Project of Decommissioning and Contaminated Water Management - Development of Small Neutron Detector RosRAO, FSUE– Summary of the Project for Small Neutron Detector Development (phase 1)

Object & Goals

1. Within the Phase different designs of industrial detectors – corona counter & multilayer fission chamber (MFC) have to be tested in order to identify feasible technology that meets KPI's and case specific requirements.

2. Based on the results of industrial design detectors testing prototypes of downsized corona counters and MFC' have to be developed and tested to verify key technical parameters.

Key performance indicators for small neutron detector:

- Detection range of neutron flux $10^{-1} \sim 10^3 \text{ n/(cm}^2 \cdot \text{s})$;
- Radiation resistance: 1000Gy/h. Integral dose 1000 Gy;
- Maximum dimensions: 20x40 cylinder, mm;
- Cable Φ 3mm, length up to 50 m;
- Tolerance for humid environment & temperature up to +60 C.

Overview and Standout Points of Project

AmLi neutron source with CHM-F (0.1 n/(cm² · s)

neutron flux up to 1000 n/(cm^{2*}s)

TANDETRON,

Neutron detectors have been tested with cable line 50m length with radiation sources





Achieved Results by Now

PROTOTYPES TESTING RESULTS

Experimental program fully accomplished: feasible technology of neutron flux detection and its performance indicators identified.

Conceptual design of downsized ND equipment – a) corona counter and b) fission chamber developed. Set of technological prototypes of the smallsized corona counters and fission chambers manufactured and tested

Prototype of corona counter verified project KPI's, including additional functionality – GDR measurement, compatibility with existing robotic systems, and considered as a basic technological solution for further development. Alternative options and scenarios including development of combination of CC & MFC were considered.



Detector	Corona co	unter (¹⁰ B)	Fission cham	ber (²³⁵ U)		
Item	CHM-F (verified)	CHM-F2 (verified)	KHT-35-1 (estimated)	KHT-35 (verified)		
Size, mm	Ø 18.5×40	Ø 18.5×20	Ø 18.5×40	Ø 18.5×20		
Detection range, n/(cm ² s)	0.1-10 ⁴	0.1-10 ⁴	0.1-10 ⁴	0.1-10 ⁴		
Sensitivity, pulse*cm ² /n	0,17	0,1	0,051	0,017		
Counts per 1 h for flux 0,1 n/(cm ² s) (error)	62 (12%)	36 (16%)	18,6 (23%)	6,2 (40%)		
Operably with cumulative dose not less Gy	50 000	50 000 50 000 30 000				
Discrimination from gamma-ray, not less Gy	1338	984		1630		
Environment adaptability	IP 68					
Other	Gamma dos measureme	Gamma dose-rate measurement				

Overa	ll Schedule										(20	Selection of optimal technology (filling type)SelectionDetectors in test: CHM-11, CHM-79, KHK-15DetectorsEnvironment: 0-1000 Gy/h, 0,12 -1000 n/(cm²s)Environment	ction of optimal design (shield type) ctors in test: CHM-18, KHK-15 ronment: 0-1000 Gy/h, up to 50 °C
		FY2017								- 19.1	▼		
Large Category	Small Category		Apr. May Jun. Jul.		Aug. Sept. Oct.		ct. 1	Nov.	Dec.	a de	Obtained data: neutron sensitivity, radiation Obtain	Obtained data: temperature stability,	
Development of program and method for test and irrangement of tests of tance of relevant neutron- ind gamma ionization nesatrement devices to external factors	(1) Development of program and methods	to perform the element test		_							St 15.06	tolerance, applicability without preamplifier, electro cable effect (50 m) cable	romagnetic acceptance, connectors and e effect (50 m)
	(2) Procurement of industrial detectors of	neutron and gamma		-							Ċ		V
	(3) Comprehensive test of industrial detect fields 0-100 Gy/h	ors of neutron and gamma in range gamma				-						Arrangement of initial data to manufacture	re small neutron detector
	(4) Comprehensive test of industrial detect fields 100-1000 Gy/h	ors of neutron and gamma in range gamma										(corona and ission chamber technology)	
1.1 a resis n	(5) Interim report preparation					-						Technology benchmark	
 Development of conceptual design and mockup test 	 Development of conceptual design sma detector unit. 	Il neutron detector and mockup integral										Detectors in test: prototype of small corona	plementary equipment test
	(2) Manufacturing of small neutron detected	or and mockup integral detector unit									2 0.10)	Environment: 0-1000 Gy/h, 0,12-1000 n/(cm ² s)	
	(3) Comprehensive test in range gamma fi	elds 0-100 Gy/h									in the second se		▼
	(4) Comprehensive test in range gamma fi	elds 100-1000 Gy/h									a ita		
	(5) Update of conceptual design							_			∞ <u>-</u>	Obtained data: neutron sensitivity, radiation to	plerance, temperature stability
	(6) Interim report preparation										<u>e</u>	v	•
Major Milestones					Pro	port		Progress report				Verified parameters and initial data for Verified industrial small neutron detectors precise	ied parameters and initial data for is debris allocation system
						<u> </u>						industrial small neutron detectors	se debris allocation system