OAK RIDGE National Laboratory

SG-8 ICSBEP Rating System Status

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Objective and Scope

This activity will develop a methodology for collecting and disseminating feedback on evaluations from qualified experts to better serve users of the ICSBEP benchmarks.

Over twenty-five years of benchmarking activity, the expectations and review rigor required for ICSBEP has evolved, the benchmarks are being used for unanticipated scenarios, tools and computational power exist to solve more complex problems, and new practitioners are entering the field.

A need has been recognized to preserve expert knowledge and judgement regarding the suitability of ICSBEP evaluations to common uses such as modern code validation, nuclear data evaluation, and nuclear data adjustment.

Deliverables/Expected Results in 2021

1. Identify benchmarks for revision and collect feedback from experts, such as completeness of uncertainty representation, specificity of dimensions/conditions of the benchmark model, oversimplification, etc.
2. Prepare a report outlining a methodology for collecting and disseminating feedback on evaluations from qualified experts to better serve users of the ICSBEP benchmarks**. Define integration into the existing ICSBEP processes.**

Technical significance

With the increasing rigor of the ICSBEP review process, there exists a disparity between earlier and modern benchmarks in terms of uncertainty quantification and more realistic modelling of the configurations. For example, earlier benchmarks may quote unrealistic uncertainties that are then used to set safety limits or assess nuclear data evaluations. Additionally, there are benchmarks that have clear consistency problems, internally across cases or compared to other, similar benchmarks.

Timeline

- August 2019
  proposal accepted and SG-8 established
- June 2020
  "alpha" process established and feedback collected
- July 2020 (SG-8 WPNCS 2020)
  "alpha" process/feedback discussed; suggestions collected for "beta" process
- August 2020
  "beta" process discussed, new "beta" feedback form initiated
- **October 2020 (ICSBEP 2020)**
  "beta" process forms finalized and distributed to SG-8 members and colleagues
- November 2020 (ANS Winter)
  "beta" results collected in new feedback and discussed; "1.0" feedback form circulated to NCS
- July 2021 (WPNCS 2021)
  Draft report presented/discussed
- October 2021
  Final report submitted to OECD/NEA

SG-8 "Alpha" Rating System (July 2020 SG-8)

As a criticality safety expert,

RATING	
4	I am **very confident** that observed calculation bias *not explained by measurement uncertainty* is most likely due to code or data errors. I will give some information about my experience with the benchmark in the "Comments" section.
3	I am **confident** that observed calculation bias *not explained by measurement uncertainty* is most likely due to code or data errors. I will suggest the minor improvements needed to be "very confident" (4 rating) in the "Comments" section, in particular noting whether this is an issue with the uncertainty analysis (section 2) or benchmark model (section 3) or both. These benchmarks are still very useful in code/data validation and are recommended for general use, with awareness of these minor issues.
2	I am **not confident** that observed calculation bias *not explained by measurement uncertainty* is most likely due to code or data errors. I have suggested the major improvements needed to be "very confident" (4 rating) in the "Comments" section, in particular noting whether this is an issue with the uncertainty analysis (section 2) or benchmark model (section 3) or both. Even in their current state, these benchmarks are potentially useful in code/data validation. However, analysts should be aware of the issues that exist and avoid asserting too much based on these benchmarks alone.
1	I recommend declaring this revision **unacceptable** according to ICSBEP standards. I have given additional details in the "Comments" section.

SG-8 ~~"Alpha"~~ "**Beta**" Rating System

As a criticality safety expert,

RATING	
4	I believe this benchmark **fully meets the current ICSBEP standards**.
3	I believe this benchmark has **minor issues** which does not greatly affect its usefulness.
2	I believe this benchmark has **major issues** which will affect the interpretation of results.
1	I recommend declaring this revision **unacceptable** according to ICSBEP standards.

SG-8 Rating Principles

- Transfer knowledge from individual criticality safety experts to the rest of us
  - not anonymous
  - not by institution
- Conveys benchmark usefulness in a straightforward way
  - accessible to novices
  - integrates with other processes
    - ICSBEP revision process
    - selection of additional benchmarks for code validation
- Focus on how **confident** we are that a benchmark can help us **validate our data+codes**

Alpha Team

John Bess
Justin Clarity
Isabelle Duhamel
Ian Hill
Nicolas Leclaire
B.J. Marshall
Catherine Percher
Ellen Saylor
Shuichi Tsuda
Will Wieselquist

Beta Team

entire SG-8
(awaiting new feedback form)

SG-8 "Beta" Rating: **4** fully meets standards

- Essentially means that the benchmark is consistent with the current ICSBEP standard.
- Still, comments are very useful to transfer knowledge.

Benchmark			Rating	Comments	Assessor
Identifier	Case	Rev.			
PU-MET-FAST-001	PU-MET-FAST-001-001	4	4	This series have been reevaluated in September 2016 using densities and masses of the four major parts as well as as-built drawings that were discovered in the LANL archives. Experimental uncertainties were also reevaluated. It must be stressed that the four detailed cases and the simplified model are very strongly correlated and must not be used as “independent” models for validation or any other purpose.	**Isabelle Duhamel**
PU-MET-FAST-001	PU-MET-FAST-001-002	4			
PU-MET-FAST-001	PU-MET-FAST-001-003	4			
PU-MET-FAST-001	PU-MET-FAST-001-004	4			

SG-8 "Beta" Rating: 1 unacceptable

- Avoid this benchmark until it is revised!
- Comments will be very useful to help perform revision

Benchmark			Rating	Comments	Assessor
Identifier	Case	Rev.			
PU-COMP-MIXED-002	PU-COMP-MIXED-002-006	0	1	There are significant questions regarding the composition and quantity of contamination control tape/wrap used in these experiments. The expected values are not close to the results calculated with any of a number of codes with different cross section sets.	B.J. Marshall
PU-COMP-MIXED-002	PU-COMP-MIXED-002-007	0			
PU-COMP-MIXED-002	PU-COMP-MIXED-002-008	0			
PU-COMP-MIXED-002	PU-COMP-MIXED-002-009	0			
PU-COMP-MIXED-002	PU-COMP-MIXED-002-019	0			
PU-COMP-MIXED-002	PU-COMP-MIXED-002-020	0			
PU-COMP-MIXED-002	PU-COMP-MIXED-002-021	0			
PU-COMP-MIXED-002	PU-COMP-MIXED-002-022	0			
PU-COMP-MIXED-002	PU-COMP-MIXED-002-006	0	1	These benchmarks represent the only loose plutonium oxide benchmarks in the handbook, and have historically been considered important for criticality safety validation. There are a number of unquantified or under-quantified uncertainties, such as the composition and thickness of contamination control material (tape and plastic wrap) that covered each plutonium oxide-containing polyethylene box in the array. Other uncertainties could arise from the plutonium oxide density, heterogeneity of the oxide and polystyrene moderator, thermal expansion of the boxes, and loss of hydrogen due to radiolysis in the moderator. No temperature data reported, but the reason for the contaimination control material was because the boxes got so hot that they melted the glue holding the PE boxes together.	Catherine Percher
PU-COMP-MIXED-002	PU-COMP-MIXED-002-007	0			
PU-COMP-MIXED-002	PU-COMP-MIXED-002-008	0			
PU-COMP-MIXED-002	PU-COMP-MIXED-002-009	0			
PU-COMP-MIXED-002	PU-COMP-MIXED-002-019	0			
PU-COMP-MIXED-002	PU-COMP-MIXED-002-020	0			
PU-COMP-MIXED-002	PU-COMP-MIXED-002-021	0			
PU-COMP-MIXED-002	PU-COMP-MIXED-002-022	0			

SG-8 "Beta" Rating: **3 minor issues**

- This is a generally useful benchmark with a few caveats.
- Think of the 3 rating as "not quite a 4".

Benchmark			Rating	Comments	Assessor
Identifier	Case	Rev.			
LEU-COMP-THERM-027	LEU-COMP-THERM-027-001	2	3	Some overestimation (outside the 3 σ of the experimental uncertainties) appears for some cases depending on the gap thickness between the lattice of rods and the lead reflector screen and also depending of the lead reflector screen thickness. It is observed for all codes and is more or less significant depending of the nuclear data. As a result, an improvement of the lead nuclear data (angular distributions and cross sections) could lead to an improvement of results.	**Nicolas Leclaire**
LEU-COMP-THERM-027	LEU-COMP-THERM-027-002	2			
LEU-COMP-THERM-027	LEU-COMP-THERM-027-003	2			
LEU-COMP-THERM-027	LEU-COMP-THERM-027-004	2			

SG-8 "Beta" Rating: 2 major issues

- Use carefully!
- Comments should help community avoid misuse.
- Think of the 2 rating as "barely above a 1".

Benchmark			Rating	Comments	Assessor
Identifier	Case	Rev.			
PU-MET-FAST-008	PU-MET-FAST-008-001	2	2	Uncertainty of 0.0006- way too small, especially considering the model is an idealized sphere. All uncertainties were experimentally determined and no composition or geometry uncertainties were anlayzed. No room return or machine uncertainties included.	Catherine Percher

Modifications to feedback form for "beta"

- Clear how to submit feedback for multiple cases (case range), e.g. merge rows or something else
  - case number should based on section 3
- Two comment boxes
  - One for rating justification
  - One for improvements necessary--not rating amount of effort required
- New column for random/systematic error handling does not meet current standards (R or S)
- Clear that uncertainty both **larger** and **smaller** than they should be are lower ratings (<4)
- Add to examples tab some "themes" (e.g. bias mistreated as uncertainty or vice versa)
- Clear that this is keff only ICSBEP rating
- Clear that we are asking for assessment of evaluation and model--not a particular code or data library or sample calculations
  - internal/external consistency and trends are key

Example "Beta" Form

RATING	ISSUE KEYS
4 meets standards	R = random error handling needs work S = systematic error handling needs work
3 minor issues	
2 major issues	
1 unacceptable	

Benchmark			Rating	Issue Keys	Rating Justification	Improvements	Additional Notes	Assessor
Identifier	Case	Rev.						
PU-MET-FAST-001	PU-MET-FAST-001-001	4	1	R	Justification paragraph.	recommended paragraph if <4.	Anything else to note.	John Q. Safety
PU-MET-FAST-001	PU-MET-FAST-001-002	4	2	S	Justification paragraph.	recommended paragraph if <4.	Anything else to note.	John Q. Safety
PU-MET-FAST-001	PU-MET-FAST-001-003	4	3	S	Justification paragraph.	recommended paragraph if <4.	Anything else to note.	John Q. Safety
PU-MET-FAST-001	PU-MET-FAST-001-004	4	4	S	Justification paragraph.	recommended paragraph if <4.	Anything else to note.	John Q. Safety
PU-MET-FAST-002	PU-MET-FAST-002-001	1						
PU-MET-FAST-003	PU-MET-FAST-003-001	2						
PU-MET-FAST-003	PU-MET-FAST-003-002	2						