

- The 3977A is currently licensed to carry the following list of solid nuclides in tungsten liners:

Ac-225	I-131	Re-186
Ac-227	In-111	Re-188
Ac-228	Ir-192	Rh-105
Am-241	Ir-194	Se-75
As-77	Lu-177	Sm-153
Au-198	Mo-99	Sr-89
Ba-131	Na-24	Sr-90
C-14	Np-237	Tb-161
Co-60	P-32	Th-227
Cs-131	P-33	Th-228
Cs-134	Pb-203	Tl-201
Cs-137	Pb-210	W-187
Cu-67	Pd-109	W-188
Hg-203	Ra-223	Y-90
Ho-166	Ra-224	Yb-169
I-125	Ra-226	Yb-175
I-129		

The solid contents are limited to 30W
Maximum contents mass tested 9.8 kg

- Croft wish to add a new solid contents type
- The new content is a thorium puck (4mm thick at 4.57cm diameter) clad in an Inconel shell (5mm x 5.08 cm; target dimension).
- The puck is exposed to high-energy proton bombardment
- MCNPX/CINDER is used to generate the activity listing.
- Initial output generated well over 2000 isotopes. A cutoff of 0.01 activity percent was applied to reduce the list by a factor of 10.

Proposed Contents – Irradiated Thorium Puck



This table does not
include daughter
nuclides

Nuclide	Final Activity (mCi)	Nuclide	Final Activity (mCi)
Ac225	213.4	Pa232	101.3
Ac226	284.5	Pa233	88.2
Ag111	2196.0	Pd112	1876.1
Ba140	528.2	Ra223	51.4
Br82	74.8	Rh105	2544.6
Cd115	2557.6	Ru103	666.1
Ce139	3.6	Sb120m	24.0
Ce141	370.5	Sb122	282.8
Ce143	617.7	Sb124	142.7
Cs136	319.9	Sb125	19.3
I124	68.0	Sb126	420.0
I126	45.4	Sb127	836.3
I130	239.9	Sb128	70.3
I131	1144.0	Sn117m	26.8
I133	81.5	Sn125	390.1
La140	219.1	Te121	6.5
Mo99	2103.1	Te131m	345.2
Nb95	9.5	Te132	508.5
Nb96	74.4	Th227	1176.6
Nd147	231.4	Tl202	0.7
Pa228	194.4	Y87	9.4
Pa230	295.4	Zr95	364.7
		Zr97	1010.4

Proposed Contents - Inconel Capsule



24h post EOB

4 h EOB

8 h EOB

Blue rows ID the same nuclides for all decay periods

Isotope	Original Activity (Ci)	Current Activity (Ci)	% Activity Contribution	Isotope	Current Activity (Ci)	% Activity Contribution	Isotope	Current Activity (Ci)	% Activity Contribution
Mn52	2.36	2.09	2.10%	Mn52	2.31	0.79%	Mn52	2.26	1.10%
Cr51	1.31	1.28	1.29%	Cr51	1.3	0.44%	Cr51	1.3	0.63%
V48	6.39E-01	6.13E-01	0.62%	V48	6.35E-01	0.22%	V48	6.30E-01	0.31%
Ni57	5.91E-01	3.75E-01	0.38%	Ni57	5.48E-01	0.19%	Ni57	5.07E-01	0.25%
Co55	6.10E-01	2.42E-01	0.24%	Co55	5.23E-01	0.18%	Co55	4.47E-01	0.22%
Co56	1.70E-01	1.70E-01	0.17%	Co56	1.70E-01	0.06%	Co56	1.70E-01	0.08%
Mn54	1.66E-01	1.66E-01	0.17%	Mn54	1.66E-01	0.06%	Mn54	1.66E-01	0.08%
Ni56	1.05E-01	9.42E-02	0.09%	Mn56	1.57E-01	0.05%	Ni56	1.01E-01	0.05%
Fe55	8.10E-02	8.09E-02	0.08%	Ni56	1.03E-01	0.04%	Fe55	8.10E-02	0.04%
V49	7.40E-02	7.38E-02	0.07%	Fe55	8.10E-02	0.03%	V49	7.39E-02	0.04%
Zr89	6.47E-02	5.26E-02	0.05%	Nb90	7.59E-02		Nb90	6.28E-02	
Co57	4.71E-02	4.82E-02	0.05%	V49	7.40E-02		Zr89	6.03E-02	
Co58	3.82E-02	3.78E-02	0.04%	Co58m	7.28E-02		Co58m	5.37E-02	
Tc96	3.73E-02	3.18E-02	0.03%	Fe52	7.12E-02		Mn56	5.34E-02	
Nb90	9.12E-02	3.01E-02	0.03%	Zr89	6.25E-02		Fe52	5.10E-02	
Sc47	3.65E-02	2.98E-02	0.03%	Tc95	4.77E-02		Co57	4.76E-02	
Tc95	5.45E-02	2.43E-02	0.02%	Co57	4.73E-02		Tc95	4.15E-02	
Nb92m	2.04E-02	1.91E-02	0.02%	Co58	3.81E-02		Co58	3.81E-02	
Cr48	3.85E-02	1.82E-02	0.02%	Sc44	3.80E-02		Tc96	3.53E-02	
Co58m	9.75E-02	1.66E-02	0.02%	Tc96	3.63E-02		Sc47	3.41E-02	
Mo99	2.12E-02	1.66E-02	0.02%	Sc47	3.53E-02		Cr48	2.99E-02	
Fe52	9.84E-02	1.39E-02	0.01%	Cr48	3.40E-02		Nb92m	1.99E-02	
Y87	1.69E-02	1.38E-02	0.01%	Mo90	3.07E-02		Mo99	1.95E-02	
Sc48	1.79E-02	1.23E-02	0.01%	Ti45	2.04E-02		Mo90	1.88E-02	
Sc46	8.18E-03	8.11E-03	0.01%	Mo99	2.03E-02		Sc44	1.87E-02	

- If a 0.4 total activity % cutoff is applied this percentage appears to capture isotopes that would be produced under a variety of irradiation conditions. This provides a list of approximately 50 isotopes for consideration for a new SARP table to ship irradiated targets in the 3977A
- If the contents were screened at the 1.0 total activity % level for routine shipment, approximately 30 isotopes would need to be discussed in the SAR.
- We are concerned about the risk of the introduction of an isotope not captured in a contents table revision due to an unforeseen change in target design, irradiation condition or some other uncharacterized factor.
- Is there some way to accommodate a small fraction of isotopes (say 5-10) that may not be captured in a contents table. This would give significant peace of mind that this would be a Type B container that would serve for the present and emerging thorium target irradiation needs.

Contents Packing Arrangement



- Could the target be loaded directly into the containment vessel cavity?
- Would any testing be required to demonstrate the target would remain intact during NCT and HAC conditions?