RESPONSE TO TASK ASSIGMENTS: FRANS DE CORTE

1. **Neutron spectrum characterization: provide recommendations for other candidate materials that have suitable capture and threshold reactions.**

- Au, Zr and Lu are already available as components of k0-IAEA.

- Additionally recommended:

[prices depend on foil sizes and quantities; see: http://www.goodfellow.com/scripts/web.wl?MGWLPN=MNT&PROG=GOTOSTAT&LAN=A&CTRY=100 (→ index → go to element → foil → click code number → prices)]

Goodfellow IN000200, indium 99.999 %, foil 0.05 mm thick [→ ~0.29 mg In per 1mm diam. foil]

^{115}In(n,n') ^{115m}In [T½ = 4.486 h; Eγ = 336.2 keV, 45.9 %]
~ 0.025 MBq /mg·ϕ_f (= 1x10^{11}). t_{irr} (=5 h)
~ 12000 γ·s^{-1} / mg·ϕ_f (= 1x10^{11}) ·t_{irr} (=5 h)
notes: 1. to be used under Cd-cover; 2. not to be used for (n,γ) activation, because of neutron self-shielding problems.

Goodfellow ZN000301, zinc 99.95+ %, foil 0.25 mm thick [→ ~1.4 mg Zn per mm diam. foil]

^{64}Zn(n,p)^{64}Cu [T½ = 12.70 h; Eγ = 511.0 keV, 35.7 %]
~ 0.0033 MBq /mg·ϕ_f (= 1x10^{11}). t_{irr} (=5 h)
~ 1200 γ·s^{-1} / mg·ϕ_f (= 1x10^{11}) ·t_{irr} (=5 h)
notes: 1. to be used under Cd-cover; 2. low Cu-content = 15 ppm.

^{64}Zn(n,γ)^{65}Zn [T½ = 244.3 d; Eγ = 1115.5 keV, 50.6 %]
~ 0.0038 MBq /mg·ϕ_{th} (= 2x10^{12}). t_{irr} (=5 h); ~ 0.00038 MBq /mg·ϕ_{epi} (= 1x10^{11}). t_{irr} (=5 h)
~ 1900 γ·s^{-1} / mg·ϕ_{th} (= 2x10^{12}) ·t_{irr} (=5 h); ~ 190 γ·s^{-1} / mg·ϕ_{epi} (= 1x10^{11}) ·t_{irr} (=5 h)

^{68}Zn(n,γ)^{69m}Zn [T½ = 13.76 h; Eγ = 438.6 keV, 94.8 %]
~ 0.054 MBq /mg·ϕ_{th} (= 2x10^{12}). t_{irr} (=5 h); ~ 0.0086 MBq /mg·ϕ_{epi} (= 1x10^{11}). t_{irr} (=5 h)
~ 51000 γ·s^{-1} / mg·ϕ_{th} (= 2x10^{12}) ·t_{irr} (=5 h); ~ 8100 γ·s^{-1} / mg·ϕ_{epi} (= 1x10^{11}) ·t_{irr} (=5 h)

Goodfellow NI000531, nickel 99.98 %, foil 0.125 mm thick [→ ~0.87 mg Ni per mm diam. foil]

^{58}Ni(n,p)^{58}Co [T½ = 70.86 d; Eγ = 810.8 keV, 99.5 %]
~ 0.00016 MBq /mg·ϕ_f (= 1x10^{11}). t_{irr} (=5 h)
~ 160 γ·s^{-1} / mg·ϕ_f (= 1x10^{11}) ·t_{irr} (=5 h)
note: preferably to be used under Cd-cover.

Goodfellow FE000360, iron 99.99+ %, foil 0.125 mm thick [→ ~0.8 mg Fe per mm diam. foil]

^{54}Fe(n,p)^{54}Mn [T½ = 312.1 d; Eγ = 834.8 keV, 99.98 %]
~ 0.0000024 MBq /mg·ϕ_f (= 1x10^{11}). t_{irr} (=5 h)
~ 2.4 γ·s^{-1} / mg·ϕ_f (= 1x10^{11}) ·t_{irr} (=5 h)
note: preferably to be used under Cd-cover.

^{58}Fe(n,γ)^{59}Fe [T½ = 44.50 d; Eγ = 1099.3 keV, 56.5 %; Eγ = 1291.6 keV, 43.2 %]
~ 0.00026 MBq /mg·ϕ_{th} (= 2x10^{12}). t_{irr} (=5 h); ~ 0.000013 MBq /mg·ϕ_{epi} (= 1x10^{11}). t_{irr} (=5 h)
~ 150 γ·s^{-1} / mg·ϕ_{th} (= 2x10^{12}) ·t_{irr} (=5 h); ~ 7.5 γ·s^{-1} / mg·ϕ_{epi} (= 1x10^{11}) ·t_{irr} (=5 h) [1099.3 keV]

Goodfellow MO000130, molybdenum 99.9 %, foil 0.005mm thick [→ ~0.04 mg Mo per mm diam. foil]

$^{98}Mo(n,\gamma)^{99}Mo$ [T½ = 65.94 h; Eγ = 140.5 keV (^{99m}Tc; T½ = 6.01 h), 89.06 %]
~ 0.02 MBq /mg·ϕ_{th} (= $2x10^{12}$). t_{irr} (=5 h); ~ 0.05 MBq /mg·ϕ_{epi} (= $1x10^{11}$). t_{irr} (=5 h)
~ 18000 $\gamma \cdot s^{-1}$ / mg·ϕ_{th} (= $2x10^{12}$) ·t_{irr} (=5 h); ~ 45000 $\gamma \cdot s^{-1}$ / mg·ϕ_{epi} (= $1x10^{11}$) ·t_{irr} (=5 h)

$^{100}Mo(n,\gamma)^{101}Mo$ [T½ = 14.61 min; Eγ = 306.8 keV (^{101}Tc; T½ = 14.2 min), 88.7 %]
~ 0.24 MBq /mg·ϕ_{th} (= $2x10^{12}$). t_{irr} (=5 h); ~ 0.23 MBq /mg·ϕ_{epi} (= $1x10^{11}$). t_{irr} (=5 h)
~ 200000 $\gamma \cdot s^{-1}$ / mg·ϕ_{th} (= $2x10^{12}$) ·t_{irr} (=5 h); ~ 200000 $\gamma \cdot s^{-1}$ / mg·ϕ_{epi} (= $1x10^{11}$) ·t_{irr} (=5 h)

2. Materials analysis test: to review the availability and appropriateness of using synthetic multi-element standard materials (SMELS) or a suitable substitute; to look into the future possibility of SMELS production.

I contacted Peter Vermaercke (SCK, Mol) and reported him about the situation as I experienced it at the 1rst CRM (Vienna, 3-5 October 2005):

a/ Several people, when going to determine elementary concentrations in the SMELS, expressed at the CRM their intention to use radionuclides and/or gamma-lines which were not considered in the characterization of the SMELS (cf the SMELS "Certificate of Analysis"). For instance, this would, as a matter of course, be the case when applying the holistic approach incorporated in the k0-IAEA software. I expressed my opinion that by disregarding the fact that the SMELS were designed and developed as "conditional" reference materials, a loss of traceability would occur, which is ultimately leading to the situation that it is then no longer possible, from the comparison of the concentration results obtained with the reference values, to draw conclusions with respect to the correctness of implementation of k0-NAA.
b/ As a result of the above, the idea was growing among the CRM participants that the SMELS could be used as a material for intercomparison of k0-IAEA software results, without comparison with (i.e. disregarding) the SMELS reference data. I expressed my opinion that this would lead to a waste of valuable reference material, which was asking a large effort to accurately characterize it with respect to its elementary concentrations, and for which in the planned CRP exercise the only criterium for its use would then be its multi-element character and its homogeneity. In addition to this, I remarked that the SMELS exercise had already been done by some (if not most) of the CRM participants (in the context of the SMELS characterization), so that these persons already have the material available in their laboratory (in case they should want to use it again – this time for QC/QA of the k0 implementation in their lab: in my opinion this would be contradictory with their former action as "expert labs" for contributing to the SMELS characterization)
c/ As a result of the above, an alternative idea was growing among the CRM participants, namely that perhaps use could be made of another reference material as a substitute for the SMELS.

Upon considering these arguments, Peter Vermaercke decided that for the CRP participants who in the past recieved SMELS for taking part in its characterization, there is no need to be provided with extra material. For the few others (Sunday Jonah, Maria Arribere), SMELS material will be made available in the usual way, i.e. upon written request. Furthermore, Peter remarked that nothing prevents SMELS analysts from using other radionuclides/gamma-lines, e.g. for internal comparisons, but he emphasized that thus obtained results should not be used with the aim to validate the implementation of k0 in their laboratory.

In view of the above, there is no need to look for a suitable substitute for SMELS.

I talked with Peter Vermaercke and with other colleagues about
the production of new SMELS, but I experienced that this would not be possible in the near future.

3. Nuclear Data: provide half-life data (to Mark Kellet) from the k0 database

This has been done during the 1st CRM (Vienna, 3-5 October 2005).