

January 14, 2005

Mr. Jeffery B. Archie
Vice President, Nuclear Plant Operations
South Carolina Electric & Gas Company
Virgil C. Summer Nuclear Station
Post Office Box 88
Jenkinsville, South Carolina 29065

SUBJECT: V. C. SUMMER NUCLEAR STATION - EXEMPTION FROM THE
REQUIREMENTS OF 10 CFR PART 50, SECTIONS 50.44, 50.46, AND
APPENDIX K (TAC NO. MC4462)

Dear Mr. Archie:

The Commission has approved the enclosed exemption from specific requirements of Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Sections 50.44 and 50.46, and Appendix K, for the V. C. Summer Nuclear Station. This action is in response to your letter of September 3, 2004, as supplemented by letter dated November 11, 2004, that submitted an exemption to allow up to four lead test assemblies containing fuel rods with Optimized ZIRLO™ and several different developmental clad alloys.

A copy of the exemption has been forwarded to the Office of the Federal Register for publication.

Sincerely,

/RA/

Karen R. Cotton, Project Manager, Section 1
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-395

Enclosure: Exemption

cc w/enclosure: See next page

January 14, 2005

Mr. Jeffery B. Archie
Vice President, Nuclear Plant Operations
South Carolina Electric & Gas Company
Virgil C. Summer Nuclear Station
Post Office Box 88
Jenkinsville, South Carolina 29065

SUBJECT: V. C. SUMMER NUCLEAR STATION - EXEMPTION FROM THE
REQUIREMENTS OF 10 CFR PART 50, SECTIONS 50.44, 50.46, AND
APPENDIX K (TAC NO. MC4462)

Dear Mr. Archie:

The Commission has approved the enclosed exemption from specific requirements of Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Sections 50.44 and 50.46, and Appendix K, for the V. C. Summer Nuclear Station. This action is in response to your letter of September 3, 2004, as supplemented by letter dated November 11, 2004, that submitted an exemption to allow up to four lead test assemblies containing fuel rods with Optimized ZIRLO™ and several different developmental clad alloys.

A copy of the exemption has been forwarded to the Office of the Federal Register for publication.

Sincerely,

/RA/

Karen R. Cotton, Project Manager, Section 1
Project Directorate II
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-395

Enclosure: Exemption

cc w/enclosure: See next page

DISTRIBUTION:

PUBLIC	RidsNrrDlpmDpr	RidsNrrPMKCotton
PDII-1 R/F	RidsOgcRp	FAkstulewicz
RidsNrrDlpmLpdii (EHackett)	GHill (2 Copies)	AHsia, EDO
RidsNrrDlpmLpdii1 (JNakoski)	RidsAcrsAcnwMailCenter	
BClayton (Hard Copy)	RidsRgn2MailCenter (KLandis)	

ADAMS Accession Number: ML050040249

* no legal objection

NRR-048

OFFICE	PDII-1/PM	PDII-1/LA	SRXB/SC	OGC	PDII-1/SC	PDI/D	DLPM/D
NAME	KCotton	BClayton	Fakstulewicz by memo dated	SLewis "NLO" *	JNakoski	EHackett	JLyons for LMarsh
DATE	1/10/05	1/10/05	11/18/04	1/6/05	1/10/05	1/10/05	1/14/05

OFFICIAL RECORD COPY

VIRGIL C. SUMMER NUCLEAR STATION
South Carolina Electric & Gas Company

cc:

Mr. R. J. White
Nuclear Coordinator
S.C. Public Service Authority
c/o Virgil C. Summer Nuclear Station
Post Office Box 88, Mail Code 802
Jenkinsville, South Carolina 29065

Ms. Kathryn M. Sutton, Esquire
Winston & Strawn Law Firm
1400 L Street, NW
Washington, DC 20005-3502

Resident Inspector/Summer NPS
c/o U.S. Nuclear Regulatory Commission
576 Stairway Road
Jenkinsville, South Carolina 29065

Chairman, Fairfield County Council
Drawer 60
Winnsboro, South Carolina 29180

Mr. Henry Porter, Assistant Director
Division of Waste Management
Bureau of Land & Waste Management
Dept. of Health & Environmental Control
2600 Bull Street
Columbia, South Carolina 29201

Mr. Thomas D. Gatlin, General Manager
Nuclear Plant Operations
South Carolina Electric & Gas Company
Virgil C. Summer Nuclear Station
Post Office Box 88, Mail Code 300
Jenkinsville, South Carolina 29065

Mr. Ronald B. Clary, Manager
Nuclear Licensing
South Carolina Electric & Gas Company
Virgil C. Summer Nuclear Station
Post Office Box 88, Mail Code 830
Jenkinsville, South Carolina 29065

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
SOUTH CAROLINA ELECTRIC & GAS COMPANY
VIRGIL C. SUMMER NUCLEAR STATION
DOCKET NO. 50-395
EXEMPTION

1.0 BACKGROUND

The South Carolina Electric & Gas Company (SCE&G, the licensee) is the holder of the Renewed Facility Operating License No. NPF-12 which authorizes operation of the Virgil C. Summer Nuclear Station (VSNS). The license provides, among other things, that the facility is subject to all rules, regulations, and orders of the Nuclear Regulatory Commission (NRC or the Commission) now or hereafter in effect.

The facility consists of a pressurized-water reactor located in Fairfield County in South Carolina.

2.0 REQUEST/ACTION

Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Section 50.44 specifies requirements for the control of hydrogen gas generated after a postulated loss-of-coolant accident (LOCA) for reactors fueled with zirconium cladding. Acceptance criteria contained in 10 CFR 50.46 are for emergency core cooling systems (ECCSs) for reactors fueled with zircaloy or ZIRLO™ cladding. In addition, Appendix K to 10 CFR Part 50 requires that the Baker-Just equation be used to predict the rates of energy release, hydrogen concentration, and cladding oxidation from the metal-water reaction.

In summary, the exemption request relates solely to the specific types of cladding material specified in these regulations. As written, the regulations presume the use of zircaloy

or ZIRLO™ fuel rod cladding. Thus, an exemption from the requirements of 10 CFR 50.44, 10 CFR 50.46, and Appendix K to 10 CFR Part 50 is needed to irradiate lead test assemblies (LTAs) consisting of developmental clad alloys at VSNS.

3.0 DISCUSSION

3.1 Fuel Mechanical Design

Optimized ZIRLO™

Optimized ZIRLO™ has a lower tin content than the licensed ZIRLO™. Tin is a solid solution strengthener and α -phase stabilizer present entirely in the base α -phase zirconium crystalline structure. Potential impacts of a reduced tin content on material properties include (1) a reduced tensile strength, (2) an increased thermal creep rate, (3) an increased irradiation growth rate, (4) a reduced $\alpha \div \alpha + \beta$ phase transition temperature, and (5) an improved corrosion resistance. The slight reduction in tin content will not effect the size, shape, or distribution of any second phase or inter-metallic precipitates, nor the overall microstructure of this developmental zirconium alloy. With a consistent microstructure, low tin ZIRLO™ will exhibit many similar material characteristics as the licensed ZIRLO™. Further, the final annealing of Optimized ZIRLO™ has been designed to improve mechanical performance.

In the exemption request, SCE&G provides details of the planned post-irradiation examinations (PIEs) of the LTAs. Examinations include rod profilometry, rod growth, rod oxidation, and visual inspection. In response to a request for additional information, the licensee stated that PIE data, as well as data from other Westinghouse LTA programs, will be used to ensure existing design models remain valid.

As a result of the PIEs, any negative aspects of the low tin alloy's performance, including the potential impacts of a reduced tin content identified above, will be identified and resolved. Furthermore, significant deviations from model predictions will be reconciled.

The fuel rod burnup and fuel duty experienced by the LTAs in VSNS will remain well within the operating experience base and applicable licensed limits for ZIRLO™.

Utilizing currently approved fuel performance and fuel mechanical design models and methods, SCE&G and Westinghouse will perform cycle-specific reload evaluations to ensure that the LTAs satisfy existing design criteria.

Based upon LTA irradiation experience of similar low tin versions of ZIRLO™, expected performance due to similar material properties, and an LTA PIE program aimed at qualifying model predictions, the staff finds the LTA mechanical design acceptable for VSNS.

3.2 Core Physics and Non-LOCA Safety Analysis

The SCE&G exemption request relates solely to the specific types of cladding material specified in the regulations. No new or altered design limits for purposes of 10 CFR Part 50, Appendix A, General Design Criterion 10, "Reactor Design," need to be applied or are required for this program.

Optimized ZIRLO™

Due to similar material properties, any impact of low tin ZIRLO™ on the safety analysis models and methods is expected to be minimal. Utilizing currently approved core physics, core thermal-hydraulics, and non-LOCA safety analysis models and methods, SCE&G and Westinghouse will perform cycle-specific reload evaluations to ensure that the LTAs satisfy design criteria.

Nuclear design evaluations will ensure that LTAs be placed in nonlimiting core locations. As such, additional thermal margin to design limits will be maintained between LTA fuel rods and the hot rod evaluated in safety analyses. Thermal-hydraulic and non-LOCA evaluations will confirm that the LTAs are bounded by the current analysis of record.

Based upon the use of approved models and methods, expected material performance, and the placement of LTAs in nonlimiting core locations, the staff finds that the

irradiation of up to four LTAs in VSNS will not result in unsafe operation nor violation of Specified Acceptable Fuel Design Limits. Furthermore, in the event of a Design Basis Accident, these LTAs will not promote consequences beyond those currently analyzed.

3.3 Regulatory Evaluation

Pursuant to 10 CFR 50.12, the Commission may, upon application by any interested person or upon its own initiative, grant exemptions from the requirements of 10 CFR Part 50 if, (1) the exemptions are authorized by law, will not present an undue risk to public health or safety, and are consistent with the common defense and security; and (2) special circumstances are present.

3.3.1 10 CFR 50.44

The underlying purpose of 10 CFR 50.44 is to ensure that means are provided for the control of hydrogen gas that may be generated following a LOCA. The licensee has provided means for controlling hydrogen gas and has previously considered the potential for hydrogen gas generation stemming from a metal-water reaction. The LTA rods containing a low tin version of ZIRLO™ cladding are similar in chemical composition to zircaloy cladding. Metal-water reaction tests performed by Westinghouse on low tin versions of ZIRLO™ (documented in Appendix B of Addendum 1 to WCAP-12610-P-A) demonstrate comparable reaction rates. Accordingly, the previous calculations of hydrogen production resulting from a metal-water reaction will not be significantly changed. As such, application of 10 CFR 50.44 is not necessary for the licensee to achieve its underlying purpose in these circumstances.

3.3.2 10 CFR 50.46

The underlying purpose of 10 CFR 50.46 is to establish acceptance criteria for ECCS performance. The applicability of these ECCS acceptance criteria has been demonstrated by Westinghouse. Ring compression tests performed by Westinghouse on low tin versions of ZIRLO™ (documented in Appendix B of Addendum 1 to WCAP-12610-P-A) demonstrate an

acceptable retention of post-LOCA ductility up to 10 CFR 50.46 limits of 2200 EF and 17 percent Equivalent Cladding Reacted. Utilizing currently approved LOCA models and methods, Westinghouse will perform cycle-specific reload evaluations prior to use to ensure that the LTAs satisfy 10 CFR 50.46 acceptance criteria. Therefore, the exemption to expand the application of 10 CFR 50.46 to include Optimized ZIRLO™ is acceptable.

3.3.3 10 CFR Part 50, Appendix K

Paragraph I.A.5 of Appendix K to 10 CFR Part 50 states that the rates of energy, hydrogen concentration, and cladding oxidation from the metal-water reaction shall be calculated using the Baker-Just equation. Since the Baker-Just equation presumes the use of zircaloy clad fuel, strict application of the rule would not permit use of the equation for the LTA cladding for determining acceptable fuel performance. Metal-water reaction tests performed by Westinghouse on low tin versions of ZIRLO™ (documented in Appendix B of Addendum 1 to WCAP-12610-P-A) demonstrate conservative reaction rates relative to the Baker-Just equation. Thus, application of Appendix K, Paragraph I.A.5 is not necessary for the licensee to achieve its underlying purpose in these circumstances.

3.3.4 Special Circumstances

In summary, the staff reviewed the licensee's request of proposed exemption to allow up to four LTAs containing fuel rods, guide thimble tubes, and instrumentation tubes fabricated with Optimized ZIRLO™. Based on the staff's evaluation, as set forth above, the staff considers that granting the proposed exemption will not defeat the underlying purpose of 10 CFR 50.44, 10 CFR 50.46, or Appendix K to 10 CFR Part 50. Accordingly, special circumstances, are present pursuant to 10 CFR 50.12(a)(2)(ii).

3.3.5. Other Standards in 10 CFR 50.12

The staff examined the rest of the licensee's rationale to support the exemption request, and concluded that the use of Optimized ZIRLO™ would satisfy 10 CFR 50.12(a) as follows:

1) The requested exemption is authorized by law:

No law precludes the activities covered by this exemption request. The Commission, based on technical reasons set forth in rulemaking records, specified the specific cladding materials identified in 10 CFR 50.44, 10 CFR 50.46, and 10 CFR Part 50, Appendix K. Cladding materials are not specified by statute.

2) The requested exemption does not present an undue risk to the public health and safety as stated by the licensee:

The LTA safety evaluation will ensure that these acceptance criteria [in the Commission's regulations] are met following the insertion of LTAs containing Optimized ZIRLO™ material. Fuel assemblies using Optimized ZIRLO™ cladding will be evaluated using NRC-approved analytical methods and plant specific models to address the changes in the cladding material properties. The safety analysis for VSNS is supported by the applicable technical specification. The VSNS reload cores containing Optimized ZIRLO™ cladding will continue to be operated in accordance with the operating limits specified in the technical specifications. LTAs utilizing Optimized ZIRLO™ cladding will be placed in non-limiting core locations. Thus, the granting of this exemption request will not pose an undue risk to public health and safety.

The NRC staff has evaluated these considerations as set forth in Section 3.1 of this exemption. For the reasons set forth in that Section, the staff concludes that Optimized ZIRLO™ may be used as a cladding material for no more than four LTAs to be placed in nonlimiting core locations during VSNS' next refueling outage, and that an exemption from the requirements of 10 CFR 50.44, 10 CFR 50.46, and 10 CFR Part 50, Appendix K does not pose an undue risk to the public health and safety.

4.0 CONCLUSION

Accordingly, the Commission has determined that, pursuant to 10 CFR 50.12(a), the exemption is authorized by law, will not present an undue risk to the public health and safety, and is consistent with the common defense and security. Also, special circumstances are present. Therefore, the Commission hereby grants SCE&G exemptions from the requirements of 10 CFR 50.44, 10 CFR 50.46, and 10 CFR Part 50, Appendix K, to allow four LTAs containing fuel rods with Optimized ZIRLO™ and several different developmental clad alloys.

Pursuant to 10 CFR 51.32, the Commission has determined that the granting of this exemption will not have a significant effect on the quality of the human environment (70 FR 1742).

This exemption is effective upon issuance.

Dated at Rockville, Maryland, this 14th day of January 2005.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

James E. Lyons, Deputy Director
Division of Licensing Project Management
Office of Nuclear Reactor Regulation