March 10, 2008

Mr. M. R. Blevins
Executive Vice President
& Chief Nuclear Officer
Luminant Generation Company LLC
ATTN: Regulatory Affairs
P. O. Box 1002
Glen Rose, TX 76043

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION, UNIT 2 – REQUEST FOR RELIEF B-5 FOR SECOND 10-YEAR ISI INTERVAL FROM 10 CFR 50.55a REQUIREMENTS FOR CLASS 1 REPAIR/REPLACEMENT OF CONTROL ROD DRIVE MECHANISM CANOPY SEAL WELDS (TAC NO. MD7528)

Dear Mr. Blevins:

The U.S. Nuclear Regulatory Commission (NRC) staff has reviewed and evaluated the information provided by Luminant Generation Company LLC (the licensee), in its letter dated December 19, 2007. The licensee requested approval of Relief Request (RR) B-5, for Comanche Peak Steam Electric Station (CPSES), Unit 2, in which the licensee requested relief from the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, for an alternative method for weld overlay of control rod drive mechanism (CRDM) canopy seal welds. Specifically, the licensee's relief request will allow the use of the ASME Code, Section XI, Code Case N-504-2, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping," for weld repair and perform an enhanced visual examination and a pressure test.

Based on the information provided in the licensee's submittal, the NRC staff determines that the Code-specified repair method and the surface examination of the CRDM canopy seal welds would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. In addition, the proposed alternative method for weld overlay of CRDM canopy seal welds provides reasonable assurance of structural integrity. Therefore, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, paragraph 50.55a(a)(3)(ii), the proposed alternatives are authorized for the CPSES, Unit 2, for the remainder of its second 10-year ISI interval.

All other ASME Code, Section XI, requirements for which relief was not specifically requested and authorized herein by the NRC staff remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

The NRC staff's safety evaluation is enclosed.

Sincerely,

/RA/

Thomas G. Hiltz, Chief
Plant Licensing Branch IV
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket No. 50-446

Enclosure: Safety Evaluation

cc w/encl: See next page

All other ASME Code, Section XI, requirements for which relief was not specifically requested and authorized herein by the NRC staff remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

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OFFICE	NRR/LPL4/PM	NRR/LPL4/LA	NRR/CPNB/BC	OGC-**NIo***	NRR/LPL4/BC
NAME	BSingal:gkl	JBurkhardt	TChan (*)	JBiggins	THiltz
DATE	2-29-08	2/29/08	2/15/08	3/7/08	3/10/08

OFFICIAL AGENCY RECORD *w/changes

cc:
Senior Resident Inspector
U.S. Nuclear Regulatory Commission
P.O. Box 2159
Glen Rose, TX 76403-2159

Regional Administrator, Region IV
U.S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011

Mr. Fred W. Madden, Director
Regulatory Affairs
Luminant Generation Company LLC
P.O. Box 1002
Glen Rose, TX 76043

Timothy P. Matthews, Esq.
Morgan Lewis
1111 Pennsylvania Avenue, NW
Washington, DC 20004

County Judge
P.O. Box 851
Glen Rose, TX 76043

Environmental and Natural
Resources Policy Director
Office of the Governor
P.O. Box 12428
Austin, TX 78711-3189

Mr. Richard A. Ratliff, Chief
Bureau of Radiation Control
Texas Department of Health
1100 West 49th Street
Austin, TX 78756-3189

Mr. Brian Almon
Public Utility Commission
William B. Travis Building
P.O. Box 13326
1701 North Congress Avenue
Austin, TX 78701-3326

Ms. Susan M. Jablonski
Office of Permitting, Remediation
and Registration
Texas Commission on Environmental
Quality
MC-122
P.O. Box 13087
Austin, TX 78711-3087

Anthony P. Jones
Chief Boiler Inspector
Texas Department of Licensing
and Regulation
Boiler Division
E.O. Thompson State Office Building
P.O. Box 12157
Austin, TX 78711

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELIEF REQUEST B-5, REPAIR/REPLACEMENT OF

CONTROL ROD DRIVE MECHANISM CANOPY SEAL WELDS

COMANCHE PEAK STEAM ELECTRIC STATION, UNIT 2

LUMINANT GENERATION COMPANY LLC

DOCKET NO. 50-446

1.0 INTRODUCTION

By letter dated December 19, 2007 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML073620209), Luminant Generation Company LLC (the licensee) requested relief from the requirements of the 1998 Edition through the 2000 Addenda of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), Section XI, for an alternative method for a weld overlay of a control rod drive mechanism (CRDM) canopy seal welds for Comanche Peak Steam Electric Station (CPSES), Unit 2. The licensee submitted Relief Request (RR) B-5 for the second 10-year inservice inspection (ISI) interval which began on August 3, 2004. This request is essentially a request for re-approval of an earlier RR B-10 (ADAMS Accession No. ML030800600, dated March 31, 2003, TAC No. MB7742) for CPSES, Unit 2 as the edition for ASME Code, Section XI at CPSES, Unit 2 has been updated from the 1986 Edition, no Addenda to the 1998 Edition through the 2000 Addenda. The code revisions have not negated the need for an alternative.

Article IWA-4340, “Mitigation of Defects by Modification,” of the ASME Code, Section XI, requires that modification shall meet the original Construction code and Owner’s requirements for the item. The licensee has proposed the use of ASME Code, Case N-504-2, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping," for guidance to establish the acceptability of a repair by increasing weld thickness by weld overlay as an alternative to IWA-4300. In this request, Alloy 52 nickel-based weld repair material would be used rather than austenitic stainless steel as required by Code Case N-504-2, Paragraph (b), for the repair. Consequently, the ferrite requirements of Code Case N-504-2, Paragraph (e) would not apply. In addition, the CRDM canopy seal weld is a Code seal weld as described in Article NB-3227 of the ASME Code, Section III, and requires a liquid penetrant test (PT) examination of the final weld in accordance with Article NB-5271. As an alternative to the PT examination, the licensee will perform an enhanced 8X VT-1 visual examination of the repair.

The repair of leaking seal welds would be performed using the guidelines of ASME Code Case N-504-2, which establishes acceptability of a repair by increasing the weld thickness, and performing an enhanced 8X VT-1 visual examination and pressure verification test in lieu of the

Code-required surface examination for final acceptance of the repaired weld. The licensee's basis for the request is that the Code-required repair method and the required surface examination of the seal welds would expose personnel to a high radiation dose, which would create a hardship or unusual difficulty without a compensating increase in the level of quality and safety. The use of Alloy 52 nickel-based weld repair material is based upon its resistance to stress-corrosion cracking.

2.0 REGULATORY EVALUATION

The ISI of ASME Code Class 1, 2, and 3 components is to be performed in accordance with Section XI of the ASME Code and applicable edition and addenda as required by paragraph 50.55a(g), "Codes and standards," of Title 10 of the *Code of Federal Regulations* (10 CFR), except where specific written relief has been granted by the Commission. Paragraph 50.55a(a)(3) states, in part, that alternatives to the requirements of paragraph (g) may be used, when authorized by the U.S. Nuclear Regulatory Commission (NRC), if the licensee demonstrates that: (i) the proposed alternatives would provide an acceptable level of quality and safety, or (ii) compliance with the specified requirements would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

Pursuant to 10 CFR 50.55a(g)(4), ASME Code Class 1, 2, and 3 components (including supports) must meet the requirements, except design and access provisions and preservice examination requirements, set forth in ASME Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," that inservice examination of components and system pressure tests, conducted during the first 10-year interval and subsequent intervals, comply with the requirements in the latest edition and addenda of Section XI of the ASME Code incorporated by reference in 10 CFR 50.55a(b), 12 months prior to the start of the 120-month interval, subject to the limitations and modifications listed therein. The Code of record for the second 10-year ISI interval at CPSES, Unit 2, is the 1998 Edition with the 2000 Addenda of Section XI of the ASME Code.

3.0 TECHNICAL EVALUATION

3.1 Components for Which Relief is Requested (as stated by licensee)

Reactor control rod drive mechanism (CRDM) canopy seal welds - Class 1 Appurtenance to the reactor vessel.

3.2 Applicable Code Edition and Addenda (as stated by licensee)

ASME Code, Section XI, 1998 Edition with the 2000 Addenda. Designed and fabricated to ASME Code, Section III, 1974 Edition, Summer 1974 Addenda.

3.3 ASME Code Requirements for which Relief is Requested (as stated by licensee)

Article IWA-4340 "Mitigation of Defects by Modification" of the ASME Code, Section XI requires that the modification shall meet the original construction Code and Owner's requirements for the item. The CRDM canopy seal weld is a Code seal weld as described in Article NB-3227 of ASME Code, Section III and requires a liquid PT examination of the final weld in accordance with Article NB-5271. As an alternative to

the PT examination, this request will require an 8X visual examination of the repair. Additionally, this request includes use of ASME Code, Code Case N-504-2 for guidance to establish the acceptability of a repair by increasing the weld thickness by weld overlay as an alternative to Article IWA-4300. Furthermore, the licensee is requesting the use of Alloy 52 nickel-based weld repair material rather than austenitic stainless steel as required by Code Case N-504-2. Consequently, the ferrite requirements of Code Case N-504-2, Paragraph (e) do not apply.

3.4 Licensee's Basis for Relief and Proposed Alternative (as stated)

During an inspection of a CRDM in Unit 1 in 2002, the licensee identified boric acid crystal buildup on the CRDM housing. Further investigation revealed evidence of minor leakage at the intermediate CRDM canopy seal weld. The CRDM canopy seal welds are located above the Reactor Vessel Closure Head, which is highly congested and subject to high radiation levels. In the event that Unit 2 develops a similar damaged mechanism, the Code-required repair method would involve excavation of the defects and restoration to the original configuration. The Code repair method requires manual excavation of the defects and manual repair welding, and has a higher risk of failure due to the difficulty of making a quality weld on the canopy seal accompanied by the required back-purging and cleaning. In addition to the difficulty and time required to remove the defect and re-weld the canopy, a similar level of difficulty and resultant time is required for a PT examination of the weld repair. The high radiological dose associated with strict compliance with these requirements would be contrary to the intent of the ALARA (as low as reasonably achievable) radiological controls program. The PT examination would result in an estimated total dose of approximately 0.6 person-Rem [roentgen equivalent man] per CRDM canopy seal weld. The licensee requests relief from the requirements of Article IWA-4000 in accordance with 10 CFR 50.55a(a)(3)(ii) by proposing an alternative method of repair and nondestructive examination due to hardship and unusual difficulty without a compensating increase in quality or safety.

ASME Code, Code Case N-504-2, "Alternative Rules for Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping, Section XI, Division 1," (approved in RG 1.147 Rev. 14, [Regulatory Guide 1.147, Revision 14, "Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1"] with conditions) will be used as guidance for repair by weld overlay which increases the weld thickness to establish the acceptability of the defect in accordance with Article IWA-4340. In addition, alloy 52 nickel-based weld repair material will be used rather than austenitic stainless steel as required by Code Case N-504-2. In lieu of performance of PT examinations of CRDM seal weld repairs or replacement, an enhanced 8X visual (VT-1) examination will be performed after welding is completed.

The alternative method of repair and nondestructive examination is being requested to facilitate such a repair in CPSES, Unit 2, should the need arise, for the second interval of CPSES, Unit 2 operation.

Industry experience with failure analyses performed on leaking canopy seal welds removed from service at other plants has attributed the majority of the cases to transgranular stress corrosion cracking (SCC). The size of the opening where leakage occurs has been extremely small, normally a few thousandths of an inch. The crack orientations vary, but often radiate outward such that a pinhole appears on the surface,

as opposed to a long crack. The SCC results from exposure of a susceptible material to residual stress, which is often concentrated by weld discontinuities, and to a corrosive environment, such as water trapped in the cavity behind the seal weld that is mixed with the air initially in the cavity, resulting in higher oxygen content than is in the bulk primary coolant.

As allowed by the guidance of Code Case N-504-2, the CRDM canopy seal weld flaws will not be removed, but an analysis of the repaired weldment will be performed using Paragraph (g) of the Code case as guidance to assure that the remaining flaw will not propagate unacceptably. This analysis establishes the critical flaw size used to qualify the VT-1 examination method to ensure capability of detecting a flaw sufficiently small to assure an adequate margin of safety is maintained. The CRDM canopy seal weld is not a structural weld, nor a pressure-retaining weld, but provides a seal to prevent reactor coolant leakage if the mechanical joint leaks.

The alternative CRDM canopy seal weld repair uses a Gas Tungsten Arc Welding (GTAW) process and VT-1 examination controlled remotely. The VT-1 examination will use a video camera with approximately 8X magnification within several inches of the weld, qualified to ensure identification of a flaw significantly smaller than the analyzed critical flaw size. The examination technique will be demonstrated to resolve a 0.001 inch thick wire against the surface of the weld. The proposed alternative is an enhanced visual examination technique with resolution and consistency much greater than that provided by the requirements of a Code (visually unaided) VT-1 and comparable to flaw sizes detectable using PT. Based on the capability of the remote visual examination system to resolve flaws of a size 0.001 inch in width, reasonable assurance of the weld integrity is provided.

Additionally, alloy 52 nickel-based weld repair material will be used rather than austenitic stainless steel as required by Code Case N-504-2. Alloy 52 nickel-base weld repair material was selected rather than austenitic stainless steel as required by Code Case N-504-2, Paragraph (b), for the repair because of its resistance to SSC. Consequently, the ferrite requirements of Code Case N-504-2, Paragraph (e) do not apply. The repair will be documented on Form NIS-2A, reviewed by the Authorized Nuclear Inspector, and maintained in accordance with the requirements for archiving permanent plant records.

The GTAW weld repair and VT-1 examination methods result in significantly lower radiation exposure because the equipment is remotely operated after setup.

The use of remote visual examination and pressure test provide weld integrity for the multiple layer seal weld repair or the seal weld replacement. The radiation exposure associated with performance of a Code-required repair or surface examination would not result in a compensating increase in the level of quality and safety.

3.5 NRC Staff Evaluation

The licensee has proposed to perform the repair of leaking seal welds using the applicable provisions of Code Case N-504-2, which establishes acceptability of a repair by increasing the weld thickness and performing an enhanced 8X VT-1 visual examination and pressure

verification test, in lieu of the Code-required surface examination for final acceptance of the repaired welds. The Code case allows deposition of one or more layers of weld overlay to seal unacceptable indications in the area to be repaired without excavation. The Code case further requires an analysis of the repaired weldment to assure that the existing flaw will not propagate unacceptably for the design life of the repair, considering potential flaw growth due to fatigue and SCC, the mechanism believed to have caused the flaw. This analysis will establish a critical flaw size that can be used as a benchmark to qualify the VT-1 examination method to ensure the capability of detecting flaws of a size small enough to assure that an adequate margin of safety is maintained. Since the seal weld is neither a structural weld nor a pressure-retaining weld, the NRC staff finds the proposed alternative repair method to be acceptable. The licensee has also proposed to use Alloy 52 nickel-based weld repair material in place of austenitic stainless steel as required by Code Case N-504-2 due to its resistance to SCC and is, therefore, acceptable.

The welding process consists of multiple layers of weld metal welded over the existing seal weld. The multiple layers of weld metal provide a redundant CRDM nozzle-to-canopy seal. Each layer is a seal in and of itself. The adequacy of the seal is verified with a routine system leakage test that is performed at normal operating temperature and pressure, and held at such conditions for a Code-required soak time prior to returning to the system to service.

In lieu of surface examination, the licensee proposes to conduct a remote VT using a video camera with an 8X magnification and 0.001 inch resolution within several inches of the weld. The visual resolution of the video camera system has greater capability than that of the ASME Code-required direct VT-1 visual examination of resolving a wire segment as narrow as a 1/32-inch black line on an 18 percent neutral gray card. Therefore, the resolution and consistency of the licensee's enhanced visual examination technique are much greater than that provided by the ASME Code (visually unaided) VT-1 examination and comparable to flaw sizes detectable using PT. Based on the capability of the remote visual examination system to resolve flaws of a size 0.001 inches in width, reasonable assurance of detecting surface flaws is provided.

The licensee's basis for performing the remote 8X enhanced visual examination with a resolution of 0.001 inches in lieu of a PT is the radiation dose saving that is anticipated to be achieved through the use of the remote visual examination process when compared to a manual PT examination process. The licensee stated that the radiological dose associated with strict compliance with the ASME Code-required repair and inspection would be high and contrary to the intent of the ALARA (as low as reasonable achievable) radiological controls program because the canopy seal weld is located in a high radiation area. According to the licensee, the PT examination alone would result in an estimated total dose of approximately 0.6 person-rem per CRDM canopy seal weld. This dose estimate represents the total amount that could be averted for the examination since the dose associated with setting up the remote visual examination system is included in the dose associated with installing and removing the GTAW apparatus. Based on the determination above, that reasonable assurance of detecting surface flaws is provided for the multiple layer seal weld by use of the remote visual examination and the pressure test, the radiation exposure associated with the performance of the Code-required surface examination is a hardship or unusual difficulty without a compensating increase in the level of quality and safety.

The NRC staff finds that the proposed alternative will result in reducing radiation dose exposure and that the proposed alternative repair will provide acceptable leakage integrity for the CRDM canopy seal welds while maintaining reasonable assurance of structural integrity.

4.0 CONCLUSION

Based on the above evaluation, the NRC staff concludes that the Code-required repair and surface examination of the canopy seal welds would result in a hardship or unusual difficulty without a compensating increase in the level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(ii), the staff authorizes the proposed alternative stated in RR B-5 for CPSES, Unit 2, for the second 10-year ISI interval for repair of the subject welds.

All other ASME Code, Section XI requirements for which relief was not specifically requested and approved in this relief request remain applicable, including third party review by the Authorized Nuclear Inservice Inspector.

Principal Contributor: Carol A. Nove

Date: March 10, 2008