

Fission Energy Release Format Revision

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Fission Energy Release – format revision

- The current format accommodates the work of Sher and Beck (EPRI-NP-1771, published in 1981).
 - recognizes 9 components (fission products, ν , γ , neutrinos, ...)
 - ET = sum of all partial energies that follow
 - EFR = fission product kinetic energy
 - ENP, END = prompt & delayed fission neutron kinetic energy
 - EGP,EGD = total prompt & delayed γ -ray emission energy
 - EB = total delayed β particle energy
 - ENU = neutrino energy
 - ER = ET-ENU, “pseudo-Q” used in mf3, mt18
 - values and uncertainties for these components at zero incident neutron energy are tabulated in an 18 element “LIST” record.
 - formulas for incident neutron energy dependence (or lack thereof) are provided in the ENDF-102 Format Manual. They cannot be inferred from the data tabulated by the evaluator.

Fission Energy Release – format revision

- This format revision is based upon recent work by Madland (*Nucl. Phys.* A772 (2006) 113-137)
 - this topic summarized in the ENDF/B-VII.0 “Big Paper”.
 - Madland’s conclusion:
 - historical energy dependencies (or lack thereof) contradict experiment.
 - can be replaced by polynomial expansions for each of the 9 components.
 - specify whatever polynomial order is necessary to fit the data:
 - $E_i(E_{inc}) = c_0 + c_1 * E_{inc} + c_2 * E_{inc}^2 + \dots$
- Total energy release is substantially equivalent with either method – it’s the components that differ.

Fission Energy Release – format revision

- Format revision was conditionally accepted last year
 - LANL was tasked to provide a revision to the ENDF format manual to define the expanded format – this has been done.
- The original format is:

```

– [MAT, 1, 458/  ZA,    AWR,    0,      0,      0,      0      ] HEAD
– [MAT, 1, 458/  0.0,    0.0,    0,      NPLY=0, N1=18,  N2=9    /
–                EFR,    ΔEFR,   ENP,    ΔENP,   END,    ΔEND
–                EGP,    ΔEGP,   EGD,    ΔEGD,   EB,     ΔEB
–                ENU,    ΔENU,   ER,     ΔER,    ET,     ΔET     ] LIST
– [MAT, 1,  0/   0.0,    0.0,    0,      0,      0,      0      ] SEND

```

Fission Energy Release – format revision

- The expanded format retains the “HEAD”, “LIST”, “SEND” structure, as follows:

```

– [MAT, 1, 458/ ZA,      AWR,      0,      0,      0,      0      ] HEAD
– [MAT, 1, 458/ 0.0,    0.0,      0,      NPLY>0, 18*(NPLY+1), 9*(NPLY+1) /
–      c0EFR,    Δc0EFR,    c0ENP,    Δc0ENP,    c0END,    Δc0END
–      c0EGP,    Δc0EGP,    c0EGD,    Δc0EGD,    c0EB,      Δc0EB
–      c0ENU,    Δc0ENU,    c0ER,     Δc0ER,     c0ET,     Δc0ET
–      c1EFR,    Δc1EFR,    c1ENP,    Δc1ENP,    c1END,    Δc1END
–      c1EGP,    Δc1EGP,    c1EGD,    Δc1EGD,    c1EB,     Δc1EB
–      c1ENU,    Δc1ENU,    c1ER,     Δc1ER,     c1ET,     Δc1ET
–
–
–      ...
– [MAT, 1, 0/ 0.0,    0.0,      0,      0,      0,      0      ] LIST
– [MAT, 1, 0/ 0.0,    0.0,      0,      0,      0,      0      ] SEND

```

- This revision allows the energy release to be determined solely from the data tabulated by the evaluator without regard to the historical functional forms provided in the ENDF-102 Format Manual.