

# Project of Decommissioning and Contaminated Water Management - Development of Small Neutron Detector

## RosRAO, FSUE – Summary of the Project for Small Neutron Detector Development (phase 2)

### Object & Goals

Based on results of the feasibility studies (Phase 1) of neutron detection technologies manufacture the industrial system for neutron flux measurement ready-to-use at the real operating environment of Fukushima 1 NPP

1. Development of detailed design for corona counter based measurement system (SINAKS) and fission chamber based measurement system (KIN-IKD)
2. Launching onto industrial manufacturing of measurement system (SINAKS)
3. Verification of robustness and stability within external environmental parameters (vibration, humidity, electromagnetic interference & temperature).

### Overview and Standout Points of Project

SINAKS cabinet: general view



Industrial corona counters (CC)



Seismic stability tests



Radiation tolerance tests



EMC tests



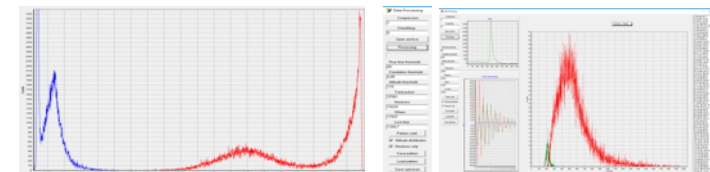
Climatic stability tests



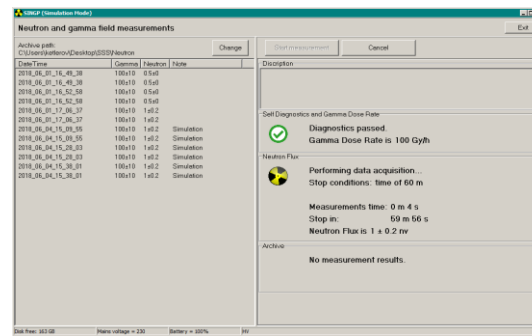
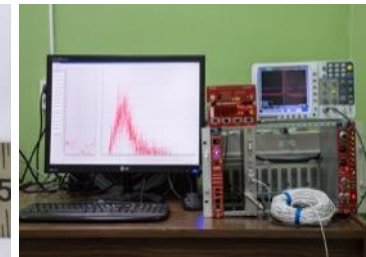
Fission chamber



Software of KIN-IKD with digital processing algorithm



KIN-IKD test system



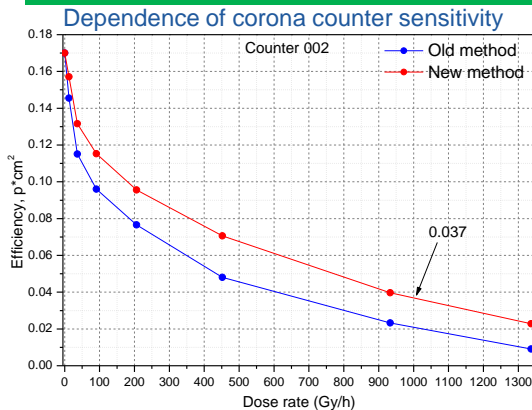
Software of SINAKS with health check and gamma dose rate measurement algorithm

## Achieved Results by Now

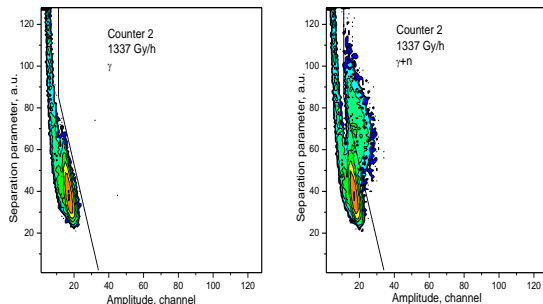
### Project specification achieved and outperformed

Term	Project specification	Corona counter
1.1 Sensitivity	0,1 n/(cm <sup>2</sup> *s)	<b>0,17 n/(cm<sup>2</sup>*s)</b>
1.2 Neutron-Gamma Discrimination	1000 Gy/h	<b>1337 Gy/h</b>
1.3 Range of measured neutron flux	0,1 n/(cm <sup>2</sup> *s) – 1000 n/(cm <sup>2</sup> *s)	<b>0,1 n/(cm<sup>2</sup>*s) – 1000 n/(cm<sup>2</sup>*s)</b>
2.1 Radiation resistance	1 000 Gy	<b>640 000 Gy</b>
2.2 Heat resistance	40 °C	<b>40 °C</b>
2.3 Others (water)	Submerged operation	<b>Submerged operation</b>
3.1 Dimension	cylinder of 20mm diam. x 40mm	<b>cylinder of 20mm diam. x 40mm*</b>

### Digital signal processing (DSP): software algorithms optimized (SINAKS)

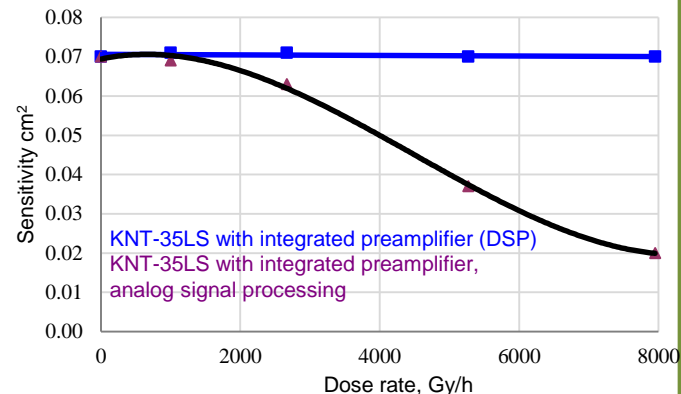


### Conception of two-dimension dynamic threshold (SINAKS)



### DSP adapted and verified for multilayer fission chamber

#### Dependence of fission chamber sensitivity



### Iterative and sustainable progress in measurement system specification improvement from 1<sup>st</sup> to 2<sup>nd</sup> Phases

(Project evolution) Item	CHM-11 (conventional detector) Initial data for 1st phase	CHM-F1 & CHM-F2 (prototypes) 1st phase results	CHM-F3 (industrial detector) 2nd phase results
Sensitivity with gamma influent 1000 Gy/h	----	+	<b>↑ 2.6 times</b>
Radiation tolerance, Gy/h	200	1000	<b>1300</b>
Gamma dose measurement, Gy/h	----	up to 1600	<b>up to 1650</b>
Automatization level	manual	semi-automatic	<b>full automatic</b>
EMI protection	---	---	<b>full protection</b>

### Resume:

- Corona counter based system (SINAKS) manufactured and tested in accordance with project plan and met all the imposed requirements
- Corona counter' applications verified for intense gamma fields;
- Downsized corona counters are manufactured within industrial design.
- SINAKS is developed to a ready-to-use industrial product;
- Improved digital signal processing algorithm for SINAKS implemented within an upgraded software;
- Multilayer fission chamber based system (KIN-IKD) was adopted for digital signal processing method.. Discrimination and interference tolerance verified for designs with integrated and detached preamplifier;
- Developed a concept for block-modular electronics integration of KIN-IKD and SINAKS;
- Optional applications for SINAKS considered.