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Summary Report

Third Research Coordination Meeting on

Updated Decay Data Library for Actinides

IAEA Headquarters, Vienna, Austria
8 – 10 October 2008

Prepared by

Mark A. Kellett
IAEA Nuclear Data Section
Vienna, Austria

July 2009

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Abstract

The third meeting of the Coordinated Research Project on "Updated Decay Data Library for Actinides" was held at the IAEA, Vienna on 8-10 October 2008. A summary of the presentations made by each participant is given, along with subsequent discussions. The evaluation procedure was reviewed, and a short tutorial session was given on the use of software adopted from the Decay Data Evaluation Project (DDEP). The list of radionuclides under review and evaluation was updated, along with their agreed allocation amongst participants.

July 2009

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1. Introduction

The third Research Coordination Meeting (RCM) of the Coordinated Research Project (CRP) on "Updated Decay Data Library for Actinides" was held at the IAEA, Vienna, 8-10 October 2008. This meeting followed the first Research Coordination Meeting, held 17-19 October 2005, summarized in INDC(NDS)-0479, and the second Research Coordination Meeting, held 28-30 March 2007, summarized in INDC(NDS)-0508. The Agenda as adopted at this meeting, and the list of participants are given in Appendix A and B, respectively.

This CRP originated on the strong recommendation of the International Nuclear Data Committee (INDC) which advises the Nuclear Data Section (NDS) on nuclear data issues. INDC members based their request on the need for this work to be undertaken in support of a wide range of applications. The INDC recommended in a Summary Report of their meeting of May 2002 (INDC/P(02)-23) that a CRP on "*Updated Decay Data Library for Actinides*" be initiated in 2005, and re-emphasised their support in May 2004.

A.L. Nichols, Head of the IAEA-NDS, opened the meeting and stressed the need to draw the work to a close in the forthcoming year. M.A. Kellett (IAEA-NDS), as Project Officer, reiterated the aims and scope of the CRP, and also the need to define appropriate deadlines for the evaluation effort. F.G. Kondev (ANL, USA) was elected Chairman of the meeting, and M.A. Kellett was nominated Rapporteur.

Following the adoption of the Agenda (see Appendix A), all actions from the previous meeting were reviewed.

2. Review of Actions from the Second RCM

1) **ALL:** Check the Q_{eff} calculated from the level scheme and compare with Audi *et al*. Add a paragraph into the comments file stating this balance. Could lead the evaluator to see where the level feeding might be inconsistent.
   Action to be maintained and treated as a guideline.
2) **ALL:** Check the calculated X-ray emissions with any available experimental data, as differences can be quite significant. Add a paragraph into the comments file stating this balance.
   Action to be maintained and treated as a guideline.
3) **Bé:** Check the ability of the SAISINUC program to add the EMISSION program output data correctly.
   The problem was discussed and resolved during the SAISINUC demonstration session.
4) **Bé:** Investigate adding the capability for the SAISINUC program to read the level energy information from an ENSDF (or equivalent) file.
   This capability has been added to the latest version of the SAISINUC program.
5) **Kondev:** Contact E. Browne to see if the EC-CAPTURE program can be modified to output the P_{L1}, P_{L2} and P_{L3} values.
   A modification request was sent to E. Browne, but use of a modified version of the LOGFT program was suggested as an alternative. The modified version of the LOGFT program is available from M-M. Bé.
6) **Bé:** Contact the ^{240}Pu measurers (EUROMET project - G. Sibbens, IRMM) to obtain information as soon as possible.
   The measurers confirmed that publication of their final results on the alpha-particle emission probabilities of ^{240}Pu and a half-life measurement on ^{233}U were expected during 2009.
7) **Pearce/Mukherjee:** Investigate possibility of ^{233}Th and ^{233}Pa γ-ray emission probability measurements (produced from n-capture on ^{232}Th, hence need a reactor source).
   No measurements are currently possible.
8) **Pearce/Mukherjee:** Investigate ^{237}U emission probability and half-life measurements. A large δQ discrepancy exists.
   No measurements are currently possible.

9) **Chechev:** Calculate the total relative intensity of the unplaced γ rays of ^{239}U (2006Wo03) compared to placed γ rays, in order to quantify unplaced intensity.
Unplaced γ rays contribute ~0.5% to the total intensity.

10) **Kondev:** Investigate the EC/β^- branching fraction problem in ^{236,236m}Np, as the measurements were originally made at Argonne National Laboratory.
No further information was available from Argonne owing to the time that has elapsed since these measurements were made. The difference between the resulting P(β⁻) value evaluated by Chechev 47(1)% and that in Nuclear Data Sheets of 50(3)% arises from the adoption of differing normalization data.

11) **Kondev/Bé:** Investigate the possibility of undertaking α-particle emission probability measurements for ^{224,226}Ra (should sources be available).
No such sources are available.

The Chairman invited each participant (see Appendix B) to present summaries of their relevant evaluation and/or measurement work being carried out under the auspices of the CRP.

3. Presentations

3.1. V. Chechev: Progress Report on Production of Recommended Decay Data Files

The progress on the evaluation of eighteen actinides was presented (^{227}Ac, ^{233}Th, ^{233}Pa, $^{237,\ 239}$U, $^{236,\ 236m,\ 237,\ 238,\ 239}$Np, $^{238,\ 239,\ 240,\ 241,\ 242}$Pu, ^{241}Am, $^{242,\ 244}$Cm), including details on the quality of the available data and the consistencies achieved for each evaluation. The recurring problem of limited experimental data for certain radionuclides was highlighted.

All evaluations have been completed and reviewed, but minor updates are still required to some if complete compatibility with the methodology adopted within the framework of the CRP is to be achieved, e.g. use the BRICC code to calculate internal conversion coefficients.

3.2. M.-M. Bé: Status of Evaluations at LNHB

A comparison of the Q_{eff} calculated from the proposed decay scheme and the value taken from the Atomic Mass Evaluation 2003 was presented for the fifteen radionuclides evaluated at LNHB. The evaluation of one remaining radionuclide is still ongoing (^{243}Am). The comparison showed satisfactory agreement within the data uncertainties for all but two cases:

calculated Q-value is ~1% lower than the value adopted for ^{218}At, suggesting the possible existence of a weak gamma transition from the 62-keV level to the ground state of daughter ^{214}Bi;

calculated Q-value for ^{210}Tl has a very large data uncertainty (~18%) owing to the lack of knowledge of the decay scheme.

The intensities of the K and L X-rays, as determined from the decay scheme, were compared with measured values, if available, for seven radionuclides. Overall agreement was found, with the particular exception of ^{214}Bi for which a major disagreement exists, but this may arise from the complexity of the measured X-ray spectrum making resolution and deconvolution difficult.

The status of available experimental data for the fifteen radionuclides already evaluated was presented, and requirements for future measurements were listed. No direct measurements of transition probabilities exist in a number of cases, and only one or two half-life studies have been published for specific nuclides, making their evaluation extremely susceptible to the uncertainties in these values.

The LNHB publish evaluations carried out within the Decay Data Evaluation Project (DDEP) in the form of a *Monographie* of the *Bureau International des Poids et Mésures* (BIPM), Sèvres, France. Volume 4 of *Monographie BIPM-5* will appear at the end of 2008, and should contain details of thirty-two evaluations, twenty-seven of which are associated with the CRP, while volume 5 should be published in 2009, which will also predominantly contain decay data evaluations produced by the CRP.

3.3. A. Pearce: Evaluation of Decay Data of ^{232}U

A final report was given on the evaluation of ^{232}U (effectively 100% α decay) to daughter ^{228}Th with a total of nine alpha transitions and fifteen γ rays from eight excited states, which is currently under review. While five measurements of the half-life exist, they constitute an inconsistent set - however, by removing the earliest measured and only inconsistent value, a consistent set is obtained with an acceptable value, albeit with a larger uncertainty (1.6%) than previous evaluations. The final alpha transition probabilities were calculated by the GTOL code, based on the γ-ray spectrometry measurements, producing values consistent with those measured, but further measurements would aid in the characterisation of the weaker alpha lines. Final values for the extremely small branching fractions of both spontaneous fission and ^{24}Ne cluster decay were given, but confusion exists in the literature between these two very minor decay modes, making the evaluation task difficult. Although further measurements would be beneficial, the current evaluation provides appropriately quantified information for foreseeable applications.

The evaluation for ^{232}Th is also almost complete and should be submitted for review in the forthcoming weeks. Both ^{228}Ac and ^{231}Pa are both in the early stages of evaluation, to be followed later by ^{223}Ra.

3.4. A. Luca: Evaluation of Decay Data of ^{236}U, ^{234}Th and ^{228}Ra

The evaluation of ^{236}U decay data was described, which is currently under review. This radionuclide decays almost exclusively via α decay to ^{232}Th daughter (with a very small spontaneous fission branch), via four alpha transitions and three γ rays, one from each of three excited states. A comparison of the results from the BRICC and ICC2005 codes showed good consistency for the calculation of the internal conversion coefficients for two of the γ-ray transitions, one of which is highly converted.

Evaluation work on ^{234}Th and ^{228}Ra is still at an early stage – after some discussion, CRP participants decided that the β^- decay of 1.159 min ^{234m}Pa daughter from the β^- decay of ^{234}Th merited fully separate evaluation. Complications arise in the β^- decay of ^{228}Ra due to the very small Q-value (~45.9 keV), hence the resulting γ-ray transitions are highly converted. This situation is further complicated in that any measurement of the β^- spectrum includes overlapping conversion electrons that make the determination of all β^- transitions uncertain. Hence help was requested from more experienced evaluators for these remaining two radionuclides.

3.5. F.G. Kondev: Experimental and Evaluation Activities at ANL in Support of IAEA-CRP on "Updated Decay Data Library for Actinides"

Details were presented of the experimental and evaluation activities carried out at Argonne National Laboratory (ANL) in connection with the CRP.

Experimental Activities

Include half-life measurements for ^{240}Pu, ^{245}Cm and ^{246}Cm using mass-separated sources, all of which have now been published in the open literature. Alpha-particle emission probability measurements were made for both ^{243}Cm and ^{246}Cm:

^{246}Cm - three α emissions were measured and found to be consistent with previous data;

^{243}Cm - a specific study was performed to compare modern measurements made with semiconductor detectors with earlier measurements undertaken by means of a magnetic spectrometer because consistently significant discrepancies were believed to exist between these two techniques. However, when new measurements made with a passivated implanted planar silicon (PIPS) detector, i.e. a semiconductor detector, were compared with magnetic spectrometer data taken in the mid 1970s, good consistency was found between the two techniques – therefore, past observed discrepancies can most likely be attributed to differences in the data analysis procedures, rather than to the inherent applicability and nature of the two methods. Measurements were also reported on the γ-ray emission probabilities following the α-decay of ^{243}Cm for γ rays between 200 and 300 keV.

A series of measurements of the ^{233}Pa γ-ray emission probabilities was also reported. Initial data from ANL measurements performed in 2006 failed to produce a direct and accurate measurement of the emission probability for the important 28.6-keV γ ray. Hence a second series of measurements were carried out during 2008 in which careful attention was paid to the production route of the ^{233}Pa, as well as chemical separation from the ^{237}Np progenitor. The spectra showed clearly that following this chemical separation the individual ^{233}Pa γ rays could be successfully measured as there was no longer the problem of resolving these lines from adjacent ^{237}Np lines. Preliminary analysis shows the newly measured ANL data are consistent with some of the earlier measurements for the 28.6-keV γ ray, and with most experimental studies of the higher energy γ rays. A newly measured set of ^{233}Pa X-ray emission probabilities was also reported, and found to be consistent with earlier measurements.

Evaluation Activities
A summary of the evaluation activities was given. Evaluations of ^{206}Tl and ^{246}Cm have been completed, reviewed and published in two ANL reports of the Nuclear Data and Measurements Series (ANL/NDM-162 and -164, respectively), as well as appeared on the DDEP website. The decay data evaluation for ^{206}Hg is under review, and the associated ANL/NDM-166 report is in preparation. Work is progressing well on the evaluations of ^{243,} ^{245}Cm, and ^{209}Tl and ^{209}Pb studies are underway in collaboration with G. Mukherjee of India. The two remaining allocated nuclides are still in the early stages of evaluation (^{207}Tl and ^{211}Pb), but they are expected to be completed within the desired timeframe.

3.6. X. Huang: Summary Report of Evaluation and Recommendation of Decay Data for Some Actinides

Progress on the evaluations of ten actinides and associated decay daughters was presented. All ten evaluations have been completed and are in different stages of review or publication. Four nuclei have been reviewed and published on the DDEP website: ^{213}Po, ^{217}Rn, ^{217}At and ^{221}Fr; ^{235}U is currently under review; and the remaining five nuclides are awaiting review: ^{213}Bi, ^{223}Fr, ^{225}Ra, ^{225}Ac and ^{231}Th. A number of measurement requests for various quantities (i.e. half-life and γ-ray and/or α-particle emission probabilities) were suggested and have been included in Table 1 of this report.

The γ-ray emission probabilities for γ rays below 120 keV associated with the decay of ^{231}Th require further study; although a relatively large dataset exists, there are some inconsistencies. A new half-life measurement is suggested for ^{225}Ac, as well as both γ-ray and α-particle emission probability studies to help resolve the inconsistency seen with the two γ rays of 99.65 and 99.90 keV. Half-life measurements are deemed to be necessary in the case of ^{225}Ra, as well as a determination of the emission probability for the associated 40.1-keV γ ray, as is also the case for the 218.1-keV γ ray in the decay of ^{221}Fr. In this latter case, care has to be taken in the evaluation of the decay data for ^{221}Fr because a γ ray of similar energy (218.15 keV) is emitted within the same decay chain following the decay of ^{229}Th - the emission probability of this line must be subtracted prior to adoption (see Action 8 from this meeting). Finally, a new half-life measurement for ^{213}Bi is recommended, although other evaluators felt that all four relatively old measurements were sound and consistent.

3.7. G. Mukherjee: Status of Decay Data Evaluations for ^{233}U and ^{229}Th

Details of the evaluation of ^{233}U were described, which is now almost complete following the review process. Many experimental measurements have been made for this radionuclide, which undergoes effectively 100% α decay to ^{229}Th, with very minor spontaneous fission and cluster branches. A consistent set of measurements for the total half-life allow a weighted mean with a reduced χ^2 of 0.39 to be calculated, whereas for the spontaneous fission branch only a lower limit has been consistently measured. A complex decay scheme has been produced containing fifty-three levels in the ^{229}Th daughter, with 267 γ rays and thirty-one α-particle transitions. An energy value of 7.6(5) eV has been determined for the very low-lying level in ^{229}Th following work published in 2007 (2007Be16). A good Q-value balance is obtained from the decay scheme that compares well with the recommended value of Audi *et al*.

Work on the decay of ^{229}Th is in the early stages, with the literature survey complete and an initial set of nuclear levels formulated.

Work will also be undertaken with F.G. Kondev on ^{209}Tl and ^{209}Pb in conjunction with his ENSDF mass chain evaluation for A = 209.

3.8. A.L. Nichols: Status of Decay Data Evaluations at the IAEA

Brief details were presented of progress in the evaluations of sixteen assigned nuclides. Two nuclei: ^{242,244}Am, have been finalised following review and will be published on the DDEP website; ^{244m}Am is about to be submitted for review. A further eight nuclides in the ^{228}Th natural decay chain are in progress (^{228}Th, ^{224}Ra, ^{220}Rn, $^{212, 216}$Po, ^{212}Bi, ^{212}Pb and ^{208}Tl), while the remaining five have yet to be started (^{242m}Am, ^{215}Bi, $^{211, 219}$At and ^{219}Rn). Progress since the previous meeting has been unavoidably hampered, but assurances were given that all of the allocated actinides would be completed in a timely manner.

4. Review of Evaluation Procedures and SAISINUC Program

Review of Evaluation Procedures

The procedures relating to the review and acceptance of a completed evaluation were discussed, and are outlined as follows:

- All evaluated data are entered into the SAISINUC program, supplied by M.-M. Bé, which produces a MS-Access database file, by default called *donnees.mdb*
- A file containing the evaluator's comments on the evaluation should be produced in MS-Word, *i.e. comments.doc*
- These two files are then sent to M.-M. Bé who will return a PDF of generated tables, *i.e. tables.pdf*
- The evaluator should then check the contents of the three files *donnees.mdb*, *comments.doc* and *tables.pdf*, prior to sending them to E. Browne, the DDEP review co-ordinator.
- E. Browne will organise an independent review (by himself or another appropriate individual) of the submitted evaluation and will return corrections/suggestions to the original evaluator.
- Once these corrections/suggestions have been incorporated into the evaluation AND the SAISINUC program, the evaluator should send the updated *donnees.mdb* and *comments.doc* files to M.-M. Bé for final acceptance and publishing on the DDEP website.

The on-going data assessment process is likely to call on CRP participants to review evaluations of other participants because of the limited availability of expertise concerned with DDEP studies. Once again emphasis was placed on the need for participants to allocate an appropriate amount of time to such reviews in order to ensure the good quality of the final evaluations.

The SAISINUC program

Since most participants have become familiar with the SAISINUC program, a session relating to user feedback and problem solving was held. A number of enhancements based on requests from participants were welcomed, particularly the ability to enter energy levels from an ENSDF formatted file, and the direct inclusion of results from auxiliary codes. Participants found these features most helpful and M.-M. Bé was thanked for her efforts in the continuing improvement of the SAISINUC program, particularly efforts to interface associated programs.

5. Review of Identified Measurement Requirements

A number of experimental needs were identified by participants during the course of their evaluations, and are grouped together in Table 1. This table is not necessarily an exhaustive list of the required measurements for all of the radionuclides being considered, but represents a subset for which specific needs have been identified to date.

TABLE 1. MEASUREMENT REQUIREMENTS IDENTIFIED TO DATE

Radionuclide	**Problem**
^{210}Tl	Decay scheme is mainly based on measurements published in 1964 (1964We06) – many β^--particle emission probabilities are uncertain, and no evidence exists for transitions > 3 MeV, thus evaluated decay schemes are conflicting – further β^--particle emission probability measurements are strongly recommended to resolve these discrepancies.
^{210}Pb	Recent L X-ray measured values are not self-consistent, nor do they agree with calculated values deduced from the decay scheme – further X-ray measurements could help determine the origin of the discrepancy.
^{214}Pb	Owing to problems associated with calculating internal conversion coefficients, suggest new measurement of the γ-ray multipolarities and mixing ratios. Also only one half-life measurement from 1931 – further measurements would be beneficial.
^{213}Bi	New half-life measurements recommended.
^{214}Bi	Only one half-life measurement from 1956 – further measurements would be beneficial.
^{214}Po	Poor and indirect experimental data – new direct measurements of α-particle and γ-ray emission probabilities are required.
^{218}Po	Decay scheme based on the β^- emission measurements in 1952 – new measurements of α- and β^--particle emission probabilities are required.
^{218}At	Early experimental data from 1948 and 1958 – new measurements of α- and β^--particle emission probabilities are required.
^{221}Fr	Measurement of the γ-ray emission probability for 218.1-keV γ ray deemed necessary.
^{218}Rn	Poor and indirect experimental data – new direct measurements of α- and β^--particle emission probabilities are required.
^{222}Rn	Very poor and early data for the α-particle emission probabilities – require further measurements.
^{224}Ra	Data for the α-particle and γ-ray emission probabilities are inconsistent and further spectroscopic studies are required.
^{225}Ra	Measurements of the half-life are deemed necessary, as well as γ-ray emission probability for the 40.1-keV γ ray.
^{226}Ra	Only two sets of inconsistent data for the α-particle emission probabilities – require further measurements. X-ray measurements would also prove useful.
^{225}Ac	Only two measurements of half-life, latest in 1950 – further measurements desirable – also require new measurements of γ-ray and α-particle emission probabilities in order to help resolve the inconsistency seen with the two γ rays of 99.65 and 99.90 keV.
^{227}Ac	Data for β^-- and γ-ray transition probabilities associated with β^--decay branch are only approximate, as are α-particle emission probabilities in the α-decay branch – further accurate measurements would give better confidence in the derived decay scheme.

Table 1 cont'd

^{231}Th	Further measurements of γ-ray emission probabilities for γ rays < 120 keV required – although there is a relatively large dataset, some inconsistency exists.
^{233}Th	All emission probabilities are reported without uncertainties – accurate measurements are required.
^{233}Pa	New precise measurements of the low-energy γ rays and LX-rays with a pure ^{233}Pa source would prove beneficial.
^{234}U	Further measurement of the γ-ray and α-particle emission probabilities required, as currently all published results from the same group.
^{237}U	Very poor and early experimental half-life data – further measurements required.
^{238}U	Further measurement of half-life and α-particle emission probabilities required.
^{239}U	A number of γ rays reported in reference 2006Wo03 were not placed in the decay scheme – although further measurements are merited, the relative intensity of these unplaced γ rays is only ~0.5% of the total.
^{236,236m}Np	Poor experimental data with two conflicting measurements of the EC/β^- branching ratio – further measurements required.
^{239}Pu	Measurements of multipolarities of the low-energy γ rays would be beneficial.
^{241}Am	A number of γ-ray transitions (27.03, 54.1 and 95.0 keV) require more detailed measurement, including associated conversion electron emission probabilities.
^{242}Am	Only three sets of half-life data – requires further measurements. Spectroscopic γ-ray study also required as no emission probability measurements exist – γ-ray energies constructed from level scheme (Akovali 2002) and emission probabilities from P_{ce}/P_{β^-} data.
^{242m}Am	Only limited internal transition data available – further measurements highly desirable.
^{244}Am	Only one half-life measurement known – requires further measurements. Spectroscopic γ-ray study also required – γ-ray energies constructed from level scheme (Akovali 2002) and emission probabilities adjusted as necessary from 1984Ho02 (only reference that quantified data uncertainties).
^{244m}Am	Only two half-life measurements from the 1950s, neither of which quote uncertainties – further measurements required. Spectroscopic γ-ray studies also required as there is only one set of data for the γ-ray emission probabilities.
^{242}Cm	Accurate measurements of the 44-, 102-, 157- and 210-keV γ rays required.
^{252}Cf	Accurate measurements of the α-particle emission probabilities required.

6. Review of Allocated Nuclides

A review of the currently allocated nuclides was made in some detail at the conclusion of the various progress and status reports.

Table 2 shows the updated list of nuclides allocated to each participant following discussion at this meeting. Two radionuclides remain unallocated after this exercise (^{215}Po and ^{215}At), and further thought needs to be given as to their process of decay data evaluation.

TABLE 2. ALLOCATION OF NUCLIDES

Participant	Actinides	Decay daughters
A. Luca	^{234}Th, ^{236}U	^{211}Bi, ^{211}Po, ^{228}Ra
A. L. Nichols	^{228}Th, $^{242, 242m, 244, 244m}$Am	^{208}Tl, ^{212}Pb, $^{212, 215}$Bi, $^{212, 216}$Po, $^{211, 219}$At, ^{219,220}Rn, ^{224}Ra
A. Pearce	^{232}Th, ^{231}Pa, ^{232}U	^{228}Ac, ^{223}Ra
F. G. Kondev	$^{243, 245, 246}$Cm	^{206}Hg, $^{206, 207, 209}$Tl, $^{209, 211}$Pb
G. Mukherjee	^{229}Th, ^{233}U	
M.-M. Bé	^{243}Am, $^{234, 238}$U, ^{252}Cf	^{210}Tl, $^{210, 214}$Pb, $^{210, 214}$Bi, $^{210, 214, 218}$Po, ^{218}At, ^{218,222}Rn, ^{226}Ra
V. P. Chechev	^{233}Th, ^{233}Pa, $^{237, 239}$U, $^{236, 236m, 237, 238, 239}$Np, $^{238, 239, 240, 241, 242}$Pu, ^{241}Am, $^{242, 244}$Cm	^{227}Ac
Huang Xiaolong	^{231}Th, $^{234, 234m}$Pa, ^{235}U	$^{221, 223}$Fr, ^{217}At, ^{217}Rn, ^{213}Bi, ^{213}Po, ^{225}Ra, ^{225}Ac
Unallocated		^{215}Po, ^{215}At

Key to colours:
Red = completed
Blue = in progress
Green = to be monitored/updated
Black = yet to be started

7. Review of Actions

Throughout the meeting a number of actions were generated on all or particular participants. A complete list of these actions is given below.

1) **All:** Check the Q_{eff} calculated from the level scheme and compare with the AME-2003 value (Audi *et al.*). Could lead the evaluator to determine where the level feeding might be inconsistent. Add a paragraph to the Comments file stating this balance.
2) **All:** Check the calculated X-ray emissions with available experimental data, as differences can be quite significant. Add a paragraph to the Comments file stating this balance.
3) **Kellett:** Ensure that E. Browne is aware of Actions 1 and 2, so that they can be checked in the review process.
4) **Kondev:** Contact E. Browne to see if the EC-CAPTURE program can be modified to output the P_{L1}, P_{L2} and P_{L3} values. [Note: LOGFT code (as modified by M.-M. Bé) can be used as an alternative]
5) **Bé:** Confirm with EUROMET project (G. Sibbens, IRMM) the current status of their ^{240}Pu measurements.

6) **Chechev:** Add a line into the Comments file of his ^{239}U evaluation stating the total relative intensity of the unplaced γ rays of ^{239}U (2006Wo03) compared to the placed γ rays, thus quantifying the unplaced intensity.
7) **Chechev:** Check with E. Browne on the origin of the uncertainties in the ^{233}Th emission probabilities quoted in the *Table of Radioactive Isotopes*, 1986, as no other publication quotes these uncertainties.
8) **Huang:** Correct ^{221}Fr evaluation to use the ^{229}Th γ-ray emission probability for the 218.15-keV γ ray once this parameter has been evaluated by G. Mukherjee, in order to obtain the correct value for ^{221}Fr – ^{229}Th γ-ray emission probability needs to be subtracted from the value quoted in 1986He06 to obtain the value for ^{221}Fr, since the cited measurement used an equilibrium source containing both ^{221}Fr and ^{229}Th.
9) **Bé/Dulieu:** Explore the possibility of the SAISINUC level scheme drawing procedure indexing the levels based on their energy rather than the order in which they were entered into the database – would be useful if an intermediate level needs to be introduced after other transitions have been defined and entered.
10) **Bé:** Check with J.K. Tuli on the requirements necessary for publishing evaluations in *Nuclear Data Sheets*, i.e. timescale, number of available pages/issues, specific format required for submission, peer review process, *etc.*
11) **Kellett:** Draft introductory pages for the final IAEA technical report describing the CRP and distribute to **All** by mid-2009 – include background of the CRP, details of contributors, evaluation procedure, identified shortfalls in existing data, *etc.*
12) **Kondev:** Contact H. Griffin and D. DeVries (University of Michigan) to verify the exceptionally small uncertainties given in published tables of their measurements of low-energy γ rays, e.g. 2008De10.
13) **All:** Ensure that any measurement of a half-life made relative to ^{244}Cm is corrected for the latest evaluated value of 18.11(3) years.
14) **All:** Ensure that all allocated evaluations are submitted to the review process (via M.-M. Bé and E. Browne) prior to the end of July 2009 AND that they take into account all references published prior to the end of 2008.
15) **Bé:** Using SAISINUC, verify the consistency of Q_{eff} values obtained by V. Chechev "by hand" for a sample of his completed evaluations.

8. Final Remarks

During the meeting various discussions were held on the appropriate outcomes required from this CRP which are summarised below.

The timescale for final delivery of the evaluations to the review process was provisionally set to the end of July 2009, with evaluations to take account of all relevant references published prior to the end of 2008.

A final IAEA technical report will be produced giving details of the evaluation procedure, including tabulations of the most important decay parameters. An accompanying CD-ROM will include the complete tabulated data in a series of PDFs and a separate set of computer-readable data files. The SAISINUC program will be used to produce files in ENSDF format. Participants urged that data files be assembled in the more applications-oriented ENDF format – since the necessary expertise to undertake this work does not exist within the group, the IAEA agreed to employ an appropriate consultant to prepare these particular files. All of the above mentioned data files will also be made available for download from a dedicated webpage on the IAEA server.

An informal offer had been made to the CRP from the editor of *Nuclear Data Sheets*, J.K. Tuli (NNDC, BNL, USA) through M.-M. Bé, to allocate space within the journal for the final set of evaluations to be published therein. However, there has been no clear guidance as to what format the evaluations should be submitted, how many pages might be made available, on what timescale, and the nature of the review process. Although participants felt that this extra exposure could be beneficial, further details were required in order to clarify how this mode of publication might be achieved. Should a significant amount of extra work be required, such efforts might not be ultimately beneficial,

given that there would be a final IAEA technical report and the DDEP has an arrangement with the BIPM to publish regular volumes in a dedicated *Monographie* series. Further discussions need to be held with J.K. Tuli in order to help clarify the situation before any final decision can be taken.

The meeting participants felt that all issues and topics had been appropriately covered, and the Chairman closed the meeting and was thanked for his good efforts.

3rd Research Coordination Meeting on

"Updated Decay Data Library for Actinides"

IAEA Headquarters, Vienna, Austria
8 – 10 October 2008

Meeting Room A2313

AGENDA

(Adopted at the meeting)

Wednesday, 8 October

08:30 - 09:30	**Registration** (IAEA Registration desk, Gate 1)
09:30 - 10:15	**Opening Session**
	Welcoming address – A.L. Nichols
	Introductory Remarks – M.A. Kellett
	Election of Chairman and Rapporteur
	Discussion and Adoption of Agenda (Chairman)
	Review of Actions from the 2nd RCM
10:15 - 11:00	**Administrative Matters**
	Coffee break
11:00 - 12:30	**Session 1: Presentations by Participants**
	(15 minutes for each presentation and 5 minutes for discussion)
12:30 – 14:00	**Lunch**
14:00 - 15:30	**Session 1 (cont'd): Presentations by Participants**
	(15 minutes for each presentation and 5 minutes for discussion)
	General Discussion
15:30 - 16:00	**Coffee break**
16:00 - 17:30	**Session 2: Status of Measurements**
	Measurements by participants – ANL, CEA (others…)
	Other measurements of relevance (IRMM, EU, etc.)

Thursday, 9 October

09:00 - 10:30	**Session 3: Status and Problems with Evaluations**
	Completed evaluations
	Evaluations under DDEP review
	Evaluations nearing completion
	Evaluations in general
	Additional nuclide requirements
10:30 – 11:00	**Coffee break**
11:00 – 12:30	**Session 3 (cont'd): Status and Problems with Evaluations**
	Technical problems arising from participants' presentations
	Other problems of note raised by participants
12:30 - 14:00	**Lunch**
14:00 – 15:30	**Session 4: Review of Evaluation Procedure and Software (SAISINUC)**
	Evaluation and review process – available manpower
	SAISINUC – User feedback/problems/additions/requirements/updates
	Auxiliary software – BrIcc, Emission, EC-Capture, etc.
15:30 – 16:00	**Coffee break**
16:00 – 17:30	**Session 5: Final Outputs of the CRP**
	Final Report – style, content and dissemination,
	e.g. IAEA Technical Report, BIPM Monographie, Nuclear Data Sheets, …
	Data Table formats and Database
	Data-file formats, *e.g.* ENSDF, ENDF
19:00	**Dinner at the Pürstner Restaurant in the Centre of Vienna**

Friday, 10 October

09:00 - 10:30	**Session 6: Allocation (and Re-allocation?) of Nuclides**
	Nuclides being measured (?)
	Nuclides being evaluated
10:30 – 11:00	**Coffee break**
11:00 – 12:00	**Session 7: Summary Report**
	Drafting of the 3rd RCM Summary Report
12:00 – 13:00	**Session 8: Concluding Remarks and Close of the Meeting**
13:00 - 14:00	**Lunch**

3rd Research Coordination Meeting on
"Updated decay data library for actinides"
IAEA Headquarters, Vienna, Austria
8 to 10 October 2008

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