable level of quality and safety, it is recommended that relief be granted in accordance with §50.55a ¶(f)(6)(i), with the provision that this test is performed during the next cold shutdown of suitable length, regardless of whether the cold shutdown was "scheduled".

2.2.3 Relief Request Number: PR-10

Relief Request: The licensee requests relief from OM Part 6, ¶ 5.2(b), which requires: "The resistance of the system shall be varied until the flow rate equals the reference value. The pressure shall then be determined and compared to its reference value. Alternatively, the flow rate can be varied until the pressure equals the reference value and the flow rate shall be determined and compared to the reference flow rate value."

Proposed Alternate Testing: "Zion will utilize a flow tolerance of ±500 gpm from the reference (set-value) when testing the service water pumps. The differential pressure will be compared to Table 3b limits to ensure the measured value is within ±10% of the pressure reference value."

Licensee's Basis for Relief: "The following facts apply:

1) The hydraulic performance test for the service water (SW) pumps is performed with the unit at cold shutdown per relief request PR-01.

2) The only flow instrumentation available for this test is an annubar flow element inserted into a 48 inch diameter pipe coupled with an "Eagle Eye" flow indicator.

3) The smallest increment of the "Eagle Eye" flow indicator used to measure flow is 1000 gpm.

4) The "Eagle Eye" flow indicator experiences large flow fluctuations while measuring flow in the 48 inch diameter pipe. These fluctuations have been attributed to low flow characteristics through the 48 inch diameter pipe with one SW pump operating.

5) Ultrasonic flow instrumentation has been utilized in the past in an attempt to measure flow in the 48 inch diameter pipe. The flow indication output did not vary with different pump combinations. In addition, the signal fluctuated widely. As a result, accurate flow measurements were not achievable.

Zion has assigned a tolerance on attainment of the reference flow (the set-value) due to the combination of the above listed facts. This tolerance is assigned as ±500 gpm. The assigned tolerance represents ±5% of the current flow reference value. This tolerance represents a deviation from the Code requirement referenced above and exceeds ±2% of the reference value as discussed in the NRC Safety Evaluation dated June 14, 1993."

Evaluation: OM Part 6 ¶5.2(b), specifies that pumps are to be tested quarterly by varying the resistance of the system until either the flow rate or the pressure equals a reference value, and the corresponding pressure or flow rate determined and compared to reference values. The Code does not allow for variance from a fixed reference value. The basis for the NRC's acceptance of the ±2% of the reference value is from Section XI, IWP-4150 which provides the requirements for instrument fluctuation. IWP-4150 allows symmetrical damping devices or averaging techniques to reduce instrument fluctuations to within 2% of the observed reading. The use of the ±2% of the reference value in this position is to allow the licensee to specify values in the implementing procedures.

These vertical turbine pumps provide strained lake water for cooling safety and non-safety related heat exchangers and equipment during normal and emergency conditions, and are tested during cold shutdowns. The licensee states that the only flow instrumentation available is an analog instrument inserted into the 48 inch diameter pipe. The smallest increment of flow on the flow element associated with this indicator is 1000 gpm. The licensee has reported large flow fluctuations while measuring flow through this pipe. These fluctuations were attributed to the low flow characteristics through this pipe with one SW pump. The licensee has investigated ultrasonic flow indication, but found that the flow indication did not vary with different pump characteristics, and that the signal varied widely.

The importance of ensuring the operability of the SW system has been addressed by the NRC through the issuance of Generic Letter 89-13, the four public workshops associated with this GL, and Information Notice (IN) 94-03. The currently installed flow instrumentation with increments of 1000 gpm, limits the precision of the flow measurements to ±500 gpm, which exceeds the Code tolerance by ±300 gpm. The licensee has investigated the possibility of ultrasonic flow indication, but concluded that more accurate flow measurements were not achievable. As discussed in Draft NUREG-1482, Section 5.5.1, the NRC does not consider the installation or replacement of instruments to meet the requirements of the Code an undue burden. The licensee has not discussed the procurement of a more precise permanent flow element (increments < 1000 gpm). The intent of measuring the specified pump parameters, to the Code specified accuracy, is to ensure that pump degradation is detected before operability is affected. The licensee has not provided any discussion to ensure that the large flow variance obtainable from the current instrumentation will not cause pump degradation to be overlooked.

The licensee states in the proposed alternate testing that "The differential pressure will be compared to Table 3b limits to ensure the measured value is within ±10% of the pressure reference value." For vertical line shaft pumps, OM Part 6 Table 3b requires that the test frequency be doubled when the differential pressure decreases by 5% of the reference value, and that the pump be declared inoperable when the differential pressure decreases by 7%, or increases by 10%, of the reference value. The licensee has not provided any information on what action will be taken when this situation arises during cold shutdown testing. The NRC has provided guidance for valves in the same situation in Draft NUREG-1482, Section 4.2.1. Corrective action is required prior to returning the plant to power, or the plant must be returned to a mode which permits testing every one and one-half months. The licensee should revise this Relief Request appropriately to discuss these discrepancies.

The licensee has requested relief from measuring the flow to the Code specified ±2% (±200 gpm) of the reference value to ±500 gpm (± 5%). Immediate imposition of the Code requirements would be burdensome since it may result in the SW pumps being removed from service while the licensee investigates the availability of a higher precision flow indicator. The presently installed flow indicator provides reasonable assurance of SW pump operability for this interim period. Based upon this information, it is recommended that interim relief be granted for one year, or until the next refueling outage, whichever is later, in accordance 10 CFR 50.55a (f)(6)(i). During this period, the licensee should investigate the availability of a more precise flow element which could provide flow indications in compliance with the Code. If not possible, the licensee should revise this relief request to provide a discussion demonstrating why the flow variance is not sufficiently large as to result in pump degradation being overlooked. The relief request should also explain what actions will be taken when the pumps enter the Alert and Required Action Ranges during cold shutdown testing. The licensee may also consider providing additional information on the applicable portion of the pump curves and instrument accuracy (similar to PR-09), to support the relief request.

2.3 Containment Spray Pumps, 1(2)CS003

2.3.1 Relief Request Number: PR-04

Relief Request: The licensee has requested relief from OM Part 6, Table 3a, which provides vibration amplitude allowed ranges, and ¶ 6.1, which states corrective action based on Table 3a.

Proposed Alternate Testing: "A rigorous preventive maintenance program is proposed whereby the flexible coupling rubber blocks would be removed, examined, compared to previous removals to detect significant changes, and replaced each refueling outage. This particular item is proposed because the flexible coupling is the power transmission link between the diesel engine and the pump, and would generally be the first physical indication (exclusive of observed vibration levels) of any detrimental engine-induced vibration effects.

Zion Station recommends, for the reasons given in the basis above, that the alert and action range absolute values be deleted and the multipliers of Vr (Vr = vibration reference value) which determine the allowable ranges be reduced to define reasonable allowable ranges (i.e., Alert: >1.2 Vr to 1.5 Vr; Action: >1.5 Vr) for the diesel driven CS Pumps.

Additionally, pump vibration spectrum plots would be recorded each time the required quarterly test is performed. The resultant spectra would be compared to spectra previously obtained and a thorough analysis would be performed on deviations identified. Thus, a realistic trending effort would be undertaken whereby minute changes to pump performance could be evaluated far in advance of any actual degradation. This vibration trending methodology would provide confidence in equipment reliability and exceeds the requirements addressed by Subarticle 5.2.d."

Licensee's Basis for Relief: The licensee states: "If relief is granted as requested in PR-02 then this basis will be applicable in regards to Table 3a. (Note: PR-02 requests the use of RMS in lieu of peak vibration readings).

The diesel driven CS Pumps have an inherent higher normal vibration level as compared with other pumps by virtue of their having a reciprocating engine as a pump driver. The reciprocating action of the engine creates vibration transients which are then induced into the pump. These transients cause vibration levels which frequently place the component in the alert range.

The proposed revision of vibration allowable limits allows trendir - and observation of the subject component, without unnecessarily declaring a component in the alert or action range. This stance is reasonable in light of the fact that Table 3a assigns different values for positive displacement pumps than for centrifugal pumps. Reciprocating (positive displacement) pumps are not required to have an absolute limit for vibration assigned. The parallel reasoning may be easily drawn between pumps and drivers; specifically a reciprocating engine driver (with its reciprocating linear motion and the attendant power strokes) that would generate significantly more vibration than a motor or turbine driven pump.

A detailed study of the vibration and maintenance history of this driver/pump combination has been performed, and no detrimental vibration characteristics have been observed in the pump. Bearings, impeller, shaft and body have displayed no undesirable conditions which can be attributed to vibration. In an effort to mitigate the effects of the diesel engine on the pumps, flexible couplings have been installed but observed vibration levels remain in excess of the alert range absolute value. While observed vibration levels were reduced slightly, no significant improvement was noted.

During evaluation of frequency spectrum plots, the diesel engine displays certain component type-specific frequency characteristics. These characteristics, also appearing in the pump spectrum plot, are unlike those generated by a motor-driven pump of this design. The frequency plot can discriminate between discrete frequencies, so that engine-generated vibration will not mask the vibration characteristics generated by a degraded pump.

The high observed pump vibration levels display frequency characteristics identical to those observed on the diesel engine. The engine supplier has indicated that the current engine vibration amplitudes are acceptable. In addition, the engine shares a common rigid mounting base with the pump. These engine frequency characteristics are attributable to installation-specific driver-induced vibration, and are not considered to be detrimental to proper component or system operation for the following reasons.

While high vibration is certainly a condition to be avoided in any installation, the recorded maintenance and vibration history of this component shows no indication of any induced adverse effects. The observed vibration predominant peak is at a frequency normally associated with misalignment. But this vibration is not attributable to misalignment, since this component has been aligned satisfactorily as evidenced by maintenance records. The possibility of temperature effects on alignment have been addressed. The pump has proven to consistently operate at its normal vibration level independent of component temperature. The other possible causative condition for this type of frequency characteristic is the pump's structural coupling with the diesel engine driver. The frequency characteristics demonstrate that the engine is clearly inducing vibration into the pump.

Vibration levels of a constant amplitude are less detrimental to rotating equipment at lower frequencies than those at higher frequencies. Any vibration thus generated by the diesel engine would be considerably less detrimental to the pump than the high frequency of vibrations normally associated with pump rotating element degradation because of the naturally lower frequency of incidence of the engine vibration. Any incidence of unbalance, misalignment or other detrimental conditions could be detected by spectral analysis and corrected.

A physical solution to high vibration was explored, that of physically splitting the pump/driver base to structurally isolate the pump from the driver. Aside from the physical challenge presented by this modification, significant mechanical and structural re-analyses would be necessitated. These analyses would be prohibitively expensive without a corresponding increase in quality, safety or reliability."

Evaluation: OM Part 6 ¶5.1 requires pump vibration to be measured quarterly and compared with corresponding reference values. Deviations from these reference values shall be compared with the limits given in Table 3a, and corrective actions taken per ¶6.1. OM Part 6 allows for the use of either pump displacement or velocity vibration measurements, and provides acceptance criteria for each. Specific acceptance criteria is provided for both centrifugal and reciprocating (positive displacement) pumps. Centrifugal pumps have an absolute limit for vibration assigned, while reciprocating pumps do not.

The licensee has stated that though the Containment Spray pump is a centrifugal type pump, because the driver is a reciprocating engine, it may be more appropriate to use the limits for reciprocating pumps, which does not include an absolute limit. International Standard ISO-2372, "Mechanical Vibration of Machines with Operating Speeds From 10 to 200 rev/s-Basis for Specifying Evaluation Standard," 1974 Edition, (Reference 27) provides guidance for several classes of machines. For Class VI machine and mechanical drive systems with unbalanced inertial effects (due to reciprocating parts), root-mean-square "velocities of 20 to 30 mm/s (.8 to 1.2 in./sec.) and higher may occur without causing trouble. In addition, if couples are acting, large displacements may be caused at points which are at some distance from the center of gravity. Resiliently mounted (Class VI machines) permit a greater tolerance in this respect." Therefore, the pump/engine unit may operate at a higher level of vibration without detrimental effects.

The licensee indicated that a detailed study of the vibration and maintenance history associated with this pump/driver combination was performed, and no detrimental vibration characteristics were observed in the pump. Bearings, impeller, shaft, and body displayed no undesirable condition which could be attributed to vibration. In an effort to mitigate the effects of the diesel engine on the pumps, flexible couplings were installed, but observed vibration levels remained in excess of the alert range absolute value. While observed vibration levels were reduced slightly, no significant improvement was noted.

If the Code requirements were imposed, the licensee would be required to physically split the pump/driver base to structurally isolate the pump from the base. In addition to the physical changes required to accomplish this, significant mechanical and structural reanalysis would be required. This would present a hardship without a corresponding increase in quality, safety, or reliability. Continuing to test the diesel-driven pump as per the Code, with vibration levels frequently in the alert range, will result in doubling the frequency of the test, which may cause unnecessary wear to the diesel, resulting in a potentially less-reliable diesel-driven pump.

In lieu of the Code requirements, the licensee's proposed rigorous preventive maintenance program (consisting of flexible coupling removal, inspection, and replacement each refueling), coupled with quarterly spectrum analysis, with an alert range defined as >1.2Vr to 1.5Vr, and a required action range defined as >1.5Vr, provides a reasonable alternative. The quarterly spectrum analysis of the quarterly vibration data (including trending of the data to previous data) will provide a comprehensive and sensitive technique of assessing pump condition capable of providing indications of pump degradation. Together, the alternative will provide adequate pump monitoring.

Based upon the undue burden upon the licensee if the Code requirements were imposed without a corresponding increase in quality and safety, and that the proposed alternative provides a reasonable alternative to assuring the operability of the pump, it is recommended that the licensee's alternative be authorized in accordance with 10CFR 50.55a(a)(3)(ii).

2.4 Auxiliary Feedwater (AFW) Pumps, 1(2)FW004, 5, 6

2.4.1 Relief Request Number: PR-06

Relief Request: The licensee has requested relief from OM Part 6, ¶ 5.2(b), which requires: "The resistance of the system shall be varied until the flow rate equals the reference value. The pressure shall then be determined and compared to its reference value. Alternatively, the flow rate can be varied until the pressure equals the reference value and the flow rate shall be determined and compared to the reference flow rate value."

Proposed Alternate Testing: "Zion will use a flow tolerance of ±10 gpm from the reference (set-value) when testing the AFW pumps. The differential pressure will be compared to Table 3b limits to ensure the measured value is within ±10% of the pressure reference value."

Licensee's Basis for Relief: The licensee states: "Flow instruments 1(2)FI-FW03, FW04, FW05 and FW25 are the flow instruments used to determine total Auxiliary Feedwater (AFW) flow. Total AFW pump flow is the summation of the flow to each of the four steam generators.

The following facts apply:

1) The "normal" AFW pump (IST) test is performed with the unit at power on a monthly frequency.

2) The flow is varied by throttling one or more (of four) motor operated throttle valves. Since the throttle valves are motor operated, incremental throttling requires "bumping" the motor operator. The test is performed at a flow rate such that a small change in flow results in a relatively significant change in discharge pressure. Therefore, a small change in one throttle valve's position changes the flow in a similarly significant manner through all four valves.

3) Another requirement of "operability" of the AFW system is that each of the throttle valves must be left in a throttled position which will deliver a minimum accident flow to each steam generator and a maximum flow to prevent pump runout. This adds an additional throttle operation after completion of the IST required testing.

Zion has assigned a tolerance on attainment of the reference flow (the set-value) due to the combination of the above listed facts. This tolerance is assigned as ±10 gpm from a reference value of 460 gpm. This tolerance represents a deviation from the code requirement referenced above and exceeds ±2% of the reference value as discussed in the NRC Safety Evaluation dated June 14, 1993. The assigned tolerance of ±10 gpm represents ±2.17% of the reference value.

Zion feels that attempted attainment of the reference value during the IST Program test to a closer tolerance than ±10 gpm, while it may be possible, is detrimental to safety related plant equipment. Specifically:

1. Adjustment to any particular flow rate (combined flow rate of four separate instruments) requires numerous "bumps" of the valve motor operators. These small incremental bumps of the valve operator motor(s) are considered to each represent some amount of wear of the safety related valves and valve operators. While the valves are throttle valves and therefore expected to be used to throttle flow, the closer the tolerance on the flow value required for any particular application the more bumps are required to attain that value. This makes a significant difference in the cumulative wear.

2. The tighter the flow tolerance required, the longer it is expected to take to achieve the desired result. During the AFW pump test, the pumps are taking a suction on the condensate storage tank (CST) and injecting into the steam generators. The CST is normally vented to the atmosphere resulting in oxygenated water. The longer the AFW pumps run, the more oxygenated water is injected into the operating steam generators. This results in an elevated steam generator dissolved oxygen level of a transient nature.

The AFW pump operability test is required by Technical Specifications on a monthly frequency. This operability test requires the pumps to be operated and inject water into the steam generators. Zion feels that IST Program testing of pump hydraulic performance at the same time is both logical and conservative. Hydraulic performance using this set value tolerance is trendable and the trends informative.

Other Alternatives:

IST test performed under Miniflow Recirculation Conditions: The AFW pumps could be tested in a monthly (or quarterly) IST test by operating the pumps in the miniflow recirculation flowpath. The miniflow recirculation flowpath contains no flow instrumentation. Testing in this flowpath does not appear to fit the requirements of Generic Letter 89-04, position 9 in that a flow path exists during normal operation to test the pump under conditions of substantial flow. Zion considers current testing practices to be much more informative and conservative than miniflow testing."

Evaluation: OM Part 6 ¶5.2(b), specifies that pumps are to be tested quarterly by varying the resistance of the system until either the flow rate or the pressure equals a reference value, and the corresponding pressure or flow rate measured and compared to reference values. The basis for the NRC's acceptance of the ±2% of the reference value is from Section XI, IWP-4150 which provides the requirements for instrument fluctuation. IWP-4150 allows symmetrical damping devices or averaging techniques to reduce instrument fluctuations to within 2% of the observed reading. The use of the ±2% of the reference value in this position is to allow the licensee to specify values in the implementing procedures.

The licensee states that in order to establish the reference flow rate for the AFW pumps requires flow throttling on one of the four MOVs. This bumping of the MOVs may result in large changes in the discharge pressure, and represent a potential source of cumulative wear on these valves. In addition, following these tests, the throttle valves must be left in a position to ensure the delivery of the minimum accident flow. This adds an additional throttle operation following the monthly Technical Specification tests. During the performance of this test, the AFW pumps are taking suction from the condensate storage tank, which is vented to the atmosphere, resulting in oxygenated water being injected into the steam generators, resulting in a higher dissolved oxygen level. The time required to perform this test is dependant upon the flow tolerance, the tighter Code tolerance may result in longer test time duration.

Based upon these facts, the licensee has established a ±10 gpm tolerance on the flow, which exceeds the ±2% Code requirement by ±.17%. This expanded tolerance range represents a flow difference of less than 1 gpm which would not significantly impact the ability of the test to detect pump degradation and operability. Compliance with the Code requirement would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety. Therefore, it is recommended that the alternative be authorized pursuant to 10 CFR 50.55a(a)(3)(ii). Table 3.1-1 Units 1 & 2 Pumps Inservice Testing Plan Listing, incorrectly references PR-05, instead of PR-06 for pump number 1(2)FW004. The licensee should also modify the Basis for Relief to discuss instrument accuracy and readability as requested by the NRC in Section 3.2.2 of the June 14, 1993 SER.

2.5 Safety Injection (SI) Pumps, 1(2)SI003, 4

2.5.1 Relief Request Number: PR-07

Relief Request: The licensee has requested relief from OM Part 6, ¶ 5.2(b) which requires: "The resistance of the system shall be varied until the flow rate equals the reference value. The pressure shall then be determined and compared to its reference value. Alternatively, the flow rate can be varied until the pressure equals the reference value and the flow rate shall then be determined and compared to the reference flow rate value."

Proposed Alternate Testing: "Zion will test the SI pumps on recirculation mode quarterly and require the flow to be within 27-32 gpm. The differential pressure will be compared to Table 3b limits to ensure the measured value is within ±10% of the pressure reference value."

Licensee's Basis for Relief: The licensee states: "The following facts apply:

1) The "normal" safety injection pump (IST) test is performed with the unit at power on a quarterly frequency.

2) The flow is established by operating the pump in miniflow recirculation through an orifice. This orifice is designed to pass 30 gpm.

3) Miniflow instrumentation exists and meets the requirements of Sections 4.6.1.1 and 4.6.1.2.

4) The recirculation line is the only flow path available to test the pumps quarterly.

5) The pump manufacturer has stated the minimum flow is 27 gpm.

In addition to the above listed facts, where these pumps are tested in a low flow condition, manual throttling (downstream of the orifice) is not prudent. Throttled flow may not be sufficient to prevent pump damage. Therefore, Zion has assigned a tolerance on attainment of the reference flow (the set-value). This tolerance is set at a maximum of ±3 gpm. This tolerance represents a deviation from the Code requirement referenced above and exceeds ±2% of the reference value as discussed in the NRC Safety Evaluation dated June 14, 1993.

A flow tolerance tighter than the range of ±3 gpm is considered impractical due to historical data where 27-32 gpm was obtained. As an example, ±2% of a reference value of 30 gpm is ±0.6 gpm, which is impractical to achieve. Repeat attempts to duplicate an exact reference value would not provide any more meaningful data at these low flows, and in making these attempts could allow pump damage to occur. Strict compliance with Section 5.2(b) is impractical for the SI pumps and would result in a hardship without a compensating increase in the level of quality and safety."

Evaluation: OM Part 6 ¶5.2(b), specifies that pumps are to be tested quarterly by varying the resistance of the system until either the flow rate or the pressure equals a reference value, and the corresponding pressure or flow rate determined and compared to reference values. The basis for the NRC's acceptance of the ±2% of the reference value is from Section XI, IWP-4150 which provides the requirements for instrument fluctuation. IWP-4150 allows symmetrical damping devices or averaging techniques to reduce instrument fluctuations to within 2% of the observed reading. The use of the ±2% of the reference value in this position is to allow the licensee to specify values in the implementing procedures.

The licensee proposes to test the Safety Injection (SI) charging pumps on miniflow recirculation quarterly, through instrumented lines in accordance with ¶4.6.1.1 and 4.6.1.2. However, as stated by the licensee, manual throttling is not prudent in the low flow condition, and may not provide the minimum flow (27 gpm) to prevent pump damage. Due to this difficulty, the licensee is unable to set the flow in accordance with the Code accuracy requirements. The licensee has requested relief from the Code requirements to set the flow within 27-32 gpm.

The licensee proposes to establish a flow tolerance of ±3 gpm for these pumps. The licensee states that a flow tolerance of ±2% in accordance with the Code (30 gpm ±0.6 gpm) is impractical based upon historical data. Repeated attempts to duplicate an exact reference value would not provide meaningful data, and may result in pump damage. As stated in Draft NUREG-1482, Section 5.3, the Code did not intend that the set reference value have an acceptable range. The ±3 gpm flow range requested represents a ±10% tolerance, which is well in excess of the NRC allowable ±2%. As stated in Section 5.2 of Draft NUREG-1482, the use of pump curves is an acceptable alternative for pump testing in specific instances when it is impractical to establish a fixed set of reference values. Using these pump curves, the licensee would be able to evaluate the pump in as-found system conditions, and be able to detect degradation.

As discussed in GL 89-04 Position 9, quarterly minimum flow pump testing provides an acceptable alternative to quarterly full flow testing, when the minimum flow return lines are the only paths which can be utilized. The licensee states that the flow instrumentation installed in these lines permits monitoring in accordance with Code requirements. However, as stated in the response to Question 48 on this Position, the NRC believes that a mini-flow test can be detrimental to a pump, and is not a desirable test configuration. These tests produce data of marginal value, and provide little confidence in the continued operability of the pump. However, in addition to the miniflow test, Technical Specifications require that these pumps be full flow tested during refueling. The combination of these two tests will produce reasonable assurance as to the operability of these pumps.

Based upon the design of the system which makes flow throttling difficult, it is impractical to set the pump flow to a reference value in accordance with the Code to perform the minimum flow quarterly tests. Without additional information, such as the pump curve, the licensee's proposed acceptance range for pump flow does not provide reasonable assurance that pump degradation will be detected, and operability assured. However, as discussed, the use of pump curves provides an acceptable alternative in instances where the flow may not be set to a prescribed reference value. The licensee should utilize pump curves for the testing of these pumps. These curves should be prepared in accordance with the NRC Recommendation specified in Draft NUREG-1482, Section 5.2, and included in the IST Program. Provisional approval is recommended in accordance with 10 CFR 50.55a(f)(6)(i), provided the licensee uses flow curves during the minimum flow quarterly testing to demonstrate acceptable pump performance. This test provides reasonable assurance of the pump's operational readiness.

2.6 Component Cooling Water Pumps, 0CC003, 4, 5, 6, 7

2.6.1 Relief Request Number: PR-08

Relief Request: The licensee has requested relief from OM Part 6, ¶ 5.2(b), which requires: "The resistance of the system shall be varied until the flow rate equals the reference value. The pressure shall then be determined and compared to its reference value. Alternatively, the flow rate can be varied until the pressure equals the reference value and the flow rate shall be determined and compared to the reference flow rate value."

Proposed Alternate Testing: "Zion will use a flow tolerance of ± 100 gpm from the reference (set-value) when testing the CC pumps. The differential pressure will be compared to Table 3b limits to ensure the measured value is within ±10% of the pressure reference value."

Licensee's Basis for Relief: The licensee states: "There is no permanent flow instrumentation installed which can be used for this pump test. Temporary (Ultrasonic) flow instruments are utilized. A procedure designed to maximize the accuracy of the ultrasonic instrumentation is utilized whereby the flow is totalized over a period of at least five minutes. Flow is then calculated based on the total flow divided by the number of minutes over which the flow was totaled. This method of measurement was required by the NRC at Byron Station when using Ultrasonic flow measuring equipment. The flow readout is digital and changes with each update.

The following additional facts apply:

1) The "normal" CC pump (IST) test is performed with the unit at power on a quarterly frequency.

2) The flow is varied by throttling one or more manually operated throttle valves which are remote from the location of reading the flow. The flow is adjusted based on instantaneous digital readout and then a five minute minimum wait is required for the ultrasonic flow instrument prior to recording data.

3) A minimum of 2 CC pumps must be in operation at all times during normal power operation to maintain the discharge pressure above the standby auto start setpoint. A change of the system resistance changes the flow through both running pumps.

4) The RCS letdown heat exchanger operates automatically to regulate CC flow via a temperature controller. Nominal CC flow through the letdown heat exchanger is 1000 gpm. While the flow is not widely variable at normal steady state, there is a constant automatic flow manipulation. This is as steady as the system permits.

Zion has assigned a tolerance on attainment of the reference flow (the set-value) due to the combination of the above listed facts. This tolerance is assigned as ±100 gpm. The assigned tolerance of ±100 gpm represents ±2.63% of the reference value. This tolerance represents a deviation from the code requirement referenced above and exceeds ±2% of the reference value as discussed in the NRC Safety Evaluation dated June 14, 1993.

While for each pump test an attempt is made to establish 3800 gpm, a flow tolerance tighter than ±100 gpm may not be consistently achievable. Data taken with this flow tolerance is trendable and the trends are informative."

Evaluation: OM Part 6 ¶5.2(b), specifies that pumps are to be tested quarterly by varying the resistance of the system until either the flow rate or the pressure equals a reference value, and the corresponding pressure or flow rate determined and compared to reference values. The basis for the NRC's acceptance of the ±2% of the reference value is from Section XI, IWP-4150 which provides the requirements for instrument fluctuation. IWP-4150 allows symmetrical damping devices or averaging techniques to reduce instrument fluctuations to within 2% of the observed reading. The use of the ±2% of the reference value in this position is to allow the licensee to specify values in the implementing procedures.

A review of P&ID M-66, Component Cooling Water System, confirms that the only flow instrumentation are the ultrasonic flowmeters (OFT CC03-07) installed on the discharge side of each pump. During this test, flow (3800 gpm) is varied by throttling the manually operated MOVs which are remote from the instantaneous digital readout. During normal plant operation, 2 CCW pumps are required to be operational to maintain the discharge pressure above the standby autostart setpoint. Varying the system resistance may change the flow through the operating pumps and the RCS letdown heat exchanger.

The licensee has established a ±100 gpm tolerance on the flow, which exceeds the ±2% (±76 gpm) Code requirement by ±.63%. This expanded tolerance range represents a flow difference of ±24 gpm which should not significantly impact the ability of the test to detect pump degradation and operability. Compliance with the Code requirement would result in a hardship based upon the remote location of the throttling valves, the automatic control of the letdown heat exchanger flow, and the delay in flow measurements with the ultrasonic flowmeters, without a compensating increase in the level of quality and safety. Therefore, it is recommended that the alternative be authorized pursuant to 10 CFR 50.55a(a)(3)(ii). The licensee should also modify the Basis to discuss instrument accuracy and readability as requested by the NRC in Section 3.2.2 of the June 14, 1993 SER.

2.7 Chemical and Volume Control Charging Pumps, 1(2)VC006,7

2.7.1 Relief Request Number: PR-09

Relief Request: The licensee has requested relief from OM Part 6, ¶ 5.2(b), which requires "The resistance of the system shall be varied until the flow rate equals the reference value. The pressure shall then be determined and compared to its reference value. Alternatively, the flow rate can be varied until the pressure equals the reference value and the flow rate shall be determined and compared to the reference flow rate value."

Proposed Alternate Testing: "Zion will use a flow tolerance of ±5 gpm from the reference (set-value) when testing the centrifugal charging pumps. The differential pressure will be compared to Table 3b limits to ensure the measured value is within ±10% of the pressure reference value."

Licensee's Basis for Relief: The licensee states: The following facts apply:

1) The "normal" charging pump (IST) test is performed with the unit at power on a quarterly frequency.

2) The flow is varied by taking manual control of the normal makeup in order to maintain a constant value. This flow control valve is normally in automatic to maintain constant pressurizer level.

3) The IST test takes 15 to 30 minutes to perform for each pump.

4) The reference value of 90 gpm was chosen due to the fact that normal flow to maintain pressurizer level constant is approximately 90 gpm. Thus, this value is the most readily duplicated value for the normal at power test.

5) It is important while operating at power to maintain a relatively constant pressurizer level since pressurizer level changes are primary initial indicators of some accidents and malfunctions.

Zion has assigned a tolerance on attainment of the reference flow (the set-value) due to the combination of the above listed facts. This tolerance is assigned as ±5 gpm from a reference value of 90 gpm. This tolerance represents a deviation from the Code requirement referenced above and exceeds ±2% of the reference value as discussed in the NRC Safety Evaluation dated June 14, 1993. The assigned tolerance of ±5 gpm represents ±5.56% of the flow reference value.

The instrument used to measure flow for this test is 1(2)FI-121 with smallest increments on the control room indicator being 5 gpm. A flow tolerance tighter than ± 5 gpm may not allow for the manually adjusted flow to be set such as to maintain steady pressurizer level conditions during the test. Data taken with this flow tolerance is trendable and the trends appear to be informative. From a review of the trend graphs for all four pumps, it is not apparent that a tighter flow tolerance would enhance the trend graphs or provide any additional information, especially in light of the fact that the pump curve is essentially horizontal between 85 and 95 gpm."

Evaluation: OM Part 6 ¶5.2(b), specifies that pumps are to be tested quarterly by varying the resistance of the system until either the flow rate or the pressure equals a reference value, and the corresponding pressure or flow rate determined and compared to reference values. The Code does not allow for variance from a fixed reference value. The basis for the NRC's acceptance of the ±2% of the reference value is from Section XI, IWP-4150 which provides the requirements for instrument fluctuation. IWP-4150 allows symmetrical damping devices or averaging techniques to reduce instrument fluctuations to within 2% of the observed reading. The use of the ±2% of the reference value in this position is to allow the licensee to specify values in the implementing procedures.

As discussed, the reference flow of 90 gpm (approximate flow required to maintain pressurizer level constant) is set by manually controlling the flow control valve, which is normally in the automatic mode to maintain constant pressurizer level. A flow tolerance greater than ±5 gpm may not be achievable due to the readability of the flow instrument and may not permit the flow to be manually set to maintain steady pressurizer level during the test. The licensee stated that data with this tolerance is trendable, and that a tighter tolerance would not provide additional information, especially for this flow, since the pump curve is "essentially horizontal between 85 and 95 gpm."

From the information provided in the Basis, a primary factor in setting the expanded range was the increments on the flow instrument. The licensee does not state whether this is an analog or digital instrument. As discussed in the Basis of Section 5.3 of Draft NUREG-1482, the precision of an analog gauge is determined by the increments on the scale. Readings would be acceptable to a degree of precision no greater than one-half the smallest increment. In this instance, that would correspond to ±2.5 gpm (±2.7%). Nevertheless, since the pump curve is essentially horizontal in this flow region, the effect on the differential pressure would be minimal, and should not impact the ability of the test to detect pump degradation.

The licensee has established a ±5 gpm tolerance on the flow, which exceeds the ±2% Code requirement by ±3.56%. This expanded tolerance range represents a flow difference of ±2.7 gpm which should not significantly impact the ability of the test to detect pump degradation and operability, since the shape of the pump curve in this region is essentially horizontal. Compliance with the Code requirement would result in an unusual difficulty based upon the need to maintain a steady pressurizer level, without a compensating increase in the level of quality and safety. It is recommended that the alternate be authorized pursuant to 10 CFR 50.55a(a)(3)(ii). The licensee should modify the Basis to discuss instrument accuracy as requested by the NRC in Section 3.2.2 of the June 14, 1993 SER, and incorporate the instrument accuracy guidance provided in Draft NUREG-1482. The licensee should ensure that the minimum flow line is isolated using manual valves VC 8479A and B (per VC-05, MOV-VC-8110 and 8111 cannot be isolated) during the performance of the flow test to ensure that the flow measured by 1FE-121 is the total pump output. If isolating the individual minimum flow lines is not practical, the licensee should revise this relief request accordingly.

3.0 VALVE IST PROGRAM RELIEF REQUESTS

In accordance with §50.55a, Commonwealth Edison Company has submitted 9 relief requests for valves at the Zion Station, Unit 1 and 2 which are subject to inservice testing under the requirements of ASME Section XI. One valve relief request (VR-04) was authorized by Generic Letter 89-04, and is not included in this Section. The relief requests not authorized by Generic Letter 89-04 have been reviewed to verify their technical basis and determine their acceptability. These eight relief requests, along with the technical evaluation by BNL, are summarized below.

3.1 Safety Injection

3.1.1 Relief Request Number: VR-01, SI Accumulator Tank Discharge Check Valves, 1(2)SI8948A, B, C, D and 1(2)SI8956A, B, C, D

Relief Request: The licensee has requested relief from OM Part 10, ¶ 4.3.2, which requires quarterly exercising of check valves.

Proposed Alternate Testing: "Zion Station will perform a reduced pressure flow test of the accumulator discharge check valves at a frequency of one accumulator per refueling outage. In the event that one of the tested accumulator check valves fails, a different accumulator's check valves will be tested. In the event that this additional test fails, the sample will be expanded to include all accumulators on the affected unit. As a further means of detecting degradation of these check valves, acoustic monitoring will be attempted in conjunction with this test. Zion Station considers this alternative to be sufficient to detect degradation in a timely manner yet will not unduly burden the station or needlessly challenge the accumulators more frequently than discussed."

Licensee's Basis for Relief: The licensee states: "The accumulator check valves cannot be exercised during unit operation due to the pressure differential between the accumulators (600 psig) and the Reactor Coolant System (2235 psig). Full stroke exercising of these valves can be accomplished by dumping one accumulator under nitrogen pressure into a partially drained refueling water cavity during refueling with the reactor vessel head off. Therefore, partial stroking is not possible during normal operation or in a cold shutdown condition.

Zion Station is proposing to test one set of two accumulator valves per refueling outage using this method since this test involves considerable time and expense. The initial conditions of the test are extensive. Temporary instrumentation must be installed and accumulator tank samples are obtained to verify fluorine, chlorine, sodium and boron concentrations are within applicable limits. If water chemistry is not within the specifications, then the accumulator must be drained, filled, and resampled until satisfactory results are obtained.

Due to the required plant condition to perform the testing (reactor head off, lower reactor internals installed and a specific reactor cavity level), this must be performed on critical path time. Thus, additional accumulator testing would directly affect the total outage length. By discharging additional accumulators, it is likely that the maximum refueling cavity water level permitted for continued ECCS full flow testing would be reached. This would require an evolution to drain the refueling cavity which would again increase the outage critical path time.

This test also has the unavoidable potential to introduce a crud burst into the Reactor Coolant System. Testing more than one accumulator per outage will increase the potential crud burst. Crud in the RCS can result in higher dose rates and, instrumentation and fuel fouling.

Zion believes that the costs of testing all accumulators every outage in terms of set up time, critical path time, the potential for crud bursts and the increased challenge to the accumulators and associated components more than outweigh the actual benefits.

It should be noted that Zion Station has evaluated the Westinghouse Corporation notification of potential for thermal transients in the accumulator as a result of this testing methodology. Zion has determined that the testing methodology employed - reduced accumulator pressure and immediate termination of the flow upon obtaining data - has reduced the transient to an acceptably low level. By testing each accumulator once per four refueling outages, the integrity of the accumulators is not expected to be challenged. This analysis is documented in Zion Station's response to this notification."

Evaluation: Accumulator tank discharge check valves,1(2)SI8948A through D and 1(2)SI8956A through D, are required to open for safety injection into the reactor coolant system (RCS), when the RCS pressure decreases to 600 psig.

The licensee has proposed performing a "reduced pressure flow test" as a means of full-stroke exercising the valves. "As a further means of detecting degradation of these check valves, acoustic monitoring will be attempted in conjunction with this test." It is not evident how a reduced pressure flow test alone will verify that the valves are full-stroke exercised. The licensee should clarify whether this test is conducted at the maximum required accident flowrate as discussed in Generic Letter 89-04, Position 1. If a reduced flow rate will be used, a positive means of verifying the valves open to the full-stroke position is required. Draft NUREG-1482, Section 4.1.2 further discusses the use of nonintrusive techniques as a means of verifying valve position and allows sample testing. The licensee should revise the relief request to clarify the testing method, as it does not appear to comply with Generic Letter 89-04, Position 1.

With regards to the test frequency, it is impractical to partial-stroke or full-stroke exercise these valves open quarterly because the maximum operating pressure in the accumulators is less than the normal operating pressure in the RCS. However, the licensee has not provided justification for not performing a full-stroke open or at least a partial-stroke open test at cold shutdowns. Cold Shutdown Justification VC-18 discusses the impracticality of exercising the valves closed quarterly.

Furthermore, the licensee provides an explanation of the burden of testing all four accumulator check valves each refueling outage and refers to a notification by Westinghouse Electric Corporation (WEC), which identified a concern in utilizing a test method resulting in rapid blowdown of the safety injection accumulators, as justification for testing only one of the four accumulators check valves at each refueling outage. The expansion of the nitrogen gas in the accumulators generates a temperature transient which was not analyzed in the original design of the accumulators, and multiple transients of this nature could generate through-wall cracks in the tank as a result of thermal fatigue. WEC recommended that other means of verifying check valve operability at refueling outages, such as valve disassembly, could be acceptable alternatives in determining that a valve's disk will full-stroke open. Other means could include maintaining a constant nitrogen pressure in the accumulator for the time required to reach low level and terminating the test immediately thereafter.

Although testing with flow is generally the preferred method of testing check valves, sample disassembly and inspection in accordance with Generic Letter 89-04, Position 2 provides an acceptable means of verifying the full-stroke exercise of check valves. Other Westinghouse units have recently proposed a sample disassembly and inspection program in accordance with Generic Letter 89-04, Position 2 (Pt. Beach, Callaway, McGuire) or a reduced accumulator pressure blowdown test in conjunction with a nonintrusive techniques at refueling outages (Beaver Valley, Summer). It does not appear that the burden at Zion to comply with Position 1 or 2 of Generic Letter 89-04 is any more excessive than at these other PWRs. Therefore, it is recommended that relief as requested not be authorized. The licensee should full-stroke exercise the valves in accordance with Generic Letter 89-04 Positions 1 or 2. If full or partial flow exercising during cold shutdowns is impractical, the licensee should clarify this relief request. Generic Letter 89-04 Position 2, and Draft NUREG-1482 Section 4.1.2 allows a sampling technique to be used. However, if the sample valve fails, then all valves in the sample group must be tested. The licensees proposed sampling plan does not agree with this. The licensee should consider the safety significance and historical reliability of these valves when proposing alternate testing.

3.1.2 Relief Request Number: VR-03, RHR Cold Leg Injection PIVs, 1(2)SI9OOlA, B, C, D and 1(2)SI9002A, B, C, D

Relief Request: The licensee has requested relief from OM Part 10, ¶ 4.3.2, which requires quarterly full-flow exercising of check valves.

Licensee's Basis for Relief and Proposed Alternate Testing: The licensee states: "Relief is requested to measure flow to check valves SI9001 A thru D and SI9002 A thru D by an indirect method to verify maximum accident flow. During pre-operational testing, differential pressure gages were temporarily installed between check valves SI9001 and SI9002 in order to calculate the flow through each of the four Safety Injection cold leg lines. This testing demonstrated that flow was approximately equal through each line. Due to radiation concerns and the difficulty to install the temporary differential pressure gages because of physical parameters, Zion Station will assume that flow through each of the four SI cold leg lines is still balanced. This assumption is based on the fact that if one of the check valves should become impaired, flow through this line would become obstructed and flow would become imbalanced through the four lines. This imbalance of flow would be indicated on the flow instrumentation located between the common RHR discharge header and check valves SI8957A, B.

Zion Station is proposing that maximum accident flow will be verified for check valves SI9001 A thru D and SI9002 A thru D if the ratio of flow through this flow instrumentation is approximately equal to one. Specific acceptance criteria will be included with the test procedure. If the ratio of flow does not meet this acceptance criteria then differential pressure gages will be temporarily installed between check valves SI9001 and SI9002 to determine which line is causing the imbalance of flow and the necessary corrective action will be taken.

These valves will be exercised for required accident flow during a refueling outage when the RCS pressure will then be low enough to allow adequate flow through the check valves. In addition, partial stroke exercising will be performed during CSD.

This alternative will provide adequate assurance of the required level of safety and that operational readiness is maintained."

Evaluation: These check valves are pressure isolation valves on the RHR cold leg injection lines. They provide protection of the lower pressure RHR injection piping from the higher pressure Reactor Coolant System during normal operation. There are no individual flow elements that could be used to verify the flow of the maximum required accident flow rate through these valves. The licensee has asserted that full flow will pass through the four check valves by verifying that the total flow has not changed. Differential pressure will not be measured.

In Appendix A of Draft NUREG-1482, regarding NRC Position 1 on full flow testing of check valves, there is a discussion under Question Group 2 as to why knowledge of total flow through multiple parallel lines is unacceptable when the total flow through each path was known when it was established.

The NRC response is that the objective of inservice testing is to evaluate and investigate the possibility of degradation of components and to take corrective action before components fail. Verification of total header flow rate might not identify a problem, developing or occurring, with an individual check valve in one of the parallel flow paths.

With respect to balancing of flow, the Technical Specification requirement is based on the flow from one loop being lost through a break. Consequently, that flow path is restricted or throttled to minimize significant diversion of flow. The Technical Specification requirement was not intended to verify individual check valve operability.

The Beaver Valley Power Station (Docket No. 50-334) submitted a similar request. The NRC, in a safety evaluation dated January 24, 1992, provided a detailed evaluation of this testing method and concluded that it will not demonstrate positively full-stroking of the individual check valves. The NRC recommended either that permanent or temporary flow instruments be used on each of the branch lines, or the valves be disassembled and inspected, or that nonintrusive diagnostic methods be employed.

In Generic Letter 89-04, Position 1, (see also Draft NUREG-1482, page A-2), the NRC recognizes that it may be impractical to perform full flow testing of some check valves and that it may be possible to qualify other techniques to confirm that the valve is exercised to the position required to perform its safety function. In addition to complying with the six criteria identified in Position 1, the licensee should consider Section 4 of Draft NUREG-1482, specifically ¶ 4.1.2, which states that the NRC has determined that the use of nonintrusive techniques is acceptable to verify the full stroke of a check valve, although the flow rate must be sufficient to full-stroke the valve. These techniques are considered "other positive means" in accordance with ¶ 4.3.2.4(a) of OM Part 10, and relief is not required except as would be necessary for the testing frequency. Such nonintrusive techniques may be used in a sampling plan as described in ¶ 4.1.2 of Draft NUREG-1482.

Therefore, the licensee's proposed alternative should not be authorized. Testing during operation or cold shutdowns is impractical. However, the licensee should develop an alternate testing method that could be used for the next and subsequent refueling outages and revise the IST program accordingly.

3.1.3 Relief Request Number: VR-06, Containment Recirculation Sump Isolation Valves, 1(2)MOV-SI8811A, B

Relief Request: The licensee has requested relief from the requirements of OM Part 10, ¶ 4.1, which requires local verification of valve position indication every two years.

Proposed Alternate Testing: "Zion Station requests relief to perform remote position indication verification of 1(2)MOV-SI8811A and B on an alternating basis. That is, one valve is inspected each refueling outage to coincide with the required E.Q. inspection. Since Zion is on an 18 month refueling schedule, each valve would be tested once every 3 years rather than once every 2 years. This alternative would provide adequate assurance that operational readiness is maintained."

Licensee's Basis for Relief: The licensee states: "The containment recirculation sump isolation valves are each contained in a metal closure which can withstand post LOCA containment pressure. There are no indicators outside the container which can be used to determine the actual physical position (open/closed) of the valves. It is necessary to remove the exterior closure each time remote position verification is required.

Removal of the metal closure is time and labor intensive. The removal of both enclosures each refueling outage is a burden to the Station due to the time required to remove the containers (scaffolding and rigging), stroke and verify indicators, and reinstall the containers."

Evaluation: Containment recirculation sump isolation valves are opened manually to provide suction to the residual heat removal (RHR) pumps during cold leg recirculation. The valves are closed when taking RHR pump suction from the hot leg.

Per the Valve Program Tables, these valves are exercised open and closed and stroke time tested quarterly. OM Part 10 ¶ 4.1 requires that valves with remote position indication be observed locally at least once every 2 years to verify that valve operation is accurately indicated. Where practicable, this local observation should be supplemented by other indications such as use of flow meters or other suitable instrumentation to verify obturator position. These observations need not be concurrent. Where local observation is not possible, other indications shall be used for verification of valve operation.

The licensee's request that these valves be verified for local position indication at 3 year intervals when the enclosures are removed to verify the environmental qualification of the valve operators would not result in a significant decrease in the level of safety versus the hardship of time-consuming dismantling of the valve enclosures and the consequent increased risk of failure to restore the enclosures to their design basis integrity. Therefore, based on the hardship without a compensating increase in quality and safety, it is recommended that the proposed alternative testing be authorized in accordance with 10 CFR 50.55a(a)(3)(ii).

However, the licensee should evaluate the practicality of supplementing the triennial local position indication verification with observation of system characteristics such as leak testing as prescribed by the Code.

3.1.4 Relief Request Number: VR-07, High Head Safety Injection Header RCS Isolation Valves,1(2)SI8900A, B, C,D and 1(2)SI9032

Relief Request: The licensee has requested relief from the requirements of OM Part 10, ¶ 4.3.2.4 (a), which requires quarterly verification of check valve closure capability.

Proposed Alternate Testing: "Zion Station has recently completed modifications on both Units 1 and 2 to prevent any leakage into the area behind these check valves either from the check valves themselves or through the upstream motor-operated valves from the Charging system, from causing thermally-induced piping stress. These modifications were installed in response to Generic Letter 88-08.

The modifications installed an annunciator at the Main Control Board (MCB) which alarms when the pressure in the piping behind these check valves reaches 2000 psig. This annunciator alerts the operator to depressurize the header. Since RCS pressure during operation is 2235 psig any leakage through the subject check valves would cause annunciation at the MCB. This annunciator provides continuous monitoring capability of the integrity of the series combination of check valves 1(2)SI8900A-D and 1(2)SI9032 and will enable timely identification of leakage through these valves.

Zion Station believes that this annunciator provides sufficient monitoring capability to ensure that the integrity of these check valves is maintained."

Licensee's Basis for Relief: The licensee states: "Valves 1(2)SI8900A-D are arranged in parallel and are the isolation check valves closest to the reactor on each of the Charging to Cold Legs branch lines. Valve 1(2)SI9032 is located on the common portion of this header upstream of valves 1(2)SI8900A-D and acts in series with each of these check valves. The Code requires that each of these valves be tested for backleakage. While such a test could be devised in which the backleakage through these valves could be routed through the Safety Injection system test header and measured, Zion considers such testing to be excessively burdensome.

The aforementioned test method is similar to that employed with the RCS Pressure Isolation Check Valves (PIV) as defined by Zion's Technical Specifications. This testing is necessarily performed on startup in Mode 3 at normal RCS operating temperature and pressure. This places the testing directly on critical path for reactor startup. Based on Zion Station's experience with PIV testing, it is estimated that at least 12 hours of critical path outage time would be required to accomplish this testing. In addition, the charging system piping is designed to the same pressure rating as the RCS piping so that any backleakage that may be present through these check valves wou'd not serve to overpressurize the upstream piping. Also, due to the high operating pressure of the Charging system, any backleakage through these check valves would not be able to enter the Charging system."

Evaluation: These check valves are located on the High Head Safety Injection Header (Charging pumps to RCS Cold Legs). 1(2)SI8900A-D serve as one of two in-series boundary isolation valves between

ASME Class 1 and Class 2 piping. 1(2)SI9032 is a secondary passive isolation between the RCS and Charging systems.

The Code requires individual verification of valve closure. OM Part 10 ¶ 4.3.2.3 states that check valves which operate in the course of plant operation at a frequency which would satisfy the exercising requirements of ¶ 4.3 need not be additionally exercised provided that the observations otherwise required for testing are made and analyzed during such operation and are recorded in the plant records at intervals no greater than specified in ¶ 4.3.2.1.

The only practical means of verifying valve closure is by leak testing. The licensee has installed annunciators in the control room to continuously monitor the valves in series by monitoring the pressure in the piping behind these check valves.

The NRC has provided guidance, in Draft NUREG-1482, Section 4.1.1, for preparing relief requests when licensees have two check valves in series with no provisions for verifying that each can close. As discussed in the NUREG, the licensee must provide information that the safety analysis does not require both of these Class 1 valves to function, i.e., one valve could be removed without creating an unreviewed safety question or creating a conflict with regulatory or license requirements.

The licensee is implying that the main purpose for the modifications described is to ensure that the piping in which the subject check valves are contained is properly protected from any thermal expansion caused by backleakage of these check valves by alerting the operator to depressurize the piping header when the pressure reaches 2000 psig. However, it is not clearly stated whether one of these check valves could be removed without creating an unreviewed safety question or a conflict with regulatory or license requirements.

Therefore, provided the licensee verifies that only one of the two Class 1 valves is required, and the provisions of ¶ 4.3.2.3 are met, relief can be recommended pursuant to 10CFR50.55a(f)(6)(i). However, if the series valves are required by the plant safety analysis assumptions, verification of the capability of each of the valves is required and relief cannot be granted. As stated in Draft NUREG-1482, Section 4.1.1, the licensee may demonstrate the capability of both valves to close by disassembly and inspection, or other positive means (e.g., radiography). The licensee should revise the relief request accordingly.

3.2 <u>Chemical and Volume Control System</u>

3.2.1 Relief Request Number: VR-02, Charging Pumps Minimum Flow Valves, 1(2)VC8542A and B

Relief Request: The licensee has requested relief from OM Part 10, ¶4.3.2, which requires full-flow exercising of check valves.

Proposed Alternate Testing: "Zion Station utilizes an indirect method of testing check valves VC8542A-B since these lines are not instrumented with flow or differential pressure indicators. Total charging pump flow is calculated using measured pump differential pressure and the manufacturer's pump curve. Total pump flow includes flow through the pump discharge header and the mini-flow line. The flowrate through the mini-flow line is equal to the calculated flow from the pump curve minus the measured flow in the discharge header."

Licensee's Basis for Relief: The licensee states: "A review of pump performance data shows that, on average, all the charging pumps perform within ± 2% of the manufacturer's pump curve. At the time this check valve test is performed, a correction factor is determined accounting for the actual difference in performance of the pump from the pump curve. Since the flow required through the mini-flow line is small (50 gpm), only a small portion of the pump curve is utilized for this test. Therefore, the correction factor is accurate over this small range of the pump curve and accurate testing results are obtained.

Due to an insufficient length of straight piping in the mini-flow line and resultant flow instabilities, routine use of temporary ultrasonic flow instrumentation does not yield consistent results. However, Zion did attempt a best effort validation of this testing method with temporary ultrasonic flow meters.

The alternative method will provide adequate assurance that operational readiness is maintained."

Evaluation: In Pump relief request PR-09, the licensee states that the centrifugal charging pump reference flowrate is 90 gpm and that "the pump curve is essentially horizontal between 85 and 95 gpm." It appears, therefore, that the flowrate through the minimum flow check valve cannot be determined using the pump curve with much accuracy. The licensee has not provided any information in the relief request concerning the portion of the pump curve being used or provided an example. Without this ...itional information, the alternative does not appear to provide an adequate quantitative measure to ... that the required flowrate is passed through the valve. The licensee may use this relief request ...ovide additional justification of the acceptability of the proposed indirect method to ensure the flowrate through these valves quarterly.

As discussed in Generic Letter 89-04, Position 1, full-stroke exercising of check valves requires that the maximum required accident flowrate be passed through the valve. The licensee has stated that using temporary flow instruments on the mini-flow line did not provide acceptable results. The licensee should consider measuring the flowrate upstream of the pumps using temporary instruments and then subtracting the flowrate measured downstream using flow element 1FE121 to determine the mini-flow line flowrate. ... cases where the maximum required accident flowrate cannot be passed or where flow instrumentation ... not installed or cannot be determined, the use of nonintrusive methods to determine valve obturator full-stroke is acceptable. Nonintrusive methods, such as acoustic monitoring and ultrasonics, can provide a "positive means" of verifying the valve obturator travels to the required safety position and therefore meets the Code requirements, i.e., OM Part 10, ¶4.3.2.4(a).

Immediate compliance with the Code requirements is impractical given the current system design. Compliance would require a plant shutdown to allow the licensee to evaluate and obtain temporary flow instruments upstream of the pumps or nonintrusive methods. An interim period of time is necessary for the licensee revise the relief request or evaluate the options, procure instrumentation and revise the procedures to comply with the Code. In the interim the licensee should evaluate the use of temporary flow instruments, or the use of non-intrusion methods. The licensee's current method of determining flowrate should provide a reasonable assurance of the check valve's operational readiness during the interim.

Therefore, it is recommended that interim relief be granted in accordance with 10CFR50.55a(f)(6)(i) for one year or until the next refueling outage, whichever comes later.

3.2.2 Refueling Outage Justification: VR-08, RCP Seal Injection Check Valves, 1(2)VC8367A, B, C, 1(2)VC836D, and 1(2)VC8375A, B, C, D

Relief Request: The licensee has requested relief from OM Part 10 ¶ 4.3.2.4 (a), which requires verification of individual check valve closure capability quarterly.

Proposed Alternate Testing: "Zion Station will back leakage test these valves in series. Leakage identified will be attributable to both valves. This testing will ensure the integrity of the ASME Class 1 to Class 2 transition."

Licensee's Basis for Relief: The licensee states: "These valves are physically located in series with no test connection located between them. To test each valve individually would require a modification to install a test connection between them. A modification to install a test connection on all eight seal injection lines would be an excessive cost burden to the Station. These valves can be tested in series with the current piping configuration.

To perform the check valve closure test, the flow to the Reactor Coolant Pump seals needs to be isolated. Since seal injection is required during normal operation to prevent potentially damaging the seals, it is not practical to isolate seal injection during normal operations. Therefore, this test is impractical to perform during normal operations.

The methodology used in testing these valves would require the RCPs and Charging Seal Injection to be secured. A blank flange would be installed on the inlet to the seals to provide a test boundary as well as to prevent any test water leakage into the seals. Test equipment would need to be installed on the system to perform the leakage test. To set up and perform this test as required by the Code would be burdensome to perform at cold shutdown due to the costs involved in remaining shutdown even if the RCPs were secured.

Therefore, taking the above mentioned items into account, these check valves will be tested at reactor refueling."

Evaluation: The subject valves are normally open, simple Class 1 check valves, located inside the missile barrier, inside containment. The only practical method for testing these valves is by leak testing since they do not have position indication or pressure instrumentation. It is impractical to leak test these valves during operation as they must remain open to supply seal injection to the reactor coolant pumps. Interrupting seal flow could damage the pump seals. Testing during cold shutdowns is also impractical due to the test setup and performance limitations. The licensees justification for testing the valves during refueling outages in accordance with OM Part 10 ¶4.3.2.2(e) is acceptable.

The Code requires individual verification of valve closure. The only practical means of verifying valve closure is by leak testing. However, due to the lack of test connections between the valves, the licensee has proposed to test the valves in series. The NRC has provided guidance, in Draft NUREG-1482, Section 4.1.1, for preparing relief requests when licensees have two check valves in series with no provisions for verifying that each can close. As discussed in this NUREG, the licensee must ensure that the safety analysis does not require both of these Class 1 valves to function, i.e., one valve could be removed without creating an unreviewed safety question or creating a conflict with regulatory or license requirements. The licensee's basis does not discuss the function of the valves. Provided the licensee verifies that only one of the two Class 1 valves is required, relief can be recommended pursuant to 10CFR50.55a(f)(6)(i). If however, the series valves are required by the plant safety analysis assumptions, verification of the capability of each of the valves is required and relief cannot be granted. Generic Letter 89-04, Position 2 provides an acceptable alternative for demonstrating the capability of both valves to close by disassembly and inspection. The licensee should revise the relief request accordingly.

3.3 Auxiliary Feedwater System

3.3.1 Relief Request Number: VR-05, Steam Supply to AFW Pump Turbine Check Valves, 1(2)MS0006, 7

Relief Request: The licensee has requested relief from OM Part 10, ¶ 4.3.2, which requires quarterly verification of individual check valve closure capability.

Proposed Alternate Testing: "The Station is currently pursuing acoustic monitoring as a potential method of determining valve closure. This testing could only be done during a refueling outage. However, until sufficient baseline data can be obtained there will not be enough conclusive evidence to determine valve degradation, if any, in a timely manner.

The valves are tested quarterly for full flow. The valves have had an excellent Inservice Testing record. This test is sufficient to detect valve degradation for the required open stroke. However, valve closure can not be verified quantitatively.

The Station believes that the current testing and development of acoustics for these valves would provide reasonable assurance to maintain valve operational readiness."

Licensee's Basis for Relief: The licensee states: "Zion has investigated methods of testing these valves for closure as required by the Code. The Plant piping configuration does not provide a positive way to verify valve closure. Compliance with the Code exercising requirements could only be achieved after a significant redesign of the system. Any modification would require cooling to vent Main Steam. The modification would also require engineering to prevent flooding. These modifications would be burdensome due to the costs involved.

As an example, in the same lines, motor operated valves are provided as isolation in the event of a steam line break. A test could be developed during normal operation where the motor operated valve could be used to isolate the check valve while supplying steam flow to the upstream side of the disk which would cause the valve to close. However, there are no vent, drain, or test lines to depressurize the pipe between the isolation valve and check valve. Hence, the check valve may not close fully. If the test could be performed, permanent or temporary instrumentation would be needed to detect steam flow or pressure and the piping design at Zion does not facilitate the use of this methodology.

These check valves are a Crane/Chapman 623A W.E. tilting disc type. The valve body is split with the disc on one half and the seat on the other half of the valve. Valve disassembly and inspection is not an option for these valves because there are inherent risks involved with this sort of disassembly. In order to get a good seating match of valve disc and seat, the valve must be assembled while removed from the pipe to visually accept its seating ability. These 6 inch valves would require their welds cut out, and the valve itself removed for disassembly/reassembly and then welded back in place. The cost and critical path time during an outage would be extensive and a burden for the Station."

Evaluation: Check Valves, 1(2)MS0006 and 7 are six inch, normally closed valves located in the steam supply to the turbine driven AFW pump turbine. These check valves open to allow main steam to the AFW Pump Turbine. Additionally, these valves perform a safety function in the closed position to prevent diversion of steam flow from the AFW pump turbine in the event of a failure of one of the steam lines.

As required by OM Part 10, ¶4.3.2.2 and 4.3.2.4, check valves which serve a safety function in the closed position are to be tested in a manner which demonstrates that the valve disc travels promptly to the seat upon flow reversal or cessation, quarterly. Confirmation that the disc is seated shall be a direct indicator such as a position indicating device, or by other indicators such as changes in system pressure, flowrate, level, temperature, seat leakage testing, or other positive means, such as nonintrusive techniques or disassembly and inspection.

These valves are simple check valves and do not have position indication or system instrumentation that would allow verification that the valve was closed during operation. The design of the valve (as shown on the Chapman Division Drawing No. C-53485, supplied by the licensee) makes disassembly and inspection impractical. However, it appears, based upon a review of P&ID M-20, that a leak test (i.e., a pressure decay test) may be performed utilizing drain valves or temporary connections downstream of the check valves. It would be impractical to perform this test during operation, due to the personnel safety hazard, or during cold shutdowns, due to the extensive test setup and performance limitations, which could extend the outage. However, the licensee should consider this method of testing during refueling outages.

It is recommended that the licensee pursue the use of nonintrusive testing techniques, including techniques besides acoustic monitoring, and leak testing and implement them if they are demonstrated to be effective.

Based on the impracticality of verifying the closure capability during operation or cold shutdowns, it is recommended that interim relief be granted in accordance with 10CFR50.55a(f)(6)(i), for one year, or until the next refueling outage, whichever is later. In the interim, the licensee should investigate and implement leak testing or other positive means for verifying valve closure. Full-flow testing the valves quarterly should provide adequate assurance of the valves' operational readiness in the interim. If the licensee determines that acoustics, or another method verifies closure, relief may no longer be required.

3.4 Containment Spray System

3.4.1 Relief Request Number: VR-09, CS Pumps' Cooling Water Solenoid Valves, 1(2)SOV-SW0153

Relief Request: The licensee has requested relief from the requirements of OM Part 10, ¶4.2.1.2, which requires quarterly measurement of valve stroke times.

Proposed Alternate Testing: "Zion Station tests the 1(2) C Diesel Driven CS Pumps on a quarterly frequency. During this test, the flow rate of cooling water through 1(2)SOV-SW0153 is recorded and verified to be within a certain range. The verification of flow through the valve during operation of the diesel-driven CS pump is considered sufficient to ensure that the valve is capable of opening on demand to meet its safety function."

Licensee's Basis for Relief: The licensee states: "1(2)SOV-SW0153 is a solenoid-operated valve which is required to open upon starting of the 1(2) C Diesel-Driven Containment Spray (CS) pump to provide cooling to the engine and to the CS room coolers. The valve opens automatically on starting of the pump. This valve is an integral component of the CS Diesel-Driven pump skid and, as such, does not have control circuit or indication independent of the pump engine. This lack of remote position indication coupled with the fact that position of solenoid valves cannot be determined by observation makes it impossible to perform stroke time testing on this valve."

Evaluation: OM Part 10, ¶4.2.1.3 requires that the necessary valve obturator movement be determined by exercising the valve while observing an appropriate indicator or by observing other evidence such as changes in system flow rate which reflect change of obturator position. Simply verifying the flowrate is within a range can substantiate that the valve moves to the required position, however, this alternative does not provide a means for detecting valve degradation. Measuring the length of time between pump start and the detection of flow rate through 1(2)FISW84 can provide an adequate means of measuring the stroke time in accordance with the Code. Therefore, it is recommended that relief be denied. The licensee should perform stroke time testing in accordance with the Code as described above. Alternatively, the licensee could consider using nonintrusive methods to determine valve stroke time.

4.0 EVALUATION OF DEFERRED TESTING JUSTIFICATIONS

Commonwealth Edison has submitted 30 justifications for deferring valve testing. These justifications document the impracticality of testing 270 valves for both units quarterly, during power operation, or during cold shutdowns. These justifications were reviewed to verify their technical basis.

As discussed in Generic Letter 91-18, it is not the intent of IST to cause unwarranted plant shutdowns or to unnecessarily challenge other safety systems. Generally, those tests involving the potential for a plant trip, or damage to a system or component, or excessive personnel hazards are not considered practical. Removing one train for testing or entering a Technical Specification limiting condition of operation is not sufficient basis for not performing the required tests, unless the testing renders systems inoperable for extended periods of time (Reference Generic Letter 87-09). Other factors, such as the effect on plant safety and the difficulty of the test, may be considered.

Valves, whose failure in a non-conservative position during exercising would cause a loss of system function, such as non-redundant valves in lines (e.g., a single line from the RWST), or the RHR pump discharge crossover valves for plants whose licensing bases assumes that all four cold legs are being supplied by water from at least one pump (Reference NRC Information Notice 87-01), should not be exercised during conditions when the system is required to be operable. Other valves may fall into this category under certain system configurations or plant operating modes, e.g., when one train of a redundant ECCS system is inoperable, non-redundant valves in the remaining train should not be cycled because their failure would cause a total loss of system function or when one valve in a containment penetration is open and inoperable, the redundant valve should not be exercised during this system configuration.

BNL's evaluation of each cold shutdown justification is provided in Table 4.1. Each refueling outage justification is provided in Table 4.2. The anomalies associated with the specific justifications are provided in Section 5.0 of this TER (Subsections 5.20-5.31).

5.0 IST PROGRAM RECOMMENDED ACTION ITEMS

Inconsistencies, omissions, and required licensee actions identified during the review of the licensee's third interval Inservice Testing Program are summarized below. The licensee should resolve these items in accordance with the evaluations presented in this report.

5.1 The IST Program does not include a description of how testing requirements were identified for each component, or the safety function of the valves. The review performed for this TER did not include verification that all pumps and valves within the scope of 10 CFR 50.55a and Section XI are contained in the IST Program, and did not ensure that all applicable testing requirements have been identified. The licensee is requested to include this information in the IST Program. The program should describe the development process, such as a listing of the documents used, the method of the basis for categorizing valves, and the method or process used for maintaining the program current with design modifications or other activities performed under 10 CFR 50.59. Additionally, for each interval, the licensee should maintain an accurate status of the relief requests including their revision and NRC approval.

The licensee has classified components in accordance with Regulatory Guide 1.26. Some non-Code classified safety-related components are included in the IST program, as augmented requirements. The licensee should ensure that all safety-related components are tested commensurate with their importance to safety. as required by 10CFR50, Appendix A, Criterion 1.

5.2 The IST Program's scope was reviewed for selected systems. The pumps and valves in the Unit 1 Auxiliary Feedwater System, Main Steam, Reactor Vessel Head Vent, Containment Spray, and Service Water Systems were reviewed against the requirements of Section XI and the regulations. The UFSAR was used to determine if the specified valve categories and valve functions were consistent with the plant's safety analyses. The review results showed compliance with the Code, except for the following items. The licensee should review these items and make changes to the IST Program, where appropriate. Additionally, the licensee should verify that there are not similar problems with the IST Program for other systems.

- The IST Program does not require fail-safe testing or exercising closed the solenoid operated reactor vessel head vent valves (1SOV-RC08 through 11). Per UFSAR Section 5.4.15, "These valves are operated from the Control Room and fail in the closed position." The licensee should verify the function of these valves and revise the IST program appropriately.

- The IST Program, Table 4.1-1 identifies the AFW pump service water suction crossover valves (1MOV-SW106 and 107) as normally open. Drawing M-037-1 (Revision AT) depicts them as normally closed.

- The MSIVs (1HOV-MS001 through 4), are hydraulically-pneumatically operated. The IST Program does not require fail-safe testing of these valves. The licensee should review NRC IE Information Notice No. 85-84 and revise the IST Program appropriately. Additionally, UFSAR Section 10.3.4 states that the MSIVs and check valves (1MS008 through 11) have a seat leakage acceptance criteria of 10 cubic centimeters per inch of valve seat diameter per hour. The IST Program, however, indicates that these valves are Category B and C, respectively. The Code requires valves that have a specific maximum seat leakage rate in order for the valves to fulfill their safety function to be categorized as A or AC. The licensee should review the safety analysis and the function/category of these valves. In accordance with P&ID M-020, the main steam line check valves (1MS008 through 11) are safety related but not Code Class. The licensee should also review the code classification of these valves.

• The IST Program only requires fail-safe testing and position verification of the main steam atmospheric relief valves (1MOV-MS0017 through 20). The valves are not required by the program to be stroke exercised. Per UFSAR 10.3.2.2, these valves are "provided to automatically maintain the steam pressure below 1105 psig under emergency shutdown." The licensee should review the function of these valves and revise the IST program appropriately.

• The main feedwater check valves upstream of the feedwater isolation valves (1FW-005 through 8) are identified on P&ID M-022 as safety related, but not Code Class. The licensee should review the code classification of these valves, as they may be required to isolate a feedwater line break prior to isolation by the motor-operated valves.

• The vacuum breakers at the discharge of the service water pumps (1SW0648 through 650) are not included in the IST Program. As discussed in draft NUREG-1482, Section 4.3.8, if these valves are required to provide overpressure protection to the service water system, they should be included in the IST program.

• A number of motor-operated valves in the service water system are only exercised open (e.g., 0MOV-SW0007). The UFSAR Section 9.2.1.3 discusses the capability of the system to be isolated under postulated leakage conditions. The licensee should verify that these valves are not required by the safety analysis to have a closed function and therefore are required to be tested in the closed position.

5.3 In Pump Relief Request PR-01, relief was granted to perform flow testing on the Service Water Pumps during cold shutdowns and refuelings. The licensee should continue to monitor pump vibration and differential pressure quarterly in accordance with Generic Letter 89-04 Position 9. Table 3.1-1 "Units 1 and 2 Pumps Inservice Testing Plan Listing" should be revised to reflect this.(TER Section 2.2.1)

5.4 In Pump Relief Request PR-05, relief was granted from measuring individual Service Water pump flow rates following maintenance. The licensee proposes to use brake horsepower, instead of flow rate, as the set reference parameter when performing the retest to verify operability following maintenance (onsite or offsite). In addition, the licensee proposes to perform an additional inservice test, with flow during "a scheduled cold shutdown." This inservice test, with flow, should be performed during the next cold shutdown of suitable length, regardless of whether the cold shutdown was "scheduled". (TER Section 2.2.2)

5.5 In Pump Relief Requests PR-06,-07,-08,-09, and -10, the licensee proposed pump flow tolerances in excess of Code requirements. The licensee should modify these relief requests to discuss the instrument accuracy and readability as requested by the NRC in Section 3.2.2 of the June 14, 1993 SER. (TER Sections 2.2.3, 2.4.1, 2.5.1, 2.6.1, and 2.7.1)

5.6 In the Proposed Alternate Testing for Pump Relief Request PR-10, the licensee states that "The differential pressures will be compared to Table 3b limits to ensure the measured value is within ±10% of the pressure reference value." As per OM Part 6 Table 3b, vertical line shaft pumps are required to be declared inoperable when the differential pressure decreases by 7%, or increases by 10%, from the reference value. In addition, Table 3b requires the test frequency to be doubled (i.e., once every one and one-half months) when the pump is in the Alert Range.

It is unclear what actions the licensee plans to take when this situation arises during cold shutdown testing when the Code requires doubling the test frequency. The NRC has provided guidance for valves in this same situation (Draft NUREG-1482, Section 4.2.1). Corrective action is required prior to returning the plant to power, or the plant must be returned to a mode which permits testing every one and one-half months. The licensee should revise this Relief Request to correct these discrepancies. (TER Section 2.2.3)

5.7 In Pump Relief Request PR-04, the licensee states that the current Containment Spray engine vibration amplitudes are acceptable to the engine supplier. Since the pump is an equally critical component, the licensee should also verify the acceptability with the pump supplier. (TER Section 2.3.1)

5.8 Table 3.1-1 "Units 1 and 2 Pumps Inservice Testing Plan Listing" incorrectly references Relief Request PR-05, instead of PR-06 for pumps 1(2)FW004 on Page 12. (TER Section 2.4.1)

5.9 In Pump Relief Request PR-10, the licensee bases the precision obtainable for measuring Service Water pump flow (± 500 gpm) upon the increments (1000 gpm) of the currently installed flow instrumentation. The replacement or installation of instruments to meet the Code requirements is not considered an undue burden. The licensee should investigate the availability of a more precise flow element. If one is not available, a more detailed discussion is needed to ensure that the large flow variance will not overlook pump degradation. (TER Section 2.2.3)

5.10 In PR-07, the licensee proposed a ±3 gpm (±10%) flow range for the Safety Injection pumps, which is well in excess of the NRC approved ±2%. The licensee has not provided sufficient information to ensure that the proposed acceptance range will provide reasonable assurance that pump degradation will be detected, and operability assured. The use of pump curves provides an acceptable alternative in instances where the flow can not be set to a prescribed reference value. The licensee should revise this Relief Request to reflect the use of pump curves. These curves should be prepared in accordance with the NRC Recommendation specified in Draft NUREG-1482, Section 5.2, and be included in the IST Program. (TER Section 2.5.1)

5.11 While performing the centrifrigal charging pump flow test in PR-09, the licensee should ensure that the minimum flow line is isolated using manual valves VC 8479A and B (per VC-05, MOV-VC-8110 and 8111 cannot be isolated) during the performance of the test to ensure that the flow measured by 1FE-121 is the total pump output. If isolating the individual minimum flow lines is not practical, the licensee should revise the relief request accordingly. (TER Section 2.7.1)

5.12 The licensee has proposed performing a "reduced pressure flow test" as a means of full-stroke exercising the SI accumulator check valves. "As a further means of detecting degradation of these check valves, acoustic monitoring will be attempted in conjunction with this test." It is not evident how a reduced pressure flow test alone will verify that the valves are full-stroke exercised. The licensee should clarify whether this test is conducted at the maximum required accident flowrate as discussed in Generic Letter 89-04, Position 1. If a reduced flow rate will be used, a positive means of verifying the valves open to the full-stroke position is required. Draft NUREG-1482, Section 4.1.2 further discusses the use of nonintrusive techniques as a means of verifying valve position and allows sample testing. The licensee should revise relief request VR-01 to clarify the testing method, as it does not appear to comply with Generic Letter 89-04, Position 1.

With regards to the test frequency, it is impractical to partial-stroke or full-stroke exercise these valves open quarterly because the maximum operating pressure in the accumulators is less than the normal operating pressure in the RCS. However, the licensee has not provided justification for not performing a full-stroke open or at least a partial-stroke open test at cold shutdowns. Cold Shutdown Justification VC-18 discusses the impracticality of exercising the valves closed quarterly.

Furthermore, the licensee provides an explanation of the burden of testing all four accumulator check valves each refueling outage. Other Westinghouse units have recently proposed a sample disassembly and inspection program in accordance with Generic Letter 89-04, Position 2 (Pt. Beach, Callaway, McGuire) or a reduced accumulator pressure blowdown test in conjunction with a nonintrusive techniques at refueling outages (Beaver Valley, Summer). It does not appear that the burden at Zion to comply with Position 1 or 2 of Generic Letter 89-04 is any more excessive than at these other PWRs. Therefore, it is recommended that relief as requested be denied. The licensee should full-stroke exercise the valves in accordance with Generic Letter 89-04, Positions 1 or 2. If full or partial flow exercising during cold shutdowns is impractical, the licensee should clarify this relief request. Generic Letter 89-04 Position 2, and Draft NUREG-1482 Section 4.1.2 allows a sampling technique to be used. However, if the sample valve fails, then all valves in the sample group must be tested. The licensees proposed sampling plan does not agree with this. The licensee should consider the safety significance and historical reliability of these valves when proposing alternate testing. (TER Section 3.1.1)

5.13 It is recommended that the alternate testing proposed in VR-03 not be authorized (See TER Section 3.1.2). The licensee should develop and implement at the first refueling outage of the interval an alternate testing method to verify the full-stroke opening of the RHR cold leg injection PIVs. Acceptable methods include the use of nonintrusives, disassembly and inspection, or the installation of flow instrumentation. (TER Section 3.1.2)

5.14 The alternative proposed by the licensee in VR-06 to verify the valve position indication locally every three years is recommended to be authorized. The licensee should, however, evaluate the practicality of supplementing the triennial local position indication verification with observation of system characteristics. (TER Section 3.1.3)

5.15 In Pump relief request PR-09, the licensee states that the centrifugal charging pump reference flowrate is 90 gpm and that "the pump curve is essentially horizontal between 85 and 95 gpm." It appears, therefore, that the flowrate through the minimum flow check valve cannot be determined using the pump curve with much accuracy. The licensee has not provided any information in Relief Request VR-02 concerning the portion of the pump curve being used or provided an example. Without additional information, the alternative does not appear to provide an adequate quantitative measure of the flowrate through the check valves. The licensee may use this relief request to provide additional justification of the acceptability of the proposed indirect method to ensure the flowrate through the valve is above the minimum quantity.

As discussed in Generic Letter 89-04, Position 1, full-stroke exercising of check valves requires that the maximum required accident flowrate be passed through the valve. The licensee has stated that using temporary flow instruments on the mini-flow line did not provide acceptable results. The licensee should consider measuring the flowrate upstream of the pumps using temporary instruments and then subtracting the flowrate measured downstream using flow element 1FE121 to determine the mini-flow line flowrate. In cases where the maximum required accident flowrate cannot be passed or where flow instrumentation is not installed or cannot be determined, the use of nonintrusive methods to determine valve obturator full-stroke is acceptable. Nonintrusive methods, such as acoustic monitoring and ultrasonics, can provide a "positive means" of verifying the valve obturator travels to the required safety position and therefore meets the Code requirements, i.e., OM Part 10, ¶4.3.2.4(a).

Requiring immediate compliance with the Code requirements is impractical given the current system design. Compliance would require a plant shutdown to allow the licensee to evaluate and obtain temporary flow instruments upstream of the pumps or nonintrusive methods. An interim period of time is necessary for the licensee to revise the relief request or evaluate the use of temporary flow instruments, or non-intrusive techniques. In the interim, the licensee's current method of determining flowrate should provide a reasonable assurance of the check valve's operational readiness. (TER Section 3.2.1)

5.16 The licensee's basis in Relief Requests VR-07 and VR-08 does not discuss the function of the valves as required by the safety analysis. Provided the licensee verifies that only one of the two check valves is required, relief can be recommended pursuant to 10CFR50.55a(f)(6)(i). If however, the series valves are required by the plant safety analysis assumptions, verification of the capability of each of the valves is required and relief cannot be granted. As stated in Draft NUREG-1482, Section 4.1.1, the licensee may demonstrate the capability of both valves to close by disassembly and inspection, or other positive means (e.g., radiography). The licensee should revise the relief requests accordingly. (TER Sections 3.2.2 and 3.1.4)

5.17 It appears, based upon a review of P&ID M-20, (VR-05) that a leak test (i.e., a pressure decay test) may be performed utilizing drain valves or temporary connections downstream of the steam supply to AFW pump turbine check valves could be used to verify the valves' closure capability. It would be impractical to perform this test during operation, due to the personnel safety hazard, or during cold shutdowns, due to the extensive test setup and performance limitations, which could extend the outage. However, the licensee should consider this method of testing during refueling outages.

It is recommended that the licensee pursue the use of nonintrusive testing techniques, including techniques besides acoustic monitoring, and leak testing and implement them if they are demonstrated to be effective.

Based on the impracticality of verifying the closure capability during operation or cold shutdowns, it is recommended that interim relief be granted in accordance with 10CFR50.55a(f)(6)(i), for one year, or until the next refueling outage, whichever is later. In the interim, the licensee should investigate and implement leak testing or other positive means for verifying valve closure. Full-flow testing the valves quarterly should provide adequate assurance of the valves' operational readiness in the interim. (TER Section 3.3.1)

5.18 The licensee's proposal to simply verify that the flowrate is within a range can substantiate that the CS pumps' cooling water solenoid valves moved to the required position, however, this alternative does not provide a means for detecting and monitoring valve degradation. Measuring the length of time between pump start and the detection of flow rate through 1(2)FISW84 can provide an adequate means of measuring the stroke time in accordance with the Code. Therefore, it is recommended that relief request VR-09 be denied. The licensee should perform stroke time testing in accordance with the Code. Alternatively, the licensee could consider using nonintrusive methods to determine valve stroke time. (TER Section 3.4.1)

5.19 The licensee has proposed a sample disassembly and inspection program for 35 check valves in Relief Request VR-04, based on the lack of a quantitative means to verify the valves' full-stroke. This program appears to comply with the criteria of Generic Letter 89-04, Position 2. Position 2 was developed prior to the wide-spread use of nonintrusive techniques. Disassembly and inspection of a check valve is not considered a true substitute for an operability test conducted under operating flow conditions, but is allowed when no other means for testing is available. In the Generic Letter 89-04 public meetings, in response to questions on the use of disassembly and inspection, the NRC indicated that the use of other alternate techniques, including nonintrusives, were under investigation and were being encouraged by the NRC. The licensee should evaluate the use of nonintrusives in lieu of disassembly.

5.20 According to the Technical Specifications (Tech Specs) 4.8.5.A.4 and 4.8.3.A.7, valves MOV-SI8808A through D and MOV-RH8703, respectively, "shall be stroke tested only during refueling outage." The licensee's proposed testing at cold shutdowns (VC-16 and VC-02) conflicts with these Tech Specs. The licensee should verify when testing is allowed and practical. Additionally, Technical Position VP-03 identifies conflicting requirements in Tech Spec 4.4 and UFSAR Table 16.3-3. Tech Spec Section 4.4 addresses safeguards instrumentation and control channel testing and does not appear to address testing of these valves. UFSAR Table 16.3-3, however, in Note "*" states that the valves will be stroked at refueling and "energization of these valves is permissible to support other testing..." As required by 10CFR50.55a(f)(5)(ii), the licensee is required to apply for a Tech Spec amendment when the Tech Specs conflict with the IST program.

5.21 The licensee has not, provided justification for not testing the SI8957A and B valves closed quarterly in Justification VC-10. However, since these valves are located inside containment, it appears that to establish such a test setup during normal plant operation would be excessively burdensome and impractical because of increased radiation exposure to personnel. The licensee, however, should revise the justification in future program submittals.

5.22 The licensee describes a safety function for the RHR pumps' discharge check valves, RH8730A and B, in the closed position in Justification VC-11. However, neither the justification nor the Valve Program Tables identifies any required testing in the closed direction. The licensee should revise the program as appropriate.

5.23 As discussed in Section 4.0 of this TER, entering a LCO is not sufficient basis for not performing the required tests, unless the testing renders systems inoperable for extended periods of time. The licensee should evaluate quarterly testing of the valves discussed in VC-20 within the Technical Specification allowed outage time, or further investigate the effects of testing, which may provide additional basis for the deferral. In particular, the licensee should refer to NRC Information Notice IN 87-01, "RHR Valve Misalignment Causes Degradation of ECCS in PWRs," for guidance with respect to closure during power operation of RHR discharge cross-over isolation valves. The licensee should revise this justification.

5.24 Although there is no individual pump flow instrumentation, it is not clear why the licensee could not use nonintrusive diagnostic techniques (e.g., acoustics) to determine whether the service water pumps' discharge check valves have full-stroke opened during normal pump operation.

Therefore, the licensee should investigate the practicality of using nonintrusive diagnostic techniques to verify full disk lift during quarterly flow testing and revise Justification VC-19 accordingly.

5.25 Table 4.1-1, Valve Inservice Testing Plan Listing, Page 91, does not indicate a reverse flow closure test for 1VC8546. The licensee should verify that this valve does not have a safety function in the closed direction, or revise the program accordingly.

5.26 The licensee should note that the NRC position, as described in the "Minutes of the Public Meetings on Generic Letter 89-04," dated October 25, 1989, Response to Question 24, is that if a valve performs a safety function in only the closed position, demonstration of a full-stroke open before verification of closure capability is not required by the ASME Code. This closure verification is required to be performed at the frequency specified by the Code. The licensee should review the Valve Testing Program to assure that testing of check valves is not unnecessarily deferred due to a misinterpretation of the ASME Code and provide additional justification for not testing the valves closed quarterly or at cold shutdowns (Justifications VO-09, VO-03, VO-04, VO-02).

5.27 The licensee has proposed testing the RCP seal water supply valves at refueling outages in Justification VO-08. The licensee should, however, consider testing these valves whenever the associated RCP is not running during cold shutdowns.

5.28 For the automatically initiated portions of the IVSW System (Justification VO-06), it is acceptable to defer testing to refueling outages in accordance with OM Part 10 ¶ 4.3.2.2(e). However, the licensee should revise the test procedure to a method which would verify positively that each individual check valve opens during testing.

The licensee should verify that the valves, whether in the automatic or manual portions of the IVSW System, do not perform a safety function in the closed position, since the Containment Isolation components to which the IVSW check valves are connected include Pressure Isolation Valves and other high energy line valves such as for the RCP seal water supply line and the CVCS Letdown line.

5.29 The licensee in Technical Position VP-06, has stated that "Subarticle 1.2(a)(2) allows valves which are used for system control to be exempt from OM Part 10" and has proposed only fail-safe testing these valves in accordance with ¶4.2.1.6. OM Part 10, excludes valves used only for system control. If a control valve has a fail-safe function, it is not exempt from the requirements of OM Part 10. As described in draft NUREG-1482, Section 4.2.9, control valves with a fail-safe function are required to be stroke exercised and fail-safe tested in accordance with OM Part 10, ¶4.2.1. The licensee should revise the IST program, accordingly.

5.30 The licensee has provided in Technical Positions VP-02 and 4, discussions of situations where testing may be impractical given certain operating configurations or constraints. Deferral of testing to periods when testing is practical complies with the requirements of OM Part 10 and is therefore acceptable. The licensee should, however, provide specific evaluations of the impracticality of testing valves in the IST records.

5.31 The licensee has stated in VO-02 that differential pressure gages will be used to calculate flow rate through the RHR hot leg injection valves. The licensee should clarify why flow transmitter FT600 cannot be used.

6.0 REFERENCES

1. NRC Regulatory Guide 1.147, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1," Revision 9, April 1992.

2. ASME Boiler and Pressure Vessel Code, Section XI, Rules for Inservice Inspection of Nuclear Power Plant Components, 1989 Edition.

3. Zion Technical Specifications.

4. Zion Station, Updated Final Safety Analysis Report, June 1992.

5. ASME/ANSI OMa-1988, Part 6, "Inservice Testing of Pumps in Light-Water Reactor Power Plants."

6. ASME/ANSI OMa-1988, Part 10, "Inservice Testing of Valves in Light-Water Reactor Power Plants."

7. Title 10, Code of Federal Regulations, Section 50.55a, Codes and Standards.

8. Standard Review Plan, NUREG 0800, Section 3.9.6, Inservice Testing of Pumps and Valves, Rev. 2, July 1981.

9. NRC Generic Letter 89-04, "Guidance on Developing Acceptable Inservice Testing Programs," April 3, 1989.

10. Minutes of the Public Meetings on Generic Letter 89-04, October 25, 1989.

11. Supplement to the Minutes of the Public Meetings on Generic Letter 89-04, September 26, 1991.

12. Draft NUREG-1482, "Guidelines for Inservice Testing at Nuclear Power Plants," P. Campbell, November 1993.

13. ASME OMb-S/G-1992, Part 14, "Vibration Monitoring of Rotating Equipment in Nuclear Power Plants."

14. "Required Vibration Analysis Techniques and Instrumentation on Low Speed Pumps," J. E. Berry, Technical Associates of Charlotte, 347 North Caswell Road, Charlotte, NC 28204, Second Edition, 1992.

15. "Understanding Vibration Measurement," R. Chitwood, *Orbit*, Bentley Nevada, March 1994.

16. "A Comparison of Peak and rms for Measuring Vibration," J. C. Mitchell, *Vibrations*, Vol. 3, No. 3/4, December 1987.

17. Goldman, S., **Vibration Spectrum Analysis, A Practical Approach**, Industrial Press Inc., 1991.

18. Generic Letter 91-18, "Information to Licensees Regarding Two NRC Inspection Manual Sections on Resolution of Degraded and Nonconforming Conditions and on Operability," November 7, 1991.

19. Generic Letter 87-09, Sections 3.0 and 4.0 of the Standard Technical Specifications (STS) on the Applicability of Limiting Conditions for Operation and Surveillance Requirements," June 4, 1987.

20. NRC IE Information Notice 87-01, "RHR Valve Misalignment Causes Degradation of ECCS in PWRs," January 6, 1987.

21. NRC IE Information Notice No. 85-84 , "Inadequate Inservice Testing of Main Steam Isolation Valves," October 30, 1985.

22. Karassik, Igor J., **Centrifugal Pump Clinic - Second Edition**, Marcel Dekker, Inc., 1989.

23. Karassik, Igor J. and Carter, Roy, **Centrifugal Pumps**, McGraw-Hill, 1960.

24. Generic Letter 94-03: Deficiencies Identified During Service Water System Operational Performance Inspections, January 11, 1994.

25. Generic Letter 89-13: Service Water System Problems Affecting Safety-Related Equipment, July 18, 1989.

26. Generic Letter 89-13 Supplement 1: Service Water System Problems Affecting Safety-Related Equipment, April 4, 1990.

27. International Standard ISO-2372, "Mechanical Vibration For Machines with Operating Speeds From 10 to 200 rev/s - Basis For Specifying Evaluation Standard", 1974 Edition.

28. NRC Safety Evaluations:

• "Zion Nuclear Power Station, Units 1 and 2, Inservice Testing Program Relief Requests for Pumps and Valves (TAC Nos. M83016, M83017, M85479, and M85480)", USNRC to D.L. Farrar, June 14, 1993.

• "Zion Station, Units 1 and 2, Relief Requests for the Second Ten Year Interval Inservice Testing Plan for Pumps and Valves (TAC Nos. M82715 and M82722)", USNRC to T.J. Kovach, March 24, 1993.

• "Zion Nuclear Power Station, Units 1 and 2, Safety Evaluation of the Inservice Testing Program Relief Requests for Pump and Valves (TAC Nos. M86678 and M86679)", USNRC to D.L. Farrar, June 25, 1993.

Attachments:
1. Table 4.1
2. Table 4.2

Appendix A: Zion P&IDs

P&ID No	Sheet No.	System	Revision
M-18	1	Piping Symbol Sheet	Q
M-19	1	Instrument Symbol Sheet	E
M-22	1	Steam Generator Feedwater Piping	WN
M-32	1	Service Water	AN
M-32	2	Service Water	BR
M-32	4	Service Water	B
M-37	1	Condensate Storage System	AT
M-37	2	Condensate Storage System	AC
M-38	2	Fuel Oil & Diesel Oil	AD
M-39	1	Isolation Valve Seal Water	AA
M-43	1	Screen Wash & Fire Protection	YM
M-44	1	Containment Spray System	JK
M-45	1	Waste Disposal System (Liquid) Blowdown System	AK
M-45	3	Waste Disposal System (Liquid) Blowdown System	E
M-47	1	Waste Disposal System (Liquid) Auxiliary Building Drains	AH
M-52	1	Reactor Coolant Loops 1 and 2	AG
M-53	1	Reactor Coolant Loops 3&4	AW
M-62	1	Residual Heat Removal	AL
M-63	1	Spent Fuel Pit Cooling & Cleanup Piping	AC
M-64	1	Safety Injection System	AG
M-65	1	Safety Injection System	AL
M-66	1	Component Cooling System	AR
M-67	1	Component Cooling System	AE
M-69	1	Demineralized Flushing Water	AD
M-70	2	Cont. Air Monitoring Sampling & Equipment Vent System	L

Appendix A (Cont'd)

P&ID No	Sheet No.	System	Revision
M-70	1	Con't Air Monitoring Sampling & Equipment Vent System	AN
M-71	1	Service Air	AN
M-72	11	Instr. Air System Reactor Building & V.P.C.	C
M-72	12	Instr. Air System Reactor Building & V.P.C.	C
M-74	1	Nuclear Sample (Primary)	T
M-84	1	Heating System Hot Water	AF
M-87	1	Waste Drain System	AB
M-500	1	Control Room Drawing Main Steam Piping	BA
M-502	1	Steam Generator Feedwater Piping	AM
M-512	1	Isolation Valve Seal Water	V
M-513	1	Fire Protection & Screen Wash	AF
M-514	1	Containment Spray System	AF
M-515	1	Reactor Coolant System	Z
M-516	1	Reactor Coolant	AR
M-517	1	Chemical & Volume Control System	AC
M-518	1	Chemical & Volume Control System	AF
M-520	1	Residual Heat Removal	AF
M-521	1	Safety Injection System	S
M-522	1	Safety Injection System	AE
M-523	1	Component Cooling System	Z
M-529	1	Nuclear Sample System	N
M-530	11	Starting Air Piping Schematic	D
M-536	1	Containment Purge & Relief System	AJ
M-537	1	Containment Purge & Relief System	AK
M-956	1	Reactor Vessel Head Vent System	J
M-959	5	Reactor Vessel Head Vent System	G

Appendix A (Cont'd)

P&ID No	Sheet No.	System	Revision
M-1062	1	Diesel Generator 0 Starting Air	ECN No.22-00653M
M-1063	1	Diesel Generator 1A Starting Air	ECN No. 22-00656M
M-1064	1	Diesel Generator -1B Starting Air	ECN No. 22-00226M-02
M-1065	1	Diesel Generator Starting Air 2A	ECN No. 22-00230M-01
M-1056	1	Diesel Generator 2B Starting Air	ECN No. 22-00234M-01
M-20	1	Main Steam Piping	BG
M-34	1	Service Water	AT
M-54	1	Chemical & Volume Control System	A
M-55	1	Chemical & Volume Control System	AS

Table 4.1 Zion Units 1 & 2 Cold Shutdown Justification Evaluations

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
Main Steam System					
VC-01	1(2)HOV-MS0001 to MS-0004, Main Steam Isolation Valves, 34 in. hydraulically-operated, normally open, globe valves	M-020, Rev. P (M-500, Rev. BA), "Diagram of Main Steam Piping Unit 1 (Unit 2)"	"HOV-MS0001, 2, 3, and 4 will not be exercised closed during power operation because closure would result in reactor trip and safety injection."	"These valves are partially stroke exercised at least quarterly and full stroke exercised during start-up from or entering cold shutdown."	It is impractical to full-stroke exercise these valves closed quarterly because this would cause a plant transient. The alternative provides part-stroke exercising to the closed position quarterly and full-stroke exercising to the closed position at cold shutdowns in accordance with OM Part 10 ¶ 4.2.1.2(b). The Valve Program Tables do not identify a fail safe test. The licensee should review the function of these hydraulic valves. (Refer to NRC IN 85-84, "Inadequate Inservice Testing of Main Steam Isolation Valves").
VC-08	1(2)MS0008 to MS-0011, Main Steam lines 1 to 4, 34 in. check valves	M-020, Rev. P (M-500, Rev. BA), "Diagram of Main Steam Piping Unit 1 (Unit 2)"	"It is the Station's position that check valves MS0008, 9, 10 and 11 cannot be exercised closed during power operation because this would require cycling the reactor to hot standby to perform the test."	"These valves will be tested during startup from cold shutdown." Per the Valve Program Tables, these check valves are exercised closed at cold shutdowns.	It is impractical to exercise these valves closed quarterly because this would require interrupting main steam line flow. The alternative provides exercising to the closed position during cold shutdowns in accordance with OM Part 10 ¶ 4.3.2.2(c).

Table 4.1 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
Feedwater System					
VC-06	1(2)MOV-FW-0016 to FW-0019, Main Feedwater (Steam Generator Inlet) Isolation Valves, 16 in. normally open, motor-operated gate valves	M-022, Rev. WM (M-502, Rev. AM), "Diagram of Steam Generator Feedwater Piping Unit 1 (Unit 2)"	"It is the Station's position that valves MOV-FW0016, 17, 18 and 19 will not be exercised during power operation (Mode 1) because closure would result in a loss of steam generator level control and a reactor trip."	"These valves will be exercised closed during hot shutdown through cold shutdown while either: 1) all Main Feedwater (MFW) pumps off and if Steam Generator pressure < 700 psig, then all condensate/condensate booster pumps off, or 2) all MFW regulating valves and all MFW regulating bypass valves are manually isolated." Per the Valve Program Tables, these valves are exercised to the closed position at cold shutdowns without feedwater and condensate operating, but not more frequently than once every 92 days.	It is impractical to part-stroke or full-stroke exercise these valves closed quarterly because this would result in a loss of steam generator level control and a possible plant trip. The alternative provides full-stroke exercising to the closed position during cold shutdowns in accordance with OM Part 10 ¶ 4.2.1.2(c).

Table 4.1 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
Reactor Coolant System					
VC-15	1(2)SOV-RC08 to RC11, 1 in. normally closed, solenoid-operated globe valves, Reactor Head Vent Valves	M-956, Rev. J, (M-959, Rev. G), "Diagram of Reactor Vessel Head Vent System Unit 1 (Unit 2)"	"The reactor vessel head vent valves SOV-RC08, 9, 10 and 11 cannot be exercised during power operation. The normal position of these valves is de-energized closed. Technical Specification 4.3.1.G.2 addresses testing of these valves only in Modes 5 or 6. Testing of these valves during power operation will cause the integrity of the Reactor Coolant System pressure boundary to be challenged and will increase the potential for a Loss of Coolant Accident."	"These valves will be full stroke exercised during cold shutdown and refueling outages when all Reactor Coolant Pumps are secured and the Reactor Coolant System is depressurized and vented. These valves may also be stroked when the head vent manual isolation valve RC8070 is closed." Per the Valve Program Tables, these valves are exercised to the open position and stroke time tested at cold shutdowns without the Reactor Coolant Pumps operating.	It is impractical to exercise these valves to the open position quarterly because these valves are required by Technical Specifications to be closed during power operation because testing of these valves open during power operation could jeopardize the integrity of the RCS pressure boundary. The alternative provides full-stroke exercising to the open position during cold shutdowns in accordance with OM Part 10 ¶ 4.2.1.2(c).

Table 4.1 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VC-03	1(2)PCV-RC455C and RC456, Pressurizer Relief Valves (PORVs), 3 in. air-operated, normally closed, fail closed globe valves.	M-53, Rev. AV, "Diagram of Reactor Coolant Loops 3 & 4 Unit 1," (M-516, Rev. AP, "Diagram of Reactor Coolant Unit 2")	"Valves PCV-RC455C and PCV-RC456 (power operated relief valves) will not be full stroke exercised during power operation. Zion Station has committed to not stroking the PORVs during power operation in accordance with Generic Letter 90-06. This Generic Letter states, 'Stroke testing of the PORVs should not be performed during power operation', due to the risk associated with challenging these valves in this condition."	"Valves PCV-RC455C and PCV-456 will be exercised full open and closed prior to entering a plant condition in which Low Temperature Overpressure Protection (LTOP) is required to ensure the valves' ability to provide LTOP, and will be exercised quarterly while in that condition." Per the Valve Program Tables, these valves are exercised to the open and closed position with stroke time testing and fail safe tested (to the closed position) at cold shutdowns.	It is impractical to part-stroke or full-stroke exercise these valves to the open position quarterly because this could result in a loss of coolant accident. The alternative provides for full-stroke exercising to the open and closed position and fail safe testing at cold shutdowns in accordance with OM Part 10 ¶ 4.2.1.2(c) and 4.2.1.6.
Chemical & Volume Control System					
VC-14	1(2)MOV-VC8100, 4 in. normally open, motor-operated gate valve, Reactor Coolant Pumps Seal Return Isolation Valve	M-55, Rev. AS, (M-518, Rev. AF), "Diagram of Chemical & Volume Control System Unit 1 (Unit 2)"	"Stroking valve MOV-VC8100 during power operation could potentially damage the Reactor Coolant Pump seals."	"Therefore, MOV-VC8100 will be full-stroke exercised during cold shutdown when all Reactor Coolant Pumps are secured." Per the Valve Program Tables, these valves are exercised to the closed position and stroke time tested at cold shutdowns.	It is impractical to exercise these valves to the closed position quarterly because this could damage the RCP seals. The alternative provides full-stoke exercising to the closed position at cold shutdowns in accordance with OM Part 10 ¶ 4.2.1.2(c).

Table 4.1 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
Component Cooling Water					
VC-17	1(2)FCV-CC685, CC from RCP Thermal Barrier Stop Valve: 1(2)MOV-CC9413A & B CC to RCP suction isolation valves, 1(2)MOV-CC9414 & 9438, CC from RCP thermal barrier stop valve, 1(2)MOV-CC9415, CC to Unit 1 (Unit 2) equipment isolation valve Normally open, motor-operated gate valves	M-67, Rev. AE, (M-523, Rev. Z) "Diagram of Component Cooling System Unit 1 (Unit 2)", M-66, Rev. AR, "Diagram of Component Cooling System Unit 1 & 2"	"Component Cooling water flow to the Reactor Coolant Pumps and other components supplied by Component Cooling is required at all times the unit is above a cold shutdown condition. Exercising these valves during normal operation would result in a loss of cooling flow to these components. This would lead to a challenge of the RCP seals and/or exceeding the temperatures for the applicable components."	"The valves will be exercise tested during cold shutdown providing all Reactor Coolant Pumps are not in operation and the heat load to other components is reduced." Per the Valve Program Tables, these valves are exercised to the position and stroke time tested at cold shutdowns.	It is impractical to part-stroke or full-stroke exercise these valves to the closed position quarterly because this could challenge the integrity of the RCP seals and/or exceed the design temperatures for the applicable components. The alternative provides full-stroke exercising to the closed position at cold shutdowns in accordance with OM Part 10 ¶ 4.2.1.2(c).

Table 4.1 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
Safety Injection System					
VC-05	1(2)MOV-SI8802, SI Pumps Discharge isolation valve, 1(2)MOV-SI8806, RWST to SI Pump Suction Valve, 1(2)MOV-SI8813 and 8814, SI Pumps to RWST Recirculation Stop Valve, 1(2)MOV-VC8110 and 8111, Charging Pump Min. Flow Isolation Valves; Normally open, motor-operated gate valves; Safety Injection Isolation Valves	M-64, Rev. AG, (M-521, R.v. S) "Diagram of Safety Injection System Unit 1 (Unit 2)" M-55, Rev. AS, (M-518, Rev. AF), "Diagram of Chemical & Volume Control System Unit 1 (Unit 2)"	"It is the Station's position that MOV-SI8802, MOV-SI8806, MOV-SI8813 and MOV-SI8814 valves will not be full stroke exercised during power operation. MOV-SI8802 and MOV-SI8806 are normally placed in their safety positions (open) and de-energized. Testing of either of these valves renders both trains of SI incapable of accident mitigation. Closure of MOV-SI8813 and MOV-SI8814 causes both SI pumps to be considered inoperable because the minimum flowpath is isolated jeopardizing pump operation in small break Loss of Coolant Accident scenarios. Closure of MOV-VC8110 or MOV-VC8111 causes both VC pumps to be considered inoperable because the minimum flowpath is isolated jeopardizing pump operation in small break loss of coolant and secondary rupture scenarios. Zion Station philosophy does not permit entering the LCO for two inoperable SI or VC trains for testing purposes.."	"These 12 valves will be exercised full open and closed during cold shutdown."	MOV-SI8806 is on the common suction line from the RWST to both SI pumps. MOV-SI8802 is on the common discharge line to the cold leg injection lines to all four RCS loops. Closure of either valve isolates both trains of Safety Injection to the RCS cold legs. MOV-SI8813 and MOV-SI8814 are on the common minimum flow return line from both SI pumps to the RWST. Similarly, MOV-VC8110 and MOV-VC8111 are on the common minimum flow return line from the centrifugal charging pumps, which are also the high pressure safety injection pumps, to the inlet of the RCP seal water heat exchanger. Closure of any of these valves isolates either both trains of Safety Injection or Centrifugal Charging pumps. It is impractical to part-stroke or full-stroke exercise quarterly any of these valves open or closed. The alternative provides full-stroke exercising to the open and closed positions at cold shutdowns in accordance with OM Part 10 ¶ 4.2.1.2(c).
VC-16	1(2)MOV-SI8808A thru D, SI System Accumulator discharge isolation valves, 10 in. normally open, motor-operated gate valves	M-65, Rev. AL, (M-522, Rev. AE) "Diagram of Safety Injection System Unit 1 (Unit 2)"	"1(2)MOV-SI8808A-D cannot be exercised during unit operation. These valves are part of the Spurious Valve Actuation Group (SVAG) and required by the Technical Specifications to be de-energized open (their safety position) during unit operation. Stroking them during normal operations would be defeating the de-energized SVAG valve principle."	"These valves will be closed and exercised open prior to entering or during startup from cold shutdown. This is in accordance with Subarticle 4.2.1.2."	It is impractical to part-stroke or full-stroke exercise these valves to the closed position quarterly because these valves are required by the Technical Specifications to be de-energized open during plant operation. However, the licensee should verify when testing is allowed and practical in view of the test frequency in the Valve Program Tables (cold shutdowns) versus the Technical Specifications Surveillance Requirement 4.8.5.A.4 that states "These valves shall be stroke tested only during REFUELING OUTAGE."

Table 4.1 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VC-18	1(2)SI8948A thru D/ 1(2)SI8956A thru D SI Accumulator discharge 10 in. check valves	M-65, Rev. AL, (M-522, Rev. AE) "Diagram of Safety Injection System Unit 1 (Unit 2)"	"These check valves cannot be stroked during unit operation due to the pressure differential between the accumulators (600 psig) and the Reactor Coolant System (RCS) (2235 psig). The closure test will be performed by a leakage type test. This test requires the reactor to be in a hot shutdown condition. Cycling the reactor every three months is impractical. In addition, during power operation, the pressure differential between the RCS and the Safety Injection System is such that these valves would not unseat."	"Therefore, the closure test will be performed when returning from a cold shutdown." Per the Valve Program Tables, these check valves are exercised closed at cold shutdowns. (Exercise open testing is performed at refueling outages under relief request VR-001 and pressure isolation valve seat leakage testing is performed at refueling outages [within 2 years]).	The licensee states that to perform a leak test, the reactor must be in a hot shutdown condition. The basis for this statement is unclear. However, it is impractical to verify the closure capability of these check valves quarterly because of personnel hazards involved in performing a leak test at normal operating pressures and temperatures. The alternative provides exercising to the closed position at cold shutdowns in accordance with OM Part 10 ¶ 4.3.2.2(c).
Residual Heat Removal System					
VC-02	1(2)MOV-RH8703, RHR Pumps discharge isolation valve to RCS hot legs, 12 in. normally open, motor-operated gate valves	M-62, Rev. AL, (M-520, Rev. AE) "Diagram of Residual Heat Removal Unit 1 (Unit 2)"	"It is the Station's position that valve MOV-RH8703 will not be full stroke exercised during power operation. During power operation, this valve is de-energized in the open position to ensure that RHR flow can be provided to the hot legs as necessary. This is intended to satisfy the spurious valve actuation criteria. Zion Technical Specification 4.8.3.A.7 limits operation of this valve to plant conditions when Hot Leg Recirculation capability is not required."	"Since Hot Leg Recirculation capability is not required to be available during cold shutdown, valve will be exercised fully open and closed during cold shutdown."	According to the Technical Specification 4.8.3.A.7, valve MOV-RH8703 "shall be stroke tested only during refueling outage." The licensee's proposed testing conflicts with the Technical Specifications. The licensee should verify when testing is allowed and practical.

Table 4.1 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VC-04	1(2)MOV-RH8701, 1(2)MOV-RH8702, RCS to RHR Pumps isolation valves, 14 in. normally closed, motor-operated gate valves	M-62, Rev. AL, (M-520, Rev. AE) "Diagram of Residual Heat Removal Unit 1 (Unit 2)"	"It is the Station's position that MOV-RH8701 and MOV-RH8702 (Residual Heat Removal loop suction valves) will not be full stroke exercised during power operation. These valves are not designed to open under normal operating differential pressures and attempts to open these valves that are interlocked to Reactor Coolant pressure could overpressurize the RHR lines."	"These valves will be exercised full open and closed during cold shutdown when initiating or securing Residual Heat Removal." Per the Valve Program Tables, these valves are exercised to the open and closed positions and stroke time tested at cold shutdowns.	It is impractical to full-stroke exercise these valves open or closed quarterly because these valves are pressure isolation valves which protect the RHR system from RCS pressure. The alternative provides full-stroke exercising to the open and closed positions at cold shutdowns in accordance with OM Part 10 ¶ 4.2.1.2(c).
VC-07	1(2)MOV-SI8812A, 1(2)MOV-SI8812B, RHR Suction from RWST Isolation Valves, 12 in. normally open, motor-operated gate valves	M-65, Rev. AL, (M-522, Rev. AE) "Diagram of Safety Injection System Unit 1 (Unit 2)"	"It is the Station's position that closure of MOV-SI8812A and B during quarterly exercising could render the Residual Heat Removal System inoperable. MOV-SI8812A-B are placed in their safety positions (open) and de-energized. Testing of either of these valves renders both trains of RHR incapable of accident mitigation. Zion Station philosophy does not permit entering the LCO for two inoperable RHR trains for testing purposes."	"Therefore, these valves will be exercised full open and closed during cold shutdown."	"These valves provide double isolation for the Residual Heat Removal pump suction from the Refueling Water Storage Tank." It is impractical to full-stroke exercise these valves closed quarterly since closure of either of these valves would render both trains of RHR pumps, which are also the Low Pressure Safety Injection pumps, inoperable. The alternative provides full-stroke exercising to the open and closed position at cold shutdowns in accordance with OM Part 10 ¶ 4.2.1.2(c).

Table 4.1 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VC-09	1(2)RH0257, 1(2)RH0258, RHR Pumps discharge 10 in. normally closed check valves	M-62, Rev. AL, (M-520, Rev. AE) "Diagram of Residual Heat Removal Unit 1 (Unit 2)"	"....These valves cannot be full stroked open during power operation because the design of this low pressure system does not allow attainment of full system flow with the respective Unit in normal operation due to the high Reactor Coolant System pressure. The only existing flowpath which could be used to verify the opening capability of these check valves during normal Reactor Power Operation is through the SI8735 valve via RWST recirculation. This flowpath is unacceptable during power operation due to single failure concerns. Partial opening of these check valves could be accomplished during normal power operation by routing flow from a single running pump through the heat exchanger bypass line and through the non-running pump's miniflow valve. Indication of the check valve partial open stroke would be an increased miniflow recirculation flow indicated on the running pump. This method, however, is not considered to be a positive indication of the check valve opening because: a. The amount of increased flow is small, and b. The RHR heat exchanger bypass line isolation valves are not tested or required to be leak tight, and c. This method requi es an assumption that the isolation valve between the heat exchanger bypass li : and the running pump is not leaking or is leaking less than the amount of the increased flow. While this may be a good assumption, the validity of the assumption is difficult to prove.	"A flow test passing maximum accident flow will be performed at cold shutdown when full loop flow can be delivered. Closed position verification of these valves is performed quarterly at power by cycling the non-running pump's miniflow valve with the heat exchanger bypass line isolated and verifying little or no increase of the running pump's recirculation flow." Per the Valve Program Tables, these valves are exercised closed quarterly and exercised open at cold shutdowns.	The licensee states that the only existing flowpath which could be used to verify the opening capability of these check valves during normal power operation is through the SI8735 manual valve via RWST recirculation and that this flowpath is unacceptable during power operation due to single failure concerns. According to the flow diagram, it appears that failure of 8 in. manual valve SI8735 in the open position would direct all LPSI/RHR flow to the RWST instead of to the RCS Cold Legs and Hot Legs. Flow to the RCS cold legs could be restored by closure of MOV-RH8716B or MOV-RH8716C, and MOV-RH8716A, the RHR pumps' cross-tie valves downstream of the RHR heat exchangers. However, it does not appear that flow to the hot legs could be restored without closure of SI8735. According to the UFSAR, ¶ 6.3.2.1.3, injection during the initial operation of the ECCS is through the RCS cold legs. The recirculation phase consists of two modes, cold leg recirculation and simultaneous hot and cold leg recirculation. The switch to simultaneous hot and cold leg recirculation is made to replace in solution any boron which may have plated out due to flow conditions existing during the cold leg recirculation phase of ECCS operation. Therefore, the licensee's concern with failure of SI8735 in the open position is valid. The licensee states that partial opening of these check valves during power operation could occur by routing flow from a single running pump through the heat exchanger bypass line and through the non-running pump's miniflow valve. Indication of the check valve partial open stroke would be an increase in miniflow recirculation on the nonrunning pump. In view of the licensee's failure to provide valve identification numbers, it is difficult to verify the licensee's partial flow test line method. However, testing appears to be impractical due to the limited flow and lack of flow elements on the RHR pumps' miniflow lines. Therefore, the alternative provides full stroke exercising to the open position at cold shutdowns in accordance with OM Part 10 ¶ 4.3.2.2(c).

Table 4.1 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VC-10	1(2)SI8957A, 1(2)SI8957B, RHR Safety Injection 10 in. check valves	M-65, Rev. AL, (M-522, Rev. AE) "Diagram of Safety Injection System Unit 1 (Unit 2)"	"These check valves cannot be exercised fully or partially during power operation because the shut-off head of the RHR pumps is lower than the RCS pressure. There are no test return loops or recirculation paths available to allow a flowpath through these valves during power operation. For partial stroking the valves, the SI accumulator test line was considered as a possible recirculation path available during power operations. Although valves SI8957A-B are not defined as Pressure Isolation Valves (PIVs) in Technical Specification 3.3.3.F, Zion conservatively tests these valves in accordance with this Specification since they are a redundant isolation to the PIVs SI9001A-D and SI9002A-D. The PIVs isolating the RHR system from the RCS are considered "high risk valves" as described in Technical Specification Bases 3.3.3 in that they respond to prevent an Event V accident (inter-system Loss of Coolant Accident). Since SI8957A-B provide a backup function to these PIVs, it is not considered prudent to challenge these valves by unseating them for partial stroke testing quarterly."	"...these valves will be exercised open and closed during cold shutdown when the RCS pressure is low enough to reach the flow conditions necessary to verify full flow." Per the Valve Program Tables, these check valves are exercised open and closed at cold shutdowns.	These valves are located inside containment. It is impractical to full-stroke exercise these valves open quarterly because the shut-off head of the RHR pumps is less than the normal operating pressure in the Reactor Coolant System. It is impractical to part-stroke exercise these valves open quarterly because the only means to perform such a test is through the 3/4 in. accumulator test line. Due to the small size of that line with respect to the 10 in. size of the check valves in question, it does not appear that such a test would yield a flow rate sufficient to achieve meaningful results. The licensee has not, however, provided justification for not testing these valves closed quarterly. However, since these valves are located inside containment, it appears that to establish such a test setup during normal plant operation would be excessively burdensome and impractical because of increased radiation exposure to personnel. The alternative provides full-stroke exercising to the open and closed positions at cold shutdowns in accordance with OM Part 10 ¶ 4.3.2.2(c). The licensee however should consider revising the justification in future program submittals in light of the comments herein.

Table 4.1 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VC-11	1(2)RH8730A, 1(2)RH8730B, RHR Pumps Discharge 10 in. check valves	M-62, Rev. AL, (M-520, Rev. AE) "Diagram of Residual Heat Removal Unit 1 (Unit 2)"	"It is the Station's position that check valves RH8730A and B cannot be full stroke exercised during unit operation as the shutoff head of the pumps is lower than Reactor Coolant System pressure. Partial stroke exercising of these check valves will be demonstrated by establishing proper RHR pump discharge flow in the recirculation line during quarterly pump testing. Full stroke exercising of these check valves will be demonstrated while the RHR system is in normal operation during cold shutdown. This condition is required to provide system flow conditions similar to design injection flow. This alternative will assure the required level of safety and that operational readiness is maintained."	These check valves are part-stroke exercised open quarterly and full-stroke exercised open at cold shutdowns.	It is impractical to full-stroke exercise these valves open quarterly because the RHR pumps' shutoff head is lower than the RCS pressure. The alternative provides part-stroke exercising to the open position quarterly and full-stroke exercising to the open position at cold shutdowns in accordance with OM Part 10 ¶ 4.3.2.2(b). The licensee describes a safety function for these valves in the closed position. However, neither the justification nor the Valve Program Tables identifies any testing in the closed direction. The licensee should revise the program as appropriate.

Table 4.1 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VC-12	1(2)SI9001A to D, Loops B, C, D, and A Cold Leg RHR Injection Inboard PIVs, 8 in. check valves 1(2)SI9002A to D, Loops B, C, D, and A Cold Leg RHR Injection Outboard Class 1 Boundary Valves, 8 in. check valves	M-65, Rev. AL, (M-522, Rev. AE) "Diagram of Sa:ety Injection System Unit 1 (Unit 2)"	"Check valves SI9001A thru D and SI9002A thru D can only be exercised at cold shutdown when the RCS pressure is low enough to inject through the check valves. Therefore, the closure test will be performed after the partial open exercise during startup from cold shutdown. A partial stroking of these valves through the accumulator test line was evaluated as a possible recirculation path available during power operations. This partial stroke testing does not conform with the intent of Technical Specification (Tech Spec) 3.3.3.F and the associated Tech Spec Bases regarding the pressure isolation valves (PIVs) in that the ability to prevent backleakage is challenged by passing flow through the valves. In addition, the backleakage testing during operation would require positioning various spurious valve actuation group (SVAG) valves in other than their safe position for the duration of the testing. Therefore, the closure test will be performed after the partial open exercise during startup from cold shutdown."	"Therefore, the closure test will be performed after partial open exercising during startup from cold shutdown." Per the Valve Program Tables, these valves are exercised to the closed position and partial exercised open (the latter as per VR-003) at cold shutdowns and full-stroke exercised open (as per VR-003) at refueling outages.	These valves are located inside containment, to establish a test setup during normal plant operation to test for closure would be excessively burdensome and impractical because of personnel hazards arising from exposure to radiation and high energy systems. The alternative provides verification of closure at cold shutdowns in accordance with OM Part 10 ¶ 4.3.2.2(c). (The acceptability of the full-stroke exercising to the open position at refueling outages is addressed in Valve Relief Request VR-003).

Table 4.1 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VC-20	1(2)MOV-RH8716A-C, RHR Train A/B Alternate SI Isolation Valves, 8 in. normally open, motor-operated gate valves, 1(2)MOV-RH9000, RHR to Hot Leg SI Isolation Valves, 12 in. normally closed, motor-operated gate valves, 1(2)MOV-SI8809A/B, RHR HXs to Loops B & C/ A & D Cold Leg SI Isolation Valves, 10 in. normally open, motor-operated gate valves	M-62, Rev. AL, (M-520, Rev. AE) "Diagram of Residual Heat Removal Unit 1 (Unit 2) M-65, Rev. AL, (M-522, Rev. AE) "Diagram of Safety Injection System Unit 1 (Unit 2)"	"Closure of the MOV-RH8716 and MOV-SI8809 valves would isolate 2 of 4 injection points. The accident analysis only allows 1 injection point to be isolated. Zion could not meet the analysis assumption of injection into all four cold legs coincident with single failure. Opening of the MOV-RH9000 valves would result in a flow diversion, thus invalidating the cold leg injection assumption made in the accident analysis. Zion Station Philosophy does not permit entering Limiting Conditions of Operation for multiple trains of inoperable equipment for testing purposes."	"These 12 valves will be exercised full open and closed during cold shutdown."	As discussed in Section 4.0 of this TER, entering a LCO is not sufficient basis for nor performing the required tests, unless the testing renders systems inoperable for extended periods of time. The licensee should evaluate quarterly testing within the Technical Specification allowed outage time, or further investigate the effects of testing, which may provide additional basis for the deferral. In particular, the licensee should refer to NRC Information Notice IN 87-01, "RHR Valve Misalignment Causes Degradation of ECCS in PWRs," for guidance with respect to closure during power operation of RHR discharge cross-over isolation valves.

Table 4.1 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
Instrument Air System					
VC-13	1(2)FCV-1A01A/B, Instrument Air Inboard/ Outboard Containment Isolation Valves, 1.5 in., normally open, fail closed, air-operated diaphragm valves	M-72-11, Rev. C, (M-72-12, Rev. C), "Unit 1 (Unit 2) Diagram of Instrument Air System Reactor Building & V.P.C."	"It is the Station's position that FCV-1A01A and B shall be exercised closed at cold shutdown. Closure of FCV-1A01A and B for testing purposes during power operation would cause the unit to lose letdown and thus lose pressurizer level control resulting in an undesirable operating condition. Also instrument air to containment would be shutoff which causes all valves operated by IA to realign if not already in the loss of air position. Notable among these is the RCP seal leakoff valves AOV-VC8141A-D. The stroking of the FCV-1A01A/B closed could cause the AOV-VC8141A-D valves to close and thus challenge the backup number 2 RCP seal unnecessarily. In addition, pressurizer spray capability is lost making pressure control difficult. Sampling capability is also lost. Consequently, due to operational difficulties presented by stroking these valves during power operation, they will only be exercised closed in cold shutdown."	These valves are exercised closed and fail safe tested (to the closed position) at cold shutdowns.	It is impractical to full-stroke exercise these valves closed quarterly because this could cause a plant transient arising from a loss of control of letdown line flow and pressurizer level. The alternative provides full-stroke exercising to the closed position and fail safe testing at cold shutdowns in accordance with OM Part 10 ¶ 4.2.1.2(c) and 4.2.1.6.

Table 4.1 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
Service Water System					

Table 4.1 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VC-19	1(2)SW0001, 1(2)SW0004, 1(2)SW0007, Service Water Pumps C, B, A 24 in. discharge check valves	M-32-1, Rev. AN, (M-32-4, Rev. B), "Diagram of Service Water Unit 1 (Unit 2)"	"These valves can only be exercised for full flow during the Service Water pump performance test which is done at cold shutdown (Reference PR-01). The valves will be verified for full flow during their respective Service Water Pump test at cold shutdown. A partial flow test and backflow test on these check valves is performed quarterly. Zion is currently analyzing Service Water System requirements. A computerized flow model is being developed in which any particular scenario (i.e. valve line-ups) could be input to determine flows at particular points in the system. The maximum required accident flow through an individual discharge check valve cannot be determined physically until this model is finished. Zion's Service Water design basis review will determine the required flow for the pumps. Currently, the acceptance criteria for full flow of the check valves is to reach maximum discharge flow from the individual pump test during cold shutdown. This flow exercises the duo-check valve full open and is well beyond the flow required for full disk lift."	"The valves will be verified for full flow during their respective Service Water Pump test at cold shutdown. A partial flow test and backflow test on these check valves is performed quarterly."	Based on a lack of flow instrumentation, the licensee has proposed a partial flow test. It is not clear why the licensee could not use non-intrusive diagnostic techniques to determine that the valve has full-stroke opened. Therefore, the licensee should investigate the practicality of using non-intrusive diagnostic techniques to verify full disk lift during quarterly flow testing and revise the justification accordingly.

Table 4.1 Zion Units 1 & 2 Refueling Outage Justification Evaluations

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
Chemical & Volume Control System					

Table 4.2 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VO-01	1(2)VC8481A and B, Charging Pumps 4 in. Discharge Check Valves 1(2)VC8546, Charging Pumps RWST 8 in. Suction Header Check Valve	M-55, Rev. AS, (M-516, Rev. AF), "Diagram of Chemical & Volume Control System Unit 1 (Unit 2)"	"Full stroke exercising of the charging pump suction check valve cannot be demonstrated during unit operation as the Reactor Coolant System pressure prevents the pumps from reaching full injection flow conditions. Additionally, suction would have to be switched from the Volume Control Tank (VCT) to the RWST. This would inject 2400 ppm borated water into the Reactor Coolant System and would set up a power transient that would cause an undesirable xenon oscillation. Performance of this test with the Reactor Coolant System intact could challenge the overpressure system. The alternative method of protecting against overpressurization by partial draining of the Reactor Coolant System to provide a surge volume is not considered a safe practice due to concerns of maintaining adequate water level above the reactor core. Full stroke exercising of these check valves will be demonstrated during refueling while the reactor vessel head is removed. This alternative will assure operational readiness and the required level of safety is maintained. These valves can be partially stroked quarterly. Valve VC8546 will be exempt from partial stroking when the unit is at end of core life since this would setup a power transient that would cause a xenon oscillation during this period. This period typically occurs during the last quarter of core life."	"Full stroke exercising of these check valves will be demonstrated during refueling while the reactor vessel head is removed....These valves can be partially stroked quarterly. Valve VC8546 will be exempt from partial stroking when the unit is at end of core life." Per the Valve Program Tables, valves VC8481A and B are partial-stroke exercised open and exercised closed quarterly and full-stroke exercised open at refueling outages. Valve VC8546 is partial-stroke exercised open quarterly and full-stroke exercised open at refueling outages.	It is impractical to full-stroke exercise these valves open with the reactor vessel head connected. During power operation, the RCS pressure prevents the charging pump from reaching full injection flow conditions, and also suction would have to be drawn from the RWST, which in turn would result in an increase in boron concentration in the RCS and a power transient. During cold shutdowns, injection into the RCS could cause an overpressurization. The alternative of draining the RCS to provide a surge volume could jeopardize control of reactor water level above the core. VC8546 is part-stroke exercised open quarterly except when the unit is at the end of core life, typically during the last quarter, since stroking this valve at that time would cause xenon power oscillations, which is impractical. For VC8546, the alternative provides part-stroke exercising open quarterly, except when the unit is at the end of core life, and full-stroke exercising open at refueling outages in accordance with OM Part 10 ¶ 4.3.2.2(b) and (e). However, the Valve Program Tables do not indicate a reverse flow closure test for VC8546. The licensee should verify that this valve does not have a safety function in the closed direction, or revise the program accordingly. For VC8481A/B, the alternative provides part-stroke exercising open quarterly and full-stroke exercising open at refueling outages in accordance with OM Part 10 ¶ 4.3.2.2(b) and (e).

Table 4.2 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VO-09	1(2)VC8224, CVCS Header to RCS Loop Fill Inboard Containment Isolation Valve, 2 in. check valve	M-54 Sh.1, Rev. A, (M-517, Rev. AC), "Diagram of Chemical & Volume Control System Unit 1 (Unit 2)"	"The loop fill system is used during refueling outages to fill the reactor coolant piping between the steam generators and the Reactor Coolant Pumps. The loop fill system is isolated from the Reactor Coolant System during normal operation. Cycling this valve with flow would require an abnormal charging line-up resulting in a reactor coolant inventory transient and possibly a subsequent reactor trip. The loop fill line outboard containment isolation manual valves are supplied with Isolation Valve Seal Water (IVSW). These normally locked closed valves would need to be opened to perform testing. In addition, the IVSW system would need to be isolated from this line. This is not considered a prudent or safe practice at Zion during normal operation and some shutdowns. The test would require a longer duration for most cold shutdowns. This would be burdensome to the Station due to the costs involved in remaining shutdown and the draining being a burden on the radwaste system. The function of this valve is to close; however, the valve must be opened prior to performing the closure exercise. Thus, the valve closure test will be performed during a refueling outage."	"Thus, the valve closure test will be performed during a refueling outage." Per the Valve Program Tables, this valve is exercised closed at refueling outages.	The licensee should note that the NRC staff position, as described in the "Minutes of the Public Meetings on Generic Letter 89-04," dated October 25, 1989, Response to Question 24, is that if a valve performs a safety function in only the closed position, demonstration of a full-stroke open before verification of closure capability is not required by the ASME Code. This closure verification is required to be performed at the frequency specified by the Code. The licensee should review the Valve Testing Program to assure that testing of check valves is not unnecessarily deferred due to a misinterpration of the ASME Code.

Table 4.2 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VO-08	1(2)VC8368A to D, RC Pumps A to D Seal Water Supply Containment Inboard Isolation Valves, 2 in. check valves	M-54 Sh.1, Rev. A, (M-517, Rev. AC), "Diagram of Chemical & Volume Control System Unit 1 (Unit 2)"	"These valves cannot be exercised closed during normal operation. Flow to the Reactor Coolant Pumps (RCP) seals needs to be isolated during this check valve closure test. Isolating the RCP seal water flow could potentially damage the seals. Therefore, this test is impractical to perform at normal operation. The methodology used in testing these valves would require the RCPs to be secured and backseated. Test equipment would also need to be installed on the system to perform a leakage type test. To set up and perform this test as required by the Code would be burdensome to perform at cold shutdown due to the costs involved in remaining shutdown even if the RCPs were secured."	"These check valves will be tested at reactor refueling." Per the Valve Program Tables, these check valves are exercised to the closed position at refueling outages.	These valves are located inside containment. It is impractical to exercise these valves closed quarterly because this would require isolating the RCP seal water flow, which could potentially damage the seals. Furthermore, verifying closure during cold shutdowns when the RCPs are running would require stopping and restarting the RCPs, thereby increasing the wear and stress on the pumps, the number of cycles on plant equipment, and extending the length of cold shutdown outages. The alternative provides full-stroke exercising to the closed position during refueling outages in accordance with OM Part 10 ¶ 4.3.2.2(e). The licensee should, however, consider testing these valves during cold shutdowns when the associated RCP is not running.

Table 4.2 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
Safety Injection System					
VO-05	1(2)SI8926, Safety Injection Pumps Suction Header 8 in. Check Valve	M-64, Rev. AG, (M-521, Rev. S) "Diagram of Safety Injection System Unit 1 (Unit 2)"	"This check valve cannot be full stroke exercised during unit operation as the shutoff head of the pumps is lower than Reactor Coolant System pressure. Partial stroke exercising of this check valve will be demonstrated by establishing proper pump discharge flow during periodic pump testing. Full stroke exercising of this check valve with the Reactor Coolant System intact could challenge the system. The alternative method of protecting against overpressurization by partial draining of the Reactor Coolant System to provide a surge volume is not considered a safe practice due to concerns of maintaining adequate water level above the reactor core. Full stroke exercising of this check valve will be demonstrated during refueling while the reactor vessel head is removed. This alternative will provide adequate assurance of continued operational readiness and maintain the required level of safety."	"Partial stroke exercising of this check valve will be demonstrated by establishing proper pump discharge flow during periodic pump testing. Full stroke exercising of this check valve will be demonstrated during refueling while the reactor vessel head is removed." Per the Valve Program Tables, this valve is part-stroke exercised open quarterly and full-stroke exercised open at refueling outages.	It is impractical to full-stroke exercise these valves open with the reactor vessel head connected. During power operation, the RCS pressure prevents the safety injection pump from injecting into the RCS. During cold shutdowns, full-flow injection into the RCS could cause an overpressurization. The alternative of draining the RCS to provide a surge volume could jeopardize control of reactor water level above the core. The alternative provides part-stroke exercising open quarterly, and full-stroke exercising open at refueling outages in accordance with OM Part 10 ¶ 4.3.2.2(b) and (e).

Table 4.2 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VO-03	1(2)SI8922A, 1(2)SI8922B, Safety Injection Pumps Discharge 4 in. check valves	M-64, Rev. AG, (M-521, Rev. S) "Diagram of Safety Injection System Unit 1 (Unit 2)"	"These check valves cannot be exercised during unit operation as the shutoff head of the pumps is lower than Reactor Coolant System pressure. Full stroke or partial stroke exercising the check valves with the Reactor Coolant System depressurized but intact could challenge the overpressure mitigation system. The alternative method of protecting against overpressurization by partial draining of the Reactor Coolant System to provide a surge volume is not considered a safe practice due to concerns of maintaining adequate water level above the reactor core. These check valves are downstream of the minimum flow recirculation line which is used for quarterly pump testing during normal plant operations. Therefore the valves cannot be tested quarterly. Full flow exercising the check valves will be demonstrated by total pump discharge flow during refueling while the reactor vessel head is removed. This alternative will provide adequate assurance of the required level of safety and that operational readiness is maintained during this interval. Since these valves perform a safety function in both the open and closed position, the valves must be exercised to the open position prior to the close exercise. Thus, these check valves will also be exercised closed at reactor refueling."	"Full flow exercising the check valves will be demonstrated by total pump discharge flow during refueling while the reactor vessel head is removed. ...these check valves will also be exercised closed at reactor refueling." Per the Valve Program Tables, these valves are full-stroke exercised open and full-stroke exercised closed at refueling outages.	It is impractical to full-stroke exercise these valves open with the reactor vessel head connected. During power operation, the RCS pressure prevents the safety injection pumps from injecting into the RCS. Also, it is impractical to part-stroke or full-stroke exercise these valves open quarterly because these valves are downstream of the SI pumps mini-flow recirculation line to the RWST. During cold shutdowns, injection into the RCS could cause an overpressurization. The alternative of draining the RCS to provide a surge volume could jeopardize control of reactor water level above the core. The alternative provides full-stroke exercising to the open position at refueling outages in accordance with OM Part 10 ¶ 4.3.2.2(e). However, with respect to exercising the valves open prior to performing the closure exercise, the licensee should refer to the discussion in the evaluation for VO-09 which describes the NRC staff position that the ASME Code does not require full-stroke exercising open of a valve before verification of closure capability. The licensee should review the Valve Testing Program to assure that testing of check valves is not unnecessarily deferred due to a misinterpretation of the ASME Code.

Table 4.2 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VO-04	1(2)SI8900A to D, Loops A-D Cold Leg Charging Water Admission 1.5 in. check valves 1(2)SI8905A and B, Loops A and D Hot Leg Outboard Pressure Isolation Valves, 4 in. check valves 1(2)SI8949C and D, Loops B and C Hot Leg Inboard Pressure Isolation Valves, 8 in. check valves 1(2)SI9004C and D, Loops B and C Hot Leg Outboard Pressure Isolation Valves, 2 in. check valves 1(2)SI9012A to D, Loops A to D Cold Leg Outboard Pressure	M-64, Rev. AG, (M-521, Rev. S) "Diagram of Safety Injection System Unit 1 (Unit 2)"	"The safety injection hot (SI8905A-B, SI8949C-D, SI9004C-D) and cold (SI9012A-D) leg injection check valves cannot be exercised during unit operation as the shutoff head of the pumps is lower than Reactor Coolant System pressure. The charging cold leg injection check valves (SI8900A-D, SI9032) cannot be full stroke or partial stroke exercised during unit operation as the injection of cold, highly borated water would result in a change in reactor core reactivity, a large xenon oscillation, and undue thermal cycling of the injection nozzles. The charging pump cold leg check valves cannot be partial stroke exercised during cold shutdown with the reactor vessel head intact because that could result in a low temperature overpressurization (LTOP) condition. Full stroke or partial stroke exercising of all the branch run check valves with the Reactor Coolant System intact could lead to an inadvertent overpressurization of the system. The alternative method of protecting against overpressurization by partial draining of the Reactor Coolant System to provide a surge volume is not considered a safety practice due to concerns of maintaining adequate water level above the reactor core. Therefore, full flow testing of these check valves must be performed with the reactor vessel head removed.	"...full-flow testing of these check valves must be performed with the reactor vessel head removed. Thus, these check valves will be exercised closed at reactor refueling, also." Per the Valve Program Tables, these valves are exercised open and closed at refueling outages (and subject to pressure isolation valve seat leakage test at refueling outages within 2 years).	It is impractical to full-stroke exercise these valves open with the reactor vessel head connected. During power operation, the RCS pressure prevents the Safety injection pumps from injecting into the RCS. Also, it is impractical to part-stroke exercise these valves open quarterly because these valves are downstream of the SI pumps mini-flow recirculation line to the RWST. For the Charging cold leg injection check valves, SI8900A-D and SI9032, suction would have to be drawn from the RWST, which in turn would result in an increase in boron concentration in the RCS and a power transient. For all of these valves, during cold shutdown, injection into the RCS could cause an overpressurization. The alternative of draining the RCS to provide a surge volume could jeopardize control of reactor water level above the core. The alternative provides full-stroke exercising to the open position at refueling outages in accordance with OM Part 10 ¶ 4.3.2.2(e). However, with respect to exercising the valves open prior to performing the closure exercise, the licensee should refer to the discussion in the evaluation for VO-09 which describes the NRC staff position that the ASME Code does not require full-stroke exercising open of a valve before verification of closure capability. The licensee should review the Valve Testing Program to assure that testing of check valves is not unnecessarily deferred due to a misinterpration of the ASME Code.

Table 4.2 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VO-04	(Cont'd)		Full stroke exercising of all the branch run check valves will be demonstrated during the "Full Flow Test" at reactor refueling while the reactor vessel head is removed. Each loop is instrumented to obtain flow values. The test simulates a safety injection valve lineup for the Charging and Safety Injection Systems. Therefore, each branch run check valve is verified to pass at least the minimum Emergency Core Cooling System required during a design basis accident (maximum required accident flow). Since these valves perform a safety function in both the open and closed position, the valves must be exercised to the open position prior to the close exercise. Thus, these check valves will be exercised closed at reactor refreling, also. This alternative will provide adequate assurance of the required level of safety and that operational readiness is maintained during this interval."		

Table 4.2 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
Residual Heat Removal System					

Table 4.2 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VO-02	1(2)RH8735A/B Outboard RHR Injection Prssure Isolation Valves 1(2)RH8949A/B Inboard RHR Injection Prssure Isolation Valves	M-62, Rev. AL, (M-520, Rev. AE) "Diagram of Residual Heat Removal Unit 1 (Unit 2)"	"These check valves cannot be full or partial stroke exercised during unit operation as the shutoff head of the pumps is lower than Reactor Coolant System pressure. Full stroke exercising of all the branch run check valves with the Reactor Coolant System depressurized but intact would not provide adequate surge volume for influx from the RWST to allow the RHR injection system to reach design flow. The alternative method of providing a surge volume by partial draining of the Reactor Coolant System is not considered a safe practice due to concerns of maintaining adequate water level above the reactor core. This testing also requires that all RHR be injected through the hot legs only, thereby isolating cooling flow through the reactor core. Full stroke exercising of all the branch run check valves will be demonstrated by total pump discharge flow during refueling while the reactor vessel head is removed. This condition is required to establish suction from the RWST and provide system flow conditions similar to design flow. The flow through each hot leg injection line shall be verified by temporarily installed differential pressure gages and calculating the flow from the differential pressure. Since these valves perform a safety function in both the open and closed	"Full stroke exercising of all the branch run check valves will be demonstrated by total pump discharge flow during refueling while the reactor vessel head is removed.... The flow through each hot leg injection line shall be verified by temporarily installed differential pressure gages and calculating the flow from the differential pressure..... These check valves will also be exercised closed at reactor refueling."	It is impractical to part-stroke or full-stroke exercise these valves open quarterly because the shutoff head of the RHR pumps is lower than the Reactor Coolant System pressure and also the valves are located downstream of the RHR pumps miniumum flow recirculation lines. It is impractical to part-stroke or full-stroke exercise these valves open at cold shutdowns because this would require interrupting reactor decay heat removal since during normal RHR pump operation, suction is drawn from the RCS hot legs and returned to the cold legs. To test these valves, the return flow to the RCS would again be to the hot legs. The alternative provides full-stroke exercising to the open position at refueling outages in accordance with OMa-1988 Part 10 ¶ 4.3.2.2(e). However, the licensee is verifying flow through each hot leg injection line by temporarily installing differential pressure gages and calculating the flow from the differential pressure. It is not clear why the licensee would not use the flow transmitter FT600 on the common header outside containment which supplies these parallel branch lines. The licensee should verify whether that flow transmitter could be used and revise the relief request accordingly. Also, with respect to exercising the valves open prior to performing the closure exercise, the licensee should refer to the discussion in the evaluation for VO-09 which describes the NRC staff position that the ASME Code does not require full-stroke exercising open of a valve before verification of closure capability. The licensee should review the Valve Testing Program to assure that testing of check valves is not unnecessarily deferred due to a misinterpration of the ASME Code. Additionally, the licensee should clearly identify under what conditions testing could be performed and commit to testing for those suitable situations."

Table 4.2 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VO-02	(Cont'd)		position, the valves must be exercised to the open position prior to the close exercise. These check valves will also be exercised closed at reactor refueling. This alternative will provide adequate assurance of the required level of safety and that operational readiness is maintained during this interval."		

Table 4.2 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VO-07	1(2)SI8958, RHR Pumps Suction from RWST 12 in. check valve	M-65, Rev. AL, (M-522, Rev. AE) "Diagram of Safety Injection System Unit 1 (Unit 2)"	"These check valves cannot be full-stroke exercised open during unit operation as the shutoff head of the pumps is lower than Reactor Coolant System pressure. The valves cannot be partially stroked during normal operation when testing the RHR Pumps on mini-flow recirculation. Alternative flow paths were investigated and found unsuitable. The eight inch recirculation line (SI003-8") to the RWST utilizing the RHR return valve, SI8735, did not prove to be a prudent method to partial-stroke exercise this valve quarterly and during cold shutdowns. The following are the reasons for this determination: 1. This is the only valve on the line that provides isolation between the RHR System and the RWST. With this valve open the RHR System would be rendered inoperable and not able to fulfill its design basis function during an accident. 2. Manual operation of this valve would require closure within 25 to 27 seconds which is not possible due to valve size and operator action requirements. Full stroke exercising of the check valves with the Reactor Coolant System depressurized but intact could lead to an inadvertent overpressurization of the system. The alternative method of providing a surge volume by partial draining of the Reactor Coolant System is not considered a safe practice due to concerns of maintaining adequate water	"Full flow exercising of the suction check valve will be demonstrated by total pump discharge flow during refueling while the reactor vessel head is removed." Per the Valve Program Tables, this valve is exercised open at refueling outages (and exercised closed by disassembly at refueling outages by sample disassembly of subject check valve grouping under relief request VR-04).	It is impractical to full-stroke exercise this valve open with the reactor vessel head connected. During power operation, the RCS pressure prevents the RHR pumps from injecting into the RCS. Also, it is impractical to part-stroke exercise this valve open quarterly because this valve is upstream of the RHR pumps mini-flow recirculation line return to the suction of the RHR pumps. The alternative of opening SI8735 to return the RHR flow to the RWST would disable both trains of RHR, as discussed in the evaluation for VC-09. During cold shutdowns, injection into the RCS would require draining the RCS to provide a surge volume. This action could jeopardize control of reactor water level above the core. Also, the RHR pumps would have to be aligned to the RWST and not to the RCS, thereby preventing RHR decay heat removal capability during cold shutdown. The alternative provides full-stroke exercising to the open position at refueling outages in accordance with OM Part 10 ¶ 4.3.2.2(e).

Table 4.2 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
V0-07	(Cont'd)		level above the reactor core. In addition, the RHR system is required to be in operation at all times to provide shutdown cooling while in cold shutdown. In this configuration, flow through SI8958 is not possible. Full flow exercising of the suction check valve will be demonstrated by total pump discharge flow during refueling while the reactor vessel head is removed. This condition is required to establish suction from the RWST and provide system flow conditions similar to design flow."		

Table 4.2 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
Isolation Valve Seal Water System					

Table 4.2 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VO-06	1(2)IW0062, 1(2)IW0063, 1(2)IW0064, 1(2)IW0065, 1(2)IW0066, 1(2)IW0067, 1(2)IW0068, 1(2)IW0069, 1(2)IW0070, All of above are 0.5 in. IVSW check valves. 1(2)IW0074, 1(2)IW0075, 1(2)IW0076, 1(2)IW0077, 1(2)IW0078, 1(2)IW0079, All of above are 0.38 in. IVSW check valves 1(2)IW0080, 1(2)IW0081, 1(2)IW0082, 1(2)IW0083, 1(2)IW0090, 1(2)IW0095, All of the Above are 0.5 in. IVSW check valves,	A-39, Rev. AA, (M-512, Rev. U), "Diagram of Isolation Valve Seal Water Unit 1 (Unit 2)"	"The IVSW check valves and piping configuration do not allow for ease of testing. The method used to test the check valves on the automatically actuated injection lines (IW0062-69 73-83. 90 95 IW0181-186) requires the initiation of IVSW and the observation of a pressure drop at each branch of the main header. The method used to test the check valves on the manually actuated injection lines (IW0070 198) requires the initiation of IVSW and the observation of the IVSW tank level change. The applicable technique is done on one check valve at a time until all valves have been tested. The function of the IVSW system is to pressurize each supply line so that if leakage at these penetrations does exist, it will be from the seal water system into containment. The pressure introduced is slightly higher than the containment post accident design pressure. The high pressure air from the penetration pressurization system keeps the IVSW tank pressurized and maintains the required driving pressure for injection. The system is not instrumented with flow indication because it is not needed, nor is it necessary. No maximum accident flow is applicable to these valves, however, an initial opening of the valve is required to pressurize the injection line. The flow that is required to perform this function is confirmed during the test described above. This testing renders the system inoperable for 36 to 48 hours. This is	"These valves will be exercised open as stated above during a refueling outage." Per the Valve Program Tables, these valves are exercised open at refueling outages.	According to the UFSAR, § 6.2.4.4, the Isolation Valve Seal Water (IVSW) System provides a water seal at certain containment isolation valves during any condition which requires containment isolation. Such valves are located in lines which could be exposed to containment atmosphere following a LOCA. The system injects seal water between the seats and stem packing of globe and double-disk type isolation valves and into the piping between other types of valves. For lines which are connected to the RCS or that could communicate with the containment atmosphere and be void of water immediately following a LOCA, isolation and seal water injection are automatically actuated. Automatic isolation and seal water injection are also provided for other components which can be exposed to reactor coolant or containment atmosphere through leakage or failure of a related line or component. The isolated lines are not required for postaccident service. For lines that are normally filled with water and will remain filled following a LOCA or lines which must remain in service for a time following a LOCA, isolation and seal water injection are manually actuated. The seal water injection ensures a long term seal. The capacity of the system to deliver water in accordance with the design was verified during the preoperational testing. The valves in question are check valves in the seal water supply path to valves at various containment penetrations. The check valves are simple check valves not equipped with position indication or external operators. For the automatically initiated portion, the licensee states that the IVSW must be initiated and the pressure drop at each branch of the main header must be observed. From each branch line, the check valves to be tested are located on parallel sub-branches leading to the individual containment isolation valves to be served by the IVSW.

Table 4.2 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
VO-06	(Cont'd) 1(2)IW0181 to IW0186, All of above are 0.38 in. IVSW check valves, 1(2)IW0198, 0.5 in. IVSW check valve.		unacceptable during operation due to a requirement in the Technical Specifications that the IVSW system be operable at all times. The IVSW System, and portions of the Chemical and Volume Control System would require draining, thus rendering these systems inoperable. Furthermore, for the manually actuated IVSW header, the Reactor Coolant Pumps would need to be shutdown to allow isolating the Component Cooling Water return flow from the Reactor Coolant Pumps. It is unacceptable to test these valves during cold shutdown for the following additional reasons: 1) The test results in 0.5 man rem of radiation exposure for each test. 2) The IVSW System requires flushing to prevent the intrusion of impurities. This is a burden on the radwaste system. 3) Each valve test requires the same setup, i.e. draining and flushing. The plant would have to remain shutdown for at least 48 hours to perform this testing. A significant amount of time is required for pre and post test setup and could delay a return to power. Also, it would be impractical to start this test (which includes the above valve scope) without performing each valve test. These valves will be exercised open as stated above during a refueling outage. This alternative will provide adequate assurance of continued operational readiness of the check valves and maintain the required level of safety."		It does not appear that the licensee's test method for the automatic portions of the IVSW of initiating IVSW and observing the pressure drop at each branch of the main header would properly verify flow for each individual check valve since the pressure drop could be caused by excessive flow through one valve and blocked flow in another valve. For the manually initiated portion, the IVSW must be initiated and IVSW tank level must be observed individually for each check valve until all valves have been tested. Testing renders the system inoperable for 36 to 48 hours. This could extend the time for cold shutdowns by 48 hours or more. The licensee states that the Technical Specifications require that the IVSWS be operable at all times. In actuality, § 3.9.1.A and C of the Technical Specifications state that the IVSWS shall be operable unless the reactor is in the cold shutdown condition except that any one header of the IVSWS may be inoperable not to exceed four consecutive days during reactor operation to permit maintenance. Nevertheless, it is excessively burdensome to test these check valves open quarterly or during cold shutdowns because of the time consuming nature of the testing. For the automatically initiated portions of the IVSW System, it is acceptable to defer testing to refueling outages in accordance with OM Part 10 ¶ 4.3.2.2(e). However, the licensee should revise the test procedure to a method which would verify positively that each individual check valve opens during testing. For the manually initiated portions of the IVSW System, the [The] alternative provides full-stroke exercising to the open position during refueling outages in accordance with OM Part 10 ¶4.3.2.2(e). Also the licensee should verify that these valves, whether in the automatic or manual portions of the IVSW System, do not perform a safety function in the closed position, since the Containment Isolation components to which the IVSW check valves are connected include Pressure Isolation Valves and other high energy line valves such as for the RCP seal water supply line and the CVCS Letdown line.

Table 4.2 (Cont'd)

Item No.	Valve Identification	Drawing No.	Licensee's Justification for Deferring Valve Exercising	Proposed Alternate Testing	Evaluation of Licensee's Justification
Containment Isolation Valve System					
VO-10	1(2)CS0005/CS0009/ CS0013, Cont. Spray Pumps Admission 10 in. check valves 1(2)DT9158, Nitrogen Supply to RCDT 1 in. check valve 1(2)PR0029, Cont. Air Sampling Blower Discharge CIV, 1 in. check valve 1(2)RC8047, PRT Nitrogen Supply 0.75 in. check valve 1(2)RC8079, ECCS Discharge Line to PRT CIV, 4 in. check valve 1(2)SI8933, Accumulator Nitrogen Supply CIV, 1 in. check valve	M-44, Rev. JL, (M-514, Rev. AF), M-87, Rev. AB, M-70-1, Rev. AN, M-53, Rev. AV, M-65, Rev. AL, (M-522, Rev. AE)	"All these containment isolation valves are simple check valves that have no position indication. A leak test will be performed to verify closure. To test 1(2)DT9158, 1(2)PR0029, 1(2)RC8047, and 1(2)SI8933 on a quarterly basis would require a containment entry during reactor operation to manually close these valves. As for 1(2)CS0005, 1(2)CS0009, and 1(2)CS0013, a containment entry to manually blank off the CS discharge header would be required. Testing these 14 valves during cold shutdown would result in unnecessary delays in unit startup and an unnecessary accumulation of radiation dose. 1(2)RC8079 also would require a containment entry, but to install spectacle flanges in order to isolate the test area. As such, this would eliminate the relief capabilities of the ECCS pumps. Thus, in order to test these valves, the reactor head must be removed which is only done during a refueling outage. Consequently, the containment isolation valves listed will be exercised closed every refueling outage, not to exceed two years, as directed by 10CFR50 Appendix J leak rate testing."	"Consequently, the containment isolation valves listed will be exercised closed every refueling outage, not to exceed two years. as directed by 10CFR50 Appendix J leak rate testing." Per the Valve Program Tables, CS0005, CS0009, and CS0013 are exercised open quarterly and exercised closed at refueling outages. DT9158, PR0029, RC8047, and SI8933 are exercised closed at refueling outages. RC8079 is exercised closed at refueling outages and exercised open at refueling outages by sample disassembly of the subject check valve grouping (as per relief request VR-04).	The only available method for testing these valves is by leak testing. It is impractical to test these valves closed quarterly or during cold shutdowns because the valves and test connections are located inside containment and the licensee has demonstrated that an undue burden would exist to leak test these valves during cold shutdown because of extended time required for the shutdown and additional radiation exposure to personnel. For RC8079, containment entry would be required to install spectacle flanges which would isolate the pressure relief capabilities of the ECCS pumps. The alternative provides full-stroke exercising to the closed position at refueling outages in accordance with OM Part 10 ¶ 4.3.2.2(c).