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User Experiences with the ICSBEP Distributed SDFs with SCALE – 2019 Edition

Justin Clarity

B. J. Marshall

Ellen Saylor

Oak Ridge National Laboratory

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Overview

- S/U techniques for validation -briefly
- Where to find the SDFs
- What is available
- User experiences with SCALE and the ICSBEP SDFs
- Logistical tips and tricks

S/U Techniques for Validation

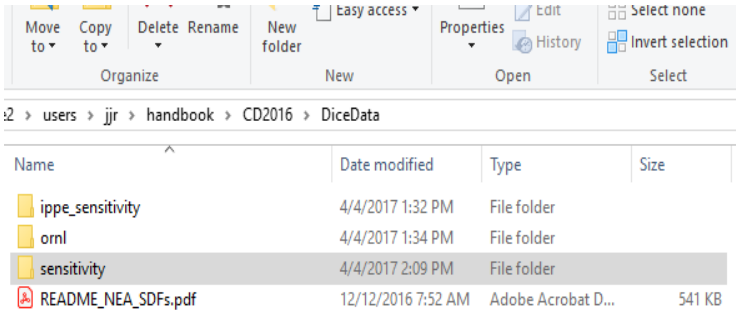
- Typically used for:
  - Judging similarity of safety application model to critical experiment benchmarks (integral indices)
  - Propagating nuclear data uncertainties into uncertainties in k_{eff} – used for penalty for unvalidated minor constituents in model
- Calculate sensitivities of k_{eff} to the underlying nuclear data and propagate
  - $C_{kk} = SC_{\propto\propto}S^T$
- Calculate correlation coefficients for similarity
  - $c_k = \frac{\sigma^2_{appexp}}{\sigma_{app}\sigma_{exp}}$

S/U Techniques for Validation (continued)

- Practically speaking this means that you need sensitivity profiles (SDFs) for the application model and a relatively large number of experiments.
- SDFs can take hours to days to calculate with no guarantee that the experiment will be useful.
- Building the Monte Carlo models is also very time consuming
- Fortunately there are a large number of SDFs distributed with the ICSBEP handbook

Location of SDFs

- Located in DiceData directory
  - /ornl – contains VALID generated SDFs
    - Organized by 1D (40) or 3D (464) calculation method
    - Stored as .zip files (unzip utility)
  - /sensitivity – contains the NEA generated SDFs
    - Organized by ICSBEP fissionable species designation (HEU, PU, U233…)
    - Generated with a variety of methods
  - /ippe_sensitivity – generated by the Institute of Physics and Power Engineering
    - Do not work with TSUNAMI-IP



Using TSUNAMI-IP with the ICSBEP SDFs

- All of the ORNL generated SDFs work with TSUNAMI-IP
- Presently TSUNAMI-IP doesn't support all of the NEA generated SDFs
  - MCNP generated SDFs – conveniently have MCNP in the title
  - 368 SDFs generated using MKK KENO with elastic P-1 scattering sensitivity
    - These cases will run but the calculated c_k values are generally near zero
    - Can find a list of these files by performing following command:
      - grep "elastic-P1" list_of_file_names

Uses for ICSBEP SDFs

- Excellent for initial screening of experiments for a given application
  - Akin to comparing an application parameter to a value from DICE
- For further use, the user should perform direct perturbations
  - c_k trending
    - Must also make sure that the k_{eff} comes from the library and code version you are validating and not the SDFs are used
  - Penalty calculation
- Not every case would need to be checked
  - Those that are similar from the same series should be representative

File handling tips and tricks

- TSUNAMI-IP input files can be cumbersome with large numbers of experiments
- File injection has been supported since SCALE 6.0
  - Allows for a complete file to be brought into a scale input at execution
  - Can save time and aggravation
  - Can be used in experiments section and linking in SDFs before execution

```
read exps
< /path_to_my_base_directory/experiments/exps.dat
end exps
```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Generating a file for injection

- First unzip the files from the media to a location of your choosing
- Can generate a single column listing of the SDFs of interest piped to a text file

```
ls -1 IEU* | awk '{print "ln -s "$1, $1}' > shell.file
```

- The add the path to the files remembering to escape /

```
> sed -i 's/-s /-s \/projects\/NEA_SDF\/IEU\/testing\//'
shell.file
```

Conclusion and Acknowledgement

- One of the highest barriers to implementation of S/U based validation is availability of SDFs
- There are a number of SDFs available with the ICSBEP handbook
- This document is intended to provide a living guide on how to most efficiently access those files and use them in validation
- This work was sponsored by the US Department of Energy Nuclear Criticality Safety Program

Questions?