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Proposal of 51 isotopes for ENDF/B-VIII

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Summary

- Why ?
- 51 isotopes from TENDL-2015
- Example
- Conclusion

Why TENDL for ENDF/B-VIII ?

- We are proposing to add some short/long lived (and 3 stable) isotopes to ENDF/B-VIII
- A modest TENDL statement :

“The smaller the importance of a nuclide, the larger the probability that TENDL provides the best evaluated file in the world.”

- ENDF/B-VIII already includes a number of short/long-lived isotopes: *e.g.*
 - $t_{1/2} > 10^5$ years: ^{93}Zr , ^{107}Pd , ^{126}Sn , ^{129}I , ^{135}Cs
 - $10^5 > t_{1/2} > 10^3$ years: ^{94}Nb
 - $100 > t_{1/2} > 10$ years: ^{85}Kr , ^{90}Sr , ^{137}Cs , ^{133}Ba ,
 - $10 > t_{1/2} > 1$ year: ^3H , ^{22}Na , ^{91}Y , ^{106}Ru , $^{110\text{m}}\text{Ag}$, ^{125}Sb , ^{134}Cs
 - $1 \text{ y} > t_{1/2} > 1 \text{ d}$: ^7Be , $^{58,58\text{m}}\text{Co}$, ^{65}Zn , $^{73,74}\text{As}$, ^{86}Rb , ^{89}Sr , ^{90}Y , ^{96}Zr , ^{95}Nb , ^{99}Mo
 ^{103}Ru , ^{105}Rh , ^{111}Ag , $^{115\text{m}}\text{Cd}$, ^{113}Sn , $^{123,125}\text{Sn}$, $^{124,126}\text{Sb}$,
 $^{127\text{m},129\text{m},132}\text{Te}$, ^{131}I , ^{133}Xe , ^{136}Cs , ^{140}Ba , ^{140}La
 - $1 \text{ d} > t_{1/2}$: ^{105}Ru , $^{130,135}\text{I}$, $^{123,135}\text{Xe}$

51 isotopes from TENDL-2015

- These stable, long-lived and short-lived isotopes can be added to ENDF/B-VIII:

– Stable:

$^{20,21,22}\text{Ne}$

– $t_{1/2} > 10^5$ years:

$^{26\text{m}}\text{Al}$, ^{36}Cl , ^{41}Ar , ^{81}Kr , ^{98}Tc , $^{186\text{m}}\text{Re}$, ^{205}Pb , $^{210\text{m}}\text{Bi}$

– $10^5 > t_{1/2} > 10^3$ years:

^{93}Mo

– $10^3 > t_{1/2} > 100$ years:

^{32}Si , $^{118\text{m}}\text{Ag}$, ^{158}Tb , ^{209}Po

– $100 > t_{1/2} > 10$ years:

^{35}S , ^{63}Ni , $^{121\text{m}}\text{Sn}$, ^{145}Pm , ^{193}Pt

– $10 > t_{1/2} > 1$ year:

^{55}Fe , ^{109}Cd , $^{144,146}\text{Pm}$, ^{171}Tm , ^{204}Tl , ^{208}Po

– $1 \text{ y} > t_{1/2} > 1 \text{ d}$:

^{37}Ar , $^{45,47}\text{Ca}$, ^{49}V , ^{51}Cr , ^{54}Mn , ^{71}Ge , ^{75}Se , ^{97}Ru , ^{103}Pd , ^{143}Pm

^{145}Sm , ^{161}Tb , ^{169}Er , ^{175}Yb , ^{181}W , $^{185,191}\text{Os}$, $^{192,194\text{m}}\text{Ir}$, ^{203}Hg , ^{210}Po

Fusion, spallation

Medical, radiotracer

Spent nuclear fuel management

Gamma/beta/x-ray source

With this addition ENDF/B-VIII is complete for all nuclides stable or $t > 1$ year.

Typical structure of a TENDL-2015 file

- ➡ MF-1: Description + fission parameters
 - ➡ MF-2: Resonance parameters (Reich-Moore or Multi-level Breit Wigner)
 - ➡ MF-3: Cross sections (n, tot) , (n, el) , (n, non) , (n, inl_i) , ..., (n, γ) , (n, p_i) , (n, α_i)
 - ➡ MF-4: Elastic angular distribution (Legendre Polynomials)
 - ➡ MF-5: Fission neutron spectrum
 - ➡ MF-6: Double differential distributions and spectra for $(n, 2n)$, ..., (n, α_i)
 - ➡ MF- 8-10: Isomeric cross sections
 - ➡ MF- 12-15: Gamma yields, angular distributions and spectra
 - ➡ MF- 31-32-33-34-35, 40: nubar, Resonance parameter, cross section, angular distribution and fission neutron spectrum, radionuclide production.
- All up to 200 MeV
 - Adjusted to thermal (n, g)
 - If no RRR measurement: use of statistical resonances in the RRR, consistent with TALYS (fast range)

Conclusion

- ENDF/B-VIII beta already contains some short/long-lived isotopes (mainly coming from JENDL),
- We are proposing 48 short/long-lived isotopes and 3 stables (Ne) from TENDL-2015 (not in ENDF/B-VIII, not in JENDL)
- They will not affect criticality benchmarks,
- Users already complement ENDF/B-VII with TENDL data,

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Generic Application of the SSP CMS to PWRs

SSP-14/P01-028-TR-NP

The CASMO5 neutron data library is based on ENDF/B-VII.1 data files (supplemented with TENDL-2012 data) and was processed with NJOY-94.105 [2] and NJOY-2012.8 [3]. In addition, other auxiliary Studsvik

- So it will help them if ENDF/B-VIII directly contains “all” their isotopes of interest.

