

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 $10^{-1} \sim 10^3$ n/(cm²·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

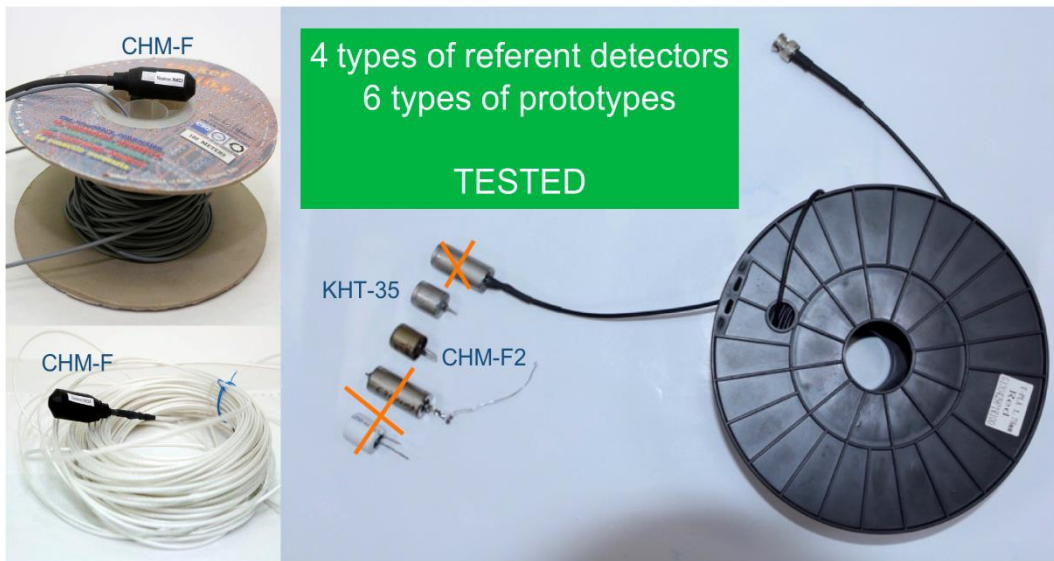
TANDETRON,
neutron flux up
to 1000 n/(cm²*s)



Gamma hi-dose
rate source
KSV- 500
(Co-60) 2000 Gy/h



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



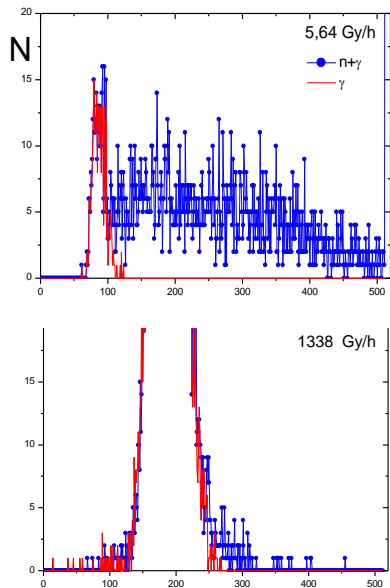
AmLi neutron source
with CHM-F
(0.1 n/(cm²·s))



Achieved Results by Now

PROTOTYPES TESTING RESULTS

Spectra for CHM-F counter in high dose rate gamma field



Detector Item	Corona counter (¹⁰ B)		Fission chamber (²³⁵ U)	
	CHM-F (verified)	CHM-F2 (verified)	KHT-35-1 (estimated)	KHT-35 (verified)
Size, mm	∅ 18.5x40	∅ 18.5x20	∅ 18.5x40	∅ 18.5x20
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	30 000	30 000
Discrimination from gamma-ray, not less Gy	1338	984		1630
Environment adaptability	IP 68			
Other	Gamma dose-rate measurement			

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 small-sized 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.

Overall Schedule

Large Category	Small Category	FY2017											
		Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.			
1. Development of program and method for test and arrangement of tests of resistance of relevant neutron and gamma ionization measurement devices to external factors	(1) Development of program and methods to perform the element test												
	(2) Procurement of industrial detectors of neutron and gamma												
	(3) Comprehensive test of industrial detectors of neutron and gamma in range gamma fields 0-100 Gy/h												
	(4) Comprehensive test of industrial detectors of neutron and gamma in range gamma fields 100-1000 Gy/h												
	(5) Interim report preparation												
2. Development of conceptual design and mockup test	(1) Development of conceptual design small neutron detector and mockup integral detector unit.												
	(2) Manufacturing of small neutron detector and mockup integral detector unit												
	(3) Comprehensive test in range gamma fields 0-100 Gy/h												
	(4) Comprehensive test in range gamma fields 100-1000 Gy/h												
	(5) Update of conceptual design												
	(6) Interim report preparation												
Major Milestones													

