AUG 1 1984

Docket No. 50-354

APPLICANT: Public Service Electric & Gas Company (PSE&G)

FACILITY: Hope Creek Generating Station

SUBJECT: SUMMARY OF MATERIALS ENGINEERING BRANCH DRAFT SER OPEN ITEMS MEETING

On July 24, 1984, a meeting was held in the Bethesda, Maryland offices of the NRC to discuss Draft SER open items identified by the Materials Engineering Branch. A list of attendees is included as Enclosure 1 to this meeting summary.

The open items discussed at this meeting are identified in Enclosure 2. The applicant's proposed responses are identified in Enclosure 3. The staff indicated that pending review of the chlorine content limits by the Chemical Engineering Branch, the responses appear to sufficiently address the Draft SER concerns. PSE&G representatives indicated that the enclosed responses will be submitted formally for staff review by mid-August 1984.

David H. Wagner, Project Manager
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Enclosures: As stated

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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Enclosure 1

MEETING TITLE: Materials Engineering Branch DSER Open Item Meeting

APPLICANT: Public Service Electric & Gas Company

FACILITY: Hope Creek Generating Station

DATE: July 24, 1984

NAME	AFFILIATION
Dave Wagner	NRC
Jeannette E. Szupillo	PSE&G
Joseph E. Rogozenski	PSE&G
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D. M. O'Connor	Bechtel
George W. Toth	International Energy Assoc., LTD.
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Ronald J. Tkach	PSE&G
Robert Rader	Conner & Wetterhahn, P.C.
Dave Smith	NRC
Lee Dewey	NRC

DSER Section 4.5.1

CONTROL ROD DRIVE STRUCTURAL MAT'LS

(control rod drive)

211a The controls imposed on the austenitic stainless steel of the mechanisms conform to the extent practicable to the recommendations of RG 1.31, "Control of Ferrite Content in Stainless Steel Weld Metal." The alternative approaches to RG 1.31 taken by the applicant of using chemical analysis to determine ferrite content instead of magnetic methods is acceptable to the staff. For Regulatory Guide 1.44, the applicant has set high chloride content limits that exceed the recommendations of the guide. The applicant's high chloride limit of 200 ppm and the chloride limits for other materials that come in contact with austenitic stainless steels do not provide protection from concentrations of chlorides that can occur by evaporation. The same situation applies to the 100-ppm limit for chloride content of the final flushing water.

HOPE CREEK Open Items (PSE&G number 211c)

DSER Section 4.5.1

CONTROL ROD DRIVE STRUCTURAL MAT'LS

The allowed welding heat input limit of 100 Kj/in. has been shown by General Electric to sensitize Type 304 austenitic stainless steel and accordingly is unacceptable.

DSER Section 4.5.1

CONTROL ROD DRIVE STRUCTURAL MAT'LS

Cleaning and cleanliness control are not in accordance with the recommendations of RG 1.37, "Quality Assurance Requirements for Cleaning Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants." The chloride content limits for flushing fluids are too high and are not acceptable to the staff. That the oxygen content of the flushing water cannot be maintained at reactor operating levels is acceptable to the staff, because the systems' temperatures will be below 200°F and damage cannot occur in this situation provided chlorides are controlled to the levels recommended in the Regulatory Guide.

DSER Section 4.5.1

CONTROL ROD DRIVE STRUCTURAL MAT'LS

The applicant should identify the materials specifications used in the control rod drive components made of ARMCO 17-4PH and INCONEL X-750. The staff concludes that the control rod drive mechanism structural materials may not be acceptable and may not meet the requirements of GDC 1, 14, and 26 and 10 CFR 50.55a. The main concern is that the applicant's alternative approaches to RGs 1.37, "Quality Assurance Reguirements for Cleaning Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants," and 1.44, "Control of the Use of Sensitized Stainless Steel," do not provide an acceptable level of protection from intergranular stress corrosion cracking.

DSER Section 4.5.2

REACTOR INTERNALS MAT'LS

The staff concludes that the materials used for the construction of the reactor internals and core support are not acceptable and do not meet the requirements of GDC 1 because the applicant did not follow the recommendations of RG 1.44, "Control of the Use of Sensitized Stainless Steels," or provide acceptable alternative approaches.

DSER Section 5.2.3

REACTOR COOLANT PRESSURE BOUNDARY MATERIALS

The materials of construction of the RCPB exposed to the reactor coolant have been identified, and all of the materials are compatible with the primary coolant water, which is chemically controlled in accordance with appropriate Technical Specifications when the recommendations of RG 1.44, "Control of the Use of Sensitized Stainless Steel," or alternative approaches of technical merit are followed. This compatiblity has been proven by extensive testing and satisfactory performance. The applicant's alternative approaches to the recommendations of RC 1.44 are not acceptable to the staff (see Section 4.5.1). General corrosion of all materials, except for carbon and low-alloy steels, will be negligible. For these materials, conservative corrosion allowances have been provided for all surfaces in accordance with the requirements of ASME Code, Section III, and the monitoring of reactor coolant chemistry and reactor coolant chemistry controls ensure corrosion control.

The controls to avoid stress corrosion cracking in RCPB components constructed of austenitic stainless steels limit yield strength of cold worked stainless steels to 90,000 psi maximum. The applicant's alternative approaches to the recommendations of RG 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Nuclear Power Plants," and 1.44, "Control of the Use of Sensitized Stainless Steel," are not acceptable as discussed in Section 4.5.1.

DSER Section 6.1.1

ENGINEERED SAFETY FEATURES MAT'LS

The recommendations of RG 1.44, "Control of the Use of Sensitized Stainless Steel," have not been met, and the applicant's alternative approaches to the guide are not acceptable to the staff (see Section 4.5.1).

The controls placed on component and system cleaning are not in accordance with the recommendations of RG 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants," and the applicant's alternative approaches have been evaluated and are not acceptable to the staff as discussed in Section 4.5.1.

DSER Section 10.3.6

MAIN STEAM & FEEDWATER SYSTEM MAT'LS

The onsite cleaning and cleanliness controls during fabrication do not satisfy the positions in RG 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants," as discussed in Section 4.5.1.

DSER Section 5.3.1

REACTOR VESSEL MATERIALS (MATERIALS & FABRICATION)

216a The controls (during all stages of welding) to avoid contamination and sensitization that could cause stress corrosion cracking in austenitic stainless steels conform with the recommendations of applicable regulatory guides as follows:

(1) The controls to avoid contamination and sensitization of austenitic stainless steel are not in conformance with the recommendations of RG 1.44, "Control of the Use of Sensitized Stainless Steel," and the applicant's alternative approaches are not acceptable to the staff (see Section 4.5.1). These controls do not satisfy the quality standards requirements of GDC 1 and 30 and 10 CFR 50.55a and the GDC 4 requirement relative to material compatibility.

(2) The onsite cleaning and cleanliness controls of austenitic stainless steel are not in conformance with the recommendations of RG 1.37, "Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants," and the applicant's alternative approaches are not acceptable to the staff (see Section 4.5.1).

216b The reactor vessel studs and fasteners satisfy some of the recommendations of RG 1.65, "Materials and Inspections for Reactor Vessel Closure Studs." The FSAR does not discuss the nondestructive examinations of the stud bolts and nuts.

HOPE CREEK

DSER OPEN ITEMS 211a, b, d; 212, 213, 214, 215, 216a

The main concern is that the applicant's alternative approaches to RGs 1.37, "Quality Assurance Requirements for Cleaning Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants," and 1.44, "Control of the Use of Sensitized Stainless Steel," do not provide an acceptble level of protection from intergranular stress corrosion cracking . . . For Regulatory Guide 1.44, the applicant has set high chloride content limits that exceed the recommendations of the guide. The applicant's high chloride limit of 200 ppm and the chloride limits for other materials that come in contact with austenitic stainless steels do not provide protection from concentrations of chlorides that can occur by evaporation. The same situation applies to the 100-ppm limit for chloride content of the final flushing water.

Cleaning and cleanliness control are not in accordance with the recommendations of RG 1.37, "Quality Assurance Requirements for Cleaning Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants." The chloride content limits for flushing fluids are too high and are not acceptable to the staff.

RESPONSE

In Regulatory Guide 1.44 reference is made to Regulatory Guide 1.37 for the quality of water for cleaning and flushing of fluid systems. Regulatory Guide 1.37 further references ANSI N45.2.1.-1973 as an acceptable basis for complying with the pertinent quality assurance requirements of Appendix B to 10CFR Part 50.

For the NSSS and non-NSSS scope of supply the requirements specified in the applicable GE and Bechtel specifications for cleanness of piping and equipment are in strict compliance with Regulatory Guide 1.37 and ANSI N45.2.1-1973 regarding the water quality requirements of freshwater and demineralized water for rinsing and flushing purposes.

For non-metallic materials that come in contact with austenitic stainless steel, such as die lubricants, marking materials, masking tape, cleaning solutions, etc., the GE and Bechtel specifications require that the chloride concentrations be controlled in accordance with the various relevant Regulatory Guides and ANSI standards. Further these materials are removed and the surfaces cleaned and rinsed immediately following the operation in which they are used. Since the quality of the rinse and flush water is being

maintained there is adequate protection from concentrations of chlorides that could occur by evaporation.

FSAR Section 1.8.1.44 has been reviewed to the applicable GE and Bechtel specifications. This review resulted in the revision of Position C1 to provide clarification of several statements and the deletion of references to the use of trichlorotrifluoroethane (TCTFE), which is prohibited, such that this section more accurately describes the actual practice.

are controlled so that halogen and sulfer levels agree with the various Regulatory Guides or ANSI standards covering these materials. In addition, these materials are removed immediately following the operation in which they are used and prior to any elevated-temperature treatment.

1.8.1.44 Conformance to Regulatory Guide 1.44, Revision 0, May 1973: Control of the Use of Sensitized Stainless Steel

HCGS complies with Regulatory Guide 1.44, except as noted below.

Architect-engineer-procured items and architect-engineer field work comply with Regulatory Guide 1.44, subject to exceptions or clarifications stated below that are applied to ASME B&PV Code, Section III equipment and piping in safety-related systems. They are not generally applied to HVAC systems or to instruments.

in accordance with Regulatory Guide 1.37 and ANSI N45.2.1-1973.

Position C.1 of Regulatory Guide 1.44 is complied with since contamination of austenitic stainless steel (Type 300 series) by compounds that could cause stress corrosion cracking is avoided during all stages of fabrication and installation. Except for trichlorotrifluoroethane (TCTFE) meeting the requirements of Military Specification MIL-C-81302B, cleaning is limited to solutions that contain not more than 200 ppm of chlorides. Rinsing or flushing is done with water that contains not more than 200 ppm of chlorides. Special rinsing techniques are used to ensure complete removal of TCTFE where crevices or undrainable areas occur.

Nonmetallic materials ~~Foreign substances~~ in contact with austenitic stainless steel, i.e., die lubricants, penetrant materials, marking materials, masking tape, etc., are controlled so that they contain no more than 200 ppm of chlorides, or they are removed immediately following the operation in which they were used. Penetrant materials may conform to the higher contaminant levels specified in Article 6, Section V, of the ASME B&PV Code, provided that the materials are thoroughly removed immediately after the examination has been completed. Crevices and ~~undrainable areas~~ are protected prior to the use of materials containing more than 200 ppm of chlorides. All substances in contact with austenitic stainless steel are removed prior to any elevated temperature ~~treatment.~~ and the surface cleaned small openings are protected from contamination.

Completed components are packaged ~~in~~ such ~~a manner~~ that they are protected from the weather, dirt, wind, water spray, and any other extraneous environmental conditions that may be encountered during shipment and subsequent site storage.

In the field, austenitic stainless steel components are stored clean and dry. Components either are stored indoors, or, if outdoors, are stored off the ground and covered with tarps.

Contamination of austenitic stainless steels in the field during installation is avoided as described above. The system hydrostatic test and the preoperational testing and final flushing of the completed system is performed with demineralized water. ~~that contains not more than 100 ppm of chlorides.~~ Nonmetallic insulation composed of leachable chloride and fluoride materials that come into contact with austenitic stainless steel are held to the lowest practicable level by the inclusion of the requirements of Regulatory Guide 1.36 in the insulation purchase specifications.

Position C.2 of Regulatory Guide 1.44 is complied with since all grades of austenitic stainless steels (Type 300 series) are required to be furnished in the solution heat-treated condition before fabrication or assembly into components or systems. The solution heat treatment varies according to the applicable ASME or ASTM material specification.

Position C.3 of Regulatory Guide 1.44 covers all austenitic stainless steels furnished in the solution heat-treated condition in accordance with the material specification. During fabrication and installation, austenitic stainless steels are not permitted to be exposed to temperatures in the range of 800 to 1500°F, except for welding and hot forming. Welding practices are controlled to avoid severe sensitization, and solution heat treatment in accordance with the material specification is also required following hot forming in the temperature range of 800 to 1500°F. Unless otherwise required by the material specification, the maximum length of time for cooling from the solution heat-treated temperature to below 800°F is specified in the equipment specification. Corrosion testing in accordance with ASTM A 262-70, Practice A or E, may be required if the maximum length of time for cooling below 800°F is exceeded, or the solution heat-treated condition is in doubt.

No austenitic stainless steel is subjected to service temperatures in the range of 800 to 1500°F, as discussed in Position C.4 of Regulatory Guide 1.44. The only exposure of austenitic stainless steels to this range of temperatures occurs on the containment hydrogen recombiner system (CHRS) and subsequent to solution heat-treating during welding. Welding practices are controlled as discussed below. In addition, the architect-engineer-supplied austenitic stainless steel piping and

DSER Open Item 211c (Section 4.5.1)

CONTROL ROD DRIVE STRUCTURAL MATERIALS

The allowed welding heat input limit of 100 kj/in for the fabrication of control rod drive components has been shown by General Electric to sensitize Type 304 austenitic stainless steel and accordingly is unacceptable.

RESPONSE

The welding specification controlling the fabrication of control rod drive (CRD) components at GE's Wilmington, NC manufacturing operations has always specified a heat input limit of 50 Kj/in. The HCGS CRD components were fabricated under this specification. Section 4.5.1.2.1 has been revised to remove the reference to the description of compliance to Regulatory Guide 1.44 in Section 4.5.2.4.4, which deals with reactor vessel internals.

a. The cylinder and spacer (cylinder, tube and flange assembly) and the retainer (collet assembly) are hard surfaced with Colmonoy 6.

b. The following components are nitrided to provide a wear resistant surface:

1. Piston tube (piston tube assembly)

2. Index tube (drive line assembly)

3. Collet piston and guide cap (collet assembly).

Colmonoy hard surfacing is applied on the cylinder, spacer, and retainer by the flame spray process.

Nitriding is accomplished using a proprietary process called New Malcomizing. Components are exposed to a temperature of about 1080°F for approximately 20 hours during the nitriding cycle.

Colmonoy hard surfaced components have performed successfully for the past 20 years in drive mechanisms. Nitrided components have been used in CRDs since 1967. It is normal practice to remove some CRDs at each refueling outage. At this time, both the Colmonoy hard surfaced parts and the nitrided surfaces are accessible for visual examination. In addition, dye penetrant examinations have been performed on nitrided surfaces of the longest service drives. This inspection program is adequate to detect any incipient defects before they can become serious enough to cause operating problems.

Welding is performed in accordance with Section IX of the ASME B&PV Code. Heat input for stainless steel welds is restricted to a maximum of 50,000 Joules per inch and an interpass temperature of 350°F. These controls are employed to avoid severe sensitization and comply with the intent of Regulatory Guide 1.44. ~~For general compliance or alternate approach assessment for Regulatory Guide 1.44, see Section 4.5.2.4.4.~~

DSER OPEN ITEM 211C

4.5.2.4.2 Conformance with Regulatory Guide 1.34, Control of Electroslag Weld Properties

Electroslag welding is not employed for any reactor internals.

4.5.2.4.3 Conformance with Regulatory Guide 1.36, Nonmetallic Thermal Insulation for Austenitic Stainless Steel

For external applications, all nonmetallic insulation meets the requirements of Regulatory Guide 1.36.

4.5.2.4.4 Conformance with Regulatory Guide 1.44, Control of the Use of Sensitized Stainless Steel

All wrought austenitic stainless steel is purchased in the solution heat treated condition. Heating above 800°F is prohibited (except for welding) unless the stainless steel is subsequently solution annealed. For 304 stainless steel with carbon content in excess of 0.035% carbon, purchase specifications restrict the maximum weld heat input to 170,000 Joules per inch, and the weld interpass temperature to 350°F maximum. Welding is performed in accordance with Section IX of the ASME B&PV Code. These controls are employed to avoid severe sensitization, and comply with the intent of Regulatory Guide 1.44.

4.5.2.4.5 Conformance with Regulatory Guide 1.71, Welder Qualification for Areas of Limited Accessibility

There are few restrictive welds involved in the fabrication of items described in this section. Mock-up welding is performed on the welds with most difficult access. Mock-ups are examined with radiography or by sectioning.

4.5.2.4.6 Conformance with Regulatory Guide 1.37, Quality Assurance Requirements for Cleaning of Fluid Systems and Associated Components of Water-Cooled Nuclear Power Plants

Exposure to contaminants is avoided by carefully controlling all cleaning and processing materials that contact stainless steel

DSER ITEM 211C

DSER Open Item No. 211e (Section 4.5.1)

CONTROL ROD DRIVE STRUCTURAL MATERIALS

The applicant should identify the materials specifications used in the control rod drive components made of ARMCO 17-4 PH, and Inconel X-750.

RESPONSE

The fingers of the collet assemblies and the coupling spuds of the drive line assemblies of the HCGS control rod drives (CRDs) were fabricated of Inconel X-750, which was specified by a General Electric specification similar to ASTM A637, G688, Type 2. The collet springs of the CRDs were fabricated of Inconel X-750, which was specified by a General Electric specification similar to AMS 5699. The piston heads of the drive line assemblies were fabricated of 17-4 PH, which was specified by a General Electric equivalent to ASTM A564, Type G630 with a 1100°F age hardening.

DSER Open Item No. 216b (Section 5.3.1)

REACTOR VESSEL MATERIALS

The reactor vessel studs and fasteners satisfy some of the recommendations of RG 1.65, "Materials and Inspections for Reactor Vessel Closure Studs." The FSAR does not discuss the nondestructive examinations of the stud bolts and nuts.

RESPONSE

The main closure studs, nuts, and washers for the reactor vessel are ultrasonically examined in accordance with Paragraph N-322 of Section III of the ASME B&PV Code and additional GE requirements. Magnetic particle inspections of the surfaces of the main closure studs, nuts and washers, are conducted in accordance with Paragraph N-626 of Section III of the ASME B&PV Code.