



Impact of ENDF/B-VII.0 Release on FENDL-2.1

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FENDL-2.1 Background

- Revision to FENDL-2.0 (1995/96)
- Compiled November 2003, INDC(NDS)-451
- 71 elements/isotopes
- Working libraries prepared by IAEA/NDS, see INDC(NDS)-467 (2004)
- Processing performed using NJOY-99.90 at IAEA-NDS and resulting processed files are available in ACE format for MCNP and in MATXS format for multi-group transport calculations (175n-42g)
- New reference data library for ITER neutronics calculations

Data Source for FENDL-2.1

No.	Library	NMAT	Materials
1	ENDF/B-VI.8 (E6)	40	^2H , ^3H , ^4He , ^6Li , ^7Li , ^9Be , ^{10}B , ^{11}B , ^{16}O , ^{19}F , $^{28-30}\text{Si}$, ^{31}P , S, $^{35,37}\text{Cl}$, K, $^{50,52-54}\text{Cr}$, $^{54,57,58}\text{Fe}$, ^{59}Co , $^{61,62,64}\text{Ni}$, $^{63,65}\text{Cu}$, ^{197}Au , $^{206-208}\text{Pb}$, ^{209}Bi , $^{182-184,186}\text{W}$
2	JENDL-3.3 (J33)	18	^1H , ^3He , ^{23}Na , $^{46-50}\text{Ti}$, ^{55}Mn , $^{92,94-98,100}\text{Mo}$, ^{181}Ta , V
3	JENDL-3.2 (J32)	3	Mg, Ca, Ga
4	JENDL-FF (JFF)	4	^{12}C , ^{14}N , Zr, ^{93}Nb
5	JEFF-3 (EFF) JEFF3	4	^{27}Al , ^{56}Fe , ^{58}Ni , ^{60}Ni
6	BROND-2.1 (BR2)	2	^{15}N , Sn

- Data for 40 isotopes/elements were taken from ENDF/B-VI.8
- ENDF/B-VII.0 library was officially released on December 15, 2006
- Compared data for these 40 elements/isotopes



Assessment of changes made in data for the 40 isotopes/elements taken from ENDF/B-VI.8

Isotopes for which data did not change (7 isotopes)

H-2, He-4, Li-7, B-11, Fe-58, Co-59, Bi-209

"ENDF/B-VII CONVERTED FROM ENDF/B-VI BY NNDC OCT 2004"

*For Bi-209, covariance data removed except for total (MF/MT=33/1) that were judged to be of high quality

Assessment of changes made in data for the 40 isotopes/elements taken from ENDF/B-VI.8

For the following isotopes only change is in the product energy-angle distributions (MF=6) using corrected gnash code to fix an earlier bug
(19 isotopes)

*Si-28, Si-29, Si-30, P-31, Cr-50, Cr-52, Cr-53, Cr-54, Fe-54,
Fe-57, Ni-61, Ni-62, Ni-64, Cu-63, Cu-65, W-182, W-183,
W-184, W-186*

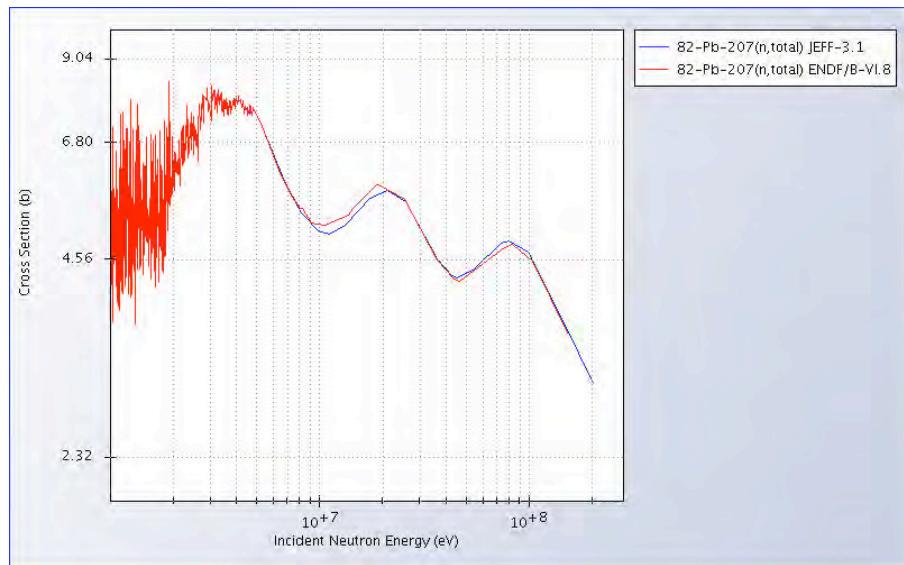
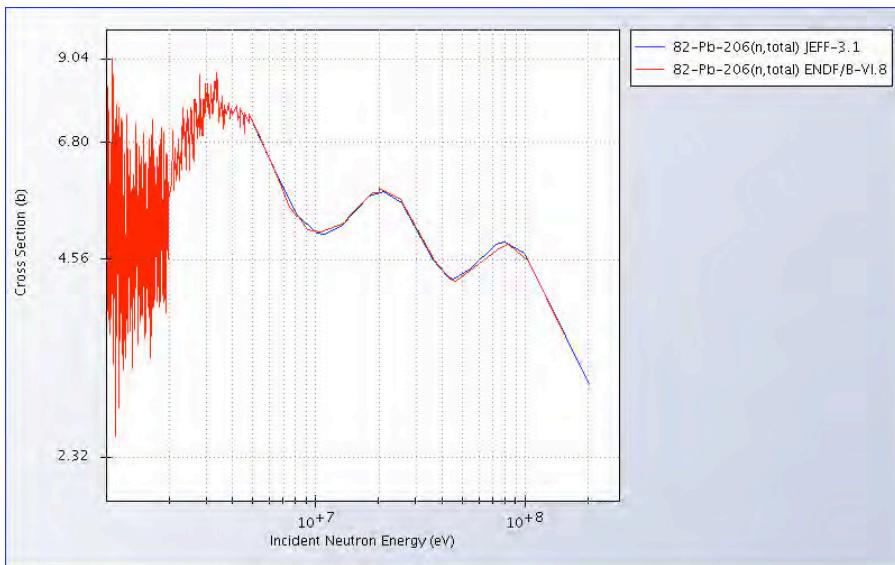
“Possible impact is reduced secondary particle production for new ENDF/B-VII release”

*For Si-28 changes were made only > 20 MeV and impact is mainly better alpha production data

Assessment of changes made in data for the 40 isotopes/elements taken from ENDF/B-VI.8

For following isotopes ENDF/B-VII.0 data were taken from JEFF-3.1 (2 isotopes)

Pb-206, Pb-207

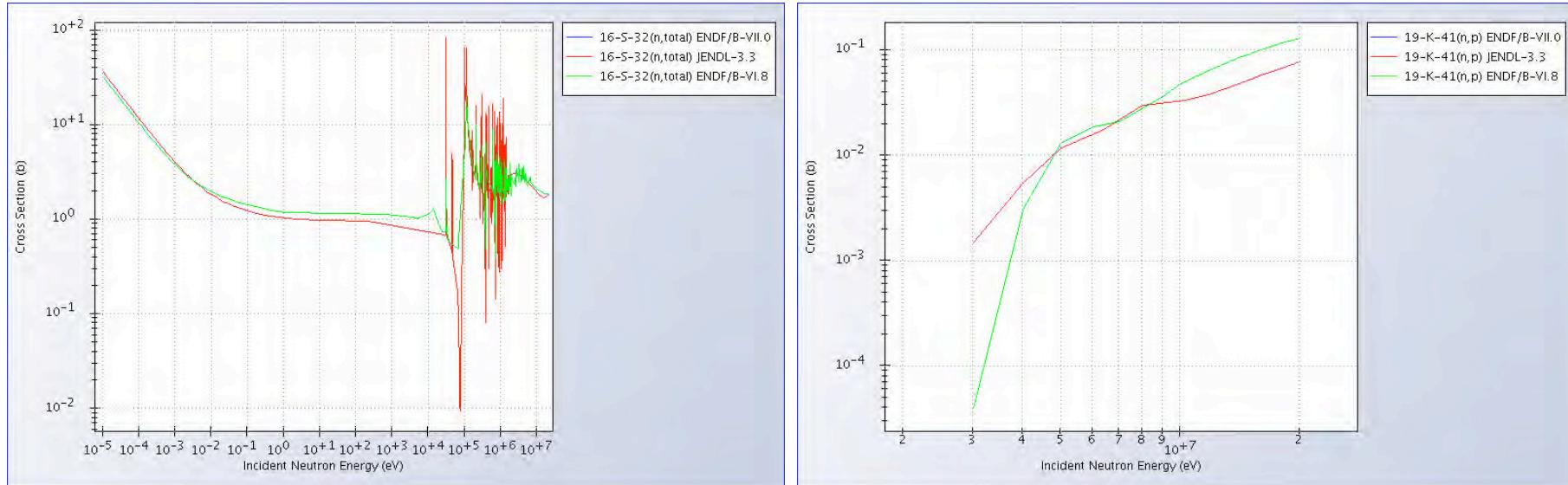


Only minor change in cross sections above ~ 5 MeV

Assessment of changes made in data for the 40 isotopes/elements taken from ENDF/B-VI.8

Only isotopic data are provided in ENDF/B-VII.0 for S and K

Data for S isotopes (*S-32, S-33, S-34, S-36*) and K isotopes (*K-39, K-40, K-41*) were taken from JENDL-3.3

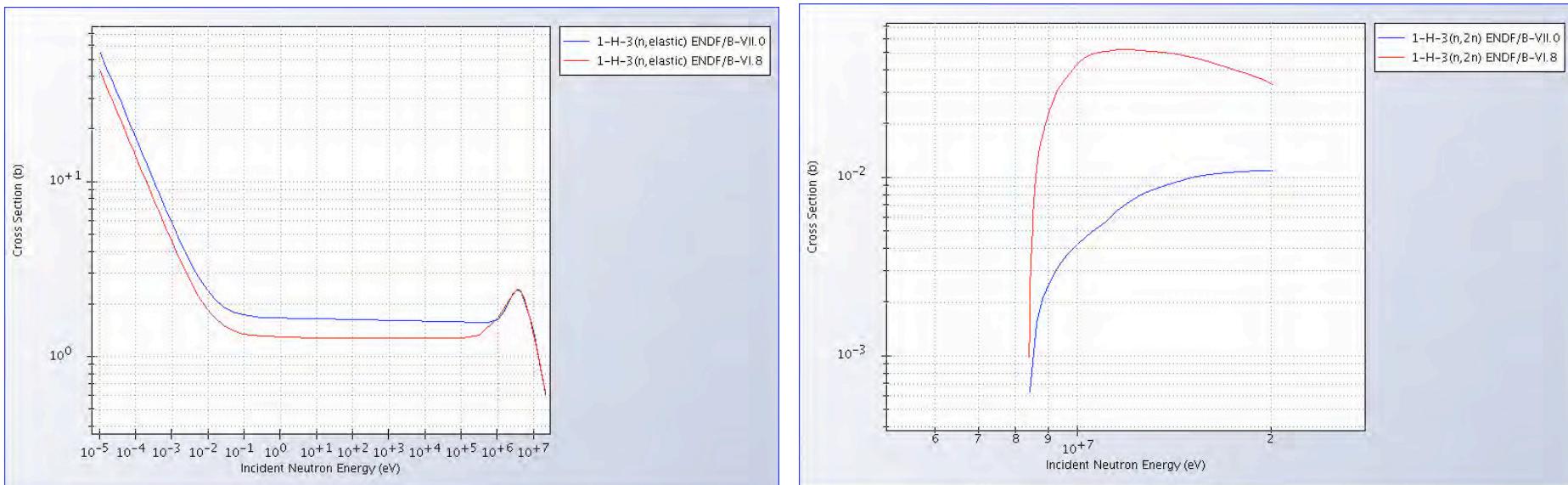


No isotopic data for K in ENDF/B-VI.8 (except for K-41(n,p))
 Large changes in cross sections

Assessment of changes made in data for the 40 isotopes/elements taken from ENDF/B-VI.8

H-3

Changes in (n,total), (n,elastic) and (n,2n) cross sections



Large changes in (n,2n) and elastic scattering cross sections

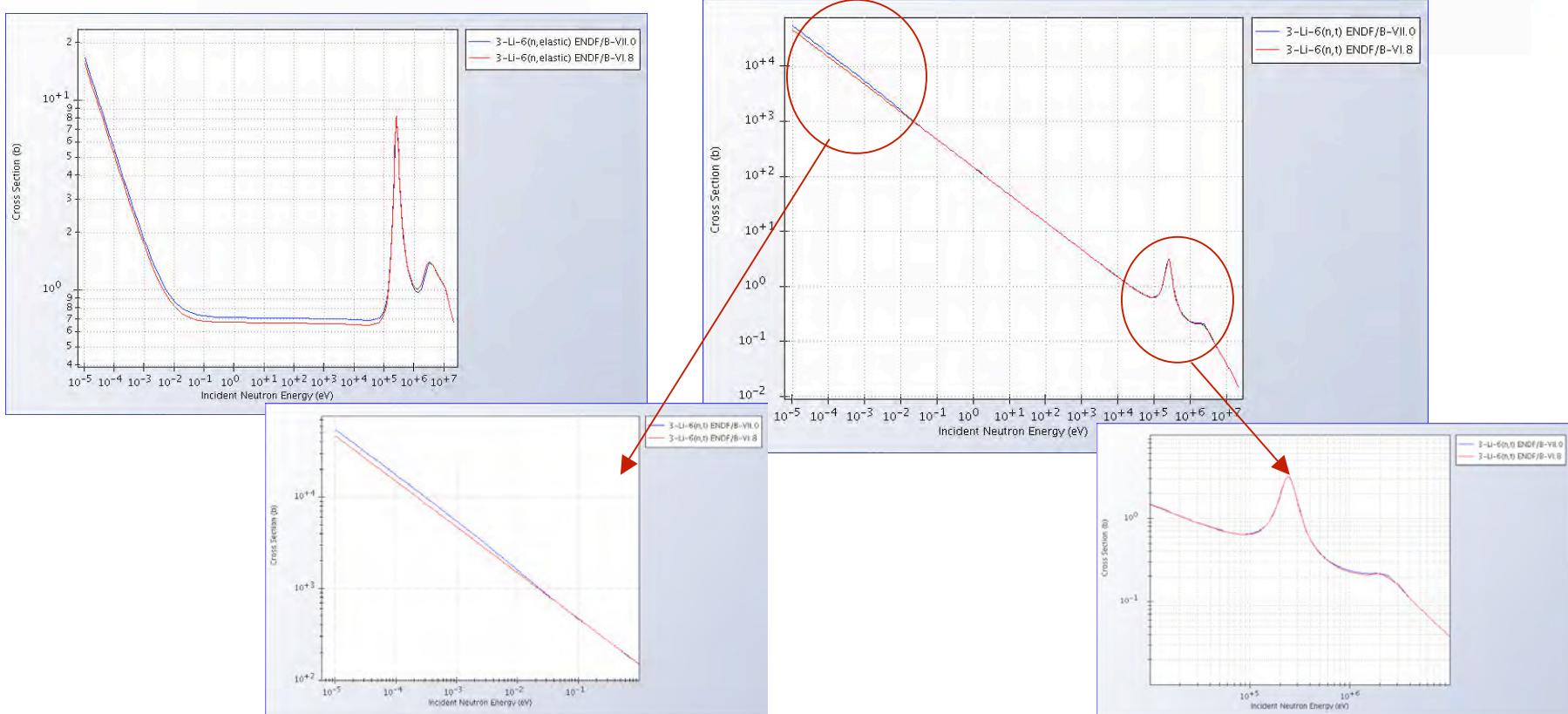
Only possible impact on ICF target neutronics

Does not impact ITER

Assessment of changes made in data for the 40 isotopes/elements taken from ENDF/B-VI.8

Li-6

Changes in (n,total), (n,elastic) and (n,t) cross sections, angular distribution and covariance data

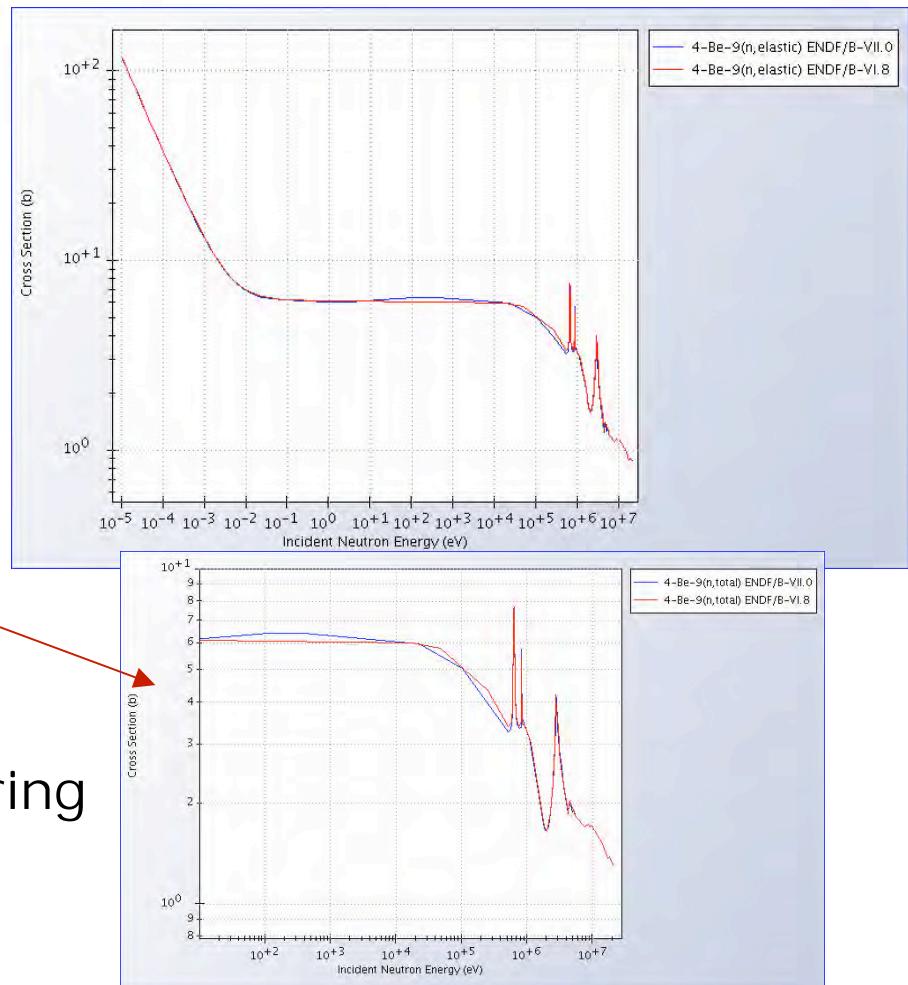


Minor increase in (n,t) at very low and high energies
 Minor impact on ITER-TBM expected

Assessment of changes made in data for the 40 isotopes/elements taken from ENDF/B-VI.8

Be-9

Changes in (n,total), (n,elastic) cross sections



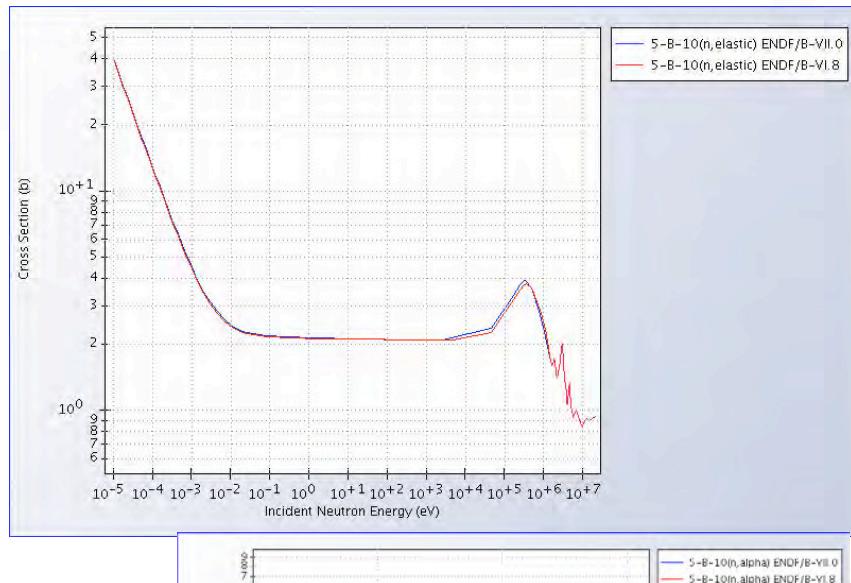
Only minor change in elastic scattering

Minor impact on ITER expected

Assessment of changes made in data for the 40 isotopes/elements taken from ENDF/B-VI.8

B-10

Changes in (n,total), (n,elastic), (n, α), angular distribution and covariance data



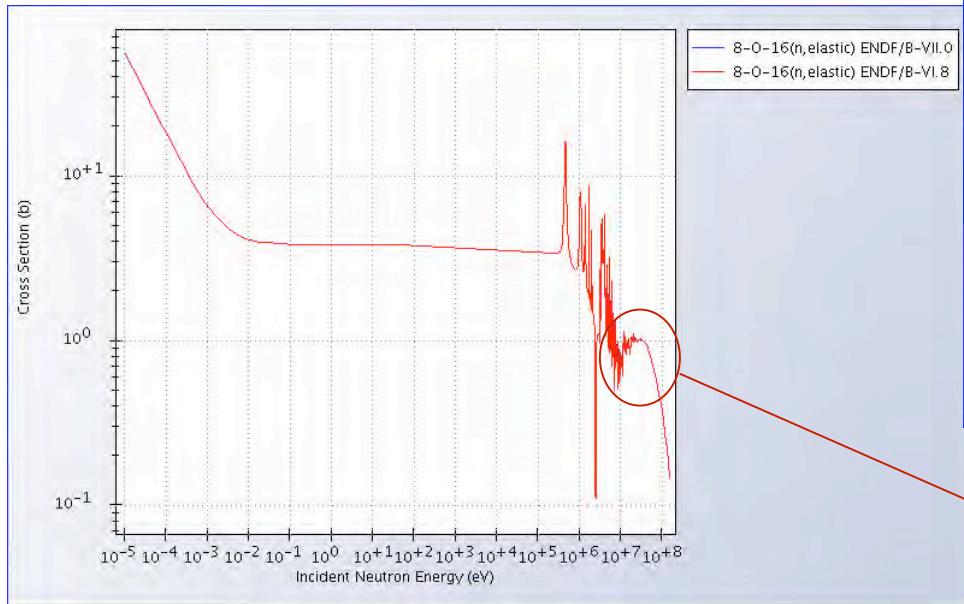
Only minor change in (n, α) and elastic scattering

Minor impact on ITER expected

Assessment of changes made in data for the 40 isotopes/elements taken from ENDF/B-VI.8

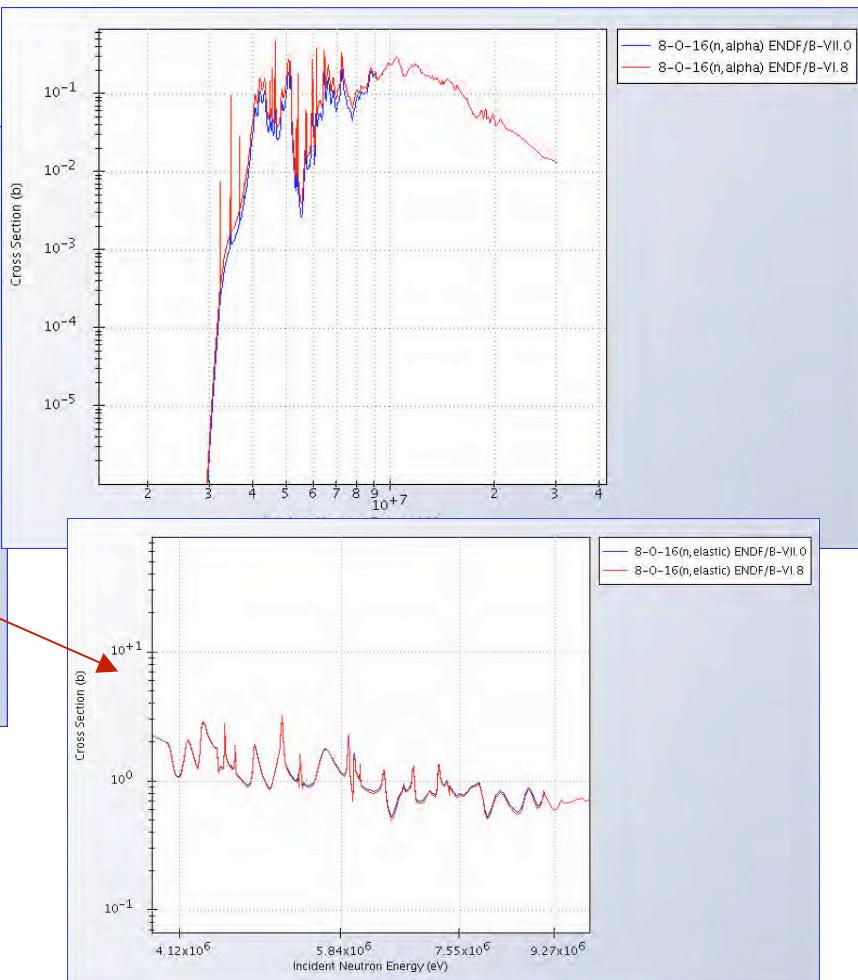
O-16

Changes in ($n, \text{elastic}$) and (n, α) cross sections



Only minor change in (n, α) and elastic scattering in range 3-9 MeV

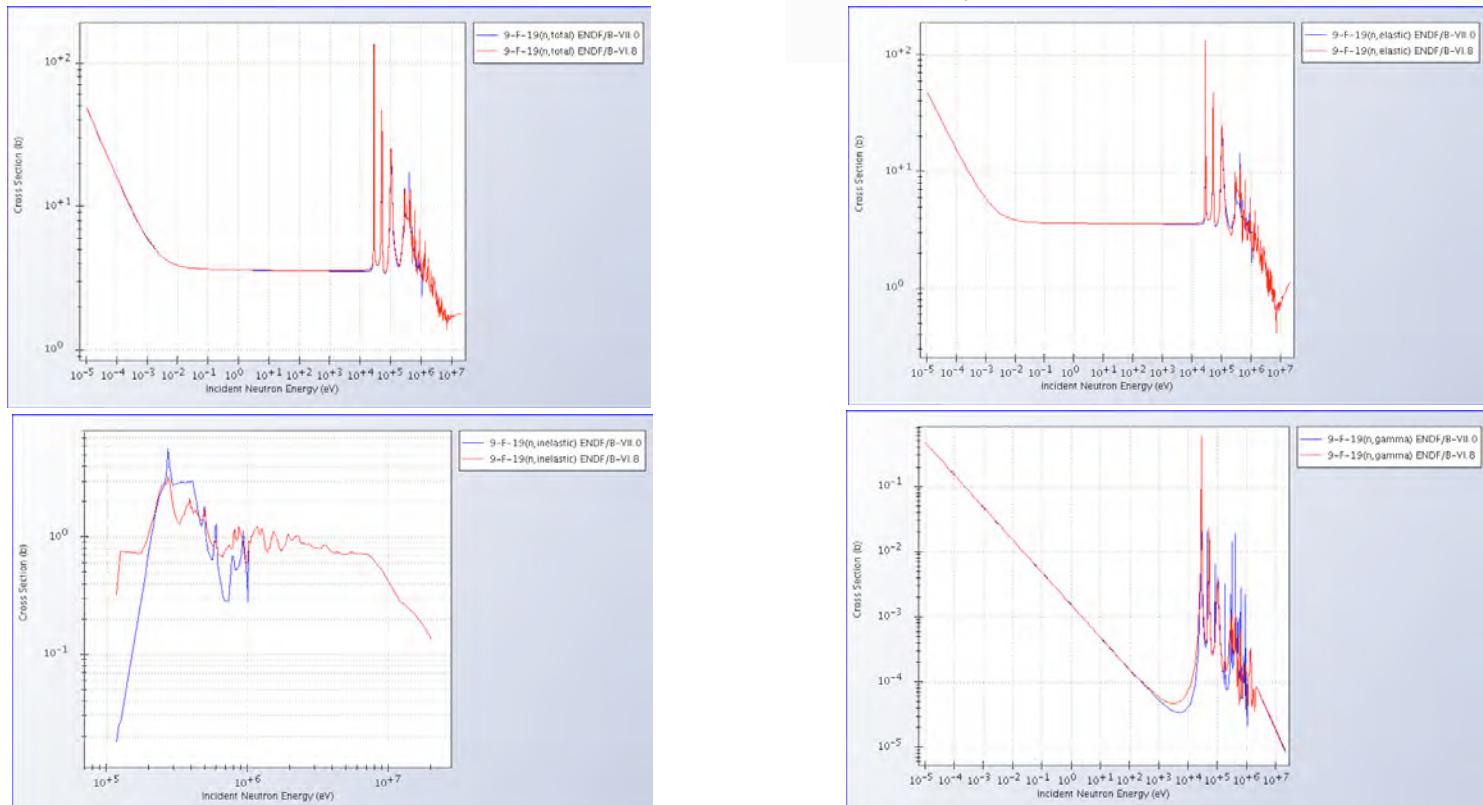
Minor impact on ITER expected



Assessment of changes made in data for the 40 isotopes/elements taken from ENDF/B-VI.8

F- 19

Changes in (n,total), (n,elastic), (n,inelastic) and (n, γ) cross sections

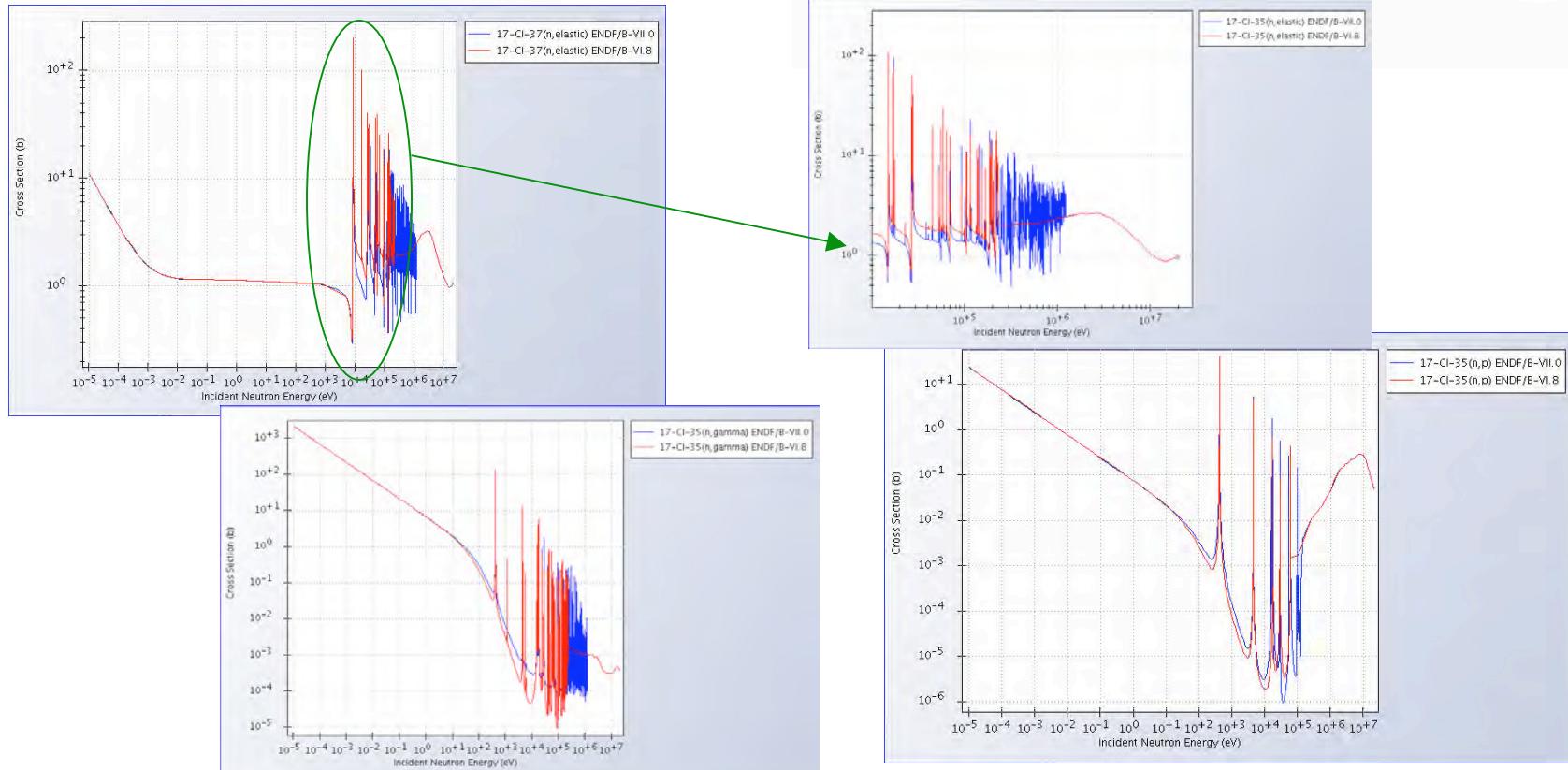


Some large change in (n, γ) and inelastic scattering
 Minor impact on ITER expected unless Flibe is used in TBM

Assessment of changes made in data for the 40 isotopes/elements taken from ENDF/B-VI.8

Cl-35

Changes in (n,total), (n,elastic), (n,p) and (n, γ) cross sections

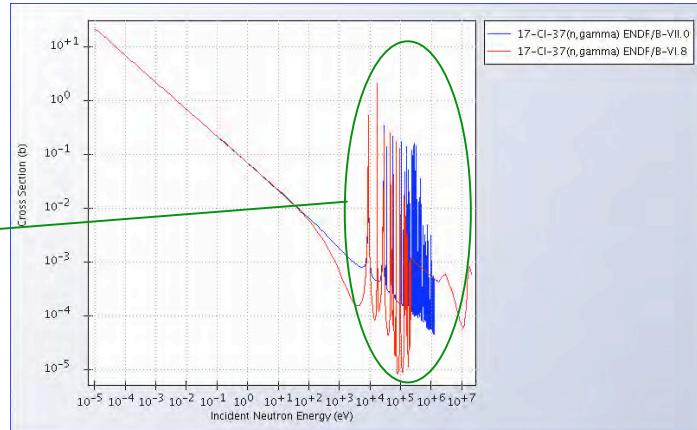
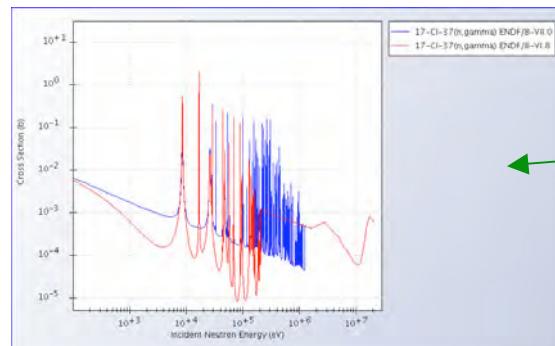
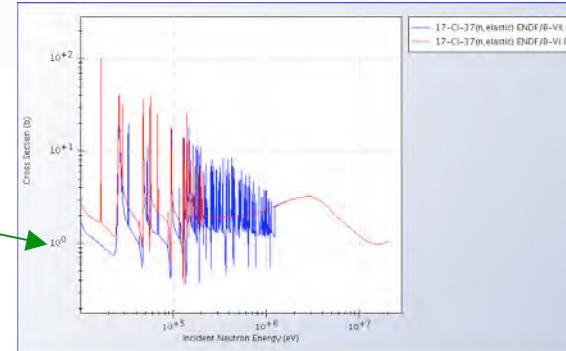
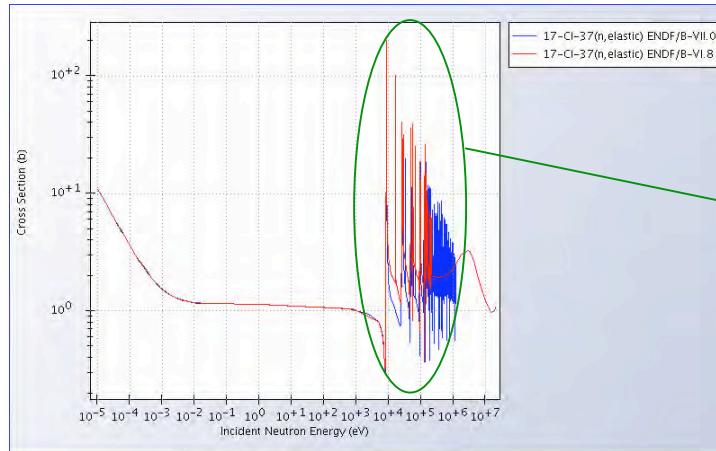


Some large changes in (n, γ), (n,p) and elastic scattering
 Minor impact on ITER expected since Cl is not used

Assessment of changes made in data for the 40 isotopes/elements taken from ENDF/B-VI.8

Cl-37

Changes in (n,total), (n,elastic), and (n, γ) cross sections

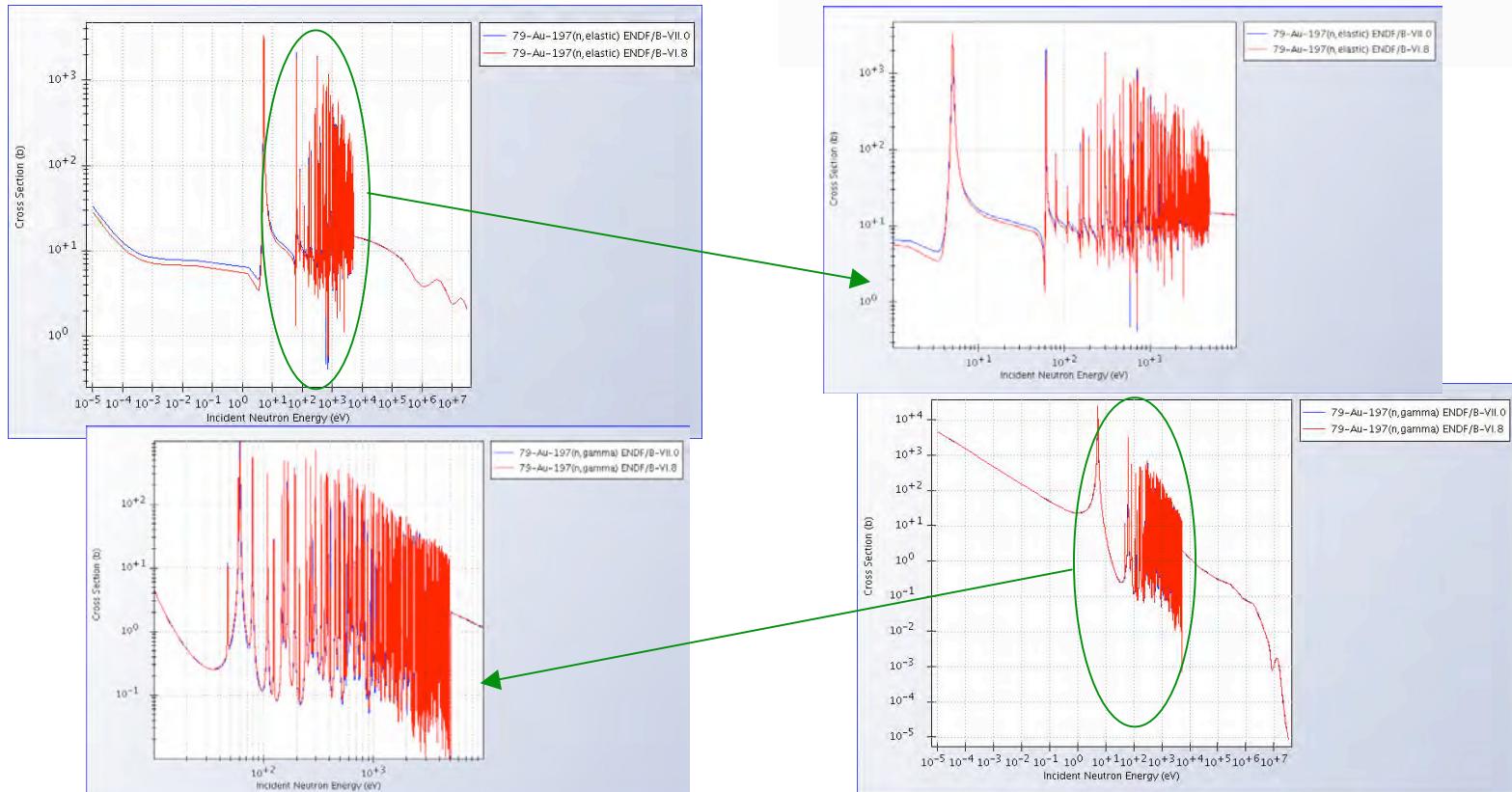


Some large changes in (n, γ) and elastic scattering
Minor impact on ITER expected since Cl is not used

Assessment of changes made in data for the 40 isotopes/elements taken from ENDF/B-VI.8

Au-197

Changes in (n,total), (n,elastic), and (n, γ) cross sections

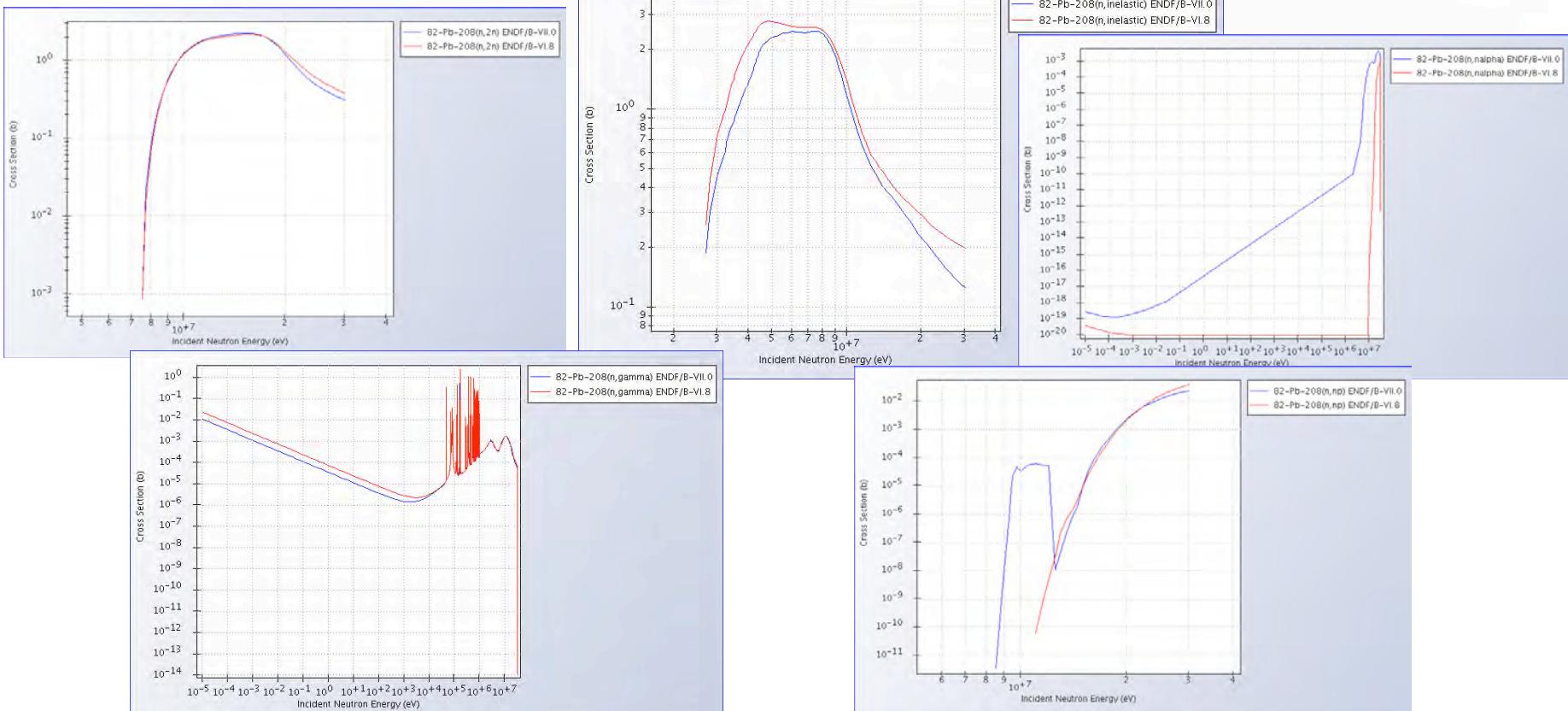


Moderate changes in (n, γ) and elastic scattering in resonance region
 Only possible impact on ICF target neutronics. Does not impact ITER

Assessment of changes made in data for the 40 isotopes/elements taken from ENDF/B-VI.8

Pb-208

Many cross sections changed

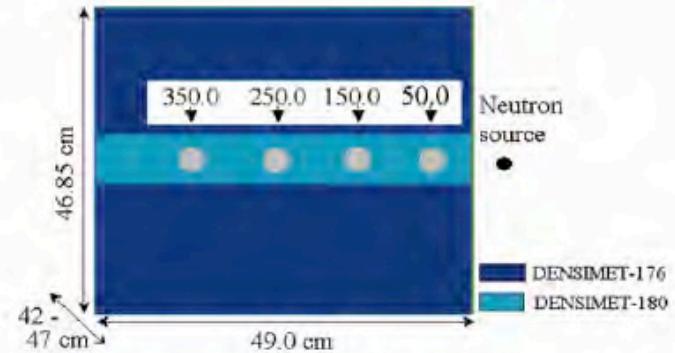
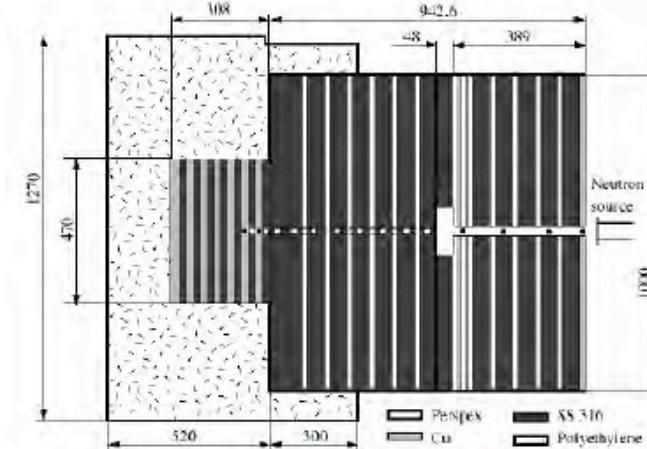


Large changes in several cross sections
Possible impact on ITER-TBM

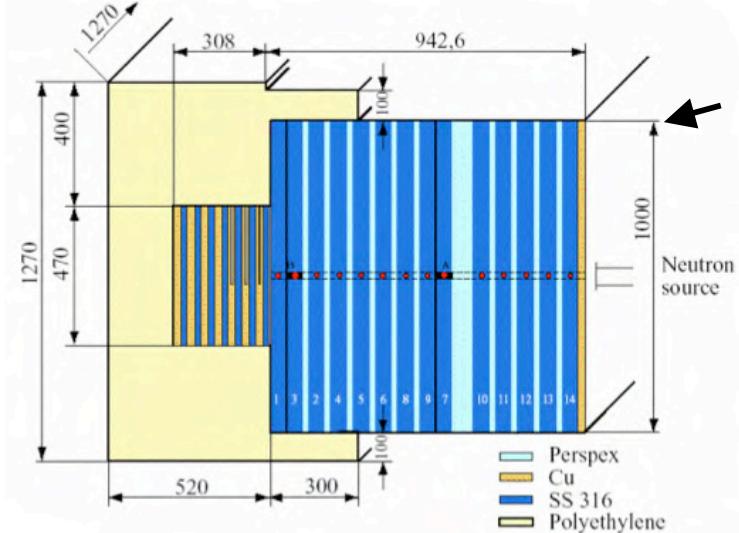
Findings

- Minor impact on ITER nuclear analysis is expected except for ITER-TBM nuclear analysis due to changes in data for Li-6, Pb-208, and F-19
- Effects of changes could be large in other fusion systems
 - Power plants with breeding blankets
 - Inertial fusion systems (e.g., H-3 and Au-197 data are important for ICF target neutronics)
- Calculation benchmarks will be used to assess possible impact on relevant nuclear parameters
 - M. Sawan, "FENDL Neutronics Benchmark: Specifications for the Calculational Neutronics and Shielding Benchmark," IAEA Nuclear Data Section Report INDC(NDS)-316 (December 1994).
- Calculations will also be made for the FNG integral experimental benchmarks
- Impact of changes introduced in JENDL-3.3, JEFF-3.1, BROND-2.2 should also be assessed
- FENDL-2.1 needs a new update (FENDL-2.2 or 3.0?) for fusion neutronics but this update is not urgently needed for ITER analysis pending the outcome of benchmark calculations

Benchmark Experiments (FNG Facility)



Tungsten Experiment



Streaming Experiment
Bulk Shielding Experiment

