Gelder, Lawrence (CONTR)

From:	Shuler, James
Sent:	Wednesday, March 07, 2018 1:31 PM
To:	Gelder, Lawrence (CONTR)
Subject:	FW: SCALE User Notice - Sponsor information
Attachments:	SCALE User Notice - March 7, 2018.pdf

Importance: High

FYI

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Sent: Wednesday, March 07, 2018 1:57 PM
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Cc: SCALE LT <scale-lt@email.ornl.gov>; Tobin Jr, Kenneth William <tobinkwjr@ornl.gov>
Subject: SCALE User Notice - Sponsor information
Importance: High

Dear SCALE Sponsors,

Per the requirements of the *Quality Assurance Plan for the SCALE Code System* and specifically the *SCALE Procedure for Discrepancy Reports*, I am notifying you about an issue that we have determine to be a *Significant Software Error* and would like to communicate to the SCALE user community. Per the 2013 *SCALE Procedure for Discrepancy Reports*

(available here: https://www.ornl.gov/scale/qa-plan), you are identified as a point of contact for DOE or NRC with the role shown in the table below.

As also documented in the *SCALE Procedure for Discrepancy Reports:*

Significant Software Errors are defined here as those program or data errors that occur with no warning or error messages, appear to allow proper execution of the software yet provide results that are:

• Inconsistent with the evaluated nuclear data or the theory models applied in the codes, and

• Judged to be of potential significance to operational safety (e.g., potential k_{eff} error greater than 1%).

As documented in the attached SCALE User Notice the following issue was identified:

> In all versions of SCALE, the Monte Carlo code KENO V.a only implements the use of non-vacuum albedo boundary conditions (e.g., mirror, periodic, white) when the outermost geometry region of the model is a cuboidal region. This limitation is noted in the user documentation in the section on *Albedo data,* where it is stated that "Albedo boundary conditions are applied only to the outermost region of a problem. In KENO V.a this geometry region must be a rectangular parallelepiped".

> It was recently discovered that—beginning with the release of SCALE 6.1 in 2011—KENO V.a will accept non-compliant input that specifies albedo boundary conditions for non-cuboidal outer shapes and will then attempt to complete the calculation. For example, a user can specify a cylinder as the outermost region and add a mirror boundary condition on the top or bottom to effectively double the volume of the system considered. A user could also add a mirror boundary condition to both the top and the bottom of the cylinder to simulate a bounding case of an infinite system. While these scenarios are accepted and perform as expected in KENO-VI, *KENO V.a requires the addition of a cuboidal region (typically an empty void region) to enable the use of these albedo boundary conditions*.

> For calculations using KENO V.a in SCALE 6.1–6.2.2 with non-compliant input in which albedo boundary conditions are applied but *without* the required cuboidal outermost region, the calculation will proceed without warning, and an underestimation of k_{eff} often results. The magnitude of underestimation in k_{eff} can vary widely, depending on the system modeled and the desired boundary conditions, but it **can exceed several percent in k_{eff}.**

> It is strongly recommended that users who rely on albedo boundary conditions in KENO V.a review their input models to ensure that the outermost region is a cube or cuboid, per the documentation requirement. Note that input models that were generated and applied with SCALE 6 and earlier versions that included the check for the cuboidal outer boundary will continue to produce the expected results with SCALE 6.1–6.2.2.

> In testing the extent of this issue by placing mirror boundary conditions on non-cuboidal outer shapes, it was found that cylinders oriented along the x-, y-, or z-axis most often produce non-conservative results without warning. The calculation will terminate prior to completion for cases in which a sphere is the outermost shape. The calculation will terminate with an error message for cases in which a hemicylinder or hemisphere is the outermost shape. The calculation performs as expected for cases in which a cube or cuboid is the outermost shape.

> This issue applies to all SCALE 6.1–6.2.2 sequences that implement KENO V.a, including CSAS5, TSUNAMI-3D-K5, T5-DEPL, and STARBUCS. No other SCALE sequences are impacted by this issue. The error condition for the attempted use of albedo boundary conditions on non-cuboidal outer shapes in KENO V.a will be restored in the pending release of SCALE 6.2.3, thus preventing users from inadvertently entering non-compliant input.

Additional details and corrective actions are provided in the 4-page attachment.

Per the *Quality Assurance Plan*, we are required to notify our community with 48-hours of determining a *Significant Software Error*. Please let me know if you have any questions about this issue or if you have any further recommendations for attached SCALE User Notice we plan to distribute to our community through the SCALE News distribution as well as through RSICC.

Best Regards,
Brad

Organization/Group	Points of Contact/Expectations
DOE	• Nuclear Criticality Safety Program Manager • Packaging Certification Program Manager • Nuclear Fuels Storage and Transportation Planning Project National Technical Director Interacts with SCALE Project Leader to understand error, judge impact on operational safety, review checklist, and make decision on issuing as Significant Software Error. Coordinates notification issuance for any errors deemed significant and interacts with DOE offices, DOE facilities, and other government organizations.
NRC	• Office of Nuclear Material Safety and Safeguards SCALE Project Manger • Office of Nuclear Regulatory Research SCALE Project Manager Interacts with SCALE Project Leader to understand error, judge impact on operational safety, review checklist, and make decision on issuing as Significant Software Error. Coordinates notification issuance for any errors deemed significant and interacts with NRC offices, licensees, and other government organizations.

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