Trip Report –
ICNC 2019 Conference & OECD-NEA-WPNCS Subgroup Meetings, Paris, France, 15-27 September 2019

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1.0 Introduction

During 15-20 Sept 2019, Brown, Rising, and Alwin participated in the International Conference on Nuclear Criticality (ICNC 2019), and during 23-27 Sept 2019, Brown and Rising participated in the OECD-NEA-WPNCS Subgroup meetings. It should be noted that LANL has been an active participant in both of these international meetings for over 15 years, and that there have been very significant benefits from that participation. International collaboration is a very effective means of peer review for new ideas and approaches to computational methods. The interchange of new ideas both for what works and for what doesn't work can save substantial amounts of development time, lead to better understanding of novel approaches, and improve the quality of advanced methods. These benefits are especially true for the OECD-NEA-WPNCS meetings due to a common focus on implementing new methods that benefit the end users – nuclear criticality safety practitioners.

2.0 ICNC 2019

During 15-20 Sept 2019, Forrest Brown, Michael Rising, and Jennifer Alwin participated in the International Conference on Nuclear Criticality (ICNC 2019). ICNC is the major conference held every 4 years for the international nuclear criticality safety (NCS) community. This year's ICNC conference was especially well-attended and included about 200 papers for talks and posters. We were directly involved with 14 of the talks and posters.

We gave 3 presentations at ICNC:

- Brown, Automated Acceleration & Convergence Testing for Monte Carlo NCS Calculations
- Rising, Evaluating Sensitivity-based Similarity Metrics between Application & Benchmarks
- Alwin, CAAS Analysis Using MCNP6.2 CSG/Unstructured Mesh Hybrid

Bobbi Merryman, Dan Timmons, and Pavel Grechanuk (XCP-3 summer interns) had 3 poster presentations:

- Merryman, Investigating Region-wise Sensitivities for NCS Validation

- Grechanuk, Comparing the Whisper Validation Methodology with Machine Learning Methods
- Timmons, High Fidelity Kcode Modeling Of Subcritical Benchmarks Using MCNP 6.2

We were also coauthors on 8 papers as part of collaborations with IRSN, OECD-NEA, and Sandia National Laboratory:

- Duhamel, International Benchmarks Intercomparison Study For Codes And Nuclear Data Validation
- Henderson, Evaluation Of Mcnp's Fission Matrix Capability For Criticality Calculations
- Cook, Whisper S/U Benchmark Analysis Of Metal-Water Critical Mass Curves
- Cook, Parametric Analysis Of Handbook Metal-Water Critical Mass Curves With Mcnp
- Hutchinson, Criticality Testing Of Recent Measurements At The National Criticality Experiments Research Center
- Miller, Use Of Whisper S/U Techniques In Support Of Benchmark Identification
- Myers, Use Of ANSI/ANS 8.6 Standard For Criticality Safety Applications In The Modern World Of Advanced Simulation Capabilities
- Tsuda, Status Of The Nea International Activities On Nuclear Criticality Safety

In addition to the paper and poster presentations, we each attend numerous technical sessions during the 4-day meeting. Between sessions, at lunch, and after each day's meetings, there were technical discussions on computer codes (e.g., mcnp6, whisper, and others), NCS validation, NCS practices, and many other topics with attendees from IRSN, CEA, AWE, JAERA, and other US DOE laboratories.

Overall, this was an outstanding meeting that covered nearly everything currently of interest to the international NCS community. We both participated and learned very much about activities at other sites.

3.0 OECD-NEA-WPNCS Subgroup Meetings

During September 23-26, 2019, Forrest Brown and Michael Rising participated in the OECD-NEA-WPNCS Subgroup (SG) meetings. Each of these meetings is summarized in the sections below.

All subgroup meetings were attended, including SG-1, SG-2, SG-3, SG-4, SG-5, SG-6, and SG-7. However, we did not attend the WPNCS executive meeting on September 27, 2019.

3.1 SG-1: Role of Integral Experiment Uncertainties and Covariance Data in Criticality Safety Validation

Overview

Maik Stuke (GRS, Germany) began the meeting by presenting some of the details from his ICNC2019 paper and talk. This paper and talk included many of the contributors to this SG study. One of the primary discussion points regarded the need to give feedback to the ICSBEP project on how experimentalists and evaluators should provide correct uncertainty information so that users of the benchmarks may be able to compute proper correlations between benchmarks that share common sources of uncertainty. Ultimately, along with a final SG report documenting the findings of the study, the primary result of this SG will be to give this "qualified feedback" to the ICSBEP community.

During this meeting, it was suggested that one or more new SGs be formed in the future to tackle a smaller scope problem which can deliver a "state-of-the-art" report to the NEA and international community. In Sections 9.2 and 9.3, these potential new SGs are discussed in a little more detail.

All of the contributors to the previous EGUACSA Benchmark Phase IV study accepted the current form of the final report and this will be published either as one or two documents at the NEA. Given the lengthy publishing time at the NEA, this document might be split into two, where the first part would consist of the general summary, conclusions and aggregated results of the benchmark problems of all participants. The second part would consist of the appendices, which were provided by each individual participant and carries their own personal views, opinions, statements, etc. regarding the benchmark problems and methodologies used in their portion of the study. If splitting this report into two separate documents does not provide any substantial gain in the timeline to publication, then the report will be kept as is and submitted for publication very soon.

General Presentations

Fabian Sommer (GRS, Germany) gave a presentation on a new method, S^2Cor, that has been employed to compute correlation coefficients between benchmarks in a more efficient manner than the standard brute force Monte Carlo approach. The standard brute force Monte Carlo approach tends to converge very slowly in the presence of weak correlations between benchmarks due to the influence of the Monte Carlo stochastic noise. In S^2Cor, two steps are employed:

1. Using Latin Hypercube Sampling, a set of sampled parameters are used as the basis for some standard Monte Carlo calculations
2. Then another series of Monte Carlo calculations are done with larger parameter uncertainty and large Monte Carlo statistical uncertainty

The correlation coefficients between the two sets of calculations should result in the same value, therefore the correlation coefficients can be inferred with less overall computational time as a brute force Monte Carlo method would require. This method does have potential, but a better understanding of the computational gains should be focused on to provide definitive proof the methodology is robust.

Axel Hoefer (Framatome, Germany) gave a reprise of his ICNC2019 talk where he discussed the impact of covariances between criticality benchmark experiments on licensing applications. The goal of this paper was to try and answer the question: is it possible to get by without proper benchmark-benchmark covariance matrices (or correlations)? This question is certainly relevant because it has been shown within this SG that the benchmark-benchmark correlations are difficult to calculate, especially when considering older benchmark experiments where the uncertainty information is far more limited. In summary, by varying benchmark correlations from 0 to 1 and using two independent statistical methods (MOCABA and linear regression), all of the confidence intervals calculated by the two methods provided a suitable calculational margin such that the application case (fresh/used fuel storage application) was considered safe no matter what correlation existed between the benchmark cases used in the evaluation. This statement is far from a generalization, but studies like this can be and should be conducted for other applications to understand the impact of all potential benchmark correlations.

3.2 SG-2: Blind Benchmark on MOX Damp Powders

Overview

Coralie Carmouze (CEA, France) gave an overview presentation of the overall participation at the ICNC2019 tracks related to sensitivity/uncertainty analysis. A total of 19 technical papers appeared at the ICNC2019 conference which discussed several very relevant topics such as the various codes that produce sensitivity coefficients, the techniques to establish similarity between benchmarks, uses of the generalized linear least squares methodology (GLLSM) and other Monte Carlo methods. At the conclusion of this presentation, a discussion regarding how we can best provide guidance on the use of these S/U-based methods within the community with a potential need for an international framework that can provide this kind of outreach and education.

At the conclusion of this session, the goal to complete a report by March 2020 was proposed. The report will focus primarily on the impact that the benchmark experiment selection has on the k-effective bias and bias uncertainty computed using various techniques. A draft of this report will be distributed to the participants in October 2019 with the intent to distribute a final draft report for final participant comments in January 2020. In the 2018 WPNCS meeting, Michael Rising (LANL, USA) presented various results at the SG-2 meeting. These results and more will be included in this report in the first quarter of FY20.

General Presentations

Paul Smith (Wood PLC, UK) presented a version of his ICNC2019 talk on categorization and similarity metrics used in the MONK code to find similar benchmarks to the MOX blind application cases used in this SG study. The categorization scheme used is a simple filtering process where fuel, reflector, configuration, etc., categories are used to down select a group of potentially suitable benchmarks. Then, the E_{sum} metric, which is a simple metric based on the similarity between two calculated sensitivity profiles, was used to rank and further filter out benchmarks which were inconsistent with the application cases. Using these methods, very few benchmarks in their two validation suites, separated by quality assurance (Tier 1 with ~800 independently reviewed cases, and Tier 2 with ~1500 cases without independent review), were suitable matches to the blind MOX applications cases. Results have been provided for the SG study.

3.3 SG-3: The Effect of Temperature on the Neutron Multiplication Factor for PWR Fuel Assemblies

Overview

Sonny Gan (Sellafield Ltd, UK) provided an overview of this very narrow scoped temperature study in SG-3. The purpose of this SG is to provide some code-to-code comparisons when the temperature is changed for a particular application of PWR fuel. This includes recent thermal scattering nuclear data for ice as well as what kind of effects density as a function of temperature may have on the effective multiplication factor. The primary driver for this is a renewed interest in addressing the IAEA nuclear material transport requirements which contain a wide range of temperatures.

The benchmark problem consists of a 17x17 PWR fuel assembly with a 1meter water reflector and an infinite extent in the axial direction. Outside of the radial water reflector, a vacuum boundary is assumed. Within the fuel assembly, both guide tubes and fuel are modeled. The temperatures considered range from 233 K to 588 K, and the fuel compositions vary between 3 burn-up cases including a fresh fuel assembly.

All of the participants, using various codes, nuclear data libraries and model preparation, provided their effective multiplication values for all cases considered. Many Monte Carlo code results were provided along with a single deterministic code result. Also, many ENDF/B and JEFF nuclear data library variations were used, again with a different, single participant using the JENDL-4.0 nuclear data library.

In general, the results among Monte Carlo codes using ENDF/B or JEFF nuclear data libraries were extremely consistent with a rather small relative standard deviation among participants. The most significant outlier in results came from the deterministic code which is not too surprising given the need to process the cross section data into a multigroup form prior to doing the criticality calculations. Another conclusion of the overview presentation was the need for more results from the JENDL nuclear data libraries.

General Presentations

Dennis Mennerdahl (EMS, Sweden) presented some interesting results with some extensions made to the PWR benchmark problem. For his SCALE results, he included a newer temperature mixing capability. He also included results from MCNP for which he used two bounding temperatures for which the nuclear data libraries had already been processed, and then interpolated the results to the given application temperature.

Marion Tiphine (CEA, France) presented a talk based on her ICNC2019 presentation. Her research was based on using the Tripoli-4.11 code with the JEFF-3.3 nuclear data library. Much like most of the other results for this PWR application, the density effects are far more important than the cross section temperature effects. The most interesting part of this research was the work done to directly perturb parameters that go into the LEAPR model and compare this uncertainty propagation method to propagating the uncertainties directly from the ice covariance data. There were definite inconsistencies between these approaches, so future research is warranted.

B.J. Marshall (ORNL, USA) presented some SCALE 6.3 results which include ENDF/B-VIII.0 data formatted in the HDF5 format. This work also included the newer temperature interpolation methodology within SCALE. The SCALE standard composition library was updated to include ice for this work.

Paul Smith (Wood PLC, UK) presented their work on validating the new ice evaluation data with a pulsed shielding experiment. This involved the MONK code and a well-known stochastic temperature mixing technique that was recently implemented within the code.

Fabian Sommer (GRS, Germany) presented results using SCALE, OpenMC and MCNP with ENDF/B-VII and ENDF/B-VIII. The results between OpenMC and MCNP are in very good agreement. It was noted in this presentation that the S(a,b) data in MCNP cannot be interpolated (stochastically-mixed) in the same way that the stochastic temperature mixing technique works with the standard cross section data.

3.4 SG-4: Analysis of Past Criticality Accident

Overview

Yuichi Yamane (JAEA, Japan) presented an overview of this SG activities. The primary analyses pursued in this SG include the JCO and the Y-12 criticality accidents. The possibility of including the Windscale Works accident in this SG was discussed. It was decided that because this SG is already at the half-way point and the Windscale accident sufficiently differed from the JCO and Y-12 accidents that a potential follow-up SG may be proposed at the 2020 WPNCS meetings to look further into the Windscale and potentially other accidents (see section 9.4).

The general purpose of this SG is to try and validate a multi-physics calculation to determine the power at first peak, number of fissions, temperature changes, and power profile of these accidents. Additionally, there is a need to move away from over-estimation to a best-estimation model, hence the multi-physics validation efforts.

General Presentations

Paul Smith (Wood PLC, UK) presented more information about the Windscale Works Incident with the help of information provided by Sonny Gan (Sellafield LTD, UK). Given the complicated nature of this incident, with an aqueous solution below a thinner emulsion layer of organic material and a seemingly simple pouring of solution into the system resulting in a geometric change causing the criticality accident, it was suggested that this Windscale Works accident be postponed and proposed as a future SG. During the next year, detailed information about the accident will be provided to potential future participants.

A few graduate students (Imperial College London, UK) presented results of recent method and code development done as part of student thesis research to support the multi-physics modeling needs to perform criticality accident calculations. They have used some of the Silene and Crac benchmark experiments to help validate the code capabilities. Then these methods were applied to the Y-12 accident. Previously, simulated results by the research group showed a $1 increase compared with earlier results. They have also investigated the effect of the initiation time of the accident on the time-dependent power profile. For many of the parameters used in the time-dependent calculation, MCNP was used to calculate these parameters.

Yuichi Yamane (JAEA, Japan) presented results of the JCO criticality accident using the AGNES code. To compute the kinetics parameters, the SRAC TWODANT code was used. Within the AGNES code, both a thermal model with energy balance and a void model with mass conservation are included.

3.5 SG-5: Experimental Needs for Criticality Safety Purpose

Overview

Isabelle Duhamel (IRSN, France) presented the overview of this SG along with recently compiled results from a survey requesting information regarding what nuclear data is needed for the nuclear criticality safety community. Of the survey participants, several nuclear data needs were prioritized:

- Low temperature data for transport requirements and space reactors (Low Priority)
- Chlorine for sea water, reprocessing, advanced reactors and disposal repository applications (High Priority)
- Intermediate energy spectra for many nuclides, including fuels and structural materials (High Priority)
- Structural materials for entire energy spectra – especially some of the constituent materials that are rarely evaluated and measured as compared to the primary structural materials (Medium Priority)
- Thermal scattering laws – ZrH, YH, Lucite, Plexiglas, CH2 (Low Priority)
- Others (Low Priority)
    - Pu-238 in thermal spectra for reprocessing
    - Fluorine
    - Accident tolerant fuels
    - Subcritical experiments in thermal systems
    - Slab fuel

While some of these nuclear data are currently being addressed in various ways, there were many common needs throughout the international nuclear criticality safety communities. The biggest looming question that was discussed was how will this information be disseminated and updated over time.

General Presentations

Jan Wagemans (SCK, Belgium) presented general information regarding the VENUS reactor and its unique capabilities. This particular research reactor has been operating for several decades and has the unique capability to operate with various spectra as has been done in the past where it has changed from both a fast to a thermal and from a thermal to a fast research reactor. One of these major changes came through the GUINEVERE program. The reactor consists of a solid core of U and Pb with B4C safety control rods. The 4 central assemblies can be removed to make the reactor subcritical, which can then be coupled to an accelerator driven system. Additionally, this reactor can obtain an epithermal spectrum with a different fuel loading pattern.

Nick Thompson (LANL, USA) presented an overview of the experimental capabilities at the NNSS. In general, he provided a description of the NCERC facility and the Planet, Flattop, Comet, and Godiva assembly machines. He discussed the various types of materials and possible experiments, including subcritical, critical and fast burst experiments.

Patrick Blaise (CEA, France) briefly presented the Phenomena Identification and Ranking Tables (PIRT) method as a potential candidate methodology to aide in the prioritization of nuclear data needs for nuclear criticality safety applications. This methodology provides a framework to rank items by importance with a scoring criterion driven by uncertainty. In high likelihood, simulations with sensitivity calculations can quantitatively support this type of ranking approach.

3.6 SG-6: Statistical Tests for Diagnosing Fission Source Convergence and Undersampling in Monte Carlo Criticality Calculations

Overview

Forrest Brown (LANL, USA) began the meeting by discussing the overall charter of this SG, which is to provide international guidance on the development and implementation of statistical tests that support Monte Carlo convergence and undersampling issues. More specifically, it is desired to investigate having the Monte Carlo codes automatically detect convergence of the fission source distribution during the iteration process, and to detect undersampling after convergence has been determined.

The timeline for the deliverables of this SG include issuing a draft report by the end of calendar year 2019, reviewing and integrating comments by March 2020, and ultimately issuing a final draft report at the WPNCS SG-6 meeting in July 2020.

At the conclusion of the SG-6 business and technical presentations, a separate and generally unrelated SG was described and proposed as a future SG of the WPNCS. The details for this presentation and proposal are described in Section 3.8.5.

General Presentations

Paul Smith (Wood PLC, UK) discussed a few convergence tests that have recently been tested within the MONK code. The first approach investigated was a nearest neighbor method. One benefit of this method is that is a mesh-free diagnostic to help assess fission source convergence. However, it can be costly, depending on the algorithm used, to compute the distances between a single fission point and all other points to find the nearest neighbor. The second approach tested in the MONK code was the differential entropy test. This can be described as a continuous version of the Shannon Entropy, proposed by Kiedrowski and Beyer in 2017 at the ANS M&C topical meeting. In general, these methods did not perform very well in determining the flux convergence so more work needs to be done to find a suitable methodology.

Eric Dumonteil (IRSN, France) presented a few concepts that may be worthwhile to investigate, but did not have recent results directly related to the current SG efforts. He discussed some of the spatial correlation function work that had been recently done both experimentally at RPI and computationally with the Moret code. During the course of that work, the observed correlations disagreed with some of the theoretical model predictions. An idea that came out of this work, related to the current SG was to compute the spatial correlation function and see when it converges. Because the spatial correlation function is essentially a higher-order solution to the transport equation, it may be hypothesized that when it is converged, then the fundamental solution is also converged. The second and third ideas to help in detecting convergence or undersampling related to time-dependent simulations and branchless Monte Carlo, respectively. These latter ideas were very briefly discussed.

Forrest Brown (LANL, USA) presented his ICNC2019 talk entitled “Automated Acceleration & Convergence Testing for Monte Carlo Criticality Calculations”. In this talk, Forrest started with a brief history of the features and capabilities developed in MCNP over the years that have enabled many of the recent successes within the code. Some of these previously studied topics were indeed studied as part of international working groups, including the WPNCS Expert Groups on Source Convergence for Criticality Safety Analyses and Advanced Monte Carlo Techniques. He then discussed the general methodology, including the fission matrix usage as the reference fission distribution, the acceleration method employed to bias the fission source distribution, and then the statistical checks that help diagnose the convergence of the fission source. Ultimately, 11 statistical tests have been added to MCNP to provide quantitative evidence that the fission source has converged, with a couple of these tests also used to help determine if undersampling is detected during the calculation. So far, with a great deal of testing on a variety of problems at both LANL and Sandia National Laboratory, these statistical tests appear to be robust. However, there is always room for more statistical tests that could provide even further evidence and support of a converged and properly sampled fission distribution.

3.7 SG-7: On the Definition of a Benchmark on Sensitivity/Uncertainty Analyses on Used Fuel Inventory

Overview

Coralie Carmouze (CEA, France) and Ludyvine Juitier (IRSN, France) presented on the newest SG, which has a very limited scope with a 1-year mandate. The scope of this SG is to simply specify an appropriate and agreed upon benchmark from the SF-COMPO2.0 database which can then be used in further studies of depletion calculations and nuclear data uncertainty quantification.

During the discussion regarding the selected benchmark, the Ariane GU3 example was first proposed by the coordinators. However, the ORNL participants counter-proposed using the Calvert Cliffs experiments for this study. During this discussion, the suggestion by ORNL was pushed very hard because some staff had already spent some effort doing simulations of these experiments.

Prior to the meeting a survey was distributed which contained a few questions regarding the general interest of any potential participants. The questions on the survey included what kind of fuel (UOx or Mox), burnup time (15, 30, 45 GWd/T), and what isotopic inventories are of interest (actinides and various burnup-credit fission products). The general selections from the survey include:

- UOx
- 45, 30, 15 GWd/T
- Actinide Inventory: U, Pu, Am
- Fission Product Inventory: ^{103}Rh, ^{133}Cs, ^{143}Nd, ^{149}Sm, ^{152}Sm, ^{155}Gd

In general, this project has a long-term goal in mind. After the conclusion of the current benchmark selection SG-7 effort, two follow-on SGs will be proposed in sequence. First, a 2-year SG will be proposed to study the calculated over experiment values of the depleted isotopic concentrations so that all participants can compare between transport and burnup methodologies. The second 2-year SG will be proposed to then focus on the calculation of isotopic abundance sensitivity profiles as well as propagation of the uncertainties, including nuclear data, experiment and model assumption uncertainties. This kind of large scope project is now only possible in the SG system by stringing together consecutive SGs.

3.8 Potential New Subgroup Proposals

3.8.1 ICSBEP benchmark quality ratings for NCS applications

William Wieselquist (ORNL, USA) volunteered to be the proposer and coordinator of a new SG which is planned to focus on how to identify and possibly rank the current ICSBEP benchmarks which are of questionable quality. Currently, based on modern experiment and evaluation standards, especially as they relate to the uncertainty components of the evaluation, many of the older benchmarks are severely lacking adequate information. From the perspective of a user of the ICSBEP, it is difficult to assess the quality of the current collection of benchmarks in the handbook. The purpose of this SG is to attempt to provide a methodology that can be used for quality assessment of a benchmark in the ICSBEP, where something like a tiered or starred system may be considered. Presently, this is geared more toward qualitative feedback to the ICSBEP community compared to looking more toward quantitative feedback. A follow-on SG should be considered that can look into quantitative methods that can properly determine outliers in the ICSBEP benchmarks.

3.8.2 Calculating benchmark-benchmark correlations

As a follow-on of the work performed in the EGUACSA Phase IV study, due to the fact that there were calculational discrepancies between some participants for some of the benchmark-benchmark correlations, the potential for another SG dedicated on just this topic is quite appealing. Especially given that the scope of the EGUACSA Phase IV grew quite large during the lifetime of the expert group, determining the reason for the discrepancies and providing guidance on benchmark-benchmark correlation calculation methodologies would be very valuable to the ICSBEP experimentalists and evaluators. This new SG will likely be proposed at the 2020 WPNCS meeting.

3.8.3 Calculating bias-corrected multiplication factors

Like the new SG idea in section 9.2, due to the growth in the scope of the EGUACSA Phase IV study and the transition from expert groups to the new SG system, it isn't clear if and how the benchmark-benchmark correlations impact criticality safety validation applications. This follow-on SG would focus on the end uses of benchmark-benchmark correlations within the context of various statistical tools to help determine if these values have an impact. Ultimately it would be beneficial to the community as a whole to have a comparison of validation cases with and without correlations so that applications cases can be assessed appropriately.

3.8.4 Criticality accident analysis: Windscale Works

Because of some similarities between the current SG-4 solution-based criticality accident studies, the Windscale Works accident has been brought up and discussed at both the 2018 and 2019 WPNCS meetings. However, there is complexity in this particular accident that isn't present in the other studies. With an organic emulsion layer above the aqueous solution in the tank, when the pouring of the solution takes place, the organic emulsion layer changes shape causing the criticality accident to take place. With these changes and the complexity of the system, this accident is not being included in the analysis of the SG-4 experiments. Paul Smith (Wood PLC, UK) and Sonny Gan (Sellafield LTD, UK) will likely put together a description sheet to be distributed to all potential participants prior to the 2020 meeting.

3.8.5 Geometric uncertainties as they relate to criticality safety

Coline Larmier (CEA, FR) presented a proposal to study the effects of random geometric perturbations on criticality calculations. The main idea is to produce random tessellations/realizations of the material locations so that the effects of random media can be studied for the effective multiplication and other reactor kinetics parameters of interest. One thing to note is that it is assumed that the random geometries are reasonably coarse, above the atomic mix limit. It is unclear if this SG was proposed this year or if it will proposed in 2020 after some modifications with detailed specifications of the problem definition.

Trip report – International Conference on Nuclear Criticality 2019
Paris, France, 15-20 September 2019

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Trip Report Date 10/09/2019

Purpose of the trip: to present the ongoing evaluation work for neutron induced reactions on $^{234,236}U$ and ^{239}Pu targets in a contributed talk at the 11th International Conference on Nuclear Criticality 2019, and to discuss with other participants the needs for nuclear data for criticality simulations worldwide. In preamble, a paper was accepted to be included in the proceedings.

Title of the presentation: "Evaluation updates for major and minor actinides"

Abstract:
Evaluations of most physical observables are based on a statistical analysis of a compilation of experimental data, model calculations and their uncertainties, heavily biased toward the former for observables with sufficient experimental data. Hence, as new experimental data become available, they are incorporated into the evaluation files. The latest LANL measurements at LANSCE of the neutron capture on $^{234,236,238}U$, as well as WNR measurements of the fission cross section ratio to ^{235}U for both ^{234}U and ^{236}U have prompted the re-evaluation of all the reactions channels for these reactions. In the case of ^{239}Pu, the evaluation of the prompt neutron spectrum (PFNS) is updated based on LANSCE measurements by the Chi-Nu collaboration. In addition to discussing the evaluation of the minor U isotopes, we will give an update of the PFNS evaluation, as well as latest cross section evaluations for neutron induced reactions on ^{239}Pu.

Report:
I have fulfilled my main objective of the trip by delivering a talk on the status of the evaluation of minor Uranium isotopes and ^{239}Pu in Track 2 (Nuclear Data) of the conference, that took place in one of the afternoon parallel sessions on Monday September 16, 2019. The main question raised during the talk was about the ^{239}Pu cross section that is being now re-evaluated based on the updated uncertainties. This preliminary update in the cross section, based on updated uncertainties, but not mean values, produces a change in k_{eff} by 89 pcm in the Jezebel benchmark. In breaks after the talk, I have discussed with a few participants the implications and the need for improved data and uncertainties.
I have also attended several talks in Tracks 1 (Codes and Other Calculation Methods), 2 (Nuclear Data), 3 (Uncertainty and Sensitivity Analysis) and 4 (Measurements, Experiments and Benchmarks). Having worked on the evaluation of the prompt fission gamma properties in major actinides, I found especially interesting the talk by Y. Nauchi entitled "Measurement of Gamma Rays from Radiative Capture of Uranium-238 and Decay of Shirt Lived Fission Products from Subcritical Experiments." This talk alluded to missing data in the JENDL-4 evaluation of the prompt fission gamma rays, and I have pointed the author to the latest ENDF/B-VIII.0

evaluation, which now contains updated information based not only on thermal data, but also on model calculations and experiments for fast neutrons on total gamma production. I would also like to highlight talks given by young scientist like D. Timmons in benchmarks using MCNP and C. Chapman on neutron cross sections evaluations in the resonance region.
I would have been interested in taking one of the technical tours offered by the organizers. However, it was impossible to obtain approval for the trip from DOE before the 7/19 deadline to register for the tours. Although I submitted a foreign travel request in June, by the end of July the request was still pending at Los Alamos for review. In addition, the organizers did not advertise very well the tours, which included spending a night in another location, that complicates the foreign travel request.