Enclosure (1)
to P-82430

PUBLIC SERVICE COMPANY OF COLORADO

FORT ST. VRAIN NUCLEAR GENERATING STATION

ADDITIONAL SURVEILLANCE REQUIREMENTS

FOR THE PCRV PENETRATIONS AND CLOSURES

Supplement to Report EE-11-0002 Rev. 2
(Enclosure 2 to PSC Letter P-80034)

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ADDITIONAL SURVEILLANCE REQUIREMENTS FOR FORT ST. VRAIN PCRV PENETRATIONS AND CLOSURES

1. INTRODUCTION

The initial review of surveillance requirements for the PCRV penetrations and closures performed by PSC was forwarded to the NRC in letter P-80034. The conclusion was that continuous leakage monitoring and periodic leak testing of the penetration interspace were adequate means of verifying the structural integrity of penetration pressure retaining boundaries. PSC also concluded, in comparing the proposed ASME Code Section XI Div. 2 with recommended surveillance requirements, that individual pressure retaining components were exempt from non-destructive examination requirements specified in the proposed ASME Code Section XI Div. 2 due to the unique design of the PCRV penetrations with double closures.

In their independent review Report Q-13:82:5, LANL/ASTA considered that the unique double closure design concept for the Fort St. Vrain penetrations was not properly addressed by the proposed Code which is based on a single closure design. Instead, LANL/ASTA recommended that other additional non-destructive examinations be performed for certain penetration components. PSC's response and comments concerning these recommendations were provided in PSC letter P-82061. At a meeting between NRC, LANL, ASTA and PSC held at Fort St. Vrain on July 29, 1982, PSC's comments were accepted and it was agreed that PSC would review the design and accessibility of the PCRV penetrations to identify those components which would be subject to these recommended examinations.

2. PCRV PENETRATION DESIGN FEATURES

Fort St. Vrain PCRV penetrations include a primary boundary and closure and a secondary boundary and closure. In those penetrations where a postulated failure of the primary closure could result in excessive impact loading of the secondary closure, limit stops are provided to preclude failure of the secondary closure.

Despite these unique design features, double failure of the primary and secondary closures in a penetration is a postulated design basis accident for Fort St. Vrain, resulting in a rapid depressurization of the PCRV. To preserve the integrity of the reactor internals, there is a maximum rate of depressurization which cannot be exceeded; this maximum depressurization rate corresponds to a maximum free flow area of 90 square inches. The size of some penetrations is such that this design basis free flow area would be exceeded if special flow restriction features were not incorporated into the penetration design.

In order to prevent the plant design basis from being exceeded, it is essential that the flow restriction features remain effective in case a double failure is postulated in one of these penetrations. The penetrations with flow restriction features are:

°steam generator penetrations
°helium circulator penetrations
°top and bottom access penetrations
°refueling penetrations
°high temperature filter adsorber penetrations

Some of these large size penetrations house equipment which has to remain operational for safe shutdown cooling, even when a double rupture of the closures in that penetration is postulated. Since a depressurization rate in excess of plant design basis could jeopardize the ability to safely shut down and cool the reactor, it is considered that all large penetrations are equally important to plant safety, whether or not they house equipment required for safe shutdown cooling.

Penetrations are fitted with special restraint devices to prevent ejection of essential flow restriction or safe shutdown cooling components as appropriate, if ejection could conceivably result from postulated rupture of the penetration closures. These restraints, which provide ultimate support during a design basis depressurization accident, must remain structurally sound.

These unique design features demonstrate that size is the deciding factor in determining the importance of the penetration to plant safety. Therefore this criteria was used to determine which penetrations should be selected for further review to identify the specific components or areas where examination, as recommended by LANL, is feasible. On this basis, the following penetrations were selected for review:

°steam generator penetrations
°helium circulator penetrations
°top and bottom access penetrations
°refueling penetrations
°high temperature filter adsorber penetrations
°PCRV safety valve penetration

The PCRV safety valve penetration, although it does not require flow restriction features, was selected because the secondary boundary design outboard of the PCRV concrete is unique and because its free flow area is a large fraction of the maximum allowable. The other PCRV penetrations are for instrumentation and have a free flow area which is a small fraction of the maximum allowable. Furthermore, because of their small size and design features, the secondary boundary is generally inaccessible for examination. Therefore, the instrument penetrations are not included and no examinations are recommended.

3. SECONDARY PRESSURE RETAINING BOUNDARIES

3.1 WELDS

The LANL Report recommended surface or visual examination of welds in three areas of the PCRV penetration shells and closures that form the secondary boundary. Each of these three areas are reviewed below.

AREA A - PRESSURE RETAINING CIRCUMFERENTIAL WELDS

The first area involves pressure retaining circumferential welds located at structural discontinuities in penetration shells and closures outboard of the PCRV concrete. The LANL Report recommended surface or visual examination for accessible portions of these welds depending on the importance of the penetration, either from outside the penetration or from the interspace region where removal of the penetration closure is a regularly scheduled event.

All of the large penetration designs were reviewed. For the helium circulator, top access, refueling, and high temperature filter adsorber penetrations there are no pressure retaining circumferential welds located at structural discontinuities and therefore no examinations are recommended for these penetrations.

For steam generator penetrations, three circumferential welds located at structural discontinuities were identified. They are the shell to closure weld, the closure to upper bellows support weld and the lower bellows support to reheat pipe sleeve weld. It is recommended that a surface examination be performed on accessible portions of these three welds in one steam generator penetration in each loop at five calendar year intervals. This schedule will provide for examination of all the steam generator penetrations during the life of the plant.

The bottom access penetration also contains two welds of this type. They are the shell to dished head weld and the dished head to closure flange weld. PSC recommends that a surface examination of accessible portions of these two welds be performed at ten calendar year intervals.

<u>AREA B</u> - <u>CIRCUMFERENTIAL WELDS BACKED BY CONCRETE OUTBOARD OF SHEAR ANCHORS</u>

The second area concerns circumferential welds in PCRV penetration shells that are located at structural discontinuities, backed by concrete but outboard of any shear anchor. The LANL report recommended that such welds be subject to surface examination from the interspace region where removal of the penetration closure is a regularly scheduled event.

PSC has reviewed the penetration designs for the large penetrations to determine if any such welds exist and their accessibility. None of these penetrations (steam generator, helium circulator, top access, bottom access, refueling, and high temperature filter adsorber) were found to have circumferential welds at structural discontinuities in this region. In fact, there are no circumferential welds at all in this region. Therefore, the LANL recommendation is not applicable to Fort St. Vrain penetration designs.

<u>AREA C</u> - <u>INTEGRAL SUPPORT ATTACHMENT WELDS</u>

The third area involves integral support attachment welds not backed by concrete. The LANL Report recommended that surface examination be performed for this type of weld.

All of the large penetration designs were reviewed and none of them were found to have any integral support attachment welds. Therefore, the LANL recommendation is not applicable to Fort St. Vrain penetration designs.

PSC's review also addressed the support attachment weld for the PCRV safety valve containment tank support skirt. This support skirt weld is of special importance since a postulated gross failure of this connection could result in loss of both the primary and secondary boundary and subsequent depressurization of the PCRV. This is not the case in any of the other penetrations, and unlike the pressure retaining welds whose structural integrity is continuously verified by penetration interspace leakage monitoring, there is no current surveillance for the support skirt weld. Therefore, it is recommended that a surface examination of this weld be performed at ten calendar year intervals to verify its integrity.

3.2 <u>BOLTING</u>

The LANL Report recommended that visual examination, torque testing and tension testing be performed on bolting for the secondary boundaries of the PCRV penetrations and closures. In their response to PSC comments, LANL agreed that their original recommendation for additional examination of secondary boundary bolting applies only to bolting larger than 2 inches nominal size, in accordance with applicable requirements of the proposed ASME Code.

All penetration secondary boundary pressure retaining bolting has been reviewed and found to be less than 2 inches in diameter. Therefore, no additional examination of this pressure retaining bolting is recommended.

The review also addressed the support bolting associated with the penetration secondary boundary which fastens the PCRV safety valve containment tank support skirt to the PCRV outer wall. This 2 inch diameter support skirt bolting is also of special importance since a postulated gross failure of this connection could result in loss of both the primary and secondary boundary and subsequent PCRV depressurization. This situation does not occur in any of the other penetrations and, unlike the pressure retaining bolting whose structural integrity is continuously verified by penetration interspace leakage monitoring, there is no current surveillance for the support skirt bolting. Therefore, it is recommended that visual examination and torque and tension testing of the PCRV safety valve tank support skirt bolting be performed at ten calendar year intervals, even though the size criteria is not exceeded.

4. FLOW RESTRICTORS AND LIMIT STOPS

The LANL Report recommended that visual examination be performed on accessible limit stops and structures identified as flow restrictors. The design and accessibility of flow restrictors and limit stops in the PCRV penetrations is discussed in the following paragraphs.

4.1 FLOW RESTRICTORS AND RESTRAINTS

Large PCRV penetration designs provide for flow restriction to prevent the maximum allowable rate of PCRV depressurization from being exceeded in case of a postulated design basis failure of both a penetration's primary and secondary pressure retaining boundaries. When required, restraints are provided to retain in place those components required for flow restriction, so that they remain effective. The restraints also prevent ejection of equipment required to operate to mitigate the consequences of the accident.

4.1.1 STEAM GENERATOR PENETRATION

The steam generator penetration design includes a flow restrictor in the form of a ring, welded to the outer surface of the lower reheat steam header, which limits the flow area between that header and the secondary closure bellows support. No separate restraint is required, since the postulated failure mode of the primary closure precludes the ejection of the reheat steam header, and since the postulated failure of the secondary closure bellows does not affect the secondary closure flange and bellows support which remain in place. Furthermore, unlike other large penetrations which have bolted closures , the steam generator penetration secondary closures are welded and no scheduled disassembly is anticipated. Consequently, examination of components located within the steam generator penetrations is not practical and none is recommended. Additional assurance that a rapid PCRV depressurization would not occur through a steam generator penetration is provided by the recommendation included in section 3.1 above concerning examination of accessible secondary closure welds.

4.1.2 HELIUM CIRCULATOR PENETRATIONS

For a postulated depressurization accident in a helium circulator penetration, a flow restriction device is provided to limit the flow area between the circulator steam ducting and the penetration liner. The flow restrictor is a segmented ring surrounding the circulator outer steam duct. Each of the 8 segments is supported by 2 sleeves that extend from the upper end of the steam duct at the primary closure.

The restrictor ring and its support sleeves are accessible for examination when a circulator is removed for inspection (at 10 year intervals per SR 5.2.18). PSC has previously proposed that SR 5.2.18 be modified to require visual examination of circulator components that are accessible with the machine out of the PCRV. Therefore, no additional changes to the SR are considered necessary. PSC will ensure that the implementing procedures for SR 5.2.18 (as modified) include visual examination of these specific circulator component parts as recommended in the LANL Report.

The helium circulator restraint system is designed to maintain the circulator machine (including its flow restrictor ring) in place in the event of a postulated double failure of the primary and secondary closures. The restraint system, which is external to the PCRV, consists of a cylinder, located about 1 1/4 inches below the secondary closure, which rests on a ring. The ring in turn is supported from the PCRV bottom by five bolt and stud anchor assemblies each 2.75 inches in diameter. These parts are accessible from the snubber deck below the PCRV and do not require dissassembly of the penetration closure or piping. Except for its own weight, the restraint system is not normally under load. Because the function of the restraint system is to provide ultimate support for the circulator under accident conditions, periodic examination will provide added assurance of its ability to perform its required function. PSC agrees to include in a new SR a requirement that the circulator restraint system be visually examined for one circulator penetration in each loop at five calendar year intervals.

4.1.3 ACCESS PENETRATIONS

There is no separate flow restriction device in the access penetrations. Flow restriction in the event of a depressurization accident in these penetrations is provided by maintaining the annular gap between the cylindrical shield plug and the penetration liner. The shield plugs are held in place by support keys around their perimeter which are designed for the maximum gas pressure differential developed across the plug. Removal of both the primary and secondary closures is required to gain access to the support key assemblies. There are no occasions where disassembly of these penetrations is scheduled for other reasons.

The design of the bottom penetration is such that removal of the primary closure and shield plug would require cutting the welded spherical head forming part of the secondary closure. Therefore, access to the shield plug and support keys for this penetration is not practical. Since it is not practical to examine the flow restrictor, other examinations are recommended to provide additional assurance that a rapid depressurization of the PCRV would not occur through this penetration, i.e. that both the primary and secondary closures remain structurally sound. Examination of the secondary closure welds, recommended in section 3.1 above, provides part of this added assurance. However, the secondary closure bolting was exempted from examination in section 3.2 because of its size. To complement the weld examination, it is recommended that the bottom access penetration primary closure split ring assembly and secondary closure bolting be visually examined at ten calendar year intervals thus providing the added assurance of penetration structural integrity.

Examination of the top access penetration shield plug support keys would involve removal of the secondary closure, removal of irradiated graphite shield pellets, and removal of the primary closure. Due to the potential for high radiation and/or contamination levels, the difficulty of controlling air ingress, the difficulty of resealing the primary closure, and since disassembly of the top access penetration is not contemplated for any other reason, examination of the shield plug support keys is not considered practical and none is recommended. Furthermore, the holddown plates on the top of the PCRV would prevent ejection of both the primary and secondary closures, should a double failure be postulated in this penetration. This would provide the required flow restriction, even if the shield plug was not effectively retained by its support keys.

Examination of the holddown plates bolting, recommended in section 4.1.4 below, provides the necessary assurance that the maximum allowable depressurization flow area would not be exceeded in the top access penetration.

4.1.4 <u>REFUELING AND HIGH TEMPERATURE FILTER ADSORBER (HTFA) PENETRATIONS</u>

For these penetrations there also is no separate flow restriction device provided. Flow restriction for a postulated depressurization accident in one of these penetrations is provided by maintaining the annular clearance between the control rod drive (CRD) or HTFA housing and the penetration liner. This is accomplished by restraining the CRD or HTFA in place with hold-down plates bolted to the secondary closures of adjacent penetrations. Visual examination of the holddown plate bolting at each refueling was previously recommended by PSC letter P-80034 during the initial review, and is in agreement with the recommendation of the LANL report.

4.1.5 <u>OTHER PENETRATIONS</u>

None of the other PCRV penetrations contain flow restriction devices or restraints and, therefore, no examinations are recommended.

4.2 <u>LIMIT STOPS</u>

The design of large PCRV penetrations includes limit stops where needed to prevent a postulated failure of a primary closure from resulting in a consequential failure of the corresponding secondary closure, and subsequently, a rapid depressurization of the PCRV.

The proposed Code (ASME Section XI Div. 2) only requires visual examination of limit stops that are installed as part of a flow restriction device and whose function is to limit movement during a depressurization accident (i.e. the restraints reviewed in Section 4.1 above). There are no Code requirements for the limit stops as discussed here which are unique to the Fort St. Vrain double closure penetration design.

Further, the steam generator penetration design does not include a limit stop. The circulator penetration limit stop is inaccessible for examination due to its location between two welded assemblies (outer steam pipe bellows and thermal shield). For the access penetrations, the limit stop is a simple cylinder located between the primary and secondary closures and resting, unloaded, on the lower closure. For the refueling and HTFA penetrations, the limit stop is an unloaded cylindrical extension of the component housing in the penetration interspace. In the two latter cases, there are no conditions that would conceivably degrade the limit stops ability to perform their intended function.

For the reasons outlined above, no examinations are recommended for the penetration limit stops.

ATTACHMENT 1

SPECIFICATION SR 5.2.28 - PCRV PENETRATIONS AND CLOSURES SURVEILLANCE

a) Accessible portions of PCRV penetration pressure retaining welds shall be examined for indications of surface defects as follows:

1. Surface examine (MT or PT) the following three welds in one steam generator penetration in each loop at five (5) calendar year intervals:

- the penetration shell to secondary closure weld,
- the secondary closure to upper bellows support weld, and
- the lower bellows support to reheat header sleeve weld.

2. Surface examine (MT or PT) the following two welds in the bottom access penetration at ten (10) calendar year intervals:

- the penetration shell to spherical head weld, and
- the spherical head to closure flange weld.

b) Accessible portions of the PCRV penetration closure and flow restrictor restraint components shall be examined for indications of defects as follows:

1. Visually examine accessible portions of the helium circulator restraint system (cylinder, ring and bolting) for one penetration in each loop at five (5) calendar year intervals.

2. Visually examine the refueling penetration holddown plate bolting at each refueling outage.

3. Visually examine the bottom access penetration's primary closure split ring assembly, and its secondary closure bolting at ten (10) calendar year intervals.

c) Accessible portions of the PCRV safety valve penetration containment tank support components shall be examined at ten (10) calendar year intervals for indications of defects as follows:

1. Surface examine (MT or PT) the support skirt to tank attachment weld.

2. Visually examine the support skirt between the tank and PCRV outer wall.

3. Visually examine, torque and tension test the bolting attaching the support skirt to the PCRV outer wall.

BASIS FOR SPECIFICATION SR 5.2.28

Structural integrity of Fort St. Vrain PCRV penetration secondary pressure retaining boundaries is normally verified by continuous leakage monitoring and by periodic leakage testing of the penetration interspace. The specified examinations of accessible circumferential welds at structural discontinuities will provide additional assurance concerning the continued integrity of the secondary pressure boundary at these critical locations.

Examination of accessible penetration closures, flow restrictors and equipment restraint or support components provides assurance that these components remain structurally sound and capable of performing their safety function under both normal and accident conditions.