Attachment 1

Surry Power Station

Proposed Technical Specification Changes

5.3 REACTOR

Applicability

Applies to the reactor core, Reactor Coolant System, and Safety Injection System.

Objective

To define those design features which are essential in providing for safe system operations.

Specifications

A. Reactor Core

1. The reactor core contains approximately 176,200 lbs of uranium dioxide in the form of slightly enriched uranium dioxide pellets. The pellets are encapsulated in Zircaloy-4 or ZIRLO tubing to form fuel rods. All fuel rods are pressurized with helium during fabrication. The reactor core is made up of 157 fuel assemblies. Each fuel assembly contains 204 fuel rods except for fuel assemblies which may be reconstituted to replace leaking fuel rods with non-fueled rods (e.g. zircaloy or stainless steel).

2. The average enrichment of the initial core is 2.51 weight percent of U-235. Three fuel enrichments are used in the initial core. The highest enrichment is 3.12 weight percent of U-235.

2d. WCAP-10054-P-A, "Westinghouse Small Break ECCS Evaluation Model Using the NOTRUMP Code," August 1985 (W Proprietary)

(Methodology for TS 3.12.B.1 and TS 3.12.B.2 - Heat Flux Hot Channel Factor)

2e. WCAP-10079-P-A, "NOTRUMP, A Nodal Transient Small Break and General Network Code," August 1985 (W Proprietary)

(Methodology for TS 3.12.B.1 and TS 3.12.B.2 - Heat Flux Hot Channel Factor)

2f. WCAP-12610, "VANTAGE+ Fuel Assembly Report," June 1990 (Westinghouse Proprietary).

(Methodology for TS 3.12.B.1 and TS 3.12.B.2 - Heat Flux Hot Channel Factor)

3a. VEP-NE-2-A, "Statistical DNBR Evaluation Methodology," June 1987

(Methodology for TS 3.12.B.1 and TS 3.12.B.2 - Nuclear Enthalpy Rise Hot Channel Factor)

3b. VEP-NE-3-A, "Qualification of the WRB-1 CHF Correlation in the Virginia Power COBRA Code," July 1990

(Methodology for TS 3.12.B.1 and TS 3.12.B.2 - Nuclear Enthalpy Rise Hot Channel Factor)

Attachment 2

Surry Power Station

Discussion of the Proposed Technical Specification Changes

DISCUSSION OF CHANGES

INTRODUCTION

Virginia Electric and Power Company plans to insert fuel assemblies containing fuel rods, guide thimble tubes, instrumentation tubes, and mid-span grids fabricated with Westinghouse Electric Corporation's (Westinghouse's) advanced zirconium alloy material, ZIRLO, into the Surry Units 1 and 2 reactors, beginning with the Cycle 13/14 refueling at each unit (late 1995 and early 1996, respectively). In the current fuel design, these components are fabricated from Zircaloy-4. Changing the material of these components from Zircaloy-4 to the ZIRLO alloy will provide operational benefit relative to the current fuel design due to the ZIRLO alloy's improved corrosion resistance and dimensional stability under irradiation.

Based both on evaluations and analyses, no unreviewed safety questions exist as a result of inserting ZIRLO cladding or ZIRLO fabricated skeleton components into the Surry Units 1 and 2 reactor cores. However, the Technical Specifications define the fuel rod cladding material as Zircaloy-4, so implementation of this material change requires changes to the Technical Specifications. It should be noted that the only component for which Technical Specification changes are required are the ZIRLO clad fuel rods. Use of the ZIRLO fabricated guide thimble tubes, instrumentation tubes, and mid-span grids does not require changes to the Technical Specifications.

BACKGROUND

Surry Units 1 and 2 are currently operating with Surry Improved Fuel (SIF), which is a Westinghouse optimized fuel assembly (OFA) design, with additional debris resistance features incorporated. A description of the fuel design can be found in our submittal to the NRC for the implementation of SIF, dated May 26, 1987 (Reference 2).

Westinghouse has developed a new zirconium based alloy, known as ZIRLO, to enhance fuel reliability and achieve extended burnup. This alloy provides a significant improvement over Zircaloy-4 in fuel rod, guide thimble tube, instrumentation tube, and mid-span grid corrosion resistance and dimensional stability under irradiation. ZIRLO corrosion resistance has been evaluated in long-term, out-of-pile tests over a wide range of temperatures (up to 680°F in water tests, up to 932°F in steam tests). Additional tests have been conducted in lithiated water environments at temperatures of 680°F. The improved corrosion resistance of ZIRLO cladding has also been demonstrated to very high burnups in the BR-3 test reactor (Mol, Belgium) and to burnups over 51,700 MWD/MTU in demonstration assemblies at North Anna Unit 1. The results at North Anna Unit 1 support the data obtained in the test reactor, with ZIRLO exhibiting peak corrosion levels which are substantially lower than those observed in the current Zircaloy-4 cladding, as well as improved dimensional stability over Zircaloy-4. Licensing approval for the use of ZIRLO cladding in fuel assemblies for North Anna Units 1 and 2 was given in a NRC letter dated May 26, 1994 (Reference 1).

Use of fuel assemblies containing ZIRLO fuel cladding and skeleton components is currently planned to begin at Surry Unit 1 starting with Cycle 14, which is anticipated to start in the fourth quarter of 1995, and at Surry Unit 2 starting with Cycle 14, currently scheduled for startup in the second quarter of 1996. The use of the ZIRLO alloy in place of Zircaloy-4 in these fuel assemblies represents the principal difference between the proposed fuel design and the fuel currently in use at both units.

The information required to support the licensing basis for the implementation of ZIRLO clad fuel rods in reload regions of fuel in Surry Units 1 and 2 is given in References 3 through 7. The areas assessed during the safety evaluation process included: chemical/mechanical properties, neutronic performance, thermal and hydraulic performance, cladding performance under non-LOCA conditions, and cladding performance under LOCA conditions.

The use of ZIRLO cladding does not alter the models and methods used for analyzing cycle specific reloads of Surry Improved Fuel (References 8 and 9) with the exception of the LOCA model and methodology as noted in Section 6 of the Safety Significance evaluation. The revised LOCA model and methodology were used as the basis to evaluate the effects of the change in cladding material. These evaluations have shown that the present LOCA related design bases and limits remain valid. Where the reload design models and methods are not affected by ZIRLO cladding, plant and cycle specific evaluations and analyses will continue to be performed for Surry Units 1 and 2 to demonstrate that the design bases and limits remain valid.

TECHNICAL SPECIFICATION CHANGES

General

The Technical Specification changes described herein apply to Surry Units 1 and 2.

Technical Specification 5.3.1

The Design Features section on the Reactor (Technical Specification 5.3.A.1) will be changed to allow fuel rods clad with either Zircaloy-4 or ZIRLO.

Technical Specification 6.2

A reference is being added in the Administrative Controls section on General Notification and Reporting Requirements (Technical Specification 6.2) for the calculation of the heat flux hot channel factor for LOCA evaluations of fuel with ZIRLO cladding in the Core Operating Limits Report.

SAFETY SIGNIFICANCE

1. Previous Irradiation Experience

Fuel rods fabricated with ZIRLO cladding have been previously irradiated in the BR-3 test reactor (Mol, Belgium) at linear power levels up to 17 kw/ft, and burnups significantly greater than those planned for the Surry fuel assemblies. Corrosion and hydriding data obtained on the ZIRLO cladding were compared with the reference Zircaloy-4 cladding of fuel rods irradiated as controls in the same test assemblies. Based on the irradiation results of the test assemblies in the foreign reactor, the Surry ZIRLO cladding waterside corrosion and hydriding will be significantly less than that expected for the Zircaloy-4 clad fuel rods. The irradiation test results substantiate a lower clad irradiation growth ($\Delta L/L$) and creepdown for the ZIRLO cladding compared to Zircaloy-4 cladding.

Two demonstration fuel assemblies containing ZIRLO clad fuel rods also began irradiation in the North Anna Unit 1 reactor during June 1987. The ZIRLO clad fuel rods achieved over 21,000 MWD/MTU burnup in their first cycle, which was completed during February, 1989. Visual and dimensional inspection during refueling showed no abnormalities. One demonstration assembly with ZIRLO clad fuel rods achieved over 37,000 MWD/MTU burnup in its second cycle of irradiation, completed in January, 1991. Visual and dimensional inspection of the two-cycle ZIRLO clad fuel rods in this assembly showed no abnormalities. Cladding corrosion measurements showed that the reduced corrosion obtained with two cycles of operation with the ZIRLO cladding was significantly better than that anticipated in the licensing basis evaluation. The second North Anna demonstration assembly with ZIRLO clad fuel rods achieved over 45,700 MWD/MTU burnup during its first two cycles of irradiation, with the second operating cycle being completed in January, 1993. Visual and dimensional inspection of this assembly after the second operating cycle continued to show no abnormalities and a significant reduction in corrosion relative to Zircaloy-4. This fuel assembly was discharged at the end of its third cycle of irradiation (September, 1994) after reaching an assembly average burnup over 51,700 MWD/MTU. Visual examinations during the normal refueling outage indicated no abnormalities. A more thorough examination of this demonstration assembly is planned during 1995. The irradiation results from these demonstration assemblies as well as from full reload regions of ZIRLO-clad fuel currently operating in commercial reactors are and will be considered in the design of the fuel rods with ZIRLO cladding to assure that the applicable fuel rod design bases are satisfied for the planned irradiation life of the Surry Units 1 and 2 fuel assemblies.

2. Chemical/Mechanical Properties

The nominal chemical composition (see Table 1) of the fuel rods, guide thimble tubes, instrumentation tubes, and mid-span grids fabricated with ZIRLO in the Surry Units 1 and 2 fuel assemblies is similar to Zircaloy-4 except for slight reductions in the content of tin (Sn) and iron (Fe), and the elimination of chromium (Cr). ZIRLO alloy also contains a nominal amount of niobium (Nb). These small composition changes are responsible for the improved corrosion resistance compared to Zircaloy-4. The physical and mechanical properties of ZIRLO are very similar to Zircaloy-4 alloy while in the same metallurgical phases. However, the temperatures at which the metallurgical phase changes occur are different for Zircaloy-4 and ZIRLO alloys

(Appendix A of Reference 4). These differences are considered in the evaluation of cladding behavior under non-LOCA and LOCA conditions. Further aspects of the ZIRLO cladding performance under LOCA conditions are given in Reference 4. Evaluations are performed using the NRC approved fuel rod performance models (References 4 and 10) to verify that the fuel rod design bases and design criteria (References 10 and 11) are met for assemblies containing ZIRLO clad fuel rods. The fuel rod design bases, criteria and models which are affected by the use of ZIRLO cladding are described in Reference 4.

3. Neutronic Performance

The design and predicted nuclear characteristics of fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated from ZIRLO alloy are similar to those of the currently used Surry Improved Fuel (Reference 2), in which these fuel assembly components are fabricated from Zircaloy-4. Evaluations (Reference 4) have shown that the nuclear design bases are satisfied for fuel rods, guide thimble tubes, instrumentations tubes, and mid-span grids fabricated with ZIRLO alloy. Standard nuclear design analytical models and methods (Reference 8) can also be used to accurately describe the neutronic behavior of fuel assemblies with fuel rod cladding, guide thimble tubes, instrumentation tubes and mid-span grids fabricated from ZIRLO alloy. The safety limit characteristics of the Surry Improved Fuel design (Reference 2) are not affected.

4. Thermal and Hydraulic Performance

The thermal and hydraulic design bases for fuel rods, guide thimble tubes, instrumentation tubes, and mid-span grids fabricated with ZIRLO alloy are identical to those of the Surry Improved Fuel design (Reference 2). Since the use of the ZIRLO alloy does not cause changes affecting the parameters which are major contributors in this area (i.e., DNB, core flow, and rod bow), the design bases of the Surry Improved Fuel design (Reference 2) remain valid.

5. Cladding Performance for Non-LOCA Events

Evaluations reported in Reference 4 concluded that the properties of Zircaloy-4 and ZIRLO are essentially the same with the exception of the differences in the phase change temperature and its related effect on the thermophysical properties. The phase change temperature shift affects the functional relationship between specific heat and temperature. The ZIRLO and Zircaloy-4 specific heats are essentially identical up to approximately 1380°F, at which the ZIRLO material undergoes an alpha-beta phase change and its specific heat rises to a plateau value. Zircaloy-4 has a similar behavior, except that the onset of the phase change occurs at a greater temperature (approximately 1500°F). This difference in specific heat-temperature relationship between the two clad materials potentially affects transient clad temperature response as the clad temperature approaches the ZIRLO phase change temperature of 1380°F.

To assess the impact of this property difference, Westinghouse conducted a review of non-LOCA licensing basis analysis results for various plant and fuel design types. It was concluded that only two events have licensing basis results in which calculated clad temperatures reach 1380°F or greater. These analyses are: 1) the peak clad temperature assessment for a single reactor coolant pump Locked Rotor/Shaft Break and 2) Rupture of a Control Rod Drive Mechanism (RCCA Ejection). The other non-LOCA analyses have reported clad temperatures which remain below approximately 1000°F. Therefore, the use of ZIRLO cladding will have no effect upon these events. The evaluations for the two non-LOCA accidents potentially affected by the use of ZIRLO clad are described below.

It was determined in Reference 4 that assuming ZIRLO cladding in the analysis of the Locked Rotor event results in a very small increase in calculated peak clad temperature (approximately 2°F). This small increase in clad temperature results in a comparable small increase in zirconium/water reaction rate, as estimated with the Baker-Just model. During the course of a postulated Locked Rotor transient, this would have a negligible effect upon the total zirconium/water reaction when compared to Zircaloy-4. This validates the results of the peak clad temperature assessment for the Surry Units 1 and 2 Locked Rotor analysis.

For the Rod Ejection event analysis, it was determined that the ZIRLO cladding results in a small reduction in both the fraction of fuel melting at the hot spot and the fuel peak stored energy when compared with the results for Zircaloy-4. The Surry Unit 1 and 2 licensing basis analysis results will therefore be applicable to either clad material. The assessment from Reference 4 as summarized here thus confirms that the conclusions in the Surry Updated Final Safety Analysis Report (UFSAR) for the two affected non-LOCA accidents remain valid (Reference 12).

6. Cladding Performance for LOCA Events

Reference 4 describes modifications necessary to model ZIRLO clad fuel in the large break 1981 Evaluation Model with the BART/BASH code and in the small break NOTRUMP Evaluation Model. For Surry Units 1 and 2, these modified Evaluation Models were utilized to demonstrate continued conformance with 10 CFR 50.46 (acceptance criteria for emergency core cooling systems) for a postulated Large and Small Break LOCA with a core containing ZIRLO clad fuel.

6.1 Large Break LOCA Evaluation

The limiting case Large Break LOCA analysis for Surry Units 1 and 2 has been shown to have a 0.4 break discharge coefficient (CD) as documented in the UFSAR. Since the hydraulic transient determines the most limiting peak clad temperature (PCT) and Reference 4 demonstrated that ZIRLO clad fuel did not result in a more severe hydraulic transient than Zircaloy-4 clad fuel, only the most limiting break size need be analyzed. In addition, the conclusions of Reference 4 indicated that since only the clad heatup portion of the transient is significantly affected by the ZIRLO clad fuel related changes, only the LOCBART computer code which incorporated the modifications described in Reference 4 was utilized for the Surry Units 1 and 2 ZIRLO clad fuel analysis.

The existing analysis of record for the Surry Units 1 and 2 Large Break LOCA transient employs the 1981 Evaluation model with the BASH code, including changes previously reported to the NRC in compliance with 10 CFR 50.46. The results of this analysis were reported to the NRC in Reference 13. This analysis of record was used as the starting point for the assessment of ZIRLO clad behavior. However, certain LOCBART model changes have been implemented since the analysis of record was performed. To obtain a direct sensitivity for the effect of ZIRLO clad fuel which is unaffected by changes in the version of the computer code, the limiting transient case was first rerun for the existing Surry Improved Fuel (SIF) with Zircaloy-4 cladding using the present version of the LOCBART code. A second LOCBART case was then run which included the appropriate changes to model the revised cladding and fuel properties design characteristics.

Due to the differences in the strain characteristics between Zircaloy-4 and ZIRLO, a study of the effects of burnup on ZIRLO clad fuel for the Large Break LOCA transient was documented in Reference 4. The conclusion from the Reference 4 study was that the requirement of 10 CFR 50, Appendix K to determine the limiting time in fuel life will continue to be met by assuming beginning of cycle fuel properties. This conclusion has been judged to be applicable for Surry Units 1 and 2 and was applied in the ZIRLO clad Large Break LOCA sensitivity analysis.

The sensitivity analysis determined that the use of ZIRLO cladding for the Surry Units 1 and 2 limiting CD=0.4 Large Break LOCA resulted in a -16°F effect on the peak clad temperature at the limiting time in life. When applied to the existing analysis of record result of 2120°F, this yields an adjusted peak clad temperature of 2104°F. For the ZIRLO analysis, the maximum local metal-water reaction and total core metal-water reaction are less than the 10 CFR 50.46 acceptance criteria of 17 percent and 1 percent, respectively. The temperature transient is terminated at a time when core geometry is still amenable to cooling. As a result, the core temperature will continue to decrease and the ability to remove decay heat generated in the fuel for an extended period of time will be provided. Therefore, the 10 CFR 50.46 acceptance criteria continue to be satisfied for Surry Units 1 and 2 operation with ZIRLO clad fuel.

6.2 Small Break LOCA Evaluation

The limiting case Small Break LOCA analysis for Surry Units 1 and 2 has been shown to have a 3 inch break size as documented in the UFSAR. As described in Section 6.1 for the Large Break LOCA event, the hydraulic transient determines the most limiting PCT for the Small Break LOCA event. It was judged in Reference 4 that the cladding differences between Zircaloy-4 and ZIRLO have a small effect on the core average fuel rod modelled in the Small Break LOCA calculation with the NOTRUMP model, and thus, the effect on the thermal-hydraulic response of the RCS would be insignificant. Therefore, only the LOCTA-IV computer code which incorporated the modifications described in Reference 4 was utilized for the limiting 3 inch break for the Surry Units 1 and 2 ZIRLO clad fuel analysis.

The existing Surry Units 1 and 2 Small Break LOCA analysis of record employed the NOTRUMP Evaluation Model which included changes previously reported to the NRC in compliance with 10 CFR 50.46. The results of this analysis were reported to the NRC in Reference 13. This analysis of record was used as the starting point for the assessment of ZIRLO clad behavior. However, certain LOCTA-IV model changes have been implemented since the analysis of record was performed. To obtain a direct sensitivity for the effect of ZIRLO clad fuel which is unaffected by changes in the version of the computer code, the limiting transient case was first rerun for the existing Surry Improved Fuel (SIF) with Zircaloy-4 cladding using a revised version of the LOCTA-IV code. A second LOCTA-IV case was then run which included the appropriate changes to model the revised cladding and fuel properties design characteristics.

The Surry analyses performed with the approved NOTRUMP Small Break LOCA Evaluation Model have assumed beginning of life fuel conditions. Both the existing Zircaloy-4 analysis of record and the ZIRLO sensitivity analysis incorporate this assumption. The reported results of each analysis have been adjusted by addition of a temporary PCT penalty which accounts for the most limiting time in life. This penalty has been quantified employing an evaluation tool developed by Westinghouse to conservatively estimate the effects associated with clad burst and heatup during the Small Break LOCA transient.

The sensitivity analysis determined that the use of ZIRLO cladding for the Surry Units 1 and 2 limiting 3 inch Small Break LOCA resulted in a +15°F effect on the peak clad temperature at the limiting time in life. When applied to the existing analysis of record result of 1839°F, this yields and adjusted PCT of 1854°F. For the ZIRLO analysis, the maximum local metal-water reaction and total core metal-water reaction are less than the 10 CFR 50.46 acceptance criteria of 17 percent and 1 percent, respectively. The temperature transient is terminated at a time when core geometry is still amenable to cooling. As a result, the core temperature will continue to decrease and the ability to remove decay heat generated in the fuel for an extended period of time will be provided. Therefore, the 10 CFR 50.46 acceptance criteria continue to be satisfied for operation of Surry Units 1 and 2 with ZIRLO clad fuel.

6.3 Conclusions

The results of studies performed to assess the effects of ZIRLO clad fuel rods on the Large and Small Break LOCA for Surry Units 1 and 2 have demonstrated continued conformance with the 10 CFR 50.46 acceptance criteria.

7. Assessment of Unreviewed Safety Question

From the previous evaluation, it is concluded that the use of fuel assemblies containing fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy in Surry Units 1 and 2 in Cycle 14 and subsequent cycles does not result in the acceptable safety limits for any incident being exceeded and does not result in any unreviewed safety questions as defined in 10 CFR 50.59. The basis for this determination is delineated below.

7.1 Probability of Previously Evaluated Accidents

This Safety Assessment documents that the probability of an accident previously evaluated in the Surry Units 1 and 2 UFSAR is not increased. The designs for Cycle 14 and subsequent cycles at both units will meet the applicable design criteria and ensure that the pertinent licensing basis acceptance criteria are met. Though the fuel and core designs are not directly related to the probability of occurrence of any previously evaluated accident, the demonstrated adherence to applicable standards and acceptance criteria precludes new challenges to components and systems that could increase the probability of any previously evaluated accident. Specifically, the use of fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy will not increase the probability of occurrence of an accident previously evaluated in the Surry Units 1 and 2 UFSAR. The clad integrity is maintained and the structural integrity of the fuel rods, fuel assemblies, and core is not affected. The ZIRLO alloy improves corrosion performance and dimensional stability and will not cause the core to operate in excess of pertinent design basis operating limits. Therefore, the probability of occurrence of an accident previously evaluated in the UFSAR has not increased.

7.2 Consequences of Previously Evaluated Accidents

This Safety Assessment documents that the consequences of an accident previously evaluated in the Surry Units 1 and 2 UFSAR are not increased. The design of Cycle 14 and subsequent cycles for each unit does not have a direct role in mitigating the consequences of any accident, and does not affect any of the bases (assumptions, actions, etc.) for the current analyses as described in the Surry Units 1 and 2 UFSAR. The reload core design for Cycle 14 and subsequent cycles at both units will meet the applicable design criteria and ensure that the pertinent licensing basis acceptance criteria are met. The demonstrated adherence to these standards and criteria precludes new challenges to components and systems that could (a) adversely affect the ability of existing components and systems to mitigate the consequences of any accident, and/or (b) adversely affect the integrity of the fuel rod cladding as a fission product barrier. Furthermore, adherence to applicable standards and criteria ensures that these fission product barriers maintain design margin to safety limits. Specifically, the use of fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy will not increase the consequences of an accident previously evaluated in the Surry Units 1 and 2 UFSAR. The ZIRLO alloy is similar in chemical composition to, and has physical and mechanical properties similar to, Zircaloy-4 and will not cause the core to operate in excess of pertinent design basis operating limits. Thus, clad integrity is maintained. Since the dose predictions presented in the UFSAR are not sensitive to the fuel rod cladding material changes specified in this report, the radiological consequences of accidents previously evaluated in the Surry Units 1 and 2 UFSAR have not increased.

7.3 Possibility of Accidents Not Previously Evaluated

This Safety Assessment documents that the possibility of an accident which is different from any already in the Surry Units 1 and 2 UFSAR is not created. The design of Cycle 14 and subsequent cycles for each unit will meet the applicable design criteria and ensure that the pertinent licensing basis acceptance criteria are met. The demonstrated adherence to these standards and criteria precludes new challenges to components and systems that could introduce a new type of accident. Specifically, the use of fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy will not create the possibility of an accident of a different type than any previously evaluated in the Surry Units 1 and 2 UFSAR. The fuel assemblies containing the fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy will satisfy the same design bases as those used for fuel assemblies in previous fuel regions (References 2, 4, and 8 through 11). The applicable design and performance criteria will continue to be met and no new single failure mechanisms have been created, nor will they cause the core to operate in excess of pertinent design basis operating limits. Therefore, the possibility of an accident of a different type than any previously evaluated in the UFSAR has not been created.

7.4 Probability of Previously Evaluated Malfunction of Equipment Important to Safety

This Safety Assessment documents that the probability of a malfunction of equipment important to safety previously evaluated in the Surry Units 1 and 2 UFSAR is not increased. The design of Cycle 14 and subsequent cycles at both units will meet the applicable design criteria and ensure that the pertinent licensing basis acceptance criteria are met. Demonstrated adherence to applicable standards and acceptance criteria precludes new challenges to components and systems that could increase the probability of any previously evaluated malfunction of equipment important to safety. Specifically, the use of fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy, in compliance with the methodology described in Reference 2, will not increase the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the Surry Units 1 and 2 UFSAR. No new performance requirements are being imposed on any system or component such that any design criteria will be exceeded nor will the core be operated in excess of pertinent design basis operating limits. No new modes or limiting single failures have been created with the ZIRLO alloy design. Therefore, the probability of occurrence of a malfunction of equipment important to safety previously evaluated in the UFSAR has not increased.

7.5 Consequences of Previously Evaluated Malfunction of Equipment Important to Safety

This Safety Assessment documents that the consequences of a malfunction of equipment important to safety previously evaluated in the Surry Units 1 and 2 UFSAR are not increased. The design of Cycle 14 and subsequent cycles at both units does not have a direct role in mitigating the consequences of any malfunction of equipment important to safety, and does not affect any of the bases (assumptions, actions, etc.) for the current analyses as described in the Surry Units 1 and 2 UFSAR. The Cycle 14 designs for both units as well as subsequent cycle designs will meet the applicable design criteria and ensure that the pertinent licensing basis acceptance criteria are met. The demonstrated adherence to these standards and criteria precludes new challenges to components and systems that could (a) adversely affect the ability of existing components and systems to mitigate the consequences of any accident, and/or (b) adversely affect the integrity of the fuel rod cladding as a fission product barrier. Furthermore, adherence to applicable standards and criteria ensures that these fission product barriers maintain the design margin of safety. Specifically, the use of fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy will not increase the consequences of a malfunction of equipment important to safety previously identified in the Surry Units 1 and 2 UFSAR. The dose predictions presented in the UFSAR are not sensitive to the fuel rod cladding material. The use of ZIRLO alloy does not change the performance requirements on any system or component such that any design criteria will be exceeded and will not cause the core to operate in excess of pertinent design basis operating limits. No new modes or limiting single failures have been created with the ZIRLO alloy design. Therefore, the radiological consequences of a malfunction of equipment important to safety previously evaluated in the Surry Units 1 and 2 UFSAR have not increased.

7.6 Possibility of Malfunction of Equipment Important to Safety Not Previously Evaluated

This Safety Assessment documents that the possibility of a malfunction of equipment important to safety different from any already evaluated in the Surry Units 1 and 2 UFSAR is not created. The design for Cycle 14 at each unit and subsequent cycles will meet the applicable design criteria and ensure that the pertinent licensing basis acceptance criteria are met. The demonstrated adherence to these standards and criteria precludes new challenges to components and systems that could introduce a new type of malfunction of equipment important to safety. Specifically, the use of fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy will not create the possibility of a malfunction of equipment important to safety of a different type than any previously evaluated in the Surry Units 1 and 2 UFSAR. The pertinent original design and performance criteria continue to be met, and no new failure modes have been created for any system, component, or piece of equipment. No new single failure mechanisms have been introduced, nor will the core operate in excess of pertinent design basis operating limits. Therefore, the possibility of a malfunction of equipment important to safety of a different type than any previously evaluated in the UFSAR has not been created.

7.7 Margin of Safety

This Safety Assessment documents that the margin of safety as defined in the Bases to any Technical Specification is not reduced. The design for Cycle 14 and subsequent cycles at both units will meet the applicable design criteria and ensure that the pertinent licensing basis acceptance criteria are met. It has been determined that the Surry Units 1 and 2 current design and safety limits (Reference 2) remain applicable, and that these limits are supported by the applicable Technical Specifications for Cycle 14 and subsequent cycles. Specifically, the use of fuel assemblies containing fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy will not reduce the margin of safety as defined in the basis for any Technical Specification. The use of these fuel assemblies will take into consideration the normal core operating conditions allowed in the Technical Specifications. For each cycle reload core, these fuel assemblies will be specifically evaluated using approved reload design methods (Reference 8) and approved fuel rod design models and methods (References 4, 10 and 11). This will include consideration of the core physics analysis peaking factors and core average linear heat rate effects. Therefore, the margin of safety as defined in the Bases to the Technical Specifications has not been reduced.

8. Conclusions

The Technical Specifications ensure that the plants operate in a manner that provides acceptable levels of protection for the health and safety of the public. The Technical Specifications are based upon assumptions made in the safety and accident analyses, including those relating to the core design. This ensures adequate margin to the regulated acceptance criteria for the accident analyses. Since it has been concluded that the core design parameters and assumptions utilized in the accident analyses are appropriate with consideration for the introduction of fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy, the conclusions in the Surry Units 1 and 2 UFSAR are valid. Therefore the regulated margin of safety as defined in the Bases of the Technical Specifications is not affected by the use of ZIRLO alloy in Surry Units 1 and 2.

Based on the acceptance criteria as specified in References 2 and 4, and on the evaluations and analysis results presented above, it can be concluded that fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy will perform better than fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with Zircaloy-4, and therefore using ZIRLO alloy does not constitute an unreviewed safety question as defined by 10 CFR 50.59 (a)(2).

SUMMARY

The foregoing analyses and evaluations demonstrate that the conclusions of the accident analyses in the Surry Units 1 and 2 UFSAR remain valid for the proposed material change from Zircaloy-4 to ZIRLO in the fuel assemblies. Each pertinent design and safety criterion was evaluated for the impact of implementing ZIRLO alloy fuel rod cladding, guide thimble tubes, instrumentation tubes, and mid-span grids, and the evaluation results were found to be acceptable. It has also been determined that the current core design parameters and methods will remain applicable for the design and analysis of fuel with fuel rod and fuel assembly components fabricated from the ZIRLO alloy.

Table 1

Nominal Compositions of
ZIRLO and Zircaloy-4 Alloys

Element	Zircaloy-4 (wt %)*	ZIRLO (wt %)
Sn	1.45	1.0
Fe	0.21	0.10
Cr	0.10	----
Nb	----	1.0
Zr	Balance	Balance

* Recent Zircaloy-4 cladding has been manufactured under a tighter specification on the concentration of tin to improve corrosion resistance. This low-tin material still falls within the nominal ranges for Zircaloy-4.

REFERENCES

1. Letter from Leon B. Engle (NRC) to W. L. Stewart (Virginia Electric and Power Company), "North Anna Units 1 and 2 - Issuance of Amendments Re: Use of ZIRLO Material for Fuel Cladding (TAC Nos. M88072 and M88073)," May 26, 1994.

2. Letter from W. L. Stewart (Virginia Electric and Power Company) to U. S. Nuclear Regulatory Commission, Subject: Proposed Technical Specifications Change, Surry Improved Fuel Assembly, Serial Number 87-188, May 26, 1987.

3. "Use of fuel with Zirconium-Based (Other than Zircaloy) Cladding (10 CFR 50.44, 50.46, and Appendix K to Part 50)," Federal Register, Vol. 57, No. 169, Rules and Regulations, Pages 39353 and 39355, August 31, 1992.

4. Davidson, S. L., and Nuhfer, D. L. (Eds.), "VANTAGE+ Fuel Assembly Reference Core Report," WCAP-12610 (Proprietary), June 1990, including Appendices A through G and Addenda 1 through 3.

5. Letter from A. C. Thadani (NRC) to S. R. Tritch (Westinghouse), "Acceptance for Referencing of Topical Report WCAP-12610, 'VANTAGE+ Fuel Assembly Reference Core Report' (TAC No. 77258)," July 1, 1991.

6. Letter from A. C. Thadani (NRC) to S. R. Tritch (Westinghouse), "Acceptance for Referencing of Licensing Topical Reports WCAP-12610, Appendices F, 'LOCA NOTRUMP Evaluation Model: ZIRLO Modifications,' and G, 'LOCA Plant Specific Accident Evaluations' (TAC No. 77258)," October 9, 1991.

7. Letter from G. M. Holahan (NRC) to N. J. Liparulo (Westinghouse), "Acceptance for Referencing of Topical Report WCAP-12610, Appendix B, Addendum 1, 'Extended Burnup Fuel Design Methodology and ZIRLO Fuel Performance Models' (TAC No. M86416)," September 15, 1994.

8. "Reload Nuclear Design Methodology," VEP-FRD-42, Rev. 1-A, September 1986.

9. Bordelon, F. M., et al., "Westinghouse Reload Safety Evaluation Methodology," WCAP-9272-P-A (Proprietary) and WCAP-9273-A (Non-Proprietary), July 1985.

10. Weiner, R. A. et al., "Improved Fuel Rod Performance Models for Westinghouse Fuel Rod Design and Safety Evaluations," WCAP-10851-P-A (Proprietary), August 1988.

11. Davidson, S. L. (Ed.), et al., "Extended Burnup Evaluation of Westinghouse Fuel," WCAP-10125-P-A (Proprietary), December 1985.

12. Updated Final Safety Analysis Report - Surry Power Station, Units 1 and 2, Docket Nos. 50-280 and 50-281.

13. Letter from James P. O'Hanlon (Virginia Electric and Power Company) to U. S. Nuclear Regulatory Commission, "Surry Power Station Units 1 and 2, 30-Day Report of ECCS Evaluation Model Changes Per Requirements of 10CFR50.46," Serial Number 94-254A, September 26, 1994.

14. Technical Specifications - Surry Power Station, Units No. 1 and 2, Dockets 50-280 and 50-281, through Amendment No. 192, August 2, 1994.

Attachment 3

Surry Power Station

Significant Hazards Consideration Determination

SIGNIFICANT HAZARDS CONSIDERATION

Virginia Electric and Power Company plans to insert fuel assemblies containing fuel rods, guide thimble tubes, instrumentation tubes, and mid-span grids fabricated with Westinghouse Electric Corporation's (Westinghouse's) advanced zirconium alloy material, ZIRLO, into the Surry Units 1 and 2 reactors, beginning with Cycle 14 at each unit. In the current fuel design, these components are fabricated from Zircaloy-4. Changing the material of these components from Zircaloy-4 to the ZIRLO alloy will provide operational benefit relative to the current fuel design due to the ZIRLO alloy's improved corrosion resistance and dimensional stability under irradiation.

Because the Technical Specifications define the fuel rod cladding material as Zircaloy-4, implementation of this material change requires changes to the Technical Specifications. Technical Specification 5.3.A.1 is being modified to allow the use of either Zircaloy-4 or ZIRLO fuel rod cladding, and an additional reference for the calculation of the heat flux hot channel factor for LOCA evaluations of fuel with ZIRLO cladding is being defined in Technical Specification 6.2. The use of the ZIRLO fabricated guide thimble tubes, instrumentation tubes, and mid-span grids does not require changes to the Technical Specifications.

Virginia Electric and Power Company has reviewed the Technical Specifications changes against the criteria of 10 CFR 50.92, and has concluded that the changes do not pose a significant hazards consideration. Specifically, operation of Surry Power Station in accordance with the Technical Specifications changes will not:

1. Involve a significant increase in the probability or consequence of an accident previously evaluated. The Surry fuel assemblies containing fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy meet the same fuel assembly and fuel rod design bases as the current fuel assemblies fabricated with Zircaloy-4 components. In addition, the 10 CFR 50.46 criteria will be applied to the fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy. The use of these fuel assemblies will not result in a change to the Surry Units 1 and 2 reload design and safety analysis limits. The ZIRLO alloy is similar in chemical composition to Zircaloy-4, and also has physical and mechanical properties similar to those of Zircaloy-4. Thus the cladding integrity is maintained and the structural integrity of the fuel assembly is not affected. The ZIRLO clad fuel rods improve corrosion resistance and dimensional stability. Since the dose predictions in the safety analyses are not sensitive to the fuel rod cladding material changes as specified in this report, the radiological consequences of accidents previously evaluated in the safety analyses remain valid. Therefore, neither the probability of occurrence nor the consequences of any accident previously evaluated is significantly increased.

2. Create the possibility of a new or different kind of accident from any accident previously identified, since the Surry Units 1 and 2 fuel assemblies containing fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy will satisfy the same design bases used for previous fuel regions containing Zircaloy-4 components. Since

the original design criteria are being met, the fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy will not be initiators for any new accident. Applicable design and performance criteria will continue to be met and no single failure mechanisms have been created. In addition, the use of these fuel assemblies does not involve any alteration to plant equipment or procedures which would introduce any new or unique operational modes or accident precursors. Therefore, the possibility for a new or different kind of accident from any accident previously evaluated is not created.

3. Involve a significant reduction in a margin of safety. The Surry Units 1 and 2 fuel assemblies containing fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy do not change the Surry Units 1 and 2 reload design and safety analysis limits. The use of fuel assemblies containing fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy will take into consideration the normal core operating conditions allowed in the Technical Specifications. For each cycle reload core these fuel assemblies will be specifically evaluated using approved reload design methods and approved fuel rod design models and methods. This will include consideration of the core physics analysis peaking factors and core average linear heat rate effects. Analyses or evaluations will be performed each cycle to confirm that the 10 CFR 50.46 criteria will be met for the use of fuel with fuel rods, guide thimble tubes, instrumentation tubes and mid-span grids fabricated with ZIRLO alloy. Therefore, the margin of safety as defined in the Bases to the Surry Units 1 and 2 Technical Specifications is not significantly reduced.

Virginia Electric and Power Company concludes that the activities associated with the proposed Technical Specifications changes satisfy the no significant hazards consideration criteria of 10 CFR 50.92 and, accordingly, a no significant hazards consideration finding is justified.