Comments from Mark Chadwick

Mark points out several issues to address. The following notes are taken verbatim from Mark's email of November 2, although they have been formatted a bit differently for easier viewing.

Ishikawa 2014 Paper

Pu-239 Capture

Discontinuities are seen in the 239Pu capture uncertainty at 2.5 keV - why? Above 2.5 keV the uncertainty increases to over 15\% up to 10 keV, then it drops to about 7\%, then increases to about 12\% below 100 keV, and from 100 keV to 1 MeV increases form 10\% to 20\%. Question - how do these uncertainties compare with the capture changes above 30 keV made for CIEL0; and what are the uncertainties in the SG34 file used by CIELO in the resonance range?

235U Fission

Question on fission unc. in the 0.5-2 keV region - VII.1 small uncertainties here (where JENDL4 was big ~ 5\%.). VII.1 has a seemingly unphysical peak to over 12\% in unc. at 2 keV - an NJOY mistake? VII.1 shows an unc increase to 3-4\% in the approx. 1--25 keV region - why?

235U Capture

Questions the rise in uncertainty above a keV to about 35\%, which remains up to 100 keV and then decreases to about 15\% at 1MeV. (MBC - in retrospect the VII.1 unc in the 0.5-2 keV region might have been too low, as we have made large changes here! The uncertainty from 2.25 keV - 1 MeV needs updating, and should now be much smaller - 10\% say (MBC estimate) - Capote will provide from his 235 analysis.

238U Capture

He (Ishikawa) notes that JENDL4 unc is much higher than ENDF in the 20-100 keV region, and then smaller in teh 100-150 keV region, and this needs to be better understood owing to the importance on breeding ratio and burnup reactivity loss in fast reactor calculations.

238U Total Inelastic Cross Sections

He notes that the JENDL4 and 7.1 total inelastic cross sections are reasonably similar but the uncertainties are ``completely different''. Threshold to 0.1 MeV 7.1 has over 20\% while JENDL is more like 15\%; 0.1- about 1. MeV, 7.1 is less than 10\% unc, and 5\% unc in some cases, while JENDL remains over 15\%. Above 1 MeV 7.1 has over 20\%, with JENDL much lower. (MBC - notes that above 6 MeV where the inelastic falls, the 7.1->Cielo changed quite a lot - 2--30\%, making the high 7.1 unc seem reasonable there; but in the plateau region

perhaps ENDF 7.1 unc was too high and now it could be smaller in CIELO). Roberto will address this. 238U total elastic unc differ quite a lot between 7.1 and JENDL4, and the latter has some negative correlations not found in ENDF file.

56Fe Total Elastic Scattering

Unc differs significantly between 7.1 and JENDL4 , esp. above 30 keV (endf is double JENDL up to 1 MeV, then this swaps). Mubar unc much bigger in 7.1, eg at 100 keV, 7.1 is over 30\%, JENDL under 5\%.

CIELO vs. Subgroup 39 Adjustment Project

Here we briefly summarize some of the cross-section changes made for CIELO, compared to insights provided by the WPEC Subgroup 39 Adjustment project. That project takes as a starting point evaluated library data of cross sections, spectra, angular distributions, and their uncertainties (covariance data), and performs an adjustment of these data based on a least-squares process to optimally match a set of benchmark-quality integral critical assembly data; mainly criticality and reaction rate (spectral index) measurements. The Subgroup 39 researchers emphasize that the adjustments obtained do not necessarily point to physically-correct nuclear data, owing to limitations in the method, including non-unique solutions and compensating effects. Still, it is useful to compare Subgroup 39 insights with CIELO evaluation decisions:

U-235 Capture

Fast reaction sodium worth reactivity measurement in Japan suggested a subtantially (20-40\%) reduced ^{235}U capture cross section in the 0.5-2 keV region, compared to ENDF/B-VII.1 (Yokoyama and Ishikawa). CIELO concurs with this, following corroborating cross section measurements at LANL/DANCE and RPI. CIELO also adopts a higher capture cross section from 2.25-50 KeV based on the Jandel DANCE data; This is partly consistent with the Japan adjustment guidance, except for the 6-20 keV where the adjustment goes in the opposite direction (however, we note that the sensitivity of the Japanese SWR measurements is almost negligible from 6-20 keV (Fukushima et al, 2016)).}

238U Inelastic

Is suggested to be lower than VII.1 in the 2-5 MeV region, and in the 0.1-1 MeV region, according to Palmiotti. This is partly consisent with the CIELO changes, although in the lower neutron energy region although CIELO is lower from 0.2-0.6 MeV, it is higher from 0.6-1 MeV. The values in the CIELO file appear to be also consistent with the conclusions from Santamarinia in a JEFF adjsutment study (NDS118, 118 (2014). We note though that changes in CIELO inelastic scattering were driven by fundamental improvements in nuclear reaction and structure modeling.

239Pu Capture

Is suggested to be higher in the 1-10 keV region, and in the region up to 100 keV, based on the impact of the PROFIL experiment (Palmiotti). CIELO has increased the capture in the fast region from 30-100 keV based on the recent Mosby and Jandel DANCE data, consistent with this. But CIELO hos not yet addressed an upgrade of the unresolved resonance region up to 30 keV.

56Fe Inelastic

Palmiotti suggests a reduced inelastic scattering cross section in the 0.6-0.8 MeV range compared to ENDF/B-VII.1. In fact, the CIELO change near threshold goes in the opposite direction, an increase. We note JENDL4 remains significantly higher than VII.1 in the 0.9-3 MeV region.