Enclosure (1) to
P-80034

FORT ST. VRAIN

INSERVICE INSPECTION AND TESTING

PROPOSED

TECHNICAL SPECIFICATION SURVEILLANCE REQUIREMENTS

PRESTRESSED CONCRETE REACTOR VESSEL (11)

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Specification SR 5.2.2 - Tendon Corrosion and Anchor Assemblies Surveillance

The serviceability of the corrosion protection applied to, and the condition of the prestressing tendons shall be monitored in accordance with paragraph (a) and (b). Surveillance of the tendon end anchor assemblies shall be performed in accordance with paragraph (c).

a) Corrosion protected wire samples of sufficient length (i.e. initially at least 15 feet where practical, or half the tendon length, whichever is shorter) shall be inserted with selected tendons (those tendons with load cells). Corrosion inspection of at least one of these wires shall be made during the first scheduled PCRV depressurization after the end of the first and third calendar year after prestressing. Additional inspections shall be conducted during the first scheduled PCRV depressurization following each five calendar year interval thereafter.

b) A sample of the atmosphere contained in a representative number of tendon tubes (tendon tubes without load cells and tendon tubes with load cells from which wire samples are examined) shall be drawn and analyzed for products of corrosion, in coordination with and at the same time intervals as for paragraph (a) above.

c) Visual examination of 5 percent of the prestressing anchor assemblies shall be performed during the first scheduled PCRV depressurization following each of the above specified five calendar year intervals. This may include the anchor assemblies which can be visually examined while performing (a) and (b) above.

Basis for Specification SR 5.2.2

The corrosion protection provided for the PCRV prestressing components is considered to be more than adequate to assure that the required prestressing forces are sustained throughout the operational life of the plant. The details of the corrosion protection system are described in Section 5.6.2.5 of the FSAR.

Sampling tendon tube atmosphere for products will provide a secondary check on the adequacy of the corrosion protection provided for the stressing tendons.

Visual examination of tendon end anchor assemblies will provide additional assurance that the prestressing system has not degraded by checking the corrosion protection and integrity of the anchor assemblies.

Specification SR 5.2.3 - Tendon Load Cell Surveillance

Checks on the possible shift in the load cell reference points for representative load cells shall be performed at the end of the first calendar year after initial prestressing and within 120 days prior to initial power operation. Additional checks shall be conducted at five calendar year intervals thereafter.

The load cell alarm circuit between the PCRV concrete data aquisition system and the control room shall be functionally tested annually to assure that the operator in the control room is alerted when tendon load settings are exceeded.

Basis for Specification SR 5.2.3

The PCRV tendons apply the force required to counteract the internal pressure. Therefore, they are the PCRV structural components most capable of being directly monitored and of indicating the capability of the vessel to resist internal pressures. Since the relation between effective prestress and internal pressure is directly and easily calculable, monitoring tendon loads is a direct and reliable means for assuring that the vessel always has capacity to resist pressures up to Reference Pressure.

Monitoring of the tendon loads will assure that deterioration of structural components including progressive tendon corrosion, concrete strength reduction, excessive steel relaxation, etc., cannot occur undetected to a degree that would jeopardize the safety of the vessel. Each of these phenomena would result in tendon load changes. These changes, as reflected by the load cells, are monitored in the control room by an

alarm system which alerts the operator when the tendon load settings are exceeded. The upper settings will be varied depending on the location of the tendon being monitored, while the lower settings for all load cells will be set to correspond to 1.25 times peak working pressure (PWP).

Specification SR 5.2.4 - PCRV Concrete Structure Surveillance

Crack patterns on the visible surfaces of the PCRV shall be mapped prior to and following the initial proof test pressure (IPTP). Concrete cracks which exceed 0.015 inches in width shall be recorded. Subsequent concrete visual inspections shall be performed after the end of the first and third calendar year following initial power operation. Recorded cracks shall be assessed for changes in length and any new cracks will be recorded. Additional inspections shall be conducted at ten calendar year intervals thereafter.

PCRV deformations and deflections at vessel midheight and at the center of the top head shall be monitored during a vessel pressurization from atmospheric to operating pressure prior to initial power operation and during the first scheduled PCRV depressurization after the end of the first, third and fifth calendar year following initial power operation. Additional monitoring shall be performed during the first scheduled PCRV depressurization following each five calendar year interval thereafter.

The PCRV support structure shall be visually examined for evidence of structural deterioration at ten calendar year intervals when performing the above PCRV crack mapping.

Basis for Specification SR 5.2.4

Cracks are expected to occur in the PCRV concrete resulting from shrinkage, thermal gradients, and local tensile strains due to mechanical loadings. The degree of cracking expected is limited to superficial effects and is not considered detrimental to the structural integrity of the PCRV. Reinforcing steel is provided to control crack growth development with respect to size and spacing. Model testing has also shown that severely cracked vessels contain the normal working pressure for extended periods of time as long as the effective prestressing forces are maintained.

Cracks up to about 0.015 inches (limits of paragraph 1508b, ACI 318-63) for concrete not exposed to weather are generally considered acceptable and corrosion of rebars at such cracks is of negligible consequence. Large crack widths will require further assessment as to their significance, depending on the width, depth, length, and location of the crack on the structure, and must be considered with reference to the observed overall PCRV response.

Further discussion on the significance of concrete cracks in the PCRV is given in Section 5.12.5 of the FSAR.

Observed crack development with time during reactor operation will be related to the PCRV structural response as monitored by the installed sensors and deflection measurements. Details of the PCRV structural monitoring provisions are given in Section 5.13.4 and Appendix E.17 of the FSAR.

The interval for surveillance after the fifth year following initial prestressing may be adjusted based on the analysis of prior results.

Monitoring of overall PCRV deformations and deflections is the best indication of PCRV structural performance and verifies that the PCRV response is elastic and that no significant permanent strains exist.

Visual examination of the PCRV support structure will assure that no structural deterioration occurs. Significant cracking patterns or sizes should be investigated with respect to their impact on the integrity of the PCRV.

Specification SR 5.2.5 - Liner Specimen Surveillance

Specimens shall be placed adjacent to the outside surface of the top head liner so that changes in notch toughtness due to irradiation of the steel can be measured during the life of the reactor.

After the fifth refueling cycle, three sets of 12 specimens of the PCRV liner materials and weld material shall be removed and tested to obtain Charpy impact data. The specimen holders shall contain dosimeters to provide integrated neutron flux measurements. Additional specimen removal and testing shall be conducted at every tenth refueling cycle thereafter.

Basis for Specification SR 5.2.5

A test program will be performed to survey and assess the shifts in NDTT of the PCRV liner materials. The testing is to be accomplished by placing Charpy impact test specimens, made from the liner materials, near the liner and exposing them to appropriate neutron fluxes and temperatures. The Charpy impact test specimens are to be removed, 36 at a time, during the life of the vessel and tested to determine the condition of the vessel steel. The total number of specimens placed in the

reactor is ∿ 750, which will allow the determination of a complete impact transition curve for the plate metal, the weld metal and the heat affected zone at each test interval.

This testing program will meet the requirements of ASTM-E-185-70, with the following exceptions:

a. Tensile specimens are not included, since the liner is not a load carrying member but only a ductile membrane.

b. No thermal control specimens have been provided, since there is no appreciable temperature cycling of the liner. The liner materials will normally be kept at or below 150°F during all plant operation.

Tests performed on this liner material (see FSAR Section 5.7.2.2) have indicated that no observable changes in material characteristics developed during an exposure to a fluence equivalent to the first five years of full power operation. Further, these tests demonstrated no significant damage after a fluence equivalent to 30 years of power operation. The testing program prescribed for the Fort St. Vrain liner is in compliance with the ASME Boiler and Pressure Vessel Code, Section III N-110.

The interval for specimen removal and testing subsequent to the fifth refueling cycle may be adjusted based on the analysis of prior results.

Basis for Specification 5.2.12

The chemical constituents in the primary coolant are routinely measured on a continuous basis. The specification of an interval for surveillance allows for routine maintenance of the chemical impurity monitoring equipment. The presence of higher than nominal impurity levels of chemical impurities is related to core materials corrosion which might occur only with very high levels for sustained periods of time.

Specification SR 5.2.13 - PCRV Concrete Helium Permeability Surveillance

The permeability of the PCRV concrete to helium shall be measured prior to the initial startup of the reactor and after the end of the third year following initial power operation. Additional measurements shall be made at five year intervals thereafter.

Basis for Specification SR 5.2.13

Measurements of the relative helium permeability throughout plant life provides, as a supplement to other surveillance efforts, information concerning the continued integrity of the PCRV concrete.

The interval for surveillance after the fifth year following the initial power operation may be adjusted based on the analysis of prior results.

Specification SR 5.2.14 - PCRV Liner Corrosion Surveillance Requirement

The PCRV liner shall be examined for corrosion induced thinning, using ultrasonic inspection techniques during the first scheduled PCRV depressurization after the end of the third and fifth years following initial power operation. Additional

examinations shall be conducted during the first scheduled PCRV depressurization after each ten year interval thereafter.

Basis for Specification SR 5.2.14

The ultrasonic inspection of the PCRV liner is provided to detect the thinning of the liner due to corrosion or to detect defects within the liner at representative areas. Although no corrosion is expected to occur, this specification allows for detection of corrosion or liner defects in the event of some unexpected and unpredicted changes in the liner characteristics. The provisions are discussed in Section 5.13 of the FSAR.

The interval for surveillance after the fifth year following initial power operation may be adjusted based on the analysis of prior results.

Specification SR 5.2.24 - Refuelling penetration holddown plates surveillance

The refueling penetration hold down plate bolting shall be visually examined at each refueling shutdown, after the hold down plates have been removed, for indications of surface damage which could be detrimental to their structural integrity.

Basis for Specification SR 5.2.24

Visual examination of the hold down plates bolting will ide assurance that the hold down plates integrity is not degraded due to frequent removal and reinstallation.