CTBT: SCIENCE AND TECHNOLOGY 2017 CONFERENCE

Mobile Laboratory for Noble Gases Analysis in Atmospheric Air

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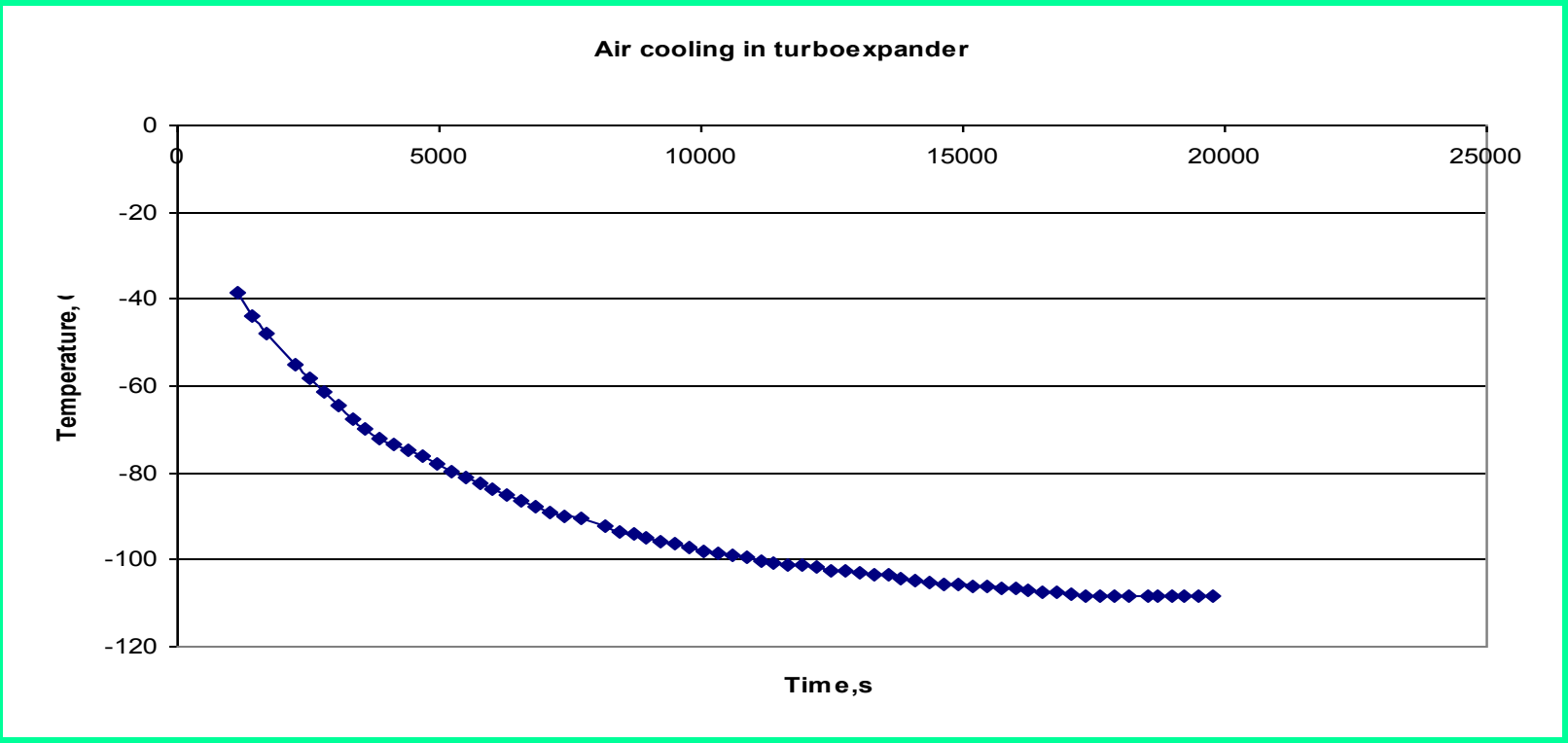
Khlopin Radium Institute

Mobile Installation for Xe Radionuclides Measurements

- Russian Installation for Noble Gas Analysis –Field (RINGA-F) was developed in the Khlopin Radium Institute (KRI) in the frame of ISTC -2133 Project, 2008 (Canada financial support). This installation has the productivity 20 m^3/h and ^{133}Xe MDC=0.35 mBq/m^3.
- Main process for sampling and processing of Xe and Kr from atmospheric air is cryogenic sorption on the activated charcoal. The turbo - expander used for cooling of the air. The minimum temperature -105° C was achieved after 6 hours, T= -80° C - after 1.5 hours. Xe extraction efficiency is ≥ 50 %. The spectrometer of β-γ coincidences consisting of the HPGe –detector and β-camera in the form of a Marinelli bottle was used initially. Scintillation NaI (Tl) -spectrometer β-γ coincidences is used now; and NaI (Tl) + Si-PIN detectors spectrometer now being developed.

Air cooled by turboexpander



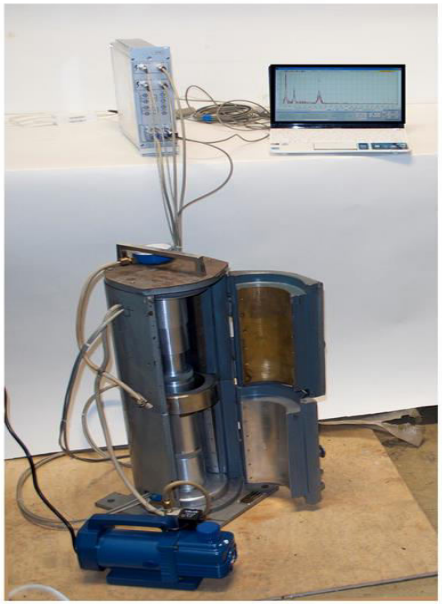
RINGA-F: Main Units

Sampling and Processing Unit

Portable chromatograph (KRI)

β-γ- Coincidence Spectrometers

β-γ- coincidence HPGe spectrometers



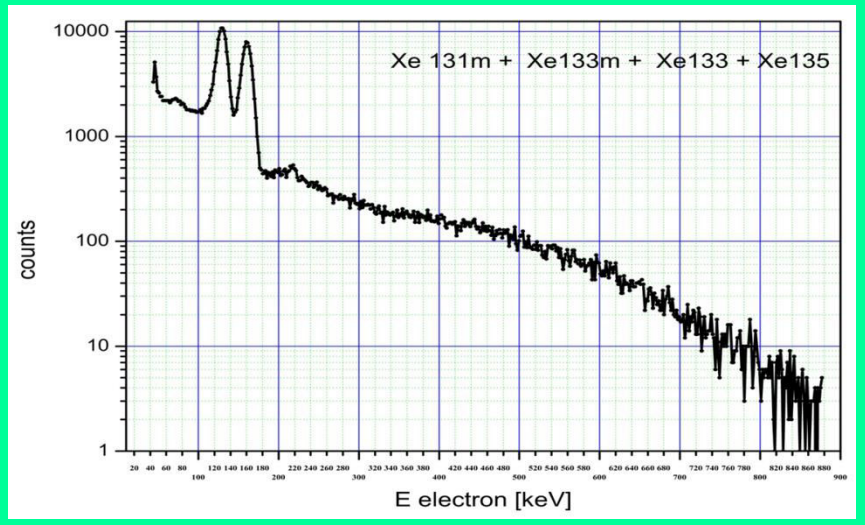
β-γ- coincidence NaI(Tl) spectrometer

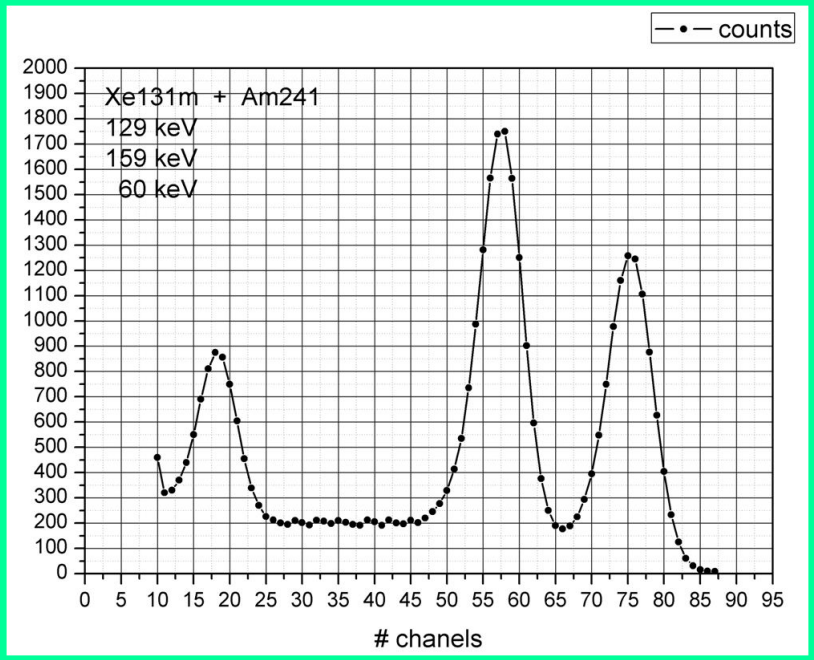
Main Characteristics

Sampling pressure	**7 bar**
Sampling flow rate	**20 m^3/h**
Maximum productivity	**140 m^3 /cycle**
Sampling time	**3 -7 h**
Concentration/ Separation time	**3 h**
Xe extraction	**≥ 50%**
Rn depletion factor	**10^5**

Deployment time	**2-3 h**
Set-up time to start up	**~20 min**
Dismantling for transportation	**5 h**
Detector system	**NaI(Tl) β- γ-spectrometer (Plastic or Si-PIN diode detectors)**
MDC, ^{133}Xe	**0.35 mBq/m^3**
Total weight: (compressor, electric generator, main units)	**~300 kg**

Si –PIN Detector





The parameters of the created detectors unit was tested by using reference gaseous source with ^{131m}Xe , ^{133}Xe, ^{133m}Xe and ^{135}Xe.

NaI(Tl)-Si-PIN detector has efficiency 30% of coincidences with the KX quanta of ^{131m}Xe (≈30 keV), energy resolution 15 keV for conversion electrons 129 keV.

Mobile NG system RINGA-F

- Field portable installation developed and manufactured in Khlopin Radium Institute is integrated as an assembly an air sampler and processing units performs sampling and a first stage of sample concentration, purification and separation. In this installation Xe and Kr sampling and sorption unit is joined together with processing unit, that is, the unit for pure Xe and Kr fraction extraction.

Leningrad NPP(RBMK)

^{133}Xe mBq/m^3	^{135}Xe mBq/m^3	$^{135}Xe/ ^{133}Xe$
0.36 Background	0.26	0.7
≤ 0.5	4.5	≥9
-	-	-
7.9	53	6.7
2008, February		

Monitoring of Xe in air at NPP area was started in 2008.

Kalinin and Kola NPP(PWR)

•Xe radionuclides background in air at these NPPs area (distance 2-18 km) variations in the interval 0.5 - 1.8 mBq/m^3

RINGA-F for Mobile Monitoring and OSI

- RINGA-F system productivity is 20 m^3/h allows to sampling air for ~3 hours, ^{133}Xe MDC will be ~ 0.3 mBq/m^3 .
- Xe concentrate is sending to the base camp after 6 h for analysis.
- This installation has been used to Xe monitoring around of Leningrad, Kalinin and Kola NPPs, as well as in the Vologda region far away from NPPs. Almost all components and installation units, despite the great distances traveled ~1200 km, were intact and functioning.
- RINGA-F system was transported by 2 off - road cars (minivan UAZ (Russian), or can place in the minivan (VW Crafter 30-35).
- RINGA-F system currently operate and has been improving.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