ISTC Project #3266 Kick-off

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ISTC-Contact Expert Group on Nuclear Transmutation related Projects Annual meeting.
January 30 – 31, 2006, **EC, Building CDMA, 21, rue de Champs de Mars, 1050 Brussels**

ISTC#3266: Formal information

Title: *Experimental and theoretical study of the residual nuclide production in 40-2600 MeV proton-irradiated thin targets of ADS structure materials*

Dates: Approved for funding in October 2005. Expected duration *2nd quarter 2006 – 3rd(or 4th) quarter 2008*

Financing party: *EU*

Budget: *$ 430 000*

Collaborators

- SCK-CEN (***Hamid Ait Abderrahim, Edouard Malambu, Thierry Aoust***)
- Royal Institute of Technology (***Waclaw Gudowsky***)
- Universitat Hannover / Zentrum fur Strahlenschutz und Radioekologie (ZSR) (***Rolf Michel***)
- CEA / DSM / DAPNIA/CEN Saclay / Service de Physique Nucleaire (***Sylvie Leray***)
- Forschungszentrum Karlsruhe Technik und Umwelt / Institut fuer Reaktorsicherheit (***Cornelis H.M. Broeders***)
- Los Alamos National Laboratory / Nuclear Physics Group (T-16) (***Eric Pitcher, Stepan Mashnik***)
- Oak Ridge National Laboratory (***Phillip D. Ferguson***)
- JAERI / Nuclear Data Center (***Tokio Fukahori***)
- Georgia Institute of Technology / The Nuclear & Radiological Engineering & Health Physics Program of the George W. Woodruff School of Mechanical Engineering (***Nolan E. Hertel***)
- + *OECF/NEA* (***Enrico Sartori***)

Prolog: the project is an extension of the researches carried out under:

- ISTC Project#17 (1994-1996, USA)*Feasibility study of the basic technologies for weapon plutonium conversion and for long-lived radioactive waste transmutation*
- ISTC #839 (1997-1998; 1999-2000, Japan, EU, Norway) *Experimental and Theoretical Study of the Residual Product Nuclide Yields in Thin Targets Irradiated with 100-2600 MeV Protons*
- *ISTC # 2002 (2002-2004, EU): Experimental and theoretical studies of the yields of residual product nuclei produced in thin Pb and Bi targets irradiated by 40-2600 MeV protons*

Brief info available via http://tech-db.istc.ru/ISTC/sc.nsf/html/projects.htm?open&id=3266

ISTC Project #3266

List of irradiation runs for beta-active nuclide production measurements.

Targets	Proton energies (MeV)										
	40	70	100	150	250	400	600	800	1200	1600	2600
^{56}Fe +	x	x	x	x	x	x	x	x	x	x	o
^{nat}Cr	x	x	x	x	x	x	x	x	x	x	x
^{nat}Ni	x	x	x	x	x	x	x	x	x	x	x
^{93}Nb	x	x	x	x	x	x	x	x	x	x	o
^{181}Ta	x	x	x	x	x	x	x	x	x	x	x
^{nat}W	x	x	x	x	x	x	x	x	x	x	o

o – the irradiations were made under the ISTC Project#839.

+ Additionally, ^{56}Fe will be irradiated by 300, 500, 750, 1000 and 1500 MeV proton to be compared with recent GSI measurements!

The Workplan is to be discussed by CEG 31 January 2006

List of irradiation runs for alpha-active nuclide (^{148}Gd) production measurements.

Targets	Proton energies (MeV)			
	600	800	1600	2600
^{181}Ta	x	x	x	x
^{nat}W	x	x	x	x

Isotopic composition of the targets

Isotope	Number of samples	Isotopic composition, %
^{56}Fe	15	^{54}Fe-0.3, ^{56}Fe-99.5±0.1, ^{57}Fe-0.2, ^{58}Fe-<0.05.
^{nat}Cr	11	^{50}Cr-4.345 , ^{52}Cr-83.789 , ^{53}Cr-9.501, ^{54}Cr-2.365 .
^{nat}Ni	11	^{58}Ni-68.077, ^{60}Ni-26.223, ^{61}Ni-1.140, ^{62}Ni-3.634, ^{64}Ni-0.926
^{93}Nb	10	^{93}Nb > 99.9
^{181}Ta	15	^{180}Ta-0.012, ^{181}Ta-99,988.
^{nat}W	14	^{180}W-0.12, ^{182}W-26.50, ^{183}W-14.31, ^{184}W-30.64, ^{186}W – 28.43.

Accelerator time requirements:

68 short (~0.7h) irradiations

8 long (~20h) irradiations

~130h accelerator time

For comparison:

ISTC#2002 took **37h** acc.time

(disregarding time for accelerator preparation and beam adjustment)

ISTC#3266 scope of activities

Scope of activities: the similar as in ISTC#2002 + alpha measurements !
(irradiation, alpha-spectra measurements, spectral analysis, ^{148}Gd CRS determination)

1. *Manufacture of samples (1-4 quarters) - 76 samples (68 – for beta, 8 – for alpha measurements)*
2. Adjusting of the additional detector for gamma-measurement (1-2 *quarters*)
3. *Calibration of spectrometers; stability tests (1-10 quarters)*
4. *Irradiation of experimental samples (1-8 quarters)*
5. *Gamma-spectrometry of the samples (1-9 quarters) (68 samples)*
6. *Processing of gamma-spectra (1-9 quarters)*
7. *Identification of gamma-lines and determination of radioactive residual nuclide yields (1-10 quarters)*
8. Pre-starting procedure to operate the alpha detector (1-4 quarters)
9. Alpha-spectrometry of the W and Ta samples (5-8 quarters) (8 samples)
10. Processing of the alpha-spectra, determination of the ^{148}Gd yield (9-10 quarters)
11. *Theoretical simulations by different codes (1-9 quarters): LAHET (we failed to get MCNPX from RSICC), CEM03 (LANL), LAQGSM(LANL), INCL4 (from CEA-Sacley), INCL5 (SCK), CASCADE-2004 (?: Jaipur Univer.), CASCADO, LAHETO.*
12. *Updating the models and codes on the basis of the new experimental data obtained under the Project (3-10 quarters)*
13. *Sending the experimental results to the Worldwide Network of Nuclear Data Centers via Center for Nuclear Structure and Reaction Data (Russia) (8-10 quarters)*
14. *Preparation of technical reports (5, 6, 9, 10 quarters)*

ISTC #3266 Irradiation schedule

ITEP U10 accelerator complex is being intensively modified to provide heavy ion beams. So, unlike previous years, in 2006 just 10 of 22 accelerator weeks are planed for protons.

Planed schedule for ITEP U-10 accelerator runs for 2006 year:

Protons
^{12}C ions
^{27}Al ions

Therefore, the previous schedule mode of irradiations used under ISTC#839&2002 cannot be applied further.

→ **We need <u>additional Ge-detector</u> (Canberra) to double the rate of irradiations (at least 12 targets during 1 accelerator run which last about a month).**

For comparison: during ISTC#2002 average rate of irradiations was 5-7 irradiation per 1 acc.run, irradiations being uniformly time distributed during a run

→ **We need to have manufactured samples (and 2nd detector) by the end of March**

However,

ISTC regulations do not allow spending money before a project signing!

Moreover, we cannot even make an order of the detector!

So,

First quarter of the Project will be partially “lost” to purchase Ge-detector probably leading to some delay of the project results.


Hoping for successful further collaboration !
KONIJN
KRIEK
KREEFTEN
FILETS DE SOLE
A L'OSTENDAISE
TONGFILETS
OP OSTENDS
WIJZE
Thank you