Expansion of the Verified, Archived, Library of Inputs and Data (VALID)

W.J. Marshall

NCSP Technical Program Review
"Oak Ridge, TN"
February 15-17, 2022

ORNL is managed by UT-Battelle LLC for the US Department of Energy

Outline

1. Brief introduction to VALID
2. A note on sponsors
3. Cases added in FY2021
4. Cases currently in progress
5. Big win for this effort
6. Future plans for VALID

Brief introduction to VALID

- QA-like process to generate high quality models from reliable reference descriptions
  - Separate origination and review by qualified individuals
  - Documentation of model generation, results, and checks
  - Results are controlled to prevent inadvertent modification
- Primarily used for ICSBEP Handbook evaluations
- Most models include both KENO and TSUNAMI models
- Basis for SCALE/KENO validation reports, papers, and studies since SCALE 6.1 in 2011

Brief introduction to VALID (2)

- Cases included in VALID are documented in validation reports
  - 6.2.2 had 618 KENO models in 14 different ICSBEP categories
  - 428 cases also had SDFs
- Discussed in WPEC SG45 (VaNDaL) final report

A note on sponsors

- NCSP funding for VALID expansion in FY21 and FY22
- NCSP funding had been provided in the mid-2010s to generate TSUNAMI models and associated SDFs for NCSP-sponsored additions to the ICSBEP Handbook
- NRC also has interest in expanding VALID for uranium-fueled systems in the 5 – 20 wt% ^{235}U enrichment range
  - LEU+ (5 – 10 wt%) and HALEU (<20 wt%)
- Synergistic here to combine funding and accomplish more

2021 VALID Expansion: 138 Benchmarks

Experiment class	ICSBEP experiment numbers	Number of configurations
HEU-MET-FAST	1, 63, 72, 73, 84, 85	40/41[a]
HEU-MET-INTER	6	4
HEU-SOL-INTER	1	2
HEU-SOL-THERM	4, 20	9
IEU-SOL-THERM	2, 3	59
LEU-COMP-THERM	25	4
PU-MET-FAST	24, 35, 40	3
PU-MET-MIXED	2	5
PU-SOL-THERM	16	11

[a]Includes both the "Godiva" and "shell" models for HMF-001.

2021 VALID Expansion: Some motivations

- HMF-001: Embarrassment
- HMF-072, -073, HMI-006: ZEUS and copper updates
- HMF-084, -085: Sensitivity for reflector materials & MG/CE results
- HSI-001, HST-004, -020: Deuterium & intermediate spectrum
- IST-002, -003, LCT-025: >5 wt% ^{235}U benchmarks
- PST-016: Isabelle Duhamel requested for benchmark intercomparison, paperwork finished here
- PMM-002: TEX baselines, be ready for additional evaluations

Cases currently in progress

Experiment class	ICSBEP experiment numbers	Number of configurations
PU-MET-FAST	1, 9, 11, 16, 27, 28, 29, 30, 31, 32, 36, 37, 39, 41	37
HEU-MET-FAST	2, 3, 4, 28	20
LEU-COMP-THERM	22, 23, 24, 39, 53, 57, 60, 70, 74, 79, 96, 97, 101	225
LEU-SOL-THERM	7, 8, 9, 10, 11, 12, 13, 20, 21, 22, 23, 24, 25	67
Deuterium	A whole mess of things	69
HEU-SOL-THERM	36, 49	24
ICT/ICM/ICI	Several evaluations with cross references	135
IEU-SOL-THERM	4, 5	2

Big win for this effort

- Results from PMM-002 (and the class foils draft evaluation) showed significant discrepancy from MCNP results
  - PMM-002: Pu + polyethylene
  - Class foils: HEU + poly + polymethyl methacrylate (Lucite)
  - SCALE C/E values much closer to 1 than MCNP results
- Alas, AMPX was processing some TSL data as described in the ENDF manual – not as it was intended to be processed
- Significant software error notification issued 2/26/21
  - SCALE answers now much worse and in agreement with MCNP
  - See Chris Chapman talk on Thursday for details

Future plans for VALID

- Working on revision 3 of SCALE computational procedure that governs VALID
  - Migrate to GitLab for tracking
  - Use GitLab repository for library
- Internal repository implementation and tracking should simplify documentation and review – less time and money per case
- Mirror of internal repository to external site should facilitate sharing with external users

Conclusions

- VALID continues as a library of high-quality models used for testing SCALE and nuclear data
- Expansion in FY21 largest expansion in a decade
- Huge number of cases in the pipeline
  - Lack of qualified staff and funding to complete reviews
- Future plans should simplify process and increase availability of models and results for external users

Acknowledgment

This presentation was supported by the Nuclear Criticality Safety Program, funded and managed by the National Nuclear Security Administration for the Department of Energy.

Questions?