# PART A

SURVEILLANCE REQUIREMENTS

FOR THE

FORT ST. VRAIN

PCRV OVERPRESSURE PROTECTION SYSTEM

## 1. INTRODUCTION

A review was performed to investigate the adequacy of the current surveillance requirements for the PCRV safety valve system. Additional or modified surveillance requirements may be recommended, as a result of this review, to satisfy the criteria established for the Fort St Vrain inservice inspection and testing program as outlined in Ref. 1.

The review included the documents listed in Section 5, and in particular the proposed ASME Code Section XI, Division 2, Draft. The proposed Code requirements are identified, and where the current or recommended surveillance differs with these requirements, an explanation is provided. The review also included the operating experience with the PCRV overpressure protection system at the plant.

## 2. SURVEILLANCE CLASSIFICATION

The Fort St. Vrain FSAR (Section 6.8) considers the PCRV safety valve system as an engineered safeguard, the prime safety function of which is to provide PCRV overpressure protection and, thus, assure the PCRV integrity. The system also has a secondary safety function, namely, primary and secondary containment of reactor coolant. Other auxiliary functions of the system are to recirculate to the PCRV the excess purified helium purge gas and to supply helium from storage to pressurize the PCRV.

In accordance with the criteria established for the inservice inspection and testing program (Ref. 1), consideration has been given to the relative importance of the system functions with respect to safety and to the respective importance of parts of the system to perform these functions in order to assign them to the following surveillance classes:

- Surveillance class S2: that part of the system which performs an active function in the pressure relief process, i.e. rupture disc membrane, safety valve;

- Surveillance class S3: that part of the system which performs a passive function to contain or potentially contain reactor coolant.

The following criteria per Ref. 1 are considered when reviewing the surveillance program. For surveillance class S2, operational readiness of the system shall demonstrate the availability and operability of the system. Operational readiness of surveillance class S2 and S3 valves shall be demonstrated by normal operation or by surveillance testing to exercise these valves which do not normally operate, unless exemption is granted by Ref. 1 or by the Code. Safety/relief valves shall be tested at least once every five years.

2. (cont.)

Operational readiness of surveillance class S2 and S3 instrumentation and control circuits shall be demonstrated by surveillance testing; generally, instrument accuracy shall be demonstrated once each year by a calibration test; applicable indication, alarm, control, and protective circuit performance shall be demonstrated by a functional test at least once each quarter or each year for each surveillance class respectively. Structural integrity shall be verified by pressure boundary leakage monitoring or testing; in case of the PCRV penetrations, leakage shall be monitored continuously and measured once each month. Exemptions from testing are allowed as outlined in Ref. 1.

## 3. OPERATIONAL READINESS

### 3.1 OPERATIONAL READINESS OF THE SYSTEM

The overpressure protection capability of the system is provided by sizing the piping and components to relieve the excess steam and gases injected or generated by a design basis moisture ingress accident (characterized by the offset rupture of a steam generator subheader in the main bundle) without allowing the pressure to exceed PCRV Reference Pressure. This is a passive capability which can be assured by testing the operational readiness of individual active components, in accordance with criteria 3.1b and 3.1f of Ref. 1.

Technical specification SR 5.2.1, which governs the testing of the PCRV overpressure protection system, requires that each overpressure protection train be tested at alternate year intervals. However, the operating experience at the plant, reflected by the results of the surveillance tests which have already been performed, indicates that the current testing requirement can be modified to allow testing each PCRV overpressure protection train every other refueling shutdown, provided that the interval between two consecutive tests for each train does not exceed five years. It is therefore recommended that Technical Specification SR 5.2.1 be modified to that effect, in order to minimize the frequency of system disassembly required for test purpose only, which could otherwise be detrimental to its integrity.

### 3.2 OPERATIONAL READINESS OF ACTIVE COMPONENTS

#### 3.2.1 RUPTURE DISCS (M11701, M11702)

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(a) Current surveillance requirements:

Operational readiness is demonstrated by checking the capability of the pressure retaining membrane to burst at the set pressure. Technical Specification SR 5.2.1 requires each of the two rupture discs to be bench tested at alternate year intervals with the reactor shutdown. This test demonstrates that the belleville washer deflects at

3.2.1 (cont.)

the correct pressure setting which allows the cutting knife to shear the membrane.

(b) Recommended surveillance requirements:
The existing surveillance requirements are consistent with the references reviewed and will demonstrate the operability of the active feature in the rupture disc. However, for the reasons outlined in paragraph 3.1 above, it is recommended that the test frequency be modified from every other year to every other refueling shutdown, with the interval between two consecutive tests of each rupture disc not to exceed five years.

(c) Proposed ASME Code requirements:
IGV-3620 requires that rupture discs with testable design features be tested in accordance with manufacturer's instructions at a frequency to be specified by the owner.

(d) The recommended surveillance meets the proposed Code requirements, as specified in criteria 3.2.2b of Ref. 1.

3.2.2 <u>SAFETY VALVES</u> (V11702, V11710)

(a) Current surveillance requirements:
Technical specification SR 4.2.1 requires that each of the two safety valves be tested at alternate year intervals with the reactor shutdown.

(b) Recommended surveillance requirements:
The review of the surveillance procedures indicates that the current surveillance requirements are adequate and will demonstrate the operability of the active feature in the safety valves.
However, for the reasons outlined in paragraph 3.1 above, it is recommended that the test frequency be modified from every other year to every other refueling shutdown, with the interval between two consecutive tests of each pressure relief valve not to exceed five years.

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(c) Proposed ASME Code requirements:
Paragraph IGV 3510 specifies that safety valve set points be tested at least once every five years and that the set point be tested in accordance with reference ANSI/ASME PTC 25.3-1979. This document is the ASME Performance test Code for Safety and Relief Valves and it provides standards primarily to determine relieving capacity and other operating characteristics required for Code certification. Section 4.09 however, does provide methods for operational readiness tests. Valves may be tested in place, on a special simulated test arrangement or by a bench test to determine operational readiness. Section 4.09 ) provides an acceptable method for testing in

3.2.2 (cont.)

place using system pressure. The procedure for this method is rather simple and involves raising the system pressure until the set pressure of the valve has been obtained. The only procedural requirement is that from 90% to 100% of set point the rate of pressure increase be limited to 2 psi/sec or whatever lower rate is necessary to obtain an accurate pressure gage reading. The only other applicable requirements would be the instructions on the use of pressure gages given in ASME PTC 19.2.

(d) The recommended surveillance meets the proposed ASME rules for test frequency. The existing surveillance procedure for testing the relief valve set point involves replacing the rupture disc with a spool piece containing a test port connected to a nitrogem supply and a calibrated pressure gage. The pressure is gradually increased until the relief valve opens as noted by the highest reading observed on the gage. This test essentially meets the requirements of the proposed ASME rules for test method.
Therefore, the recommended surveillance meets criteria 3.2.2b of Ref. 1, which specify that the surveillance be based on the proposed Code requirements.

3.2.3 <u>MANUAL ISOLATION VALVES</u> (V11751, V11752)

(a) Current surveillance requirements:
There are no explicit requirements for testing the valves. However, technical specification SR 5.2.1 requires that the position indication circuits of these valves be functionally tested and calibrated annually. This test implies full stroke exercising of each valve.

(b) Recommended surveillance requirements:
The manual isolation valves have a passive function with respect to overpressure protection, since they are required to be locked open to assure that the pressure relief capability of the system is not impaired. Only testing and maintenance require a shutoff valve to be closed, and only one valve is allowed to be closed at any one time.
It is therefore recommended that each isolation valve be full stroke exercised when performing the surveillance test of either of the PCRV overpressure protection trains, and that at the same time, their associated position indication circuits be functionally tested and calibrated. Since the valve testing interval does not exceed five years, the recommended surveillance meets criteria 3.2.2c of Ref. 1 for valve test frequency, and criteria 3.2.3d for instrumentation and control functional test and calibration.

3.2.3 (cont.)

The purge flow is maintained while a valve is closed, so that any expected leakage would be purified helium. Closing a shutoff valve to terminate depressurization, in case a safety valve fails to reseat, is discussed in Ref. 2, where it is concluded that the shutoff valves need not be considered as reactor coolant isolation valves. Therefore, no seat leak testing is recommended for these valves.

(c) Proposed ASME code requirements:

Paragraph IGV-1200(a) exempts from surveillance those valves used only for operating convenience, such as manual test valves and valves used only for maintenance. However, the shutoff valves also fall under Category E (IGV-2100), since they have to be positively locked open to assure that the pressure relief capability of the system is available. Also, one must be capable of reopening a shutoff valve to restore the system to its operating configuration. Therefore, it could be considered that the shutoff valves fall under code category B, since, as outlined in (b) above, seat leakage is inconsequential for the fulfillment of their function.

Paragraphs IGV-3410 and IGV-3412(a) require that category B valves be exercised at least every 3 months, unless such operation is not practical during plant operation, in which case part-stroke exercising is to be performed during plant operation and full-stroke exercising during each cold shutdown.

(d) Plant technical specifications and ASME code requirements for PCRV overpressure protection do not allow full stroke exercising of the shutoff valves during plant operation. It is also considered that part-stroke exercising could become an added safety hazard, due to the manipulation of valves required to be locked open. Therefore, a difference with the code part-stroking requirement during operation is considered as being justified. The recommended surveillance otherwise meets the proposed Code rules for valve testing, as specified by criteria 3.2.2c of Ref. 1

3.2.4 REMOTE MANUAL ISOLATION VALVES

(a) Current surveillance requirements: None

3.2.4 (cont.)

(b) Recommended surveillance requirements:

Two such valves are part of the reactor coolant boundary (HV1147 and HV11208), fail safe in the closed position and normally closed during reactor operation. Another one (HV1196), on the purified purge helium supply line, fail safe in the open position and normally open during reactor operation, acts as second isolation device in series with a check valve (V11703). This valve has a position indication circuit (ZI1196). Valve HV1149 is part of the containment, fail safe in the closed position and normally closed during reactor operation. Valves HV1147, HV11208 and HV1149 are exempt from testing in accordance with criteria 3.2.2d of Ref. 1. Valve HV1196 is exercised when performing the rupture disc and safety valve test (SR5.2.1a-A). This meets the criteria 3.2.2c of Ref. 1, which require testing at least every five years.

(c) Proposed ASME code requirements:

The valves fall under code category B (IGV-2100) since seat leakage is inconsequential. IGV-3411 requires such valves to be exercised at least every 3 months.

(d) The recommended surveillance differs from the proposed ASME code exercising frequency, since the valves are normally in the position required to perform their safety function or used as backup for another isolation device.

## 3.3 OPERATIONAL READINESS OF INSTRUMENTATION AND CONTROLS

### 3.3.1 MANUAL ISOLATION VALVES POSITION INDICATION (ZI1197-1, ZI1197-2)

(a) Current surveillance requirements:

This instrumentation indicates the position of the normally locked open valves (V11751, V11752), and provides assurance that the pressure relief capability of the system is restored after a valve had to be closed for testing or maintenance in a branch of the system. Technical specification SR 5.2.1 requires that the position indication circuit be functionally tested and calibrated annually.

3.3.1 (cont.)

(b) Recommended surveillance requirements:
It would seem sufficient to test and calibrate the circuit when the corresponding valve is unlocked and closed. However, test of one branch of the system requires removing the handwheel of the isolation valve on the other branch to open the containment tank. Assurance that the valve remained open is provided by testing and calibrating its position indication circuit. The recommended surveillance is specified in paragraph 3.2.3 above.

(c) Proposed ASME code requirements:
IGV-3300 requires observation at scheduled refueling outages to assure that position indications accurately reflect valve operation.

(d) The surveillance meets the proposed ASME code requirements.

3.3.2 RUPTURE DISC/SAFETY VALVE INTERSPACE PRESSURE ALARM CIRCUIT (PS/PAH1148, PS/PAH11209)

(a) Current surveillance requirements:
Technical specification SR 5.2.1 requires that these circuits be tested once each month and calibrated once each year.

(b) Recommended surveillance requirements:
This instrumentation continuously monitors the interspace and provides an alarm which indicates that there is a risk of pressure buildup in the interspace which may degrade the set burst pressure of the rupture disc. The test demonstrates that the switch setting is correct and that the alarm circuit functions properly. The existing surveillance requirement is considered adequate and meets criteria 3.2.3b of Ref. 1.

(c) Proposed ASME code requirements: Not applicable.

3.3.3 SAFETY VALVE, MONITORING OF BELLOWS INTEGRITY (PS/PAH11255, PS/PAH11256)

(a) Current surveillance requirements: None.

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(b) Recommended surveillance requirements:
Pressure switches and alarms detect leakage past the safety valve bellows, and therefore monitor its integrity which is required for proper safety valve operation. The safety valve is normally not under pressure, so that monitoring of bellows integrity can only be performed during valve setpoint testing.
It is recommended that the circuit be tested and calibrated just prior to the set point test of the corresponding safety valve, in accordance with criteria 3.2.3d of Ref. 1.

(c) Proposed ASME code requirements: Not applicable.

3.3.4 CONTAINMENT TANK PRESSURE MONITORING PS/PAH1150)

(a) Current surveillance requirements: None.

(b) Recommended surveillance requirements:
This pressure switch and alarm continuously monitors the integrity of the reactor coolant boundary within the containment tank. Due to its safety related function, it is recommended that the circuit be tested and calibrated annually, in accordance with criteria 3.2.3c of Ref. 1.

(c) Proposed ASME code requirements: Not applicable.

## 4. STRUCTURAL INTEGRITY

### 4.1 RECOMMENDED SURVEILLANCE REQUIREMENTS

#### 4.1.1 PCRV PENETRATION PIPING

Interspace leakage is monitored continuously and alarmed if above pre-set limits. The PCRV safety valve piping from the PCRV liner to the safety valve containment tank is contained within an outer pipe to provide secondary containment for this section of system piping. A bellows at each end of this piping completes the interspace, which is maintained at a pressure slightly greater than primary coolant pressure. Piping stresses are minimized by the bellows, by the cold purified helium purge, and by the low differential pressure across the pipe wall. The existing leakage monitoring is considered adequate to verify the integrity of the PCRV safety valve penetration piping, in accordance with criteria 3.3.1a of Ref. 1.

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#### 4.1.2 SYSTEM PIPING

The containment tank pressure alarm circuit continuously monitors for leakage the portion of system piping, which is normally pressurized. Any leakage which might occur would be contained and alarmed. Any pressure buildup in the containment tank can be vented to the reactor building exhaust filters if desired. Thermal stresses are minimized by the piping bellows and by the cold purified helium purge. Therefore, the leakage monitoring is considered adequate to verify the integrity of the normally pressurized system piping. The normally unpressurized system piping (between the rupture disc and safety valve) is pressurized during the safety valve set point test, which is not expected to degrade its integrity. According to criteria 3.3.1c(i) of Ref. 1 that portion of the system is exempt from leakage examination.

### 4.1.3 PCRV SAFETY VALVE TANK

The PCRV safety valve tank is not normally pressurized and is not subject to any significant thermal loading. After completing SR 5.2.1 set point testing, the tank is pressurized to 10 psig to check the closure flange leak tightness. Any other significant leakage would likely be noted at this time. However, to provide additional assurance of integrity, it is recommended that, once during each refueling cycle when the tank is open, the closure bolts be visually examined for mechanical damage or other visible surface defects.

The recommended surveillance meets criteria 3.3.1c(i) and 3.3.2d of Ref. 1.

## 4.2 PROPOSED ASME CODE REQUIREMENTS

### 4.2.1 PCRV PENETRATION AND OTHER COMPONENTS NOT ISOLABLE FROM THE PCRV

This definition applies to the PCRV safety valve system primary piping extending from the PCRV to the isolation valves. This system portion should satisfy the requirements applicable to code class 1 components. Its function is not utilized for shutdown heat removal operations, nuclear reactivity control, or chemical ingress detection or control, and a failure would not result in a primary coolant system depressurization which exceeds the rate established for the design basis depressurization accident. Therefore, IGB-1220 and IGB-1221 exempt that part of the system from examination. However, IGB-1220 requires that visual examination be performed during the leakage and pressure test required by IGB-5000. IGB-5400, which applies to PCRV penetrations is satisfied by performance of IGA-5440 which requires that a test for detection of reactor coolant leakage be conducted after each fueling outage while the reactor is operating at power.

Leakage in that part of the system is continuously monitored by the double pipe interspace pressurization flow alarm and the containment tank pressure alarm while the reactor is operating at power. Technical specification SR 5.2.16 further requires that primary and secondary closure leakage be determined at regular intervals, with the reactor operating at power.

Accordingly, the current surveillance exceeds the proposed code requirements.

4.2.2 COMPONENTS ISOLABLE FROM THE PCRV

(a) This includes the relief piping downstream of the isolation valves up to the safety valves. That part of the system is exempted from examination for the same reasons as in 4.2.1 above. With respect to pressure test, IGB-5300 and IGC-5300 apply to code class 1 and 2 pneumatic systems and components respectively and require a pressure test and examination for leakage at or near the end of each inspection interval. The test pressure is 1.2 times the system design pressure.

(b) The current technical specifications have no surveillance requirement.

(c) The proposed surveillance program requires a pressure test but differs from the proposed code requirements for the reasons outlined hereafter.

(c.1) The system sections between the isolation valves and the rupture discs, even though isolable, are normally pressurized and monitored for leakage as performed for the PCRV penetrations. Therefore, a difference with the proposed code requirements is considered justified.

(c.2) The normally non pressurized sections between rupture discs and safety valves is pressurized up to the safety valve set pressure, but not to specified code test pressure. Leak testing that portion of the system, when performing the safety valve set point test, is not required since leakage within the containment tank is continuously monitored and since this portion of the system is not submitted to any significant loading during plant operation. Therefore, differences between the recommended surveillance and the proposed Code requirements are justified.

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4.2.3 CONTAINMENT TANK AND PIPE

(a) The proposed Code requirements applicable to code class 2 components exempt the containment tank and pipe from examination (IGC-1220 and IGC-1221). Nevertheless, pressure testing and examination for leakage are required per IGA-5000 and IGC-5000 at 1.2 times the design pressure.

(b) The double pipe is continuously monitored for leakage. Therefore, it is considered that a difference with the proposed code requirements is justified.

(c) The containment tank is not normally pressurized, even though it is designed for reactor coolant pressure. No effects have been identified which could degrade the tank integrity, initially assured by fabrication testing. The

4.2.3 (cont.)

integrity of the tank closure is verified by leak testing the seal and by performing visual inspection of the closure bolts, since it is a major component of the secondary containment, and the bolts are unfastened frequently and could be damaged during such an operation. This exceeds the proposed Code requirements since the tank is exempt from examination. Examination for leakage of accessible weld portions when performing seal leakage test at 10 psi is not expected to provide detectable indications with respect to the loss of integrity of such a thick wall tank. Therefore, it is considered that a difference with the proposed Code requirements for pressure testing is justified.

## 5. LIST OF REFERENCES

References:

1. PSC report EE-SR-0001; Surveillance inspection and test criteria for the Fort St. Vrain nuclear generating station.
2. Evaluation of PCRV safety valve isolation, included as an attachment to this report.
3. FSAR Section 6.8
4. System Description 11-6
5. System Diagrams PI-11-5, PI-11-3, PI-11-1, PI-24, PI-73-1, PI-72-3
6. Schematic Diagram E-1203, P-649, to P-655
7. Technical Specification SR 5.2.1, 5.2.16, 5.4.9
8. Surveillance Procedures 5.2.1a-A, 5.2.1C1-M/A, 5.2.1C2-A, 5.2.16a-M, 5.4.9-W, 5.4.9-A
9. ASME Code Section XI, Division 2, Draft
10. ANSI/ASME PTC - 25.3-1975
11. AMETEK Procedure PS-239
12. Target Rock Technical Manual - Model 69D Safety Valves
13. Equipment Specification No. 91-M-13
14. Equipment Specification No. 91-M-1