

ATTACHMENT (3)

**PUMP AND VALVE INSERVICE TEST PROGRAM RELIEF REQUESTS
FOR CALVERT CLIFFS NUCLEAR POWER PLANT UNITS 1 AND 2
FOURTH TEN YEAR INTERVAL**

Constellation Energy (CCNPP Unit 1) IST Program

CVC-RR-01

Not Approved

Component ID	Class	Cat.	System	Label
11 RCS CHG	2	A	RC	Chemical and Volume Control Pump 11
12 RCS CHG	2	A	RC	Chemical and Volume Control Pump 12
13 RCS CHG	2	A	RC	Chemical and Volume Control Pump 13

FUNCTION:

During plant operation, the charging pumps operate to provide make-up to the RCS to maintain pressurizer level and for chemical addition. They automatically start on a SIAS to deliver concentrated boric acid to the RCS for emergency boration. 11 and 12 charging pumps are independently powered; 13 charging pump may be aligned to either power source.

Under accident conditions, the VCT is automatically isolated and NPSH to the charging pumps is provided by the boric acid make-up tanks (two 9,700 gallon tanks) through either the Direct Feed Line-up via the boric acid pumps or the Gravity Feed Line-up.

TEST REQUIREMENT:

Paragraph ISTB-3510(e)

The frequency response range of the vibration-measuring transducers and their readout system shall be from one-third minimum pump shaft rotational speed to at least 1000 Hz.

BASIS:

Constellation Energy (CCNPP Unit 1) IST Program

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The rotational shaft speed of the charging pumps is 209 rpm relating to a rotational frequency of approximately 3.48 Hz. In order to satisfy the requirements of Paragraph ISTB-3510(e) a vibration measurement system capable of measuring vibration to a lower limiting frequency of 1.16 Hz. would be required.

The instruments currently being used at Calvert Cliffs have a lower frequency limit for reliable, accurate measurement of 3 Hz. This instrumentation is "state-of-the-art" industrial grade, high quality equipment. Satisfying the Code requirements with respect to frequency response would require special calibration by off-site vendors which would involve extra expense. Because calibration of the instrument would require sending it off-site, and because of the extra expense of this special calibration, the use of this instrumentation would have to be restricted to monitoring charging pump vibration only in order to minimize the potential for damage to the instrument. Since this special calibration would require sending the instrument off-site, additional analyzers that were used solely for monitoring the charging pumps would be required in order to ensure at least two (one primary and one back up) were always in calibration and available on-site.

According to Table 6.0, "Illustrated Vibration Diagnostic Chart," contained in "Predictive Maintenance and Vibration Signature Analysis I," by J. E. Berry, Technical Associates of Charlotte, Inc., the anomaly which would normally be expected to produce only sub-harmonic vibrations is oil whip/whirl. Other conditions that could result in low frequency vibration (less than shaft speed) would normally also be detectable at shaft running speed, and harmonic and non-harmonic frequencies. Therefore, monitoring lower frequencies (less than rotational speed) is performed primarily for the purpose of detecting oil whirl or whip in journal bearings. However, the main bearings in Calvert Cliffs' charging pumps are oil-mist lubricated tapered roller bearings that are not susceptible to the oil whip or whirl phenomena. Calibrating the instruments down to 3 Hz will include some sub-harmonic frequencies. Additionally, although the instrumentation used by Calvert Cliffs will only be calibrated down to 3 Hz which is slightly less than pump running speed (approximately 85%), it will remain capable of detecting vibrations at frequencies as low as 1 Hz. This means we would still expect to detect any developing sub-harmonic vibrations which could still at least be qualitatively evaluated.

Seal rub and bearing looseness are two other conditions which may be detected at sub-harmonic frequencies. The primary indicator for seal rub is a truncation of the waveform observed through time-domain waveform analysis. Bearing looseness can also be identified through waveform analysis. Normally, harmonics of shaft speed would also be detectable in order to confirm this condition.

In addition to the ASME pump testing, Calvert Cliffs has implemented a "Rotating Machinery Vibration Monitoring Program" that includes periodic vibration monitoring of the charging pumps. This program is inclusive and encompasses a wider range of vibration analyses and frequencies, including time-domain waveform analysis, phase analysis, and spectral analysis, at various critical pump and motor locations. The data derived from this expanded program along with the IST vibration data will provide a high degree of assurance that the anomalies of concern can be identified and significant pump degradation will not go undiscovered.

Based on: (1) the fact that Calvert Cliffs' charging pumps are not susceptible to oil whip/whirl which is the major anomaly which would normally be expected to produce only sub-harmonic vibrations, (2) the low probability of any other anomalies producing vibrations at only sub-harmonic frequencies and not at running speed or harmonic and/or non-harmonic frequencies, and (3) Calvert Cliffs "Rotating Machinery Vibration Monitoring Program," the added expense of the special calibration and additional test equipment necessary outweighs their benefit.

Relief is requested pursuant to 10CFR50.55a(a)(3)(i) based on the proposed alternative providing an acceptable level of quality and safety.

ALTERNATE TESTING:

The instruments used for measuring vibration on the reactor charging water pumps will have a frequency response calibrated range that extends to a lower limiting frequency of 3 Hz.

The charging pumps will be included in the Calvert Cliffs' "Rotating Machinery Vibration Monitoring Program" that includes periodic vibration monitoring and analysis of each pump.

Constellation Energy (CCNPP Unit 1) IST Program

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This Relief Request, upon approval, will be applied to the CCNPP Fourth 10-Year Interval.

ACCEPTANCE CRITERIA:

REFERENCES:

NRC Letter, dated 2/11/98, "Safety Evaluation of the Inservice Testing Program Third Ten-Year Interval for Pumps and Valves - Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 (TAC Nos. M98523 and M98524)"
Letter from BGE to the NRC, dated 12/30/99, "Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318 Revised and New Relief Requests for the Third Ten Year Inservice Test Program"
NRC Letter, dated 8/22/00, "Safety Evaluation of Relief Requests for the Third 10-Year Pump and Valve In-Service Testing Program Calvert Cliffs Nuclear Power Plant Units 1 and 2 (TAC Nos. MA7848 and MA7849)"

APPROVAL REFERENCES:

Constellation Energy (CCNPP Unit 1) IST Program

GA-RR-01

Not Approved

Component ID	Class Cat.	System	Label
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Various

Various

FUNCTION:

The American Society of Mechanical Engineers (ASME) Operation and Maintenance (OM) Code provides the requirements for the implementation of the Inservice Testing (IST) Program.

TEST REQUIREMENT:

ISTA-3200(f)(3) The test plan for each successive test interval shall comply with the edition and addenda of the Section that have been adopted by the regulatory authority 12 months prior to the start of the inservice test interval, or subsequent editions and addenda that have been adopted by the regulatory authority.

BASIS:

The current Code edition/addenda incorporated by reference in 10CFR50.55a(b)(3) is the 2001 Edition with Addenda through OMB-2003. Calvert Cliffs Nuclear Power Plant is part of the Constellation Energy fleet of nuclear plants. The other plants in the Constellation fleet will be updating their IST Programs within the next 2 years. Constellation's goal for uniformity and economic benefit is to have all their plants in the fleet using the same ASME Code edition/addenda for their IST Programs. Constellation Energy/Calvert Cliffs Nuclear Power Plant proposes to use the ASME OM Code-2004 Edition.

Calvert Cliffs has evaluated the differences between the ASME OM Code-2004 Edition and the 2001 Edition with Addenda through OMB-2003. The majority of the changes are editorial. The changes to Subsection ISTB for pumps are limited to table and figure number updates. The changes to Subsection ISTC for valves are predominately corrections to referenced paragraph numbers. The following differences in Subsection ISTC are noted:

- 1) In ISTC-3620 & ISTC-3630 the word "Nonmandatory" has been deleted where Appendix J is referenced.
- 2) In ISTC-3630 subparagraphs (e)(1) & (e)(2) the leakage calculation conversion values and units have been revised.

The changes to Mandatory Appendix I for relief valves are predominately corrections to referenced paragraph numbers. The following differences in Mandatory Appendix I are noted:

- 1) In I-3410 subparagraph (a) the words "except for on-line testing" have been deleted.
- 2) In I-3410 subparagraph (d) the words "refurbished in place" have been deleted.
- 3) In I-3410 subparagraph (d) the requirement to 'verify open and close capability' of the main disc has been eliminated.
- 4) In I-4120, "Compressible Fluid Services Other Than Steam," the minimum time between successive openings is reduced from 10 minutes to 5 minutes. (This was already done for steam service, I-4110, and liquid service, I-4130.)

CCNPP believes these changes to be improvements that provide an acceptable level of quality and safety compared to the requirements in the existing approved ASME OM Code. This is supported by the fact that the NRC has recently issued a notice in the Federal Register of their intent to update the ASME Code referenced in 10CFR50.55a(b)(3) to the ASME OM Code-2004 Edition.

Relief is requested pursuant to 10CFR50.55a(a)(3)(i) based on the proposed alternative providing an acceptable level of quality and safety.

ALTERNATE TESTING:

Calvert Cliffs Nuclear Power Plant will use the 2004 Edition of the ASME OM Code as the Code of record for their fourth Ten-Year IST Program.

Constellation Energy (CCNPP Unit 1) IST Program

GA-RR-01

This relief request, upon approval, will be applied to the CCNPP Fourth Ten-Year IST Interval.

ACCEPTANCE CRITERIA:

REFERENCES:

APPROVAL REFERENCES:

Constellation Energy (CCNPP Unit 1) IST Program

GV-RR-01

Not Approved

Component ID	Class	Cat.	System	Label
0-CC-6501-RV	3	C	CC	Reactor Coolant Evaporators Distillate Pump Sample Coolers Relief Valve
0-CC-6503-RV	3	C	CC	Reactor Coolant Evaporators Distillate Pump Sample Coolers Relief Valve
0-CC-6512-RV	3	C	CC	Unit 1 CC Oxygen Analyzer Sample Cooler Relief Valve
0-CC-6530-RV	3	C	CC	Miscellaneous Waste Evaporators Distillate Pump Sample Coolers Relief
0-CC-6533-RV	3	C	CC	Miscellaneous Waste Evaporators Distillate Pump Sample Coolers Relief
1-CC-3823-RV	3	C	CC	11 CC Heat Exchanger Shell-Side Relief Valve
1-CC-3825-RV	3	C	CC	12 CC Heat Exchanger Shell-Side Relief Valve
1-CC-3827-RV	3	C	CC	11 Shutdown Cooling Heat Exchanger CC Inlet Relief Valve
1-CC-3829-RV	3	C	CC	12 Shutdown Cooling Heat Exchanger CC Inlet Relief Valve
1-CC-3831-RV	3	C	CC	Letdown Heat Exchanger Relief Valve
1-CC-3843-RV	3	C	CC	Waste Gas Compressors After-Coolers Return Header Relief Valve
1-CC-6450A-RV	3	C	CC	NSSS Sample Cooler Outlet Relief Valve
1-CC-6471-RV	3	C	CC	11 Steam Generator Blowdown Sample Coolers Relief Valve
1-CC-6472-RV	3	C	CC	12 Steam Generator Blowdown Sample Coolers Relief Valve
1-CVC-125-RV	2	C	CVC	Boric Acid Pump Recirculation Relief Valve
1-CVC-132-RV	2	C	CVC	Boric Acid Storage Tank Discharge Relief Valve
1-CVC-133-RV	2	C	CVC	Boric Acid Pump Discharge Relief Valve
1-CVC-141-RV	2	C	CVC	Boric Acid Storage Tank Discharge Relief Valve
1-CVC-149-RV	2	C	CVC	Boric Acid Pump Recirculation Relief Valve
1-CVC-150-RV	2	C	CVC	Boric Acid Pump Discharge Relief Valve
1-CVC-157-RV	2	C	CVC	Boric Acid Pump Common Discharge Relief Valve
1-CVC-160-RV	2	C	CVC	Boric Acid Strainer Inlet Relief Valve
1-CVC-171-RV	2	C	CVC	Boric Acid Strainer Outlet Relief Valve
1-CVC-311-RV	2	C	CVC	Charging Pump Suction Relief Valve
1-CVC-315-RV	2	C	CVC	Charging Pump Suction Relief Valve
1-CVC-318-RV	2	C	CVC	Charging Pump Suction Relief Valve
1-CVC-321-RV	2	C	CVC	Charging Pump Suction Relief Valve
1-CVC-324-RV	2	C	CVC	Charging Pump Discharge Relief Valve
1-CVC-325-RV	2	C	CVC	Charging Pump Discharge Relief Valve
1-CVC-326-RV	2	C	CVC	Charging Pump Discharge Relief Valve
1-RV-10243	3	C	DSA	Diesel 1A1 Starting Air Receiver 11 Relief Valve
1-RV-10246	3	C	DSA	Diesel 1A1 Starting Air Receiver 12 Relief Valve
1-RV-10273	3	C	DSA	Diesel 1A2 Starting Air Receiver 11 Relief Valve
1-RV-10276	3	C	DSA	Diesel 1A2 Starting Air Receiver 12 Relief Valve
1-SI-211-RV (1R	2	C	SI	Safety Injection Tank Relief Valve
1-SI-221-RV (1R	2	C	SI	Safety Injection Tank Relief Valve
1-SI-231-RV (1R	2	C	SI	Safety Injection Tank Relief Valve
1-SI-241-RV (1R	2	C	SI	Safety Injection Tank Relief Valve
1-SI-409-RV (1R	2	C	SI	High Pressure Safety Injection Header Relief Valve
1-SI-417-RV (1R	2	C	SI	High Pressure Safety Injection Header Relief Valve
1-SI-430-RV	2	C	SI	Shutdown Cooling Recirculation to High Pressure Safety Injection Pump F
1-SI-431-RV	2	C	SI	Shutdown Cooling Recirculation to High Pressure Safety Injection Pump F
1-SI-439-RV	2	C	SI	Low Pressure Safety Injection Header Relief Valve

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1-SI-446-RV	2	C	SI	Safety Injection Leak-Off Relief Valve
1-SI-468-RV (1R	2	C	SI	Shutdown Cooling Return Header Relief Valve
1-SI-469-RV (1R	2	C	SI	Shutdown Cooling Isolation Valve Relief Valve
1-SI-6302-RV	2	C	SI	Auxiliary High Pressure Safety Injection Pump 11/21 Discharge Header R
1-SRW-1575-RV	3	C	SRW	11A Service Water Heat Exchanger Relief Valve
1-SRW-1576-RV	3	C	SRW	11B Service Water Heat Exchanger Relief Valve
1-SRW-1577-RV	3	C	SRW	12A Service Water Heat Exchanger Relief Valve
1-SRW-1578-RV	3	C	SRW	12B Service Water Heat Exchanger Relief Valve
1-SRW-1582-RV	3	C	SRW	11 Containment Air Cooler Service Water Discharge/Return Relief Valve
1-SRW-1585-RV	3	C	SRW	12 Containment Air Cooler Service Water Discharge/Return Relief Valve
1-SRW-1588-RV	3	C	SRW	1B Diesel Generator Service Water Supply/Inlet Relief Valve
1-SRW-1590-RV	3	C	SRW	13 Containment Air Cooler Service Water Discharge/Return Relief Valve
1-SRW-1593-RV	3	C	SRW	14 Containment Air Cooler Service Water Discharge/Return Relief Valve
1-SRW-1596-RV	3	C	SRW	11 Spent Fuel Pool Cooler Service Water Relief Valve
1-SRW-4084-RV	3	C	SRW	12 Steam Generator Blowdown Heat Exchanger Relief Valve
1-SW-5205-RV (	3	C	SW	ECCS Pump Room Air Cooler Saltwater Relief Valve
1-SW-5206-RV (	3	C	SW	CC Heat Exchanger Saltwater Relief Valve
1-SW-5207-RV (	3	C	SW	ECCS Pump Room Air Cooler Saltwater Relief Valve
1-SW-5208-RV (	3	C	SW	CC Heat Exchanger Saltwater Relief Valve
1-SW-5209-RV (	3	C	SW	SRW Heat Exchanger Inlet Relief Valve
1-SW-5210-RV (	3	C	SW	SRW Heat Exchanger Inlet Relief Valve
1-SW-5211-RV (	3	C	SW	SRW Heat Exchanger Inlet Relief Valve
1-SW-5212-RV (	3	C	SW	SRW Heat Exchanger Inlet Relief Valve

FUNCTION:

Provide over-pressure protection to associated systems

TEST REQUIREMENT:

A minimum of 5 minutes shall elapse between successive openings. (OM Code Appendix I Para. I-8110(h) -Steam Service, I-8120(h) - Compressible Fluid Service Other Than Steam, and I-8130(g) - Liquid Service)

BASIS:

Constellation Energy (CCNPP Unit 1) IST Program

GV-RR-01

This is a generic request for relief for all Class 2 and 3 safety and relief valves, excluding the MSSVs. For these valves, the requirement for verifying temperature stability, by waiting 5 minutes between successive openings, is inappropriate and adds no value. There is negligible affect on valve setpoint due to minor temperature deviations that might occur at these conditions.

Numerous Class 2 and 3 safety/relief valves associated with contaminated systems are bench-tested in the "hot shop", located within the RCA in the Auxiliary Building, to prevent the spread of contamination. These tests are performed under ambient conditions using a test medium at ambient conditions. Therefore, there is no source of thermal imbalance that might affect the test results.

Entry into the hot shop testing facility requires full Anti-C's. During the test, personnel are exposed to background radiation levels present in the Auxiliary Building hot shop as well as the radiation levels associated with the specific valve being tested. The proposed elimination of the hold time between successive tests for Class 2 and 3 safety/relief valves tested under ambient conditions using a test medium at ambient conditions reduces the duration of each test. Most importantly, reducing the hold times reduces the length of time that the test personnel must spend in close proximity to the valve. As a result, personnel radiation exposure is reduced.

For all safety and relief valves, including those located in "clean areas" that are in-situ/bench-tested in the Mechanical Maintenance Shop, the proposed elimination of the hold time between successive tests will reduce the duration of each test. Since there are numerous safety/relief valve tests for both units and most require at least two people, the proposed elimination of the hold time between successive tests is expected to also result in a significant cumulative reduction in limited manpower resources.

Additionally, empirical data based on CCNPP plant experience supports the conclusion that the minimum hold time between successive tests has no value for safety/relief valves tested under ambient conditions using test medium at ambient conditions.

The net result of having to wait 5 minutes between successive openings is an increase in manpower and time to perform the tests, and an increase in radiation exposure when located in radiation areas, without a commensurate increase in test accuracy.

Relief is requested pursuant to 10 CFR 50.55a(a)(3)(i) based on the proposed alternative providing an acceptable level of quality and safety.

ALTERNATE TESTING:

For Class 2 and 3 safety and relief valves, excluding the MSSVs, tested under ambient conditions using test medium at ambient conditions, the 5-minute hold requirement between successive openings will be deleted.

This relief request, upon approval, will be applied to the CCNPP Fourth Ten-Year IST Interval.

ACCEPTANCE CRITERIA:

REFERENCES:

NRC Letter, dated 1/19/01

APPROVAL REFERENCES:

Constellation Energy (CCNPP Unit 1) IST Program

GV-RR-02

Not Approved

Component ID	Class Cat.	System Label
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Various

Various

FUNCTION:

Certain Motor-Operated Valves in ASME Safety Class 1, 2, and 3 systems which are required to perform a specific function in shutting down a reactor to the safe shutdown condition, in maintaining the safe shutdown condition, or in mitigating the consequences of an accident. The valves are those that include the designation "OMN1" in the "Frequency" column of the Valve Tables.

TEST REQUIREMENT:

ISTA-3130(b) states: "Code Cases shall be applicable to the edition and addenda specified in the test plan." The edition and addenda specified in the test plan for the fourth Ten-Year Interval for the Calvert Cliffs Nuclear Power Plant is the ASME OM Code 2004 Edition.

BASIS:

Code Case OMN-1 contains no applicability statement. In the latest edition/addenda incorporated by reference in 10 CFR 50.55a(b)(3) (i.e., the 2001 Edition with Addenda through the Omb-2003), the expiration date given for OMN-1 is March 30, 2004. OMN-1 is included in the 2006 Addenda to the 2004 Edition of the OM Code with a new expiration date of November 29, 2008; however, neither the 2004 Edition of the OM Code nor any Addenda have been incorporated by reference in 10 CFR 50.55a(b)(3). Paragraph 10 CFR 50.55a(b)(6) references Regulatory Guide 1.192, which conditionally approves the use of Code Case OMN-1 "in lieu of the provisions for stroke-time testing in Subsection ISTC of the 1995 Edition up to and including the 2000 Addenda of the ASME OM Code".

Relief is requested pursuant to 10CFR50.55a(a)(3)(i) based on the proposed alternative providing an acceptable level of quality and safety.

ALTERNATE TESTING:

Calvert Cliffs Nuclear Power Plant will apply the requirements of OMN-1 "Alternative Rules for Preservice and Inservice Testing of Certain Electric Motor-Operated Valve Assemblies in Light-Water Reactor Power Plants," including the conditions specified in Table 2 of USNRC Regulatory Guide 1.192, in lieu of the provisions for motor-operated valve testing in Subsection ISTC of the 2004 Edition of the ASME OM Code.

This Relief Request, upon approval, will be applied to the CCNPP Fourth 10-Year Interval.

ACCEPTANCE CRITERIA:

REFERENCES:

OM Code, 2004 Edition
Code Case OMN-1
Regulatory Guide 1.192

APPROVAL REFERENCES:

Constellation Energy (CCNPP Unit 1) IST Program

GV-RR-03

Not Approved

Component ID	Class Cat.	System Label
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Various

Various

FUNCTION:

Certain control valves in ASME Safety Class 1, 2, and 3 systems which are required fail-safe to perform a specific function in shutting down a reactor to the safe shutdown condition, in maintaining the safe shutdown condition, or in mitigating the consequences of an accident. The valves are those that include the designation "OMN-8" in the "Comments" column of the Valve Tables.

TEST REQUIREMENT:

ISTA-3130(b) states: "Code Cases shall be applicable to the edition and addenda specified in the test plan." The edition and addenda specified in the test plan for the fourth Ten-Year Interval for the Calvert Cliffs Nuclear Power Plant is the ASME OM Code 2004 Edition.

BASIS:

Code Case OMN-8 contains no applicability statement. In the latest edition/addenda incorporated by reference in 10 CFR 50.55a(b)(3) (i.e., the 2001 Edition with Addenda through the OMb-2003), the expiration date given for OMN-8 is November 20, 2006. OMN-8 is included in the 2006 Addenda to the 2004 Edition of the OM Code with a new expiration date of November 20, 2009; however, neither the 2004 Edition of the OM Code nor any subsequent Addenda have been incorporated by reference in 10 CFR 50.55a(b)(3). Paragraph 10 CFR 50.55a(b)(6) references Regulatory Guide 1.192, which approves the use of Code Case OMN-8. Code Case OMN-8 provides an alternative to stroke time testing power-operated control valves that have only a fail safe safety function.

Relief is requested pursuant to 10CFR50.55a(a)(3)(i) based on the proposed alternative providing an acceptable level of quality and safety.

ALTERNATE TESTING:

Calvert Cliffs Nuclear Power Plant will apply the requirements of Code Case OMN-8 "Alternative Rules for Preservice and Inservice Testing of Power-Operated Valves That Are Used for System Control and Have a Safety Function per OM-10," in lieu of the provisions for power-operated control valve testing specified in paragraphs ISTC-5131, ISTC-5132, ISTC-5133(b), ISTC-5141, ISTC-5142 & ISTC-5143(b), in Subsection ISTC of the 2004 Edition of the ASME OM Code.

This Relief Request, upon approval, will be applied to the CCNPP Fourth 10-Year Interval.

ACCEPTANCE CRITERIA:

REFERENCES:

OM Code, 2004 Edition
Code Case OMN-8
Regulatory Guide 1.192

APPROVAL REFERENCES:

Constellation Energy (CCNPP Unit 1) IST Program

RC-RR-01

Not Approved

Component ID	Class	Cat.	System	Label
1-RC-200-RV (1F	1	C	RC	Pressurizer Safety Valve
1-RC-201-RV (1F	1	C	RC	Pressurizer Safety Valve

FUNCTION:

The pressurizer safety valves provide overpressure protection for the reactor coolant system in the event of a loss of load without a reactor trip. They also act as the ASME Code safety/relief valves.

TEST REQUIREMENT:

Valves insulated in service shall be insulated in like manner during testing. (Appendix I, Paragraph I-8110(d) - Thermal Equilibrium).

BASIS:

Constellation Energy (CCNPP Unit 1) IST Program

RC-RR-01

Changes in safety/relief valve body temperature can change the lift setpoint measured during inservice testing. Changes in ambient temperature or modifications to insulation also may change the lift setpoint by virtue of the resulting effect on the valve body temperature. The purpose of Paragraph I-8110(d) is to ensure the effect of temperature variations are minimized. Requiring insulation to be installed during testing is clearly intended to also ensure the valve body's temperature, and therefore its performance, is similar to that under normal operating circumstances. Calvert Cliffs has determined the normal operating temperature profile for the pressurizer safety valves by instrumenting each valve body at several locations and recording empirical data during normal operation.

Recently, Calvert Cliffs commissioned testing using the valves' actual operating temperature profile at a national vendor's testing facility to determine the impact of having the insulation removed versus installed during testing of the pressurizer safety valves. This testing showed that pressurizer safety valves which have had their setpoints satisfactorily verified in-situ will perform satisfactorily two years later in a laboratory setting if the valve body's actual operating temperature profile is recreated. The test was conducted using two valves adjusted to their respective setpoints (which differ by only 65 psi).

The first series of tests was performed with each valve uninsulated. Prior to setpoint testing, each valve was thermally stabilized at the specified temperature profile to match normal operating conditions. The valves performed within their as-found setpoint tolerance.

The second series of tests was performed with each valve insulated (using the actual insulation from the plant normally installed on each valve). Prior to setpoint testing, each valve was thermally stabilized. However, due to the test configuration, the valve could not be thermally stabilized at the actual operating temperature profile. Instead, it could only be stabilized at a higher temperature. The overall impact of the higher temperature profile is that the lift pressure for the valves is lower than when at the correct temperature profile. This is a non-conservative error because, if the valves were adjusted to lift at their operating setpoint under these conditions, they would then be set to lift by as much as approximately 2% high when returned to their normal plant installation.

The third series of tests was performed with each valve insulated and with the ambient temperature being varied. The variations in ambient temperature had little effect on the valve's lift pressure.

Because of differences in the test configuration and the normal plant configuration, the vendor was unable to stabilize the valves' temperature profile when insulated consistent with the one specified for normal plant operating conditions. Rather, the temperatures measured at all the points being monitored, most notably the upper and lower bonnet, were higher.

The higher temperature profile for the insulated valves in the testing configuration occurred because, when installed in the plant, these valves are attached to long runs of piping with numerous associated piping supports which serve as heat sinks for the valves, but in the testing facility these long runs of piping are no longer attached. In the plant, these heat sinks allow the valves to stabilize at a lower temperature profile even when insulated, as compared to the temperature profiles when insulated in the vendor test facility. Additionally, the presence of forced ventilation in the field increases the heat transfer out of each valve body through the insulation for the same ambient temperature when compared to the stagnant conditions present in the test configuration.

In other words, the heat input and heat output of the insulated valves in a stagnant environment cannot be balanced in the testing facility until the valves are hot enough to create the necessary heat transfer rate through the insulation needed to offset the heat input. Since the heat transfer out of the valve to the attached piping is lost, more heat output through the insulation is required. This effect is additionally aggravated by the lack of forced ventilation. As a result, the valves stabilize at a higher temperature and the lift pressure measured was lower (by as much as approximately 2%) with the valves insulated and at these higher temperatures.

Relief is requested pursuant to 10CFR50.55a(a)(3)(i) based on the proposed alternative providing an acceptable level of quality and safety.

Constellation Energy (CCNPP Unit 1) IST Program

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ALTERNATE TESTING:

OM Code-2004 Appendix I, Paragraph I-8110(e) requires the ambient temperature of the operating environment to be simulated during the set pressure test. Additionally, if the effect of ambient temperature on set pressure can be established for a particular valve type, then Appendix I allows set pressure tests to be performed using an ambient temperature different from the operating ambient temperature as long as applicable correlations between the operating and testing ambient temperatures are used.

The intent of using the normally installed insulation per Paragraph I-8110(d) and testing using the operating ambient temperature (or test ambient temperature with the appropriate correlation) is to ensure the valve performance during the test is indicative of its expected performance under service conditions. However, Calvert Cliffs' has shown through comparative laboratory and in-situ tests that controlling the actual temperature profile of the valve body is a more realistic and more effective way of simulating inservice conditions and testing these valves. Additionally, it is much less likely to produce misleading test results that could lead to inappropriate setpoint adjustments. Therefore, Calvert Cliffs considers the requirements of Paragraph I-8110(e) to be satisfied by such testing and, based on the test results obtained at the vendor's laboratory, no correlation factor is applicable.

When testing is performed in a vendor testing facility, vice in-situ testing, the valve body's temperature profile necessary to simulate normal operating conditions for these valves will be specified. The valve shall be stabilized at the required temperature profile per the remaining portion of Paragraph I-8110(d) prior to setpoint testing without requiring the valve to be insulated in a like manner to its inservice configuration.

This Relief Request, upon approval, will be applied to the CCNPP Fourth 10-Year Interval.

ACCEPTANCE CRITERIA:

REFERENCES:

NRC Letter, dated 2/11/98, "Safety Evaluation of the Inservice Testing Program Third Ten-Year Interval for Pumps and Valves - Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 (TAC Nos. M98523 and M98524)"

APPROVAL REFERENCES:

Constellation Energy (CCNPP Unit 1) IST Program

SI-RR-01

Not Approved

Component ID	Class Cat.	System	Label
11 LPSI	2 A/B	SI	Low Pressure Safety Injection Pump 11
12 LPSI	2 A/B	SI	Low Pressure Safety Injection Pump 12

FUNCTION:

These pumps supply borated water (from the RWT during injection mode and the containment sump during recirculation mode, if necessary) to the RCS following a large break LOCA.

In the shutdown cooling mode at reduced RCS temperature/pressure, the pumps also circulate water through the shutdown cooling heat exchangers to provide long-term cooling for the reactor core.

TEST REQUIREMENT:

OM Code-2004 Requirement:

Subsection ISTB Paragraph ISTB-2000 defines group A pumps as; "pumps that are operated continuously or routinely during normal operation, cold shutdown, or refueling operations," and group B pumps as; "pumps in standby systems that are not operated routinely except for testing."

Subsection ISTB Paragraph ISTB-1400(b) states: "A pump that meets both Group A and Group B pump definitions shall be categorized as a group A pump."

Pump vibration acceptance criteria shall be in accordance with paragraph ISTB-5121(e) & Table ISTB-5121-1. Table ISTB-5121-1 provides the following acceptance criteria for vibration measurement (in terms of velocity, inches per second) for centrifugal pumps with a running speed equal to or greater than 600 rpm:

The acceptable range is < 2.5 times the reference value, but not to exceed 0.325 inches per second (ips).

The alert range is from > 2.5 times the reference value, but not to exceed 0.325 ips, up to 6 times the reference value, but not to exceed 0.700 ips.

BASIS:

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The Low Pressure Safety Injection (LPSI) Pumps are tested quarterly using the minimum recirculation flow path from each pump through the minimum recirculation flow common header and back to the refueling water tank. The common header is instrumented with an ultrasonic flow meter. However, flow is not throttled during the quarterly test to eliminate the potential for pump overheating and damage should flow inadvertently be throttled below that required to ensure adequate pump cooling.

The LPSI pumps are also tested at a substantial flow rate (approximately 3500 gpm) during every refueling outage, as well as during planned and unplanned cold shutdown periods when plant conditions and circumstances permit. These tests are the Code comprehensive pump tests (formerly known at CCNPP as "Large Flow Rate" tests.)

Differential Pressure Measurements

Calvert Cliffs' current quarterly group A pump test program requires differential pressure to be measured. Group A quarterly ECCS pump tests must be performed using very accurate ($\pm 1/2\%$) test pressure gauges. These pressure gauges would be installed prior to, and removed after, each test (an annual total of 32 gauge installation/removal evolutions). These very accurate gauges are not required by OM Code-2004; however, they are necessary because the hydraulic margin available, based on design calculations, is less than the amount of degradation allowed by ISTB. Using less accurate permanently installed pressure gauges could result in a pump being unnecessarily declared inoperable solely due to pressure gauge uncertainty.

Installation and removal of these test pressure gauges for each LPSI pump every quarter would require significant dedication of manpower, results in significant cumulative annual radiation dose, increased radioactive waste, increased wear on fittings, and additional challenges for possible personnel contamination. Calvert Cliffs' estimates that eliminating the test pressure gauge installation and removal evolutions will save at least 1/8 man-rem per year and almost 100 man-hours per year.

Quarterly LPSI pump tests are performed using the minimum recirculation flow path under low-flow conditions. In this region, the pumps are operating at or near shut-off head, the pump curves are flat or nearly flat, and pump differential pressure is not very sensitive to pump degradation. Flow rate alone is an adequate indication of possible pump degradation or flow blockage since the minimum recirculation flow path is a fixed-resistance flow path. The conclusion that measurement of pump differential pressure is of minimal value is supported by our historical test data.

As group B pumps, the operational readiness is reasonably assured without requiring quarterly differential pressure measurements. This will allow Calvert Cliffs Nuclear Power Plant (CCNPP) to cease these gauge installation and removal evolutions every quarter, while maintaining an acceptable level of quality and safety.

Vibration Measurements

Calvert Cliffs' current quarterly group A pump test program requires pump vibration measurements. The overall vibration readings recorded during quarterly low-flow testing have always been relatively "high." These vibration readings have been subject to spectral analysis under our Rotating Machinery Condition Monitoring Program, which is separate from the IST Program. The spectral analyses have consistently confirmed the major contributor to the "high" overall vibration readings occurs at the "blade pass frequency" for each LPSI pump and is not indicative of bearing degradation.

However, spectral analysis is not required by the Code. Therefore, the effects of low-flow operation on a centrifugal pump make the required broadband vibration readings during the current quarterly test of minimal value. This conclusion is supported by our historical test data. Under the 2004 Code, the operational readiness of group B pumps is reasonably assured without requiring quarterly vibration measurements. Based on this, we feel that an acceptable level of quality and safety is still maintained while many of the burdens and costs associated with vibration testing, including cumulative annual radiation dose and manpower, will be eliminated.

Minimum Pump Run-Time

As group B pumps, the two-minute minimum pump run-time for quarterly tests is also eliminated. Eliminating the

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minimum pump run-time requirement and the requirement to record differential pressure and vibration levels is expected to slightly reduce the length of each pump test. This will help to reduce the cumulative run-time of each LPSI pump under low-flow conditions to support testing, with a commensurate reduction in potential pump wear.

Other Considerations

These proposed changes simplify the quarterly IST pump test to allow combining the quarterly IST pump test into the related quarterly engineering safety features actuation logic test for each pump. As a result, the total number of starting demands on each pump motor to support testing may be reduced and the cumulative run-time of each LPSI pump under low-flow conditions to support testing may be further reduced. Calvert Cliffs Nuclear Power Plant estimates that this course of action could eliminate approximately two hours of operation under low-flow conditions for each LPSI pump per year.

This is also a significant reduction in unavailability hours against our NRC Performance Indicator for the residual heat removal safety function in Modes 1-4.

Relationship to Calvert Cliffs' Technical Specification Surveillance Requirements

The Calvert Cliffs' Technical Specification Surveillance Requirement (SR) for each pump (SR 3.5.2.3: HPSI and LPSI pumps) requires periodic testing of each pump to verify that the "developed head at the test flow point is greater than or equal to the required developed head." The specified frequency for the surveillance requirement is, "in accordance with the Inservice Test Program." Calvert Cliffs' Technical Specification Surveillance Requirements do not contain any additional (explicit or implied) testing requirements for these pumps beyond those required by the IST Program. This means that, as long as the testing complies with the requirements of the approved IST Program, there is no conflict with Calvert Cliffs' Technical Specification Surveillance Requirements. Therefore, none of the changes to the IST Program requested in this relief request would conflict with any Calvert Cliffs' Technical Specification Surveillance Requirements.

Bases for Proposed Modification of the 2004 OM Code

LPSI Pump Group Classification

Subsection ISTB Paragraph ISTB-2000 of the 2004 OM Code defines group A pumps as, "pumps that are operated continuously or routinely during normal operation, cold shutdown, or refueling operations," and group B pumps as, "pumps in standby systems that are not operated routinely except for testing." Based on these definitions and CCNPP's Operating Procedures, the LPSI pumps meet the definition of group A & group B pumps.

The LPSI pumps clearly meet the definition of group B pumps during normal operation in Modes 1-4. In Modes 5-6, the LPSI pumps are used for shutdown cooling and meet the definition of group A pumps. Subsection ISTB Paragraph ISTB-1400(b) states: "A pump that meets both Group A and Group B pump definitions shall be categorized as a group A pump." This means that the LPSI pumps would be classified as group A and would be subjected to essentially the same quarterly test requirements that currently apply under OM-1987, OMa-1988 Part 6.

NUREG/CP-0137 Vol. 1, Proceedings of the Third NRC/American Society of Mechanical Engineers (ASME) Symposium on Valve and Pump Testing, includes a paper entitled, "Description of Comprehensive Pump Test Change to ASME Code, Subsection ISTB." This paper describes the philosophy of classifying pumps in one group or the other (group A vs. group B). According to this paper, the intent of having different test requirements for the different pump groups, is to relate the amount and degree of quarterly performance monitoring required to the amount of degradation expected due to pump operation.

Requiring the LPSI pumps to be tested quarterly as group A pumps during normal operation in Modes 1-4 is contrary to the philosophy of the referenced paper. Quarterly testing subjects the LPSI pumps to increased test requirements, performance monitoring, and potentially more degradation due to low-flow operation at the time when they are standby pumps and would not otherwise be subject to operation-induced degradation. In fact, out of all of the ECCS and AFW pumps, the LPSI pumps are the ones, due to their design and test conditions, for which the detrimental effects of cumulative low-flow operation are the most drastic. Calvert Cliffs considers the requirement to test the LPSI pumps as group A pumps during normal operation in Modes 1-4 to be potentially

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detrimental on a long-term basis. Therefore, the LPSI pumps will be considered to be group B pumps during normal operation in Modes 1-4, and will be tested accordingly.

As previously stated, the LPSI pumps are typically run continuously during cold shutdown and refueling operations, depending on the decay heat rate. As a result, they may be subject to operation-induced degradation in Modes 5-6. Therefore, the LPSI pumps will be treated as group A pumps during any quarterly test that comes due during cold shutdown or refueling operations. However, typically during Modes 5-6, a Comprehensive Pump Test is preferable to a group A test for the LPSI pumps. This avoids the need to realign the LPSI pumps out of the normal shutdown cooling line-up and also avoids the detrimental effects of testing the LPSI pumps at low-flow conditions. Therefore, Calvert Cliffs expects that a Comprehensive Pump Test will typically be substituted for any group A test that may be required during Modes 5-6.

LPSI Pump Bearing Acceptance Criteria During Low-Flow Testing

Historically, the surveillance procedures used to perform these tests required vibration measurements to be recorded in terms of displacement (mils), not velocity. In recognition of the better indications provided by vibration measurements in terms of velocity, and as now permitted by ISTB, CCNPP has converted the vibration testing in the surveillance procedures to utilize velocity. However, CCNPP long ago recognized the benefit of velocity over displacement for analyzing pump vibrations and has included such measurements in the CCNPP Rotating Machinery Vibration Monitoring Program which conducts periodic vibration monitoring and analysis of numerous pumps and motors (including the LPSI pumps) beyond that required for the IST Program. The CCNPP Rotating Machinery Vibration Monitoring Program includes spectral analysis of the vibration measurements.

The long-term vibration trend (1995 through present) during quarterly testing of the LPSI pumps using the minimum recirculation flow path shows consistent results and stable performance with no unexplainable significant changes. The quarterly tests are performed at approximately 55-65 gpm which is between approximately 1.3%-1.6% of the LPSI pumps' "Best Efficiency Flow Rate." The Best Efficiency Flow Rate is based on the original Vendor Pump Curve. It is used instead of the system's design flow rate because the onset of pump internal recirculation and cavitation is a function of the pump's performance characteristics, not the system's design requirements.

Attachment 1, "Effect of Pump Operation at Low Flow Rates," discusses Calvert Cliffs' detailed academic research regarding the effects of low-flow operation on centrifugal pump vibration levels and includes extensive spectral analysis of all Calvert Cliffs' LPSI pump performance vibration data from an extended time period under low-flow and substantial-flow conditions. As discussed in Attachment 1 operating the LPSI pumps at these low flow rates results in a variety of effects (e.g., internal recirculation, cavitation, and force imbalance on the impeller) which contribute to increased vibration. Spectral analysis of the LPSI pump vibration measurements reveals (1) a general increase in the broadband noise levels which is indicative of internal recirculation and cavitation, and (2) discrete spikes at frequencies corresponding to the blade pass frequency which is indicative of force imbalances acting on the impeller. (References: "Centrifugal Pump Clinic," 2nd edition, by Igor Karassik, Published by Marcel Dekker Inc., 1989, and "Predictive Maintenance and Vibration Signature Analysis I," by J. E. Berry, Technical Associates of Charlotte, Inc., Table 6.0, "Illustrated Vibration Diagnostic Chart.") The analysis confirms the presence and effect of these phenomenon.

Many of the normal vibration levels experienced when operating the LPSI pumps under low-flow conditions during quarterly testing routinely exceed or challenge the absolute Alert Acceptance Criteria of 0.325 inches per second specified in Table ISTB-5121-1. This would necessitate either testing at six-week intervals, or a new evaluation each quarter.

The following factors lead to the conclusion that the current vibration levels recorded during LPSI minimum recirculation flow testing are acceptable and are not indicative of any pump mechanical problems or degradation, and, therefore, that the LPSI pumps are operating acceptably.

(1) The long-term stability of the vibration trend based on data from the surveillance tests and CCNPP Rotating Machinery Vibration Monitoring Program obtained during quarterly minimum recirculation flow testing.

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- (2) Spectral analysis confirmed the major contributor to the overall vibration levels recorded during quarterly minimum recirculation flow testing is consistent with phenomena which are well known to be associated with operation of a centrifugal pump at low flow rates and also well known to cause higher vibrations at these low flow rates.
- (3) The overall vibration levels recorded during large flow testing of the LPSI pumps are significantly reduced compared to the levels recorded during the quarterly minimum recirculation flow tests and are consistent with vibration levels experienced while testing centrifugal pumps at substantial flow rates in other systems and applications.
- (4) Spectral analysis confirmed that the major contributors to the overall vibration levels observed during quarterly minimum recirculation flow testing which are associated with operation of a centrifugal pump at low flow rates are significantly reduced during large flow testing of the LPSI pumps.
- (5) Similar vibration patterns have been observed for the other standby ECCS pumps, although the effects are not as pronounced as they are for the LPSI pump because the LPSI pumps are the pumps which are tested at the lowest flow condition relative to their Best Efficiency Flow Rate.
- (6) The LPSI pumps have no history of mechanical failures nor have they required significant maintenance on a regular basis.

The "Large Flow Rate" tests for the LPSI pumps have been in use at CCNPP since approximately 1991. At a minimum, each pump has been tested during each refueling outage since these tests were implemented. Vibration data (in both displacement and velocity) was collected during these tests via the surveillance tests themselves and the CCNPP Rotating Machinery Vibration Monitoring Program. The vibration data recorded during these large flow tests show the overall vibration levels drop significantly, as expected. Furthermore, spectral analysis of these results show the general broadband noise and spikes at discrete frequencies caused by the blade passing are significantly reduced.

The overall vibration levels observed during quarterly LPSI pump minimum recirculation flow testing, augmented by spectral analysis, are not sufficiently high as to prevent detection of increases in the LPSI pump vibration levels which would be indicative of mechanical degradation. Furthermore, the vibration monitoring during less frequent LPSI comprehensive pump (large flow) testing, also augmented by spectral analysis, provides even greater opportunities to detect increases in the LPSI pump vibration levels which would be indicative of mechanical degradation. CCNPP's experience has shown that spectral analysis of the vibration measurements obtained during quarterly minimum recirculation flow testing is sufficiently sensitive to changes in the pumps' mechanical condition and provides reasonable assurance that mechanical degradation can be detected early.

Performing pump testing at double the normal quarterly frequency when vibration levels exceed the acceptance criteria specified in Table ISTB-5121-1 is physically possible, i.e. it is practicable. However, based on the discussions contained in Attachment 1, such increased frequency testing will potentially reduce LPSI pump reliability and increase the probability of LPSI pump degradation, damage, or failure. Therefore, such testing is considered impractical because, though it is possible to perform such increased frequency testing, the potential reduction in LPSI pump reliability and potential increase in the probability of LPSI pump degradation, damage, or failure is a result which is contrary to the intent of the IST Program.

The running time of these pumps during the operating cycle is very limited since operation at low flow rates is detrimental to the pumps. Performing increased frequency testing on a regular basis during the operating cycle would increase the run time of these pumps by as much as approximately 30%. 10 CFR 50.55a(a)(3)(i) and (ii) address alternatives when the Code requirement would result in either a use of resources or a hardship/burden with no commensurate increase in the level of quality or safety. Not only would increased frequency testing of the LPSI pumps be both a waste of resources and a hardship/burden with no commensurate increase in the level of quality or safety, but such unnecessary testing will actually result in a very real potential to reduce the level of

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quality and safety and, therefore, should be considered impractical.

Therefore, a new set of relative and absolute vibration Alert Acceptance Criteria and a new set of relative Action Acceptance Criteria for the specific LPSI pump bearings typically affected by this phenomenon have been established. During any required group A test of the LPSI pumps (e.g., a quarterly test during an extended outage) conducted at low-flow conditions, the vibration analysis and acceptance criteria shall be revised, as appropriate, as described in the following paragraphs:

Table ISTB-5121-1 specifies that the value defining the upper limit of the acceptable range and the lower limit of the alert range shall be 2.5 times the reference value, not to exceed 0.325 ips. This means that up to a reference value of 0.13 ips, a 250% margin is allowed between the reference value and the "alert limit."

Clearly, relief is required for any vibration measurement with a reference value which is greater than the absolute alert limit of 0.325 ips specified by ISTB. However, there are also several vibration measurements which are close to the limit of 0.325 ips but do not exceed it. For these velocity measurements, relatively small increases in the overall vibration level which would normally be considered acceptable will cause them to exceed 0.325 ips, thus reducing the benefit and effectiveness of this relief request. Therefore, the alternative criteria are intended to allow a minimum of a 25% margin between each vibration reference value and the respective alert limit.

However, in no case shall the alert limit exceed 90% of the maximum vibration level allowed by the Code (i.e., the 'action limit'). This corresponds to a maximum allowable alert limit of 0.630 ips (90% X 0.700 ips). Based on the vibration instrumentation accuracy requirements in ISTB, this level is sufficient to ensure that a reading in the acceptable range cannot actually be greater than the action limit of 0.700 ips due to instrument accuracy/uncertainty.

CCNPP believes this approach provides greater flexibility than does seeking approval of specific values. This flexibility will permit CCNPP to revise the alert limits (within the guidelines contained in this relief request) should the need arise, such as following maintenance, after the necessary technical evaluation without using significant additional CCNPP or NRC resources.

Spectral analysis of quarterly minimum flow vibration results and less frequent comprehensive pump (large flow) vibration results in accordance with CCNPP's Rotating Machinery Vibration Monitoring Program will continue to provide adequate assurance that increases in vibration levels at discrete frequencies which are not sufficiently large to effect the overall vibration reading will be detected and analyzed.

Relief is requested pursuant to 10CFR50.55a(a)(3)(i) based on the proposed alternative providing an acceptable level of quality and safety.

ATTACHMENT 1

Effect of Pump Operation at Low Flow Rates

"Centrifugal Pump Clinic," 2nd edition, by Igor Karassik, Published by Marcel Dekker Inc., 1989, includes several pertinent discussions regarding the effect of pump operation at low flow rates. Throughout the book, the author discusses numerous topics

In Chapter 6, "Field Troubles," the author addresses several pertinent questions.

The answer to Question 6.31, "Vibration Caused by Operation at Low Flow," states, in part:

If a volute pump is operated at other than its design capacity, a certain imbalance of the hydraulic forces acting radially on the impeller takes place. The maximum imbalance occurs generally at zero capacity and is reduced as rated capacity is approached. This imbalance creates a radial load on the pump shaft.

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The answer to Question 6.32, "More About Operation at Reduced Flow," also states, in part:

All pumps exhibit a condition at low flows referred to as recirculation. Some pumps are worse than others, and the severity of the symptoms is dependent on the speed and diameter of the impeller. Recirculation is a turbulent reversal of a portion of the flow at the discharge of the impeller. The result is cavitation-like damage at the discharge tips of the vanes and a disturbance of the rotational flow patterns on each side of the impeller between the impeller shrouds and the casing walls. When the pump operates at or near its design capacity, the rotational flow patterns on each side of the impeller are symmetrical and impose no side thrust on the impeller. At low flows, however, the rotational flow patterns are no longer symmetrical, and a pressure differential exists between the two sides of the impeller. The result is an end thrust on the bearing.

Between the answers to Question 6.31 and 6.32, the author offers two possible solutions. The first is to switch to a dual-volute pump to balance the hydraulic forces. The second is to install a bypass line to allow increasing the pump flow rate and reduce this force imbalance. Both of these solutions require significant modifications.

The intent of installing a bypass line is to increase the flow rate and reduce the magnitude of the hydraulic force imbalance. The flow path used when these pumps are tested at low flow rates is from the discharge of the pump through the individual pump minimum flow recirculation piping to the common minimum flow recirculation flow piping and back to the refueling water tank. The only adjustable valve in this flow path is the manual valve which can be used to isolate each individual pump's minimum recirculation flow piping from the common header. This valve is already maintained in the full open position at all times, including during pump testing. (This eliminates the potential to over-throttle pump recirculation flow which could result in overheating and damaging a pump.) Therefore, this is a fixed resistance flow path in which system resistance has already been minimized. As a result, there is no simple way to increase pump flow rate during these tests.

Based on the answers to Question 4.14, "Basis for Minimum Flow," Question 4.17, "Continuous Versus Intermittent Operation," and Question 4.34, "Testing for Shutoff Head," (Chapter 4, "Operation") there are several potential effects of operation at low flows:

1. For single volute pumps, the increased radial load at reduced flows may impose excessive loads on the thrust bearing and can lead to shaft or bearing failure.
2. As the pump capacity is reduced, the temperature rise of the pumped liquid increases resulting in a lower water density and increased dissolution of dissolved gases inside the pump (leading to cavitation), as well as increased thermal expansion of pump components. Cavitation generally causes long-term cumulative damage to the impeller.
3. At reduced flow, internal circulation will occur in the suction or discharge areas of the impeller, or in both. Internal circulation can create hydraulic pulsations and mechanical vibrations leading to possible mechanical failure of pump components, such as the impeller, the bearings, or the seals. Such failures may occur catastrophically or be the result of cumulative damage. Internal circulation also results in cavitation-type damage to the impeller.

ALTERNATE TESTING:

Perform inservice testing of the LPSI Pumps per the 2004 Edition of the OM Code Subsection ISTB, "Inservice Testing of Pumps in Light-Water Reactor Power Plants," with the following modifications:

1. LPSI Pump Group Classification

The LPSI pumps will be tested as stand-by pumps (group B) during Modes 1-4 and continuously operating pumps (group A) during Modes 5-6. In Modes 5-6, the Comprehensive Pump Test may be substituted for a quarterly group A test that comes due during a mid-cycle cold shutdown period.

2. LPSI Pump Bearing Acceptance Criteria During Low-Flow Testing

The following modified vibration acceptance criteria shall be used for any low-flow LPSI pump post-maintenance (group A) testing done during cold shutdown periods:

Reference Value (VR)	Acceptable Range	Alert Range	Action Range
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VR < 0.11 ips	V < 2.5VR	2.5VR < V < 6VR	6VR < V
0.11 ips < VR < 0.13 ips	V < 2.5VR	2.5VR < V < 6VR	0.700 ips < V
0.13 ips < VR < 0.26 ips	V < 0.325 ips	0.325 ips < V < 0.700 ips	0.700 ips < V
0.26 ips < VR < 0.50 ips	V < 1.25VR	1.25VR < V < 0.700 ips	0.700 ips < V
0.50 ips < VR	V < 0.630 ips	0.630 ips < V < 0.700 ips	0.700 ips < V

The following tables (Tables 1 and 2) are the specific bearings/orthogonal directions which we are requesting relief for. Table 1 lists those bearings/orthogonal directions that regularly exceed the 0.325 inches per second alert level. Table 2 lists those bearings/orthogonal directions that periodically exceed or regularly challenge the 0.325 inches per second alert level.

Table 1 - Bearings/Orthogonal Directions that Regularly Exceed 0.325

LPSI Pump	Bearing Orthogonal Direction	Abbreviation	Typical Vibration Value/Range (ips)
11	Pump Inboard Horizontal	11 PIH	0.49
11	Pump Inboard Vertical	11 PIV	0.46
12	Pump Inboard Horizontal	12 PIH	0.29 - 0.42
12	Pump Inboard Vertical	12 PIV	0.37 - 0.44

Table 2 - Bearings/Orthogonal Directions that Periodically Exceed or Regularly Challenge 0.325

LPSI Pump	Bearing Orthogonal Direction	Abbreviation	Typical Vibration Value/Range (ips)
11	Pump Outboard Vertical	11 POV	0.28 - 0.34
12	Pump Outboard Vertical	12 POV	0.25 - 0.32

This Relief Request, upon approval, will be applied to the CCNPP Fourth 10-Year Interval.

ACCEPTANCE CRITERIA:

REFERENCES:

1. Letter from Mr. S. Singh Bajwa (NRC) to Mr. C. H. Cruse (BGE), dated February 11, 1998, "Safety Evaluation of the Inservice Testing Program Third Ten-Year Interval For Pumps and Valves, Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 (TAC Nos. M98523 and M98524)"
2. Letter from Mr. C. H. Cruse (BGE) to NRC Document Control Desk, dated December 30, 1999, "Revised and New Relief Requests for the Third Ten year Inservice Test Program"
3. Letter from Mr. C. H. Cruse (BGE) to NRC Document Control Desk, dated May 19, 2000, "Response to Request for Additional Information: Relief Request PR-11 Low Pressure Safety Injection Pumps"
4. Letter from Ms. M. Gamberoni (NRC) to Mr. C. H. Cruse (CCNPP, Inc), dated August 22, 2000, "Safety Evaluation of Relief Requests for the Third 10-Year Pump and Valve In-Service Testing Program Calvert Cliffs Nuclear Power Plant Units 1 and 2 (TAC Nos. MA7848 and MA7849)"
5. Letter from Mr. R. J. Laufer (NRC) to Mr. C. H. Cruse (CCNPP, Inc), dated May 16, 2002, "Request for Relief No. PR-12 Associated with the Third 10-Year Interval Inservice Testing Program, Calvert Cliffs Nuclear Power"

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Plant, Unit Nos. 1 and 2 (TAC Nos. MB3782 and MB3783)"

APPROVAL REFERENCES:

Constellation Energy (CCNPP Unit 2) IST Program

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Not Approved

Component ID	Class	Cat.	System	Label
21 RCS CHG	2	A	RC	Chemical and Volume Control (Charging) Pump 21
22 RCS CHG	2	A	RC	Chemical and Volume Control (Charging) Pump 22
23 RCS CHG	2	A	RC	Chemical and Volume Control (Charging) Pump 23

FUNCTION:

During plant operation, the charging pumps operate to provide make-up to the RCS to maintain pressurizer level and for chemical addition. They automatically start on a SIAS to deliver concentrated boric acid to the RCS for emergency boration. 21 and 22 charging pumps are independently powered; 23 charging pump may be aligned to either power source.

Under accident conditions, the VCT is automatically isolated and NPSH to the charging pumps is provided by the boric acid make-up tanks (two 9,700 gallon tanks) through either the Direct Feed Line-up via the boric acid pumps or the Gravity Feed Line-up.

TEST REQUIREMENT:

Paragraph ISTB-3510(e)

The frequency response range of the vibration-measuring transducers and their readout system shall be from one-third minimum pump shaft rotational speed to at least 1000 Hz.

BASIS:

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The rotational shaft speed of the charging pumps is 209 rpm relating to a rotational frequency of approximately 3.48 Hz. In order to satisfy the requirements of Paragraph ISTB-3510(e) a vibration measurement system capable of measuring vibration to a lower limiting frequency of 1.16 Hz. would be required.

The instruments currently being used at Calvert Cliffs have a lower frequency limit for reliable, accurate measurement of 3 Hz. This instrumentation is "state-of-the-art" industrial grade, high quality equipment. Satisfying the Code requirements with respect to frequency response would require special calibration by off-site vendors which would involve extra expense. Because calibration of the instrument would require sending it off-site, and because of the extra expense of this special calibration, the use of this instrumentation would have to be restricted to monitoring charging pump vibration only in order to minimize the potential for damage to the instrument. Since this special calibration would require sending the instrument off-site, additional analyzers that were used solely for monitoring the charging pumps would be required in order to ensure at least two (one primary and one back up) were always in calibration and available on-site.

According to Table 6.0, "Illustrated Vibration Diagnostic Chart," contained in "Predictive Maintenance and Vibration Signature Analysis I," by J. E. Berry, Technical Associates of Charlotte, Inc., the anomaly which would normally be expected to produce only sub-harmonic vibrations is oil whip/whirl. Other conditions that could result in low frequency vibration (less than shaft speed) would normally also be detectable at shaft running speed, and harmonic and non-harmonic frequencies. Therefore, monitoring lower frequencies (less than rotational speed) is performed primarily for the purpose of detecting oil whirl or whip in journal bearings. However, the main bearings in Calvert Cliffs' charging pumps are oil-mist lubricated tapered roller bearings that are not susceptible to the oil whip or whirl phenomena. Calibrating the instruments down to 3 Hz will include some sub-harmonic frequencies. Additionally, although the instrumentation used by Calvert Cliffs will only be calibrated down to 3 Hz which is slightly less than pump running speed (approximately 85%), it will remain capable of detecting vibrations at frequencies as low as 1 Hz. This means we would still expect to detect any developing sub-harmonic vibrations which could still at least be qualitatively evaluated.

Seal rub and bearing looseness are two other conditions which may be detected at sub-harmonic frequencies. The primary indicator for seal rub is a truncation of the waveform observed through time-domain waveform analysis. Bearing looseness can also be identified through waveform analysis. Normally, harmonics of shaft speed would also be detectable in order to confirm this condition.

In addition to the ASME pump testing, Calvert Cliffs has implemented a "Rotating Machinery Vibration Monitoring Program" that includes periodic vibration monitoring of the charging pumps. This program is inclusive and encompasses a wider range of vibration analyses and frequencies, including time-domain waveform analysis, phase analysis, and spectral analysis, at various critical pump and motor locations. The data derived from this expanded program along with the IST vibration data will provide a high degree of assurance that the anomalies of concern can be identified and significant pump degradation will not go undiscovered.

Based on: (1) the fact that Calvert Cliffs' charging pumps are not susceptible to oil whip/whirl which is the major anomaly which would normally be expected to produce only sub-harmonic vibrations, (2) the low probability of any other anomalies producing vibrations at only sub-harmonic frequencies and not at running speed or harmonic and/or non-harmonic frequencies, and (3) Calvert Cliffs "Rotating Machinery Vibration Monitoring Program," the added expense of the special calibration and additional test equipment necessary outweighs their benefit.

Relief is requested pursuant to 10CFR50.55a(a)(3)(i) based on the proposed alternative providing an acceptable level of quality and safety.

ALTERNATE TESTING:

The instruments used for measuring vibration on the reactor charging water pumps will have a frequency response calibrated range that extends to a lower limiting frequency of 3 Hz.

The charging pumps will be included in the Calvert Cliffs' "Rotating Machinery Vibration Monitoring Program" that includes periodic vibration monitoring and analysis of each pump.

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This Relief Request, upon approval, will be applied to the CCNPP Fourth 10-Year Interval.

ACCEPTANCE CRITERIA:

REFERENCES:

NRC Letter, dated 2/11/98, "Safety Evaluation of the Inservice Testing Program Third Ten-Year Interval for Pumps and Valves - Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 (TAC Nos. M98523 and M98524)"
Letter from BGE to the NRC, dated 12/30/99, "Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318 Revised and New Relief Requests for the Third Ten Year Inservice Test Program"
NRC Letter, dated 8/22/00, "Safety Evaluation of Relief Requests for the Third 10-Year Pump and Valve In-Service Testing Program Calvert Cliffs Nuclear Power Plant Units 1 and 2 (TAC Nos. MA7848 and MA7849)"

APPROVAL REFERENCES:

Constellation Energy (CCNPP Unit 2) IST Program

GA-RR-01

Not Approved

Component ID Class Cat. System Label

Various Various

FUNCTION:

The American Society of Mechanical Engineers (ASME) Operation and Maintenance (OM) Code provides the requirements for the implementation of the Inservice Testing (IST) Program.

TEST REQUIREMENT:

ISTA-3200(f)(3) The test plan for each successive test interval shall comply with the edition and addenda of the Section that have been adopted by the regulatory authority 12 months prior to the start of the inservice test interval, or subsequent editions and addenda that have been adopted by the regulatory authority.

BASIS:

The current Code edition/addenda incorporated by reference in 10CFR50.55a(b)(3) is the 2001 Edition with Addenda through OMB-2003. Calvert Cliffs Nuclear Power Plant is part of the Constellation Energy fleet of nuclear plants. The other plants in the Constellation fleet will be updating their IST Programs within the next 2 years. Constellation's goal for uniformity and economic benefit is to have all their plants in the fleet using the same ASME Code edition/addenda for their IST Programs. Constellation Energy/Calvert Cliffs Nuclear Power Plant proposes to use the ASME OM Code-2004 Edition.

Calvert Cliffs has evaluated the differences between the ASME OM Code-2004 Edition and the 2001 Edition with Addenda through OMB-2003. The majority of the changes are editorial. The changes to Subsection ISTB for pumps are limited to table and figure number updates. The changes to Subsection ISTC for valves are predominately corrections to referenced paragraph numbers. The following differences in Subsection ISTC are noted:

- 1) In ISTC-3620 & ISTC-3630 the word "Nonmandatory" has been deleted where Appendix J is referenced.
- 2) In ISTC-3630 subparagraphs (e)(1) & (e)(2) the leakage calculation conversion values and units have been revised.

The changes to Mandatory Appendix I for relief valves are predominately corrections to referenced paragraph numbers. The following differences in Mandatory Appendix I are noted:

- 1) In I-3410 subparagraph (a) the words "except for on-line testing" have been deleted.
- 2) In I-3410 subparagraph (d) the words "refurbished in place" have been deleted.
- 3) In I-3410 subparagraph (d) the requirement to 'verify open and close capability' of the main disc has been eliminated.
- 4) In I-4120, "Compressible Fluid Services Other Than Steam," the minimum time between successive openings is reduced from 10 minutes to 5 minutes. (This was already done for steam service, I-4110, and liquid service, I-4130.)

CCNPP believes these changes to be improvements that provide an acceptable level of quality and safety compared to the requirements in the existing approved ASME OM Code. This is supported by the fact that the NRC has recently issued a notice in the Federal Register of their intent to update the ASME Code referenced in 10CFR50.55a(b)(3) to the ASME OM Code-2004 Edition.

Relief is requested pursuant to 10CFR50.55a(a)(3)(i) based on the proposed alternative providing an acceptable level of quality and safety.

ALTERNATE TESTING:

Calvert Cliffs Nuclear Power Plant will use the 2004 Edition of the ASME OM Code as the Code of record for their fourth Ten-Year IST Program.

Constellation Energy (CCNPP Unit 2) IST Program

GA-RR-01

This relief request, upon approval, will be applied to the CCNPP Fourth Ten-Year IST Interval.

ACCEPTANCE CRITERIA:

REFERENCES:

APPROVAL REFERENCES:

Constellation Energy (CCNPP Unit 2) IST Program

GV-RR-01

Not Approved

Component ID	Class	Cat.	System	Label
2-CC-3823-RV	3	C	CC	21 CC Heat Exchanger Shell-Side Relief Valve
2-CC-3825-RV (;	3	C	CC	22 CC Heat Exchanger Shell-Side Relief Valve
2-CC-3827-RV	3	C	CC	21 Shutdown Cooling Heat Exchanger CC Inlet Relief Valve
2-CC-3829-RV	3	C	CC	22 Shutdown Cooling Heat Exchanger CC Inlet Relief Valve
2-CC-3831-RV	3	C	CC	Letdown Heat Exchanger Relief Valve
2-CC-6450A-RV	3	C	CC	NSSS Sample Cooler Outlet Relief Valve
2-CC-6471-RV	3	C	CC	21 Steam Generator Blowdown Sample Coolers Relief Valve
2-CC-6472-RV	3	C	CC	22 Steam Generator Blowdown Sample Coolers Relief Valve
2-CVC-125-RV (;	2	C	CVC	Boric Acid Pump Recirculation Relief Valve
2-CVC-132-RV (;	2	C	CVC	Boric Acid Storage Tank Discharge Relief Valve
2-CVC-133-RV	2	C	CVC	Boric Acid Pump Discharge Relief Valve
2-CVC-141-RV (;	2	C	CVC	Boric Acid Storage Tank Discharge Relief Valve
2-CVC-149-RV (;	2	C	CVC	Boric Acid Pump Recirculation Relief Valve
2-CVC-150-RV (;	2	C	CVC	Boric Acid Pump Discharge Relief Valve
2-CVC-157-RV (;	2	C	CVC	Boric Acid Pump Common Discharge Relief Valve
2-CVC-160-RV	2	C	CVC	Boric Acid Strainer Inlet Relief Valve
2-CVC-171-RV (;	2	C	CVC	Boric Acid Strainer Outlet Relief Valves
2-CVC-311-RV (;	2	C	CVC	Charging Pump Suction Relief Valve
2-CVC-315-RV (;	2	C	CVC	Charging Pump Suction Relief Valve
2-CVC-318-RV (;	2	C	CVC	Charging Pump Suction Relief Valve
2-CVC-321-RV (;	2	C	CVC	Charging Pump Suction Relief Valve
2-CVC-324-RV (;	2	C	CVC	Charging Pump Discharge Relief Valve
2-CVC-325-RV (;	2	C	CVC	Charging Pump Discharge Relief Valve
2-CVC-326-RV (;	2	C	CVC	Charging Pump Discharge Relief Valve
2-SI-211-RV (2R	2	C	SI	Safety Injection Tank Relief Valve
2-SI-221-RV (2R	2	C	SI	Safety Injection Tank Relief Valve
2-SI-231-RV (2R	2	C	SI	Safety Injection Tank Relief Valve
2-SI-241-RV (2R	2	C	SI	Safety Injection Tank Relief Valve
2-SI-409-RV (2R	2	C	SI	High Pressure Safety Injection Header Relief Valve
2-SI-417-RV (2R	2	C	SI	High Pressure Safety Injection Header Relief Valve
2-SI-430-RV	2	C	SI	Shutdown Cooling Recirculation to High Pressure Safety Injection Pump F
2-SI-431-RV (2R	2	C	SI	Shutdown Cooling Recirculation to High Pressure Safety Injection Pump F
2-SI-439-RV	2	C	SI	Low Pressure Safety Injection Header Relief Valve
2-SI-446-RV	2	C	SI	Safety Injection Leak-Off Relief Valve
2-SI-468-RV (2R	2	C	SI	Shutdown Cooling Return Header Relief Valve
2-SI-469-RV (2R	2	C	SI	Shutdown Cooling Isolation Valve Relief Valve
2-SI-6302-RV	2	C	SI	Auxiliary High Pressure Safety Injection Pump 21 Discharge Header Relie
2-SRW-1575-RV	3	C	SRW	21A Service Water Heat Exchanger Relief Valve
2-SRW-1576-RV	3	C	SRW	21B Service Water Heat Exchanger Relief Valve
2-SRW-1577-RV	3	C	SRW	22A Service Water Heat Exchanger Relief Valve
2-SRW-1578-RV	3	C	SRW	22B Service Water Heat Exchanger Relief Valve
2-SRW-1582-RV	3	C	SRW	21 Containment Air Cooler Service Water Discharge/Return Relief Valve
2-SRW-1585-RV	3	C	SRW	22 Containment Air Cooler Service Water Discharge/Return Relief Valve

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2-SRW-1587-RV	3	C	SRW	1B, 2A, & 2B Diesel Generator Service Water Supply/Inlet Relief Valve
2-SRW-1588-RV	3	C	SRW	2B Diesel Generator Service Water Supply/Inlet Relief Valve
2-SRW-1590-RV	3	C	SRW	23 Containment Air Cooler Service Water Discharge/Return Relief Valve
2-SRW-1593-RV	3	C	SRW	24 Containment Air Cooler Service Water Discharge/Return Relief Valve
2-SRW-1598-RV	3	C	SRW	12 Spent Fuel Pool Cooler Service Water Relief Valve
2-SRW-4084-RV	3	C	SRW	22 Steam Generator Blowdown Heat Exchanger Relief Valve
2-SW-5205-RV (	3	C	SW	ECCS Pump Room Air Coolers Saltwater Relief Valve
2-SW-5206-RV (	3	C	SW	CC Heat Exchangers Saltwater Relief Valve
2-SW-5207-RV (	3	C	SW	ECCS Pump Room Air Coolers Saltwater Relief Valve
2-SW-5208-RV (	3	C	SW	CC Heat Exchangers Saltwater Relief Valve
2-SW-5209-RV	3	C	SW	SRW Heat Exchangers Inlet Relief Valve
2-SW-5210-RV	3	C	SW	SRW Heat Exchangers Inlet Relief Valve
2-SW-5211-RV	3	C	SW	SRW Heat Exchangers Inlet Relief Valve
2-SW-5212-RV	3	C	SW	SRW Heat Exchangers Inlet Relief Valve

FUNCTION:

Provide over-pressure protection to associated systems

TEST REQUIREMENT:

A minimum of 5 minutes shall elapse between successive openings. (OM Code Appendix I Para. I-8110(h) - Steam Service, I-8120(h) - Compressible Fluid Service Other Than Steam, and I-8130(g) - Liquid Service)

BASIS:

Constellation Energy (CCNPP Unit 2) IST Program

GV-RR-01

This is a generic request for relief for all Class 2 and 3 safety and relief valves, excluding the MSSVs. For these valves, the requirement for verifying temperature stability, by waiting 5 minutes between successive openings, is inappropriate and adds no value. There is negligible affect on valve setpoint due to minor temperature deviations that might occur at these conditions.

Numerous Class 2 and 3 safety/relief valves associated with contaminated systems are bench-tested in the "hot shop", located within the RCA in the Auxiliary Building, to prevent the spread of contamination. These tests are performed under ambient conditions using a test medium at ambient conditions. Therefore, there is no source of thermal imbalance that might affect the test results.

Entry into the hot shop testing facility requires full Anti-C's. During the test, personnel are exposed to background radiation levels present in the Auxiliary Building hot shop as well as the radiation levels associated with the specific valve being tested. The proposed elimination of the hold time between successive tests for Class 2 and 3 safety/relief valves tested under ambient conditions using a test medium at ambient conditions reduces the duration of each test. Most importantly, reducing the hold times reduces the length of time that the test personnel must spend in close proximity to the valve. As a result, personnel radiation exposure is reduced.

For all safety and relief valves, including those located in "clean areas" that are in-situ/bench-tested in the Mechanical Maintenance Shop, the proposed elimination of the hold time between successive tests will reduce the duration of each test. Since there are numerous safety/relief valve tests for both units and most require at least two people, the proposed elimination of the hold time between successive tests is expected to also result in a significant cumulative reduction in limited manpower resources.

Additionally, empirical data based on CCNPP plant experience supports the conclusion that the minimum hold time between successive tests has no value for safety/relief valves tested under ambient conditions using test medium at ambient conditions.

The net result of having to wait 5 minutes between successive openings is an increase in manpower and time to perform the tests, and an increase in radiation exposure when located in radiation areas, without a commensurate increase in test accuracy.

Relief is requested pursuant to 10 CFR 50.55a(a)(3)(i) based on the proposed alternative providing an acceptable level of quality and safety.

ALTERNATE TESTING:

For Class 2 and 3 safety and relief valves, excluding the MSSVs, tested under ambient conditions using test medium at ambient conditions, the 5-minute hold requirement between successive openings will be deleted.

This relief request, upon approval, will be applied to the CCNPP Fourth Ten-Year IST Interval.

ACCEPTANCE CRITERIA:

REFERENCES:

NRC Letter, dated 1/19/01

APPROVAL REFERENCES:

Constellation Energy (CCNPP Unit 2) IST Program

GV-RR-02

Not Approved

Component ID	Class Cat.	System Label
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Various

Various

FUNCTION:

Certain Motor-Operated Valves in ASME Safety Class 1, 2, and 3 systems which are required to perform a specific function in shutting down a reactor to the safe shutdown condition, in maintaining the safe shutdown condition, or in mitigating the consequences of an accident. The valves are those that include the designation "OMN1" in the "Frequency" column of the Valve Tables.

TEST REQUIREMENT:

ISTA-3130(b) states: "Code Cases shall be applicable to the edition and addenda specified in the test plan." The edition and addenda specified in the test plan for the fourth Ten-Year Interval for the Calvert Cliffs Nuclear Power Plant is the ASME OM Code 2004 Edition.

BASIS:

Code Case OMN-1 contains no applicability statement. In the latest edition/addenda incorporated by reference in 10 CFR 50.55a(b)(3) (i.e., the 2001 Edition with Addenda through the Omb-2003), the expiration date given for OMN-1 is March 30, 2004. OMN-1 is included in the 2006 Addenda to the 2004 Edition of the OM Code with a new expiration date of November 29, 2008; however, neither the 2004 Edition of the OM Code nor any Addenda have been incorporated by reference in 10 CFR 50.55a(b)(3). Paragraph 10 CFR 50.55a(b)(6) references Regulatory Guide 1.192, which conditionally approves the use of Code Case OMN-1 "in lieu of the provisions for stroke-time testing in Subsection ISTC of the 1995 Edition up to and including the 2000 Addenda of the ASME OM Code".

Relief is requested pursuant to 10CFR50.55a(a)(3)(i) based on the proposed alternative providing an acceptable level of quality and safety.

ALTERNATE TESTING:

Calvert Cliffs Nuclear Power Plant will apply the requirements of OMN-1 "Alternative Rules for Preservice and Inservice Testing of Certain Electric Motor-Operated Valve Assemblies in Light-Water Reactor Power Plants," including the conditions specified in Table 2 of USNRC Regulatory Guide 1.192, in lieu of the provisions for motor-operated valve testing in Subsection ISTC of the 2004 Edition of the ASME OM Code. This Relief Request, upon approval, will be applied to the CCNPP Fourth 10-Year Interval.

ACCEPTANCE CRITERIA:

REFERENCES:

APPROVAL REFERENCES:

Constellation Energy (CCNPP Unit 2) IST Program

GV-RR-03

Not Approved

Component ID	Class Cat.	System	Label
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Various		Various	
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FUNCTION:

Certain control valves in ASME Safety Class 1, 2, and 3 systems which are required fail-safe to perform a specific function in shutting down a reactor to the safe shutdown condition, in maintaining the safe shutdown condition, or in mitigating the consequences of an accident. The valves are those that include the designation "OMN-8" in the "Comments" column of the Valve Tables.

TEST REQUIREMENT:

ISTA-3130(b) states: "Code Cases shall be applicable to the edition and addenda specified in the test plan." The edition and addenda specified in the test plan for the fourth Ten-Year Interval for the Calvert Cliffs Nuclear Power Plant is the ASME OM Code 2004 Edition.

BASIS:

Code Case OMN-8 contains no applicability statement. In the latest edition/addenda incorporated by reference in 10 CFR 50.55a(b)(3) (i.e., the 2001 Edition with Addenda through the OMB-2003), the expiration date given for OMN-8 is November 20, 2006. OMN-8 is included in the 2006 Addenda to the 2004 Edition of the OM Code with a new expiration date of November 20, 2009; however, neither the 2004 Edition of the OM Code nor any subsequent Addenda have been incorporated by reference in 10 CFR 50.55a(b)(3). Paragraph 10 CFR 50.55a(b)(6) references Regulatory Guide 1.192, which approves the use of Code Case OMN-8. Code Case OMN-8 provides an alternative to stroke time testing power-operated control valves that have only a fail safe safety function. Relief is requested pursuant to 10CFR50.55a(a)(3)(i) based on the proposed alternative providing an acceptable level of quality and safety.

ALTERNATE TESTING:

Calvert Cliffs Nuclear Power Plant will apply the requirements of Code Case OMN-8 "Alternative Rules for Preservice and Inservice Testing of Power-Operated Valves That Are Used for System Control and Have a Safety Function per OM-10," in lieu of the provisions for power-operated control valve testing specified in paragraphs ISTC-5131, ISTC-5132, ISTC-5133(b), ISTC-5141, ISTC-5142 & ISTC-5143(b), in Subsection ISTC of the 2004 Edition of the ASME OM Code.

This Relief Request, upon approval, will be applied to the CCNPP Fourth 10-Year Interval.

ACCEPTANCE CRITERIA:

REFERENCES:

APPROVAL REFERENCES:

Constellation Energy (CCNPP Unit 2) IST Program

RC-RR-01

Not Approved

Component ID	Class	Cat.	System	Label
2-RC-200-RV (2)	1	C	RC	Pressurizer Safety Valve
2-RC-201-RV (2)	1	C	RC	Pressurizer Safety Valve

FUNCTION:

The pressurizer safety valves provide overpressure protection for the reactor coolant system in the event of a loss of load without a reactor trip. They also act as the ASME Code safety/relief valves.

TEST REQUIREMENT:

Valves insulated in service shall be insulated in like manner during testing. (Appendix I, Paragraph I-8110(d) - Thermal Equilibrium).

BASIS:

Constellation Energy (CCNPP Unit 2) IST Program

RC-RR-01

Changes in safety/relief valve body temperature can change the lift setpoint measured during inservice testing. Changes in ambient temperature or modifications to insulation also may change the lift setpoint by virtue of the resulting effect on the valve body temperature. The purpose of Paragraph I-8110(d) is to ensure the effect of temperature variations are minimized. Requiring insulation to be installed during testing is clearly intended to also ensure the valve body's temperature, and therefore its performance, is similar to that under normal operating circumstances. Calvert Cliffs has determined the normal operating temperature profile for the pressurizer safety valves by instrumenting each valve body at several locations and recording empirical data during normal operation.

Recently, Calvert Cliffs commissioned testing using the valves' actual operating temperature profile at a national vendor's testing facility to determine the impact of having the insulation removed versus installed during testing of the pressurizer safety valves. This testing showed that pressurizer safety valves which have had their setpoints satisfactorily verified in-situ will perform satisfactorily two years later in a laboratory setting if the valve body's actual operating temperature profile is recreated. The test was conducted using two valves adjusted to their respective setpoints (which differ by only 65 psi).

The first series of tests was performed with each valve uninsulated. Prior to setpoint testing, each valve was thermally stabilized at the specified temperature profile to match normal operating conditions. The valves performed within their as-found setpoint tolerance.

The second series of tests was performed with each valve insulated (using the actual insulation from the plant normally installed on each valve). Prior to setpoint testing, each valve was thermally stabilized. However, due to the test configuration, the valve could not be thermally stabilized at the actual operating temperature profile. Instead, it could only be stabilized at a higher temperature. The overall impact of the higher temperature profile is that the lift pressure for the valves is lower than when at the correct temperature profile. This is a non-conservative error because, if the valves were adjusted to lift at their operating setpoint under these conditions, they would then be set to lift by as much as approximately 2% high when returned to their normal plant installation.

The third series of tests was performed with each valve insulated and with the ambient temperature being varied. The variations in ambient temperature had little effect on the valve's lift pressure.

Because of differences in the test configuration and the normal plant configuration, the vendor was unable to stabilize the valves' temperature profile when insulated consistent with the one specified for normal plant operating conditions. Rather, the temperatures measured at all the points being monitored, most notably the upper and lower bonnet, were higher.

The higher temperature profile for the insulated valves in the testing configuration occurred because, when installed in the plant, these valves are attached to long runs of piping with numerous associated piping supports which serve as heat sinks for the valves, but in the testing facility these long runs of piping are no longer attached. In the plant, these heat sinks allow the valves to stabilize at a lower temperature profile even when insulated, as compared to the temperature profiles when insulated in the vendor test facility. Additionally, the presence of forced ventilation in the field increases the heat transfer out of each valve body through the insulation for the same ambient temperature when compared to the stagnant conditions present in the test configuration.

In other words, the heat input and heat output of the insulated valves in a stagnant environment cannot be balanced in the testing facility until the valves are hot enough to create the necessary heat transfer rate through the insulation needed to offset the heat input. Since the heat transfer out of the valve to the attached piping is lost, more heat output through the insulation is required. This effect is additionally aggravated by the lack of forced ventilation. As a result, the valves stabilize at a higher temperature and the lift pressure measured was lower (by as much as approximately 2%) with the valves insulated and at these higher temperatures.

Relief is requested pursuant to 10CFR50.55a(a)(3)(i) based on the proposed alternative providing an acceptable level of quality and safety.

Constellation Energy (CCNPP Unit 2) IST Program

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ALTERNATE TESTING:

OM Code-2004 Appendix I, Paragraph I-8110(e) requires the ambient temperature of the operating environment to be simulated during the set pressure test. Additionally, if the effect of ambient temperature on set pressure can be established for a particular valve type, then Appendix I allows set pressure tests to be performed using an ambient temperature different from the operating ambient temperature as long as applicable correlations between the operating and testing ambient temperatures are used.

The intent of using the normally installed insulation per Paragraph I-8110(d) and testing using the operating ambient temperature (or test ambient temperature with the appropriate correlation) is to ensure the valve performance during the test is indicative of its expected performance under service conditions. However, Calvert Cliffs' has shown through comparative laboratory and in-situ tests that controlling the actual temperature profile of the valve body is a more realistic and more effective way of simulating inservice conditions and testing these valves. Additionally, it is much less likely to produce misleading test results that could lead to inappropriate setpoint adjustments. Therefore, Calvert Cliffs considers the requirements of Paragraph I-8110(e) to be satisfied by such testing and, based on the test results obtained at the vendor's laboratory, no correlation factor is applicable.

When testing is performed in a vendor testing facility, vice in-situ testing, the valve body's temperature profile necessary to simulate normal operating conditions for these valves will be specified. The valve shall be stabilized at the required temperature profile per the remaining portion of Paragraph I-8110(d) prior to setpoint testing without requiring the valve to be insulated in a like manner to its inservice configuration.

This Relief Request, upon approval, will be applied to the CCNPP Fourth 10-Year Interval.

ACCEPTANCE CRITERIA:

REFERENCES:

NRC Letter, dated 2/11/98, "Safety Evaluation of the Inservice Testing Program Third Ten-Year Interval for Pumps and Valves - Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 (TAC Nos. M98523 and M98524)"

APPROVAL REFERENCES:

Constellation Energy (CCNPP Unit 2) IST Program

SI-RR-01

Not Approved

Component ID	Class Cat.	System	Label
21 LPSI	2 A/B	SI	Low Pressure Safety Injection Pump 21
22 LPSI	2 A/B	SI	Low Pressure Safety Injection Pump 22

FUNCTION:

These pumps supply borated water (from the RWT during injection mode and the containment sump during recirculation mode, if necessary) to the RCS following a large break LOCA.

In the shutdown cooling mode at reduced RCS temperature/pressure, the pumps also circulate water through the shutdown cooling heat exchangers to provide long-term cooling for the reactor core.

TEST REQUIREMENT:

OM Code-2004 Requirement:

Subsection ISTB Paragraph ISTB-2000 defines group A pumps as; "pumps that are operated continuously or routinely during normal operation, cold shutdown, or refueling operations," and group B pumps as; "pumps in standby systems that are not operated routinely except for testing."

Subsection ISTB Paragraph ISTB-1400(b) states: "A pump that meets both Group A and Group B pump definitions shall be categorized as a group A pump."

Pump vibration acceptance criteria shall be in accordance with paragraph ISTB-5121(e) & Table ISTB-5121-1. Table ISTB-5121-1 provides the following acceptance criteria for vibration measurement (in terms of velocity, inches per second) for centrifugal pumps with a running speed equal to or greater than 600 rpm:

The acceptable range is < 2.5 times the reference value, but not to exceed 0.325 inches per second (ips).

The alert range is from > 2.5 times the reference value, but not to exceed 0.325 ips, up to 6 times the reference value, but not to exceed 0.700 ips.

BASIS:

Constellation Energy (CCNPP Unit 2) IST Program

SI-RR-01

The Low Pressure Safety Injection (LPSI) Pumps are tested quarterly using the minimum recirculation flow path from each pump through the minimum recirculation flow common header and back to the refueling water tank. The common header is instrumented with an ultrasonic flow meter. However, flow is not throttled during the quarterly test to eliminate the potential for pump overheating and damage should flow inadvertently be throttled below that required to ensure adequate pump cooling.

The LPSI pumps are also tested at a substantial flow rate (approximately 3500 gpm) during every refueling outage, as well as during planned and unplanned cold shutdown periods when plant conditions and circumstances permit. These tests are the Code comprehensive pump tests (formerly known at CCNPP as "Large Flow Rate" tests.)

Differential Pressure Measurements

Calvert Cliffs' current quarterly group A pump test program requires differential pressure to be measured. Group A quarterly ECCS pump tests must be performed using very accurate ($\pm 1/2\%$) test pressure gauges. These pressure gauges would be installed prior to, and removed after, each test (an annual total of 32 gauge installation/removal evolutions). These very accurate gauges are not required by OM Code-2004; however, they are necessary because the hydraulic margin available, based on design calculations, is less than the amount of degradation allowed by ISTB. Using less accurate permanently installed pressure gauges could result in a pump being unnecessarily declared inoperable solely due to pressure gauge uncertainty.

Installation and removal of these test pressure gauges for each LPSI pump every quarter would require significant dedication of manpower, results in significant cumulative annual radiation dose, increased radioactive waste, increased wear on fittings, and additional challenges for possible personnel contamination. Calvert Cliffs' estimates that eliminating the test pressure gauge installation and removal evolutions will save at least 1/8 man-rem per year and almost 100 man-hours per year.

Quarterly LPSI pump tests are performed using the minimum recirculation flow path under low-flow conditions. In this region, the pumps are operating at or near shut-off head, the pump curves are flat or nearly flat, and pump differential pressure is not very sensitive to pump degradation. Flow rate alone is an adequate indication of possible pump degradation or flow blockage since the minimum recirculation flow path is a fixed-resistance flow path. The conclusion that measurement of pump differential pressure is of minimal value is supported by our historical test data.

As group B pumps, the operational readiness is reasonably assured without requiring quarterly differential pressure measurements. This will allow Calvert Cliffs Nuclear Power Plant (CCNPP) to cease these gauge installation and removal evolutions every quarter, while maintaining an acceptable level of quality and safety.

Vibration Measurements

Calvert Cliffs' current quarterly group A pump test program requires pump vibration measurements. The overall vibration readings recorded during quarterly low-flow testing have always been relatively "high." These vibration readings have been subject to spectral analysis under our Rotating Machinery Condition Monitoring Program, which is separate from the IST Program. The spectral analyses have consistently confirmed the major contributor to the "high" overall vibration readings occurs at the "blade pass frequency" for each LPSI pump and is not indicative of bearing degradation.

However, spectral analysis is not required by the Code. Therefore, the effects of low-flow operation on a centrifugal pump make the required broadband vibration readings during the current quarterly test of minimal value. This conclusion is supported by our historical test data. Under the 2004 Code, the operational readiness of group B pumps is reasonably assured without requiring quarterly vibration measurements. Based on this, we feel that an acceptable level of quality and safety is still maintained while many of the burdens and costs associated with vibration testing, including cumulative annual radiation dose and manpower, will be eliminated.

Minimum Pump Run-Time

As group B pumps, the two-minute minimum pump run-time for quarterly tests is also eliminated. Eliminating the

Constellation Energy (CCNPP Unit 2) IST Program

SI-RR-01

minimum pump run-time requirement and the requirement to record differential pressure and vibration levels is expected to slightly reduce the length of each pump test. This will help to reduce the cumulative run-time of each LPSI pump under low-flow conditions to support testing, with a commensurate reduction in potential pump wear.

Other Considerations

These proposed changes simplify the quarterly IST pump test to allow combining the quarterly IST pump test into the related quarterly engineering safety features actuation logic test for each pump. As a result, the total number of starting demands on each pump motor to support testing may be reduced and the cumulative run-time of each LPSI pump under low-flow conditions to support testing may be further reduced. Calvert Cliffs Nuclear Power Plant estimates that this course of action could eliminate approximately two hours of operation under low-flow conditions for each LPSI pump per year.

This is also a significant reduction in unavailability hours against our NRC Performance Indicator for the residual heat removal safety function in Modes 1-4.

Relationship to Calvert Cliffs' Technical Specification Surveillance Requirements

The Calvert Cliffs' Technical Specification Surveillance Requirement (SR) for each pump (SR 3.5.2.3: HPSI and LPSI pumps) requires periodic testing of each pump to verify that the "developed head at the test flow point is greater than or equal to the required developed head." The specified frequency for the surveillance requirement is, "in accordance with the Inservice Test Program." Calvert Cliffs' Technical Specification Surveillance Requirements do not contain any additional (explicit or implied) testing requirements for these pumps beyond those required by the IST Program. This means that, as long as the testing complies with the requirements of the approved IST Program, there is no conflict with Calvert Cliffs' Technical Specification Surveillance Requirements. Therefore, none of the changes to the IST Program requested in this relief request would conflict with any Calvert Cliffs' Technical Specification Surveillance Requirements.

Bases for Proposed Modification of the 2004 OM Code

LPSI Pump Group Classification

Subsection ISTB Paragraph ISTB-2000 of the 2004 OM Code defines group A pumps as, "pumps that are operated continuously or routinely during normal operation, cold shutdown, or refueling operations," and group B pumps as, "pumps in standby systems that are not operated routinely except for testing." Based on these definitions and CCNPP's Operating Procedures, the LPSI pumps meet the definition of group A & group B pumps.

The LPSI pumps clearly meet the definition of group B pumps during normal operation in Modes 1-4. In Modes 5-6, the LPSI pumps are used for shutdown cooling and meet the definition of group A pumps. Subsection ISTB Paragraph ISTB-1400(b) states: "A pump that meets both Group A and Group B pump definitions shall be categorized as a group A pump." This means that the LPSI pumps would be classified as group A and would be subjected to essentially the same quarterly test requirements that currently apply under OM-1987, OMa-1988 Part 6.

NUREG/CP-0137 Vol. 1, Proceedings of the Third NRC/American Society of Mechanical Engineers (ASME) Symposium on Valve and Pump Testing, includes a paper entitled, "Description of Comprehensive Pump Test Change to ASME Code, Subsection ISTB." This paper describes the philosophy of classifying pumps in one group or the other (group A vs. group B). According to this paper, the intent of having different test requirements for the different pump groups, is to relate the amount and degree of quarterly performance monitoring required to the amount of degradation expected due to pump operation.

Requiring the LPSI pumps to be tested quarterly as group A pumps during normal operation in Modes 1-4 is contrary to the philosophy of the referenced paper. Quarterly testing subjects the LPSI pumps to increased test requirements, performance monitoring, and potentially more degradation due to low-flow operation at the time when they are standby pumps and would not otherwise be subject to operation-induced degradation. In fact, out of all of the ECCS and AFW pumps, the LPSI pumps are the ones, due to their design and test conditions, for which the detrimental effects of cumulative low-flow operation are the most drastic. Calvert Cliffs considers the requirement to test the LPSI pumps as group A pumps during normal operation in Modes 1-4 to be potentially

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detrimental on a long-term basis. Therefore, the LPSI pumps will be considered to be group B pumps during normal operation in Modes 1-4, and will be tested accordingly.

As previously stated, the LPSI pumps are typically run continuously during cold shutdown and refueling operations, depending on the decay heat rate. As a result, they may be subject to operation-induced degradation in Modes 5-6. Therefore, the LPSI pumps will be treated as group A pumps during any quarterly test that comes due during cold shutdown or refueling operations. However, typically during Modes 5-6, a Comprehensive Pump Test is preferable to a group A test for the LPSI pumps. This avoids the need to realign the LPSI pumps out of the normal shutdown cooling line-up and also avoids the detrimental effects of testing the LPSI pumps at low-flow conditions. Therefore, Calvert Cliffs expects that a Comprehensive Pump Test will typically be substituted for any group A test that may be required during Modes 5-6.

LPSI Pump Bearing Acceptance Criteria During Low-Flow Testing

Historically, the surveillance procedures used to perform these tests required vibration measurements to be recorded in terms of displacement (mils), not velocity. In recognition of the better indications provided by vibration measurements in terms of velocity, and as now permitted by ISTB, CCNPP has converted the vibration testing in the surveillance procedures to utilize velocity. However, CCNPP long ago recognized the benefit of velocity over displacement for analyzing pump vibrations and has included such measurements in the CCNPP Rotating Machinery Vibration Monitoring Program which conducts periodic vibration monitoring and analysis of numerous pumps and motors (including the LPSI pumps) beyond that required for the IST Program. The CCNPP Rotating Machinery Vibration Monitoring Program includes spectral analysis of the vibration measurements.

The long-term vibration trend (1995 through present) during quarterly testing of the LPSI pumps using the minimum recirculation flow path shows consistent results and stable performance with no unexplainable significant changes. The quarterly tests are performed at approximately 55-65 gpm which is between approximately 1.3%-1.6% of the LPSI pumps' "Best Efficiency Flow Rate." The Best Efficiency Flow Rate is based on the original Vendor Pump Curve. It is used instead of the system's design flow rate because the onset of pump internal recirculation and cavitation is a function of the pump's performance characteristics, not the system's design requirements.

Attachment 1, "Effect of Pump Operation at Low Flow Rates," discusses Calvert Cliffs' detailed academic research regarding the effects of low-flow operation on centrifugal pump vibration levels and includes extensive spectral analysis of all Calvert Cliffs' LPSI pump performance vibration data from an extended time period under low-flow and substantial-flow conditions. As discussed in Attachment 1 operating the LPSI pumps at these low flow rates results in a variety of effects (e.g., internal recirculation, cavitation, and force imbalance on the impeller) which contribute to increased vibration. Spectral analysis of the LPSI pump vibration measurements reveals (1) a general increase in the broadband noise levels which is indicative of internal recirculation and cavitation, and (2) discrete spikes at frequencies corresponding to the blade pass frequency which is indicative of force imbalances acting on the impeller. (References: "Centrifugal Pump Clinic," 2nd edition, by Igor Karassik, Published by Marcel Dekker Inc., 1989, and "Predictive Maintenance and Vibration Signature Analysis I," by J. E. Berry, Technical Associates of Charlotte, Inc., Table 6.0, "Illustrated Vibration Diagnostic Chart.") The analysis confirms the presence and effect of these phenomenon.

Many of the normal vibration levels experienced when operating the LPSI pumps under low-flow conditions during quarterly testing routinely exceed or challenge the absolute Alert Acceptance Criteria of 0.325 inches per second specified in Table ISTB-5121-1. This would necessitate either testing at six-week intervals, or a new evaluation each quarter.

The following factors lead to the conclusion that the current vibration levels recorded during LPSI minimum recirculation flow testing are acceptable and are not indicative of any pump mechanical problems or degradation, and, therefore, that the LPSI pumps are operating acceptably.

(1) The long-term stability of the vibration trend based on data from the surveillance tests and CCNPP Rotating Machinery Vibration Monitoring Program obtained during quarterly minimum recirculation flow testing.

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- (2) Spectral analysis confirmed the major contributor to the overall vibration levels recorded during quarterly minimum recirculation flow testing is consistent with phenomena which are well known to be associated with operation of a centrifugal pump at low flow rates and also well known to cause higher vibrations at these low flow rates.
- (3) The overall vibration levels recorded during large flow testing of the LPSI pumps are significantly reduced compared to the levels recorded during the quarterly minimum recirculation flow tests and are consistent with vibration levels experienced while testing centrifugal pumps at substantial flow rates in other systems and applications.
- (4) Spectral analysis confirmed that the major contributors to the overall vibration levels observed during quarterly minimum recirculation flow testing which are associated with operation of a centrifugal pump at low flow rates are significantly reduced during large flow testing of the LPSI pumps.
- (5) Similar vibration patterns have been observed for the other standby ECCS pumps, although the effects are not as pronounced as they are for the LPSI pump because the LPSI pumps are the pumps which are tested at the lowest flow condition relative to their Best Efficiency Flow Rate.
- (6) The LPSI pumps have no history of mechanical failures nor have they required significant maintenance on a regular basis.

The "Large Flow Rate" tests for the LPSI pumps have been in use at CCNPP since approximately 1991. At a minimum, each pump has been tested during each refueling outage since these tests were implemented. Vibration data (in both displacement and velocity) was collected during these tests via the surveillance tests themselves and the CCNPP Rotating Machinery Vibration Monitoring Program. The vibration data recorded during these large flow tests show the overall vibration levels drop significantly, as expected. Furthermore, spectral analysis of these results show the general broadband noise and spikes at discrete frequencies caused by the blade passing are significantly reduced.

The overall vibration levels observed during quarterly LPSI pump minimum recirculation flow testing, augmented by spectral analysis, are not sufficiently high as to prevent detection of increases in the LPSI pump vibration levels which would be indicative of mechanical degradation. Furthermore, the vibration monitoring during less frequent LPSI comprehensive pump (large flow) testing, also augmented by spectral analysis, provides even greater opportunities to detect increases in the LPSI pump vibration levels which would be indicative of mechanical degradation. CCNPP's experience has shown that spectral analysis of the vibration measurements obtained during quarterly minimum recirculation flow testing is sufficiently sensitive to changes in the pumps' mechanical condition and provides reasonable assurance that mechanical degradation can be detected early.

Performing pump testing at double the normal quarterly frequency when vibration levels exceed the acceptance criteria specified in Table ISTB-5121-1 is physically possible, i.e. it is practicable. However, based on the discussions contained in Attachment 1, such increased frequency testing will potentially reduce LPSI pump reliability and increase the probability of LPSI pump degradation, damage, or failure. Therefore, such testing is considered impractical because, though it is possible to perform such increased frequency testing, the potential reduction in LPSI pump reliability and potential increase in the probability of LPSI pump degradation, damage, or failure is a result which is contrary to the intent of the IST Program.

The running time of these pumps during the operating cycle is very limited since operation at low flow rates is detrimental to the pumps. Performing increased frequency testing on a regular basis during the operating cycle would increase the run time of these pumps by as much as approximately 30%. 10 CFR 50.55a(a)(3)(i) and (ii) address alternatives when the Code requirement would result in either a use of resources or a hardship/burden with no commensurate increase in the level of quality or safety. Not only would increased frequency testing of the LPSI pumps be both a waste of resources and a hardship/burden with no commensurate increase in the level of quality or safety, but such unnecessary testing will actually result in a very real potential to reduce the level of

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quality and safety and, therefore, should be considered impractical.

Therefore, a new set of relative and absolute vibration Alert Acceptance Criteria and a new set of relative Action Acceptance Criteria for the specific LPSI pump bearings typically affected by this phenomenon have been established. During any required group A test of the LPSI pumps (e.g., a quarterly test during an extended outage) conducted at low-flow conditions, the vibration analysis and acceptance criteria shall be revised, as appropriate, as described in the following paragraphs:

Table ISTB-5121-1 specifies that the value defining the upper limit of the acceptable range and the lower limit of the alert range shall be 2.5 times the reference value, not to exceed 0.325 ips. This means that up to a reference value of 0.13 ips, a 250% margin is allowed between the reference value and the "alert limit."

Clearly, relief is required for any vibration measurement with a reference value which is greater than the absolute alert limit of 0.325 ips specified by ISTB. However, there are also several vibration measurements which are close to the limit of 0.325 ips but do not exceed it. For these velocity measurements, relatively small increases in the overall vibration level which would normally be considered acceptable will cause them to exceed 0.325 ips, thus reducing the benefit and effectiveness of this relief request. Therefore, the alternative criteria are intended to allow a minimum of a 25% margin between each vibration reference value and the respective alert limit.

However, in no case shall the alert limit exceed 90% of the maximum vibration level allowed by the Code (i.e., the 'action limit'). This corresponds to a maximum allowable alert limit of 0.630 ips (90% X 0.700 ips). Based on the vibration instrumentation accuracy requirements in ISTB, this level is sufficient to ensure that a reading in the acceptable range cannot actually be greater than the action limit of 0.700 ips due to instrument accuracy/uncertainty.

CCNPP believes this approach provides greater flexibility than does seeking approval of specific values. This flexibility will permit CCNPP to revise the alert limits (within the guidelines contained in this relief request) should the need arise, such as following maintenance, after the necessary technical evaluation without using significant additional CCNPP or NRC resources.

Spectral analysis of quarterly minimum flow vibration results and less frequent comprehensive pump (large flow) vibration results in accordance with CCNPP's Rotating Machinery Vibration Monitoring Program will continue to provide adequate assurance that increases in vibration levels at discrete frequencies which are not sufficiently large to effect the overall vibration reading will be detected and analyzed.

Relief is requested pursuant to 10CFR50.55a(a)(3)(i) based on the proposed alternative providing an acceptable level of quality and safety.

ATTACHMENT 1 Effect of Pump Operation at Low Flow Rates

"Centrifugal Pump Clinic," 2nd edition, by Igor Karassik, Published by Marcel Dekker Inc., 1989, includes several pertinent discussions regarding the effect of pump operation at low flow rates. Throughout the book, the author discusses numerous topics

In Chapter 6, "Field Troubles," the author addresses several pertinent questions.

The answer to Question 6.31, "Vibration Caused by Operation at Low Flow," states, in part:

If a volute pump is operated at other than its design capacity, a certain imbalance of the hydraulic forces acting radially on the impeller takes place. The maximum imbalance occurs generally at zero capacity and is reduced as rated capacity is approached. This imbalance creates a radial load on the pump shaft.

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The answer to Question 6.32, "More About Operation at Reduced Flow," also states, in part:

All pumps exhibit a condition at low flows referred to as recirculation. Some pumps are worse than others, and the severity of the symptoms is dependent on the speed and diameter of the impeller. Recirculation is a turbulent reversal of a portion of the flow at the discharge of the impeller. The result is cavitation-like damage at the discharge tips of the vanes and a disturbance of the rotational flow patterns on each side of the impeller between the impeller shrouds and the casing walls. When the pump operates at or near its design capacity, the rotational flow patterns on each side of the impeller are symmetrical and impose no side thrust on the impeller. At low flows, however, the rotational flow patterns are no longer symmetrical, and a pressure differential exists between the two sides of the impeller. The result is an end thrust on the bearing.

Between the answers to Question 6.31 and 6.32, the author offers two possible solutions. The first is to switch to a dual volute pump to balance the hydraulic forces. The second is to install a bypass line to allow increasing the pump flow rate and reduce this force imbalance. Both of these solutions require significant modifications.

The intent of installing a bypass line is to increase the flow rate and reduce the magnitude of the hydraulic force imbalance. The flow path used when these pumps are tested at low flow rates is from the discharge of the pump through the individual pump minimum flow recirculation piping to the common minimum flow recirculation flow piping and back to the refueling water tank. The only adjustable valve in this flow path is the manual valve which can be used to isolate each individual pump's minimum recirculation flow piping from the common header. This valve is already maintained in the full open position at all times, including during pump testing. (This eliminates the potential to over-throttle pump recirculation flow which could result in overheating and damaging a pump.) Therefore, this is a fixed resistance flow path in which system resistance has already been minimized. As a result, there is no simple way to increase pump flow rate during these tests.

Based on the answers to Question 4.14, "Basis for Minimum Flow," Question 4.17, "Continuous Versus Intermittent Operation," and Question 4.34, "Testing for Shutoff Head," (Chapter 4, "Operation") there are several potential effects of operation at low flows:

1. For single volute pumps, the increased radial load at reduced flows may impose excessive loads on the thrust bearing and can lead to shaft or bearing failure.
2. As the pump capacity is reduced, the temperature rise of the pumped liquid increases resulting in a lower water density and increased dissolution of dissolved gases inside the pump (leading to cavitation), as well as increased thermal expansion of pump components. Cavitation generally causes long-term cumulative damage to the impeller.
3. At reduced flow, internal circulation will occur in the suction or discharge areas of the impeller, or in both. Internal circulation can create hydraulic pulsations and mechanical vibrations leading to possible mechanical failure of pump components, such as the impeller, the bearings, or the seals. Such failures may occur catastrophically or be the result of cumulative damage. Internal circulation also results in cavitation-type damage to the impeller.

ALTERNATE TESTING:

Perform inservice testing of the LPSI Pumps per the 2004 Edition of the OM Code Subsection ISTB, "Inservice Testing of Pumps in Light-Water Reactor Power Plants," with the following modifications:

1. LPSI Pump Group Classification

The LPSI pumps will be tested as stand-by pumps (group B) during Modes 1-4 and continuously operating pumps (group A) during Modes 5-6. In Modes 5-6, the Comprehensive Pump Test may be substituted for a quarterly group A test that comes due during a mid-cycle cold shutdown period.

2. LPSI Pump Bearing Acceptance Criteria During Low-Flow Testing

The following modified vibration acceptance criteria shall be used for any low-flow LPSI pump post-maintenance (group A) testing done during cold shutdown periods:

Reference Value (VR)	Acceptable Range	Alert Range	Action Range
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VR < 0.11 ips	V < 2.5VR	2.5VR < V < 6VR	6VR < V
0.11 ips < VR < 0.13 ips	V < 2.5VR	2.5VR < V < 6VR	0.700 ips < V
0.13 ips < VR < 0.26 ips	V < 0.325 ips	0.325 ips < V < 0.700 ips	0.700 ips < V
0.26 ips < VR < 0.50 ips	V < 1.25VR	1.25VR < V < 0.700 ips	0.700 ips < V
0.50 ips < VR	V < 0.630 ips	0.630 ips < V < 0.700 ips	0.700 ips < V

The following tables (Tables 1 and 2) are the specific bearings/orthogonal directions which we are requesting relief for. Table 1 lists those bearings/orthogonal directions that regularly exceed the 0.325 inches per second alert level. Table 2 lists those bearings/orthogonal directions that periodically exceed or regularly challenge the 0.325 inches per second alert level.

Table 1 - Bearings/Orthogonal Directions that Regularly Exceed 0.325

LPSI Pump	Bearing Orthogonal Direction	Abbreviation	Typical Vibration Value/Range (ips)
21	Pump Inboard Vertical	21 PIV	0.43 - 0.53
21	Pump Outboard Vertical	21 POV	0.29 - 0.34
22	Pump Inboard Vertical	22 PIV	0.29 - 0.37
22	Pump Outboard Vertical	22 POV	0.27 - 0.35

Table 2 - Bearings/Orthogonal Directions that Periodically Exceed or Regularly Challenge 0.325

LPSI Pump	Bearing Orthogonal Direction	Abbreviation	Typical Vibration Value/Range (ips)
21	Pump Inboard Horizontal	21 PIH	0.22 - 0.34
22	Pump Inboard Horizontal	22 PIH	0.18 - 0.25

This Relief Request, upon approval, will be applied to the CCNPP Fourth 10-Year Interval.

ACCEPTANCE CRITERIA:

REFERENCES:

1. Letter from Mr. S. Singh Bajwa (NRC) to Mr. C. H. Cruse (BGE), dated February 11, 1998, "Safety Evaluation of the Inservice Testing Program Third Ten-Year Interval For Pumps and Valves, Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 (TAC Nos. M98523 and M98524)"
2. Letter from Mr. C. H. Cruse (BGE) to NRC Document Control Desk, dated December 30, 1999, "Revised and New Relief Requests for the Third Ten year Inservice Test Program"
3. Letter from Mr. C. H. Cruse (BGE) to NRC Document Control Desk, dated May 19, 2000, "Response to Request for Additional Information: Relief Request PR-11 Low Pressure Safety Injection Pumps"
4. Letter from Ms. M. Gamberoni (NRC) to Mr. C. H. Cruse (CCNPP, Inc), dated August 22, 2000, "Safety Evaluation of Relief Requests for the Third 10-Year Pump and Valve In-Service Testing Program Calvert Cliffs Nuclear Power Plant Units 1 and 2 (TAC Nos. MA7848 and MA7849)"
5. Letter from Mr. R. J. Laufer (NRC) to Mr. C. H. Cruse (CCNPP, Inc), dated May 16, 2002, "Request for Relief"

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No. PR-12 Associated with the Third 10-Year Interval Inservice Testing Program, Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 (TAC Nos. MB3782 and MB3783)"

APPROVAL REFERENCES: