TOLEDO EDISON COMPANY
DAVIS-BESSE NUCLEAR POWER STATION, UNIT 1 (OL)
DOCKET NO. 50-346
SAFETY EVALUATION

MATERIALS ENGINEERING BRANCH
Materials Application Section

REACTOR

Reactor Vessel Internals

General Material Considerations

We have reviewed the selection of materials for the reactor vessel internals required for reactor shutdown and adequate core cooling. All materials are compatible with the reactor coolant, and have performed satisfactorily in similar applications. Undue susceptibility to intergranular stress-corrosion cracking has been prevented by avoiding the use of sensitized stainless steel in accordance with methods recommended in Regulatory Guide 1.44, "Control of the Use of Sensitized Stainless Steel."

The use of materials proven to be satisfactory by actual service experience and avoidance of sensitization by methods recommended in Regulatory Guide 1.44 provides reasonable assurance that the reactor vessel internals will not be susceptible to failure by corrosion or stress-corrosion cracking.

The applicant has described the measures that were taken to ensure that deleterious hot cracking of asutenitic steel welds was prevented. All weld filler metal was of selected composition, and welding processes were controlled to limit heat input and to produce welds with at least 5% delta ferrite, in conformance with recommendations in Regulatory Guide

1.31, "Control of Stainless Steel Welding." Following these recommendations provides reasonable assurance that no deleterious hot cracking will be present that could contribute to loss of integrity or functional capability.

REACTOR COOLANT SYSTEM AND CONNECTED SYSTEMS

Integrity of Reactor Coolant Pressure Boundary

General Material Considerations

We have reviewed the materials of construction for the reactor coolant pressure boundary to ensure that the possibility of serious corrosion or stress-corrosion is minimized. All materials used are compatibl with the expected environment, as proven by extensive testing and satisfactory service performance. The applicant has shown that the possibility of intergranular stress-corrosion in austenitic stainless steel used for components of the reactor coolant pressure boundary will be minimized because sensitization was avoided, and adequate precautions were taken to prevent contamination during manufacture, shipping, storage, and construction. The measures to avoid sensitization were in general conformance with the recommendations of Regulatory Guide 1.44, " Control of the Use of Sensitized Stainless," and included controls on compositions, heat treatments, welding processes, and cooling rates.

The use of materials with satisfactory service experience and the high degree of conformance with the recommendations of Regulatory Guide 1.44 provide reasonable assurance that austenitic stainless steel components will be compatible with the expected service environments, and the probability of loss of structural integrity is minimized.

Water Chemistry Control

Further protection against corrosion problems will be provided by control of the chemical environment. The composition of the reactor coolant will be controlled; and the proposed maximum contaminant levels, as well as the proposed pH, hydrogen overpressure, and boric acid concentrations, have been shown by tests and service experience to be adequate to protect against corrosion and stress-corrosion problems.

The possibility that serious corrosion or stress-corrosion problems would occur in the unlikely event that containment spray system operation is required will be minimized because the pH of the recirculating coolant will be maintained at 7.0 by additions of sodium hydroxide.

The controls on chemical composition that will be imposed on the reactor coolant and on the recirculating emergency core cooling water provide reasonable assurance that the reactor coolant boundary materials will be adequately protected from conditions that would lead to loss of integrity from stress-corrosion.

Control of Stainless Steel Welding

We have reviewed the controls to prevent hot cracking (fissuring) of austenitic stainless steel welds. These precautions included control of weld metal composition and welding processes to ensure at least 5% delta ferrite content in the weld metal. The methods complied with Section III of the ASME Code, and were in general conformance with the recommendations of Regulatory Guide 1.31, "Control of Stainless Steel Welding." The use of materials, processes, and test methods that were in accordance with these requirements and recommendations provides reasonable assurance that loss of integrity of austenitic stainless steel welds caused by hot cracking during welding will not occur.

CONTAINMENT HEAT REMOVAL AND ECCS SYSTEMS

General Material Considerations

(Compatibility with coolant)

We have reviewed the materials selection proposed for the containment heat removal and ECCS systems, in conjunction with the expected chemistry of the cooling and containment spray system water. The applicant has shown that the use of sensitized stainless steel will be avoided, and that the proposed chemistry will not cause stress-corrosion cracking of austenitic stainless steel under conditions that would be present during accident conditions.

We have concluded that the controls on material and cooling water chemistry proposed will provide reasonable assurance that the integrity of components of these systems will not be impaired by corrosion or stress-corrosion.

(Control of SS Welding)

The applicant has shown that welding of austenitic stainless steel for components of these systems will be controlled to prevent deleterious hot cracking. The proposed control of weld metal composition and welding procedures are in general conformance with the recommendations of Regulatory Guide 1.31, "Control of Stainless Steel Welding," and will provide assurance that loss of function will not result from hot cracking of welds."

MATERIALS ENGINEERING BRANCH

REFERENCES

General

Federal Register 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Plants," July 7, 1971.

Federal Register 10 CFR Part 50, § 50.55a, "AEC Codes and Standard Rules - Applicable Codes, Addenda, and Code Cases "In Effect" for Components that are part of the Reactor Coolant Pressure Boundary," June 12, 1971.

"Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants," Rev. 1, October 1972.

General Materials Considerations

Material Specifications

ASME Boiler and Pressure Vessel Code, Section III, 1971 Edition, plus Addenda through Summer 1973.

(a) Paragraph NB-2121: Permitted Material Specifications

(b) Paragraph NB-2122: Special Requirements Conflicting with Permitted Material Specifications

(c) Specifications for Materials Listed in Tables I-1.1, I-1.2, and I-1.3.

Chemistry of Reactor Coolant

AEC Regulatory Guide 1.56, "Maintenance of Water Purity in Boiling Water Reactors," June 1973.

List of AEC Approved Code Cases, February 22, 1973.

Fracture Toughness

10 CFR 50 - Appendix G, "Fracture Toughness Requirements," June 1, 1973.

ASME Boiler and Pressure Vessel Code, Section III, 1972 Summer Addenda, including Appendix C, "Protection Against Non-Ductile Failure."

ASME Specification, SA-370-71b, "Methods and Definitions for Mechanical Testing of Steel Products," ASME Boiler and Pressure Vessel Code, Section II, Part A - Ferrous, 1971 Edition, Summer and Winter, 1972 Addenda.

ASTM Specification E-208-69, "Standard Method for Conducting Dropweight Test to Determine Nil-Ductility Transition Temperature of Ferritic Steels," Annual Book of ASTM Standards, Part 31, July 1973.

ASTM Specification E 23-72, "Notched Bar Impact Testing of Metallic Materials," Annual Book of ASTM Standards, Part 31, July 1973.

Material Surveillance Programs

10 CFR 50 - Appendix H, "Reactor Vessel Material Surveillance Program Requirements," June 1, 1973.

ASTM Specification E-185-73, "Surveillance Tests on Structural Materials in Nuclear Reactors," Annual Book of ASTM Standards, Part 30, July 1973.

Austenitic Stainless Steel

AEC Regulatory Guide 1.31, "Control of Stainless Steel Welding," Revision 1, June 1973.

AEC Regulatory Guide 1.34, "Control of Electro-Slag Weld Properties," December 28, 1972.

AEC Regulatory Guide 1.36, "Nonmetallic Thermal Insulation for Austenitic Stainless Steel," February 23, 1973.

AEC Regulatory Guide 1.43, "Control of Stainless Steel Weld Cladding of Low-Alloy Steel Components," May 1973.

AEC Regulatory Guide 1.44, "Control of the Use of Sensitized Stainless Steel," May 8, 1973.

AEC Regulatory Guide 1.50, "Control of Preheat Temperature for Welding of Low-Alloy Steel," May 1973.

ASTM Specification, A-262-70, Practice E, "Copper-Copper Sulfate-Sulfuric Acid Test for Detecting Susceptibility to Intergranular Attack in Stainless Steels," Annual Book of ASTM Standards, Part 3, April 1973.

Pump Flywheels

(1) AEC Regulatory Guide 1.14, "Reactor Coolant Pump Flywheel Integrity," October 27, 1971.

RCPB Leakage Detection Systems

(1) AEC Regulatory Guide 1.45, "Reactor Coolant Pressure Boundary Leakage Detection Systems," May 1973.

Inservice Inspection Program

(1) AEC Guideline Document, "Inservice Inspection Requirements for Nuclear Power Plants Constructed with Limited Accessibility for Inservice Inspections," January 31, 1969.

(2) ASME Boiler and Pressure Vessel Code, Section XI, 1971 Edition, including Winter 1971, Summer 1971, Winter 1972, and Summer 1973 Addenda.

(3) Regulatory Guide 1.51, "Inservice Inspection of ASME, Class 2 and 3 Nuclear Power Plant Components," May 1973.

Reactor Vessel Integrity

(1) ASME Boiler and Pressure Vessel Code, Section III, 1971 Edition plus Addenda through Winter 1972.

(2) ASME Boiler and Pressure Vessel Code, Section XI, 1971 Edition plus Addenda through Winter 1972.

Containment Leakage Testing

(1) 10 CFR 50 - Appendix J, "Reactor Containment Leakage Testing for Water-Cooled Power Reactors," February 14, 1973.

(2) American National Standard ANSI N45.4-1972, "Leakage-Rate Testing of Containment Structures for Nuclear Reactors," March 16, 1972.