Sargent & Lundy LLC

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November 24, 2009
Project No. 00037-000
Docket Number 99900507

Sargent & Lundy Response to Notice of Nonconformance
NRC Inspection Report 99900507/2009-201

United States Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Dear Sir:

NRC Inspection Report 99900507/2009-201 dated October 27, 2009 identified a Notice of Nonconformance. The report requested a written response to the Notice of Nonconformance within 30 days of the date of the report.

Attached please find a complete response to the Notice of Nonconformance.

if you should require additional information, please do not hesitate to contact me.

Yours very truly,

Randall L. Kurtz
Quality Assurance Director

RLK:JWM:tls
Enclosures
Copies:
Richard Rasmussen, Chief, Quality and Vendor Branch B, Division of Construction Inspection and
  Operational Programs, Office of New Reactors
File

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Notice of Nonconformance

Requirement:

Criterion III, "Design Control" of Appendix B to 10 CFR Part 50 states, in part, that "measures shall also be established for the selection and review for suitability of application of materials, parts, equipment, and processes that are essential to the safety related functions of the structures, systems, and components." Additionally, Criterion III states in part that, "the design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program."

Section 02.00, "Quality Assurance Program," of the S&L Nuclear Quality Assurance Program Topical Report SL-TR-1A (QATR) Subsection 2.05 states that "the development and use of computer programs for quality-related activities are controlled by the Nuclear Quality Assurance Program, including Supplements 3S-1 and 11S-2, and Subpart 2.7 of ANSI/ASME NQA-1-1994." Supplements 3S-1 and 11S-2 and Subpart 2.7 of ANSI/ASME NQA-1-1994 provide requirements for design control and computer software.

S&L "Acceptance Plan for Procurement of Computer Software ACS SASSI," Revision 0, dated June 16, 2008, states the following:

> The Advanced Computer Software – System for Analysis of Soil-Structure Interaction (ACS SASSI) software shall be validated and documented in accordance with procedure SOP-0204 and guidance GAG-0204-01 prior to use. The test problems used in Ghiocel Predictive (GP) Technologies, Inc., verification and validation (V&V) shall be reviewed against S&L's intended application of the software. If S&L intends to apply the software to conditions outside the range of GP Technologies test problems, the problems shall be modified and/or supplemented to encompass the range of S&L's intended applications.

Description:

Contrary to the above, as of September 17, 2009, S&L failed to modify and/or supplement GP Technologies test problems to include the full range of S&L applications for South Texas Project (STP) Units 3 & 4. Specifically, S&L identified that a 94-soil layer model was required to perform the Soil-Structure Interaction (SSI) analysis for the STP Units 3 & 4 control building. S&L performed V&V of the ACS SASSI program using no more than 20-soil layer models.

Evaluation/Response:

This issue has been documented on S&L PIP No. 2009-1579.

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Reason for the Noncompliance:

S&L technical experts involved in the V&V of ACS SASSI utilized engineering judgment in concluding that the V&V testing performed was adequate. Lack of attention to detail resulted in the engineering judgment not being documented in the SVVR.

Supporting Information:

A Root Cause Analysis (RCA) conducted in conjunction with an earlier documented PIP (PIP 2009-1281) concluded, in part, that the ACS SASSI V&V "was done with sufficient rigor and was technically adequate", but that its documentation was somewhat lacking in attention to detail. The technical experts who prepared, reviewed, and approved the V&V did not consider the number of soil layers to be a significant factor in the overall nature of the results. They believed that the testing performed was technically adequate to validate the functionality of the program even though it did not test the software with models using as many soil layers as would eventually be used in the analyses performed in support of the STP COLA.

The V&V of ACS SASSI was performed under the S&L QA program. The test set was developed based on the expected use of the software, but not for every possible combination of variables used in the STP 3& 4 analyses. Based on industry practice, the test set was more than adequate. The V&V of ACS SASSI was consistent with the standard of care for software V&V in the nuclear power industry.

The standard of care for software verification and validation (V&V) in the nuclear power industry is defined by the Nuclear Regulatory Commission (NRC) rules and regulations for Quality Assurance 10CFR50, Appendix B, 10CFR21, and ASME NQA-1. Prior to its use for Nuclear Safety Related work, engineering application software must be validated by documented testing to demonstrate proper performance.

A variety of test problems is used in the validation. The results are checked against known classical solutions, experimental data, or results published in technical literature; solutions obtained from other verified and validated computer programs; and/or manual calculations.

For commercial software, the set of test problems is developed based on the features and capabilities, described in the user documentation, that are intended to be used. In addition to testing specific features, problems are included that demonstrate the software, as whole, is working correctly. For structural analysis applications there are countless combinations that can be analyzed. Test problems based on known classical solutions and/or published results are typically small sized problems.

For example, structural models can be made up of many nodes using several types of elements (frame, plane stress/strain, shell, and solid), and subject to multiple types of analyses (static, time history, and response spectrum). There is no defined maximum number of nodes, elements, and analyses. The number is practically limited by the amount of available memory and disk space. Validation is performed by testing each of the features individually and then running problems that combine the features. The results are compared to known classical solutions, published results, or manual calculations. The test problems, with known solutions,

are made up of a small number of nodes and elements, typically on the order of 10 nodes and elements.

The test set used for ACS SASSI consisted of a series of problems that tested individual characteristics and a set of larger problems were run to test the integration of the features. The results were compared with a set of known solutions.

To perform the V & V of ACS SASSI a set of twenty five (25) validation problems were considered. The set of V&V problems include SSI problems for which published analytical solutions (such as work performed by Luco, Kausel, Lysmer, Novak, Wong and others, who have published results addressing SSI phenomena), test results (such as Lotung's Experiment for a reduced-scale Embedded Reactor Building model), and computed results using other validated computer codes are available. None of the published solutions have more than 20 soil layers. The set of V & V problems are designed to validate different combination of the program features to cover all practical situation that could occur in SSI analyses. For example, the general results of SSI analyses are transfer functions, in-structure response spectra, and element forces in beam and plate elements. All of these features, as well as others, were validated.

S&L uses several engineering applications from vendors who provide the software under a vendor QA program. The vendor Nuclear QA programs are based on the NRC documents referenced above. As part of the acceptance of the vendor QA program, the vendor test problems are reviewed. The test sets developed by S&L are very similar in intent, complexity, and problem size when compared to vendor test sets.

Vendors of software applications provided under Nuclear QA programs routinely send reports of errors that were not detected during their V&V. It is not unusual to discover errors in verified and validated engineering applications when these applications are used in real-world situations. Software error reporting procedures exist for the purpose of reporting these occurrences. Users of engineering applications must be qualified and experienced in the processes where the software is applied and must always be alert to the possibility of anomalous results.

Impact and Extent:

The undocumented engineering judgment applied to the ACS SASSI V&V had no direct impact. The RCA concluded that additional test problems using a large number of soil layers would not necessarily have revealed the instability documented in PIP 2009-1281. Soil-Structure Interaction (SSI) is a highly complex analysis with numerous variables, specific combinations of which were needed to reveal the program's numerical instability. It is not feasible to test every possible combination of inputs. Dr. Surrendra Singh of S&L approved the S&L V&V package for ACS SASSI. Prior to this approval, Dr. Singh traveled to other companies who utilized ACS SASSI and interviewed them about their experience with the software. None of these users nor any documentation searched, such as NRC written resources and information from both domestic and foreign sources provided any indication in regards to a numerical instability issue with ACS SASSI.

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ACS SASSI is a recent S&L software acquisition that has been applied only to the analyses supporting the STP COLA, and it has subsequently been retired from service at S&L, so there is no potential impact upon any other S&L project or existing S&L-designed facility.

The acceptance of the V&V scope through undocumented engineering judgment is limited to the ACS SASSI software. This was determined through an Extent of Condition analysis based upon the Acceptance Plans currently in effect for all current production engineering applications. Each such Acceptance Plan was examined for V&V scope requirements, and case-by-case evaluations were performed on those applications for which such requirements were specified in the Acceptance Plan. The analysis concluded that ACS SASSI is the only case of a V&V completed under an Acceptance Plan that specifies a V&V scope requirement. Also, it is the only Acceptance Plan that utilizes a supplier's V&V problems while also specifying compliance with GAG-0204-01, which is otherwise non-binding. These circumstances distinguish it from all other engineering applications with regard to the requirements imposed by its Acceptance Plan.

Based upon the Extent of Condition analysis performed, it is concluded that the extent of the condition is limited to ACS SASSI software.

S&L's software QA meets or exceeds nuclear industry and ISO 9001:2008 requirements. Software V&V reports have been subjected to scrutiny on several occasions by our ISO registrar as well as by NUPIC auditors and numerous client auditors.

Corrective Steps Taken and Results Achieved:

During August, 2009, S&L requested Simpson, Gumphertz and Heger, Inc. (SGH) to perform additional testing of ACS SASSI by comparing its results with those obtained using SASSI 2000, Version 3.0. These tests confirmed that ACS SASSI had faults.

The numerical instability of ACS SASSI resulted in the reanalysis of proposed STP structures by means of different SSI software The analysis performed for the STP Project which utilized ACS SASSI have been corrected utilizing SASSI 2000.

Corrective Steps Taken to Avoid Non-Compliances:

The generic issue of greater attention to detail in the preparation, review, and approval of V&V documentation is tracked separately in PIP 2009-1571. To address the need for Preparers and Reviewers of SVVRs ensuring that the V&V fulfills the scope of the software's Acceptance Plan or Test Plan, as applicable, and that any applied engineering judgment is adequately documented, a Technical Alert (TA2009-0009) has been issued to emphasize the importance of clear, thorough, and professionally-presented V&V documentation and to clarify the responsibilities of SVVR Preparers, Reviewers, and Approvers. The Technical Alert has been published on SLweb and prepended to GAG-0204-01 as a reminder to V&V authors that V&V documentation deserves the same attention to detail and professionalism as does any deliverable that is prepared for a client. Also, SOP-0204, Computer Software Quality Policies and Requirements, has been revised to add Chief Process Manager involvement in software activities including development, deployment and training.

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S&L intends to provide additional training to Process Owners. The training will cover the Technical Alert and specific V&V documentation related PIPs.

Date When Corrective Action Will be Completed:

December 31, 2009