

# HORIZON 2020 RESEARCH AND INNOVATION FRAMEWORK PROGRAMME OF THE EUROPEAN ATOMIC ENERGY COMMUNITY

# Nuclear Fission and Radiation Protection 2018 (NFRP-2018-4)

Project acronym	: SAND	SANDA						
Project full title:	Solvir Europ	Solving Challenges in Nuclear Data for the Safety of European Nuclear facilities						
Grant Agreemer	nt no.: <b>H2020</b>	H2020 Grant Agreement number: 847552						
Workpackage N°:	WP3	WP3						
Identification N°:	MS29							
Type of documen	t: <i>Milesto</i>	ne Report	t					
Title:	Report o	Report on decision on targets to be manufactured						
Dissemination Le	vel: <b>PU</b>	PU						
Reference:								
Status:	Final							
Comments:								
	Name	Partner	Date	Signature				
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#### SANDA - WP3

# Target Preparation for Improvement of Nuclear Data Measurements Task 3.3: Target production

Task coordinator: JRC, partners: PSI

The demand for high-quality targets, specially designed for the envisaged experiment and targets manufactured for nuclear reaction studies in a broad variety of application fields is constantly increasing, with the production of radioactive samples comprising particular challenges due to the special requirements arising from the emitted radiation. Only a handful of laboratories in Europe are capable and equipped to meet these special requirements. Resource sharing, knowledge transfer as well as tight interaction with the end-users in order to fabricate tailored samples are a MUST for a more efficient and qualitatively improved delivery of urgently needed targets.

A limited number of targets could be produced according to requests from collaboration members. Both PSI and JRC were responsible for the manufacturing of the final target and were in close contact concerning the special requirements of the envisaged experiment using the possibilities of user-producer interaction provided in the frame of Task 3.1. Resources were allocated according to the effort. Target requests were submitted to the WP3 and the Task 3.3 leaders. Requests for targets related to energy (<sup>235</sup>U, <sup>238</sup>U, <sup>239</sup>Pu, <sup>242</sup>Pu, <sup>50</sup>Cr, <sup>79</sup>Se targets) and also to non-energy applications (<sup>179</sup>Ta, <sup>79</sup>Se, <sup>94</sup>Nb, <sup>10</sup>Be, <sup>163</sup>Ho, <sup>53</sup>Cr, <sup>205</sup>Pb, <sup>87</sup>Sr targets) were considered. Each target request was evaluated on the basis of the relevance of the target and the possibilities of the TP facilities.

During the first 12 months of the project, target requests from collaborators were collected and evaluated. After this time span, the decision on which targets can be manufactured was made. This report shows the list of targets to be fabricated.

In total, WP3 received 20 target requests of which 10 requests were assigned to PSI 9 requests to JRC and 1 request was cancelled before it was assigned to a target preparation lab because the project with this target was withdrawn from SANDA. The list of finished target requests is shown in Appendix 1, of pending target requests in Appendix 2 and of on hold - cancelled target requests in Appendix 3.

Twelve target requests are finished and the targets are delivered. PSI contributed with four requests and delivered high-quality and well-characterized targets which

included isotopes as <sup>179</sup>Ta, <sup>79</sup>Se, <sup>94</sup>Nb, <sup>10</sup>Be and JRC with eight requests and delivered high-quality and well-characterized targets which included isotopes as <sup>235</sup>U, <sup>238</sup>U and <sup>239</sup>Pu.

There are five target requests pending. Four of them are assigned to PSI and are under discussion. It concerns requests for targets with a higher activity as the first target delivered of <sup>179</sup>Ta and <sup>10</sup>Be, a request for a <sup>163</sup>Ho target which is known to be not very realistic and a request for thin and thick targets of <sup>50</sup>Cr and <sup>53</sup>Cr for which the target format needs to be defined. JRC has one request pending for the production of three <sup>235</sup>U deposits with an areal density of 400  $\mu$ g/cm<sup>2</sup> and a diameter of 25 mm on a 40  $\mu$ g/cm<sup>2</sup> polyimide foil by physical vapour deposition. This request is pending because the commissioning of the new <sup>235</sup>U evaporator enclosed in a glove box to produce the requested targets has been delayed several times because of the Covid-19 pandemic and technical problems.

Two target requests were cancelled: a request for a <sup>205</sup>Pb target because the isotope production is currently not feasible and a request for a <sup>242</sup>Pu target because the project was withdrawn from SANDA. One target request for a <sup>87</sup>Sr target is on hold because there is no experiment envisaged.

## Appendix 1: List of delivered targets

	SANDA	Target User			Target production				
	other	Spokeslab.	Facility	Target request	Request sent to	Target producer	Status of target preparation	Delivery	
Ta-179	non-energy application	Ruchi Garg et al. University of Edinburgh, UK <u>ruchi.garg@ed.ac.uk</u>	TRIGA reactor Mainz	Separation of Ta-179 from irradiated Hf	PSI	PSI	Finished	First target delivered, experiment performed; preparatory studies for target with higher activity under discussion	
Se-79	energy and non-energy application	V. Babiano Instituto de Física Corpuscular (IFIC), Spain <u>vbabiano@ific.uv.es</u>	CERN n_TOF	PbSe on a support foil Isolating Se from PbSe	PSI	PSI	Finished	Preparatory studies for isolating Se from Pb done. For the already irradiated target not feasible. The target is provided as PbSe on a support foil	
Nb-94	non-energy application	V. Babiano Instituto de Física Corpuscular (IFIC), Spain <u>vbabiano@ific.uv.es</u>	CERN n_TOF	Elemental Nb; target in spiral shape	PSI	PSI	Finished	Target delivered, experiment performed	
Be-10	non-energy application	M. Petri University of York	NL Argonne	Thin target ~160ug/cm2	PSI	PSI	Finished	Target delivered, first experiment performed; Targets with higher activity in discussion	
Pu-239	SANDA 2.2.1	Daniel Cano-Ott et al. CIEMAT, Spain <u>daniel.cano@ciemat.es</u>	CERN n_TOF	10x 239Pu deposits 320-330μg/cm2 + 1x 239Pu 100 μg/cm2 Ø20mm on 20 μm thick Al	JRC-Geel	JRC-Geel	Finished	Targets delivered in ionisation chamber at GELINA in May 2022 and delivered at CERN in September 2022	
Pu-239	SANDA 2.2.1	Daniel Cano-Ott et al. CIEMAT, Spain daniel.cano@ciemat.es	CERN n_TOF	100mg 239Pu powder in Al container with Ø10 mm	JRC-Geel	JRC-Geel	Finished	Target delivered in September 2022	

U-238	SANDA 1.2.3	Gilbert Bélier et al. CEA/DAM-DIF gilbert.belier@cea.fr	NFS France	3x 238U deposits (total 10 mg 238U) Ø30mm on aluminized 70-80 μg/cm2 PI foil	JRC-Geel	JRC-Geel CEA	Finished	Targets delivered in June 2021
U-238	SANDA 1.2.3	Gilbert Bélier et al. CEA/DAM-DIF gilbert.belier@cea.fr	NFS France	2x 40 μg/cm2 PI foil on test frames (one golded, and one silvered frame received from CEA).	JRC-Geel	JRC-Geel	Finished	Foils delivered in June 2021
U-238	SANDA 1.2.3	Gilbert Bélier et al. CEA/DAM-DIF gilbert.belier@cea.fr	NFS France	5x 70-80µg/cm2 PI foil on special 1mm thick Al-ring Øout 60mm Øin 40mm	JRC-Geel	JRC-Geel	Finished	Foils delivered in Oct 2021
U-235		Alexander Prokofiev et al. Uppsala, Sweden <u>alexander.prokofiev@ph</u> <u>ysics.uu.se</u>	NFS France	2x 30-50 μg/cm2 polyimide foils on 1mm thick Al-ring Øout 90mm Øin 70mm	CHANDA/ WP3 SANDA/WP3	JRC-Geel	Finished	Foils delivered in Jan 2022
U-238		Alexander Prokofiev et al. Uppsala, Sweden <u>alexander.prokofiev@ph</u> <u>ysics.uu.se</u>	NFS France	3x 238U deposits 400 μg/cm2 Ø25mm on 40 μg/cm2 PI foil	CHANDA/ WP3 SANDA/WP3	JRC-Geel	Finished	Targets delivered in June 2021
Pu-239	SANDA T2.3	Maëlle Kerveno et al. CNRS IPHC France maelle.kerveno@iphc.cn rs.fr	GELINA JRC-Geel	2g 239Pu powder in Al container with Ø 50 mm and thickness of 0.5 mm	JRC-Geel	JRC-Geel	Finished	Target delivered in April 2022

## Appendix 2: List of pending targets

	SANDA	Target User			Target production			
	Domain other	Spokeslab.	Facility	Target request	Request sent to	Target producer	Status of target preparation	Delivery
Ta-179	Non-energy application	Ruchi Garg et al. University of Edinburgh, UK <u>ruchi.garg@ed.ac.uk</u>	TRIGA reactor Mainz	Separation of Ta-179 from irradiated Hf	PSI	PSI	Under discussion	First target delivered, experiment performed; preparatory studies for target with higher activity under discussion
Be-10	Non-energy application	M. Petri University of York	NL Argonne	Thin target ~160ug/cm2	PSI	PSI	Under discussion	Target delivered, first experiment performed; Targets with higher activity under discussion
Ho-163	Non-energy application	C. Guerrero Univ. Sevilla & CNA, Spain <u>cguerrero4@us.es</u>	CERN n_TOF	<sup>163</sup> Ho target of at least 5 mg	PSI	PSI	Under discussion	Not very realistic
Cr-50/ Cr-53	Energy- application /structure material	C. Guerrero Univ. Sevilla & CNA, Spain <u>cguerrero4@us.es</u>	CERN n_TOF	Thin and thick targets (up to 80 mg/cm2)	PSI	PSI	Under discussion	Experiment scheduled for 2022; target form to be defined
U-235		Alexander Prokofiev et al. Uppsala, Sweden <u>alexander.prokofiev@ph</u> <u>ysics.uu.se</u>	NFS France	3x 235U deposits 400 μg/cm2 Ø25mm on 40 μg/cm2 PI foil	CHANDA/ WP3 SANDA/WP3	JRC-Geel	Delay on commissioning of new U235 evaporator	2024

Appendix 3: List of on hold/cancelled targets

	SANDA	Target User			Target production			
	Domain other	Spokeslab.	Facility	Target request	Request sent to	Target producer	Status of target preparation	Delivery
Pb-205	Non-energy application	Adrià Casanovas Universitat Politècnica de Catalunya (UPC) <u>adria.casanova@upc.ed</u> <u>U</u>	CERN n_TOF	Production of sufficient amount; manufacturing of a suitable target	PSI	PSI	cancelled	Isotope production currently not feasible
Sr-87	Non-energy related	F. Gunsing CEA Saclay	CERN n_TOF	Recovery of partially oxidized sample	PSI	PSI	on hold	Preparation for further use, no experiment envisaged
Pu-242		Beatriz Jurado et al. CENBG, France jurado@cenbg.in2p3.fr	IPNO France	242Pu on 100 µg/cm² thick C-nat foil	SANDA/WP3		Project withdrawn from SANDA	NA