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NEUTRON-CAPTURE YIELDS FOR GAMMA-RAY SPECTROSCOPY. Robert C. Reedy[1] and Stephanie C. Frankle[2], [1]Group NIS-2, MS D436, Los Alamos National Lab., Los Alamos, NM 87545 (rreedy@lanl.gov), [2]Group X-CI, Mail Stop F663, Los Alamos National Laboratory, Los Alamos, NM 87545 (frankles@lanl.gov).

Introduction: Good values for the yields and energies of the gamma rays emitted following the capture of thermal neutrons are needed for many studies. Gamma rays made by cosmic-ray-produced neutrons are used to determine planetary elemental abundances [1, 2]. Similar measurements are done down boreholes using neutron sources and generators [3]. Many other studies, such as neutron and photon transport calculations, also need data for neutron-capture gamma rays.

We have recently compiled and evaluated the yields of gamma rays from the capture of thermal neutrons for isotopes with Z < 31 and for a few heavier elements. Many of our yields are better than in some existing compilations that are often used.

Compilations of Yields for Gamma Rays from Neutron-Capture Reactions: There have been several evaluations and compilations done for the yields of gamma rays from neutron-capture reactions. One [2] was done in the mid-1970s for analysis of planetary gamma rays. Another was done in about 1980 [4], but it evaluated fewer sources than were used by [2]. Another compilation [5] was only done for isotopes with mass of 45 and higher using evaluations published in *Nuclear Data Sheets*. A similar compilation is presently available on-line at the Brookhaven National Laboratory's National Nuclear Data Center. It is like [5] for isotopes with A=45 and higher and uses the old compilation of [4] for A=44 and lower. However, there are some new gamma-ray yields measured since the last evaluation for many elements that should be considered. For elements with A<45, there are no adequate compilations to use for gamma-ray yields from neutron-capture reactions.

New Evaluations and Compilation: We have been evaluating yields of neutron-capture gamma rays for several years. We have, or soon will have, evaluated the yields of gamma rays from neutron-capture reactions for all isotopes for elements with atomic number (Z) up to and including 30 (Zn), plus several other heavier isotopes. We will use these evaluations to prepare a compilation for these elements.

We have already completed most elements. We have often adopted the gamma-ray yields from papers that used gamma-ray measurements made at the Los Alamos Omega West Reactor before it shut down several years ago. The Los Alamos and Oak Ridge team that does this work has tried to include as many gamma rays as possible into a decay scheme for levels in the nucleus of interest [e.g., 6], thus showing that the gamma rays are from the isotope of interest.

For most elements, there are some gamma-ray yields made using high-quality gamma-ray spectrometers. However, there are a few elements that need to have better measurements, such as Mn, Zn, and W.

In Table 1, we compare our preliminary yields for several important gamma rays with older yields [2,4]. Our yields usually are within a few per cent of the older ones. Some yields in [4] are poor, e.g., for Ti and Cl.

Conclusions: Compilations of our newly-evaluated gamma-ray yields for neutron-capture reactions will offer improvements over most previous compilations. Our results will also be added to the Evaluated Nuclear Data Files (ENDF) for use with transport codes such as the Monte Carlo N-Particle (MCNP) code.

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Table 1. Comparisons of our preliminary elemental neutron-capture yields (per 100 captures) for major γ rays with those from two earlier compilations.

Nuclide	Energy (keV)	Yield (Ours)	Yield [2]	Yield [4]
^{24}Mg	3916.9	49.1	48.	48.62
^{27}Al	7724.0	26.8	30.	27.43
^{28}Si	4934.0	62.2	61.	62.69
^{28}Si	3539.0	66.5	66.	68.00
^{32}S	5420.6	56.5	55.	59.08
^{35}Cl	6110.8	20.6	21.	20.00
^{35}Cl	1951.1	19.5	20.	21.72
^{35}Cl	1164.9	27.3	–	19.93
^{35}Cl	517.1	24.4	–	18.50
^{40}Ca	6419.6	41.9	40.	38.89
^{40}Ca	1942.7	82.3	80.	72.55
^{48}Ti	6760.1	44.0	40.	24.17
^{48}Ti	6418.4	29.0	28.	30.13
^{48}Ti	1381.8	81.2	82.	69.08
^{54}Fe	9297.8	3.3	3.4	4.15
^{56}Fe	7645.6	23.2	22.	24.13
^{56}Fe	7631.2	26.9	24.	28.51
^{58}Ni	8998.4	35.8	37.	37.74