



SYSCADE

RADIOACTIVE WASTE INSPECTION AND CHARACTERIZATION

SYS-GS-01

IOG & SGS GAMMA STATION FOR CHARACTERIZATION OF NUCLEAR WASTE DRUMS

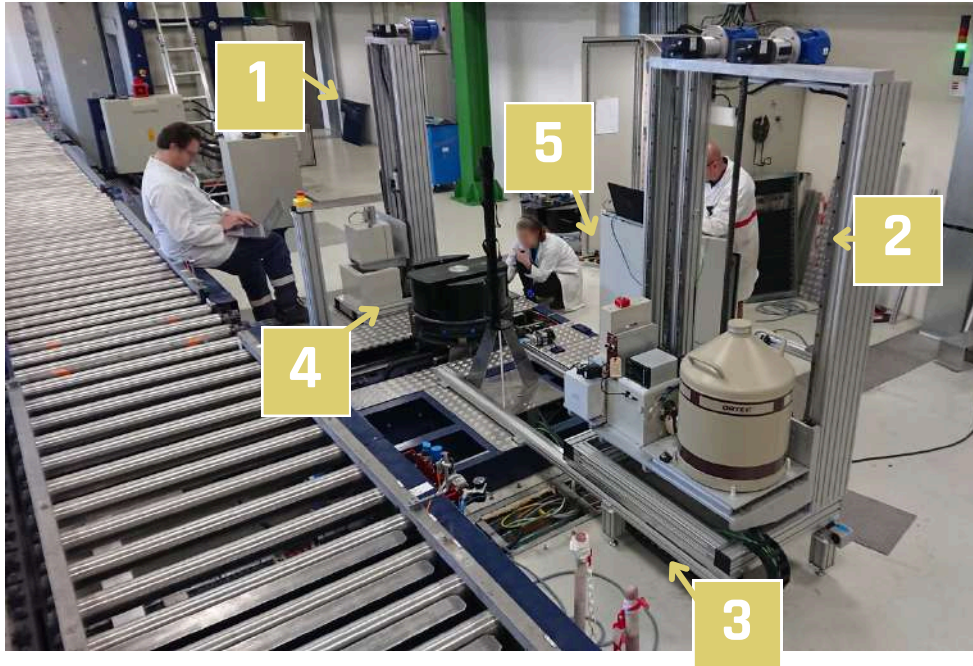
SYSCADE SA offers tailor-made solutions for characterization of nuclear wastes. Our solutions are based on X-Ray inspection for detecting the type of waste contained in metal drums, and on the use of high-resolution gamma detectors to identify radionuclides, determine their activity levels, and localize “hot spots” of radioactivity.

The Gamma Station SYS-SG-01 is designed for radiological characterization of low-level radioactive wastes stored in 80-liter, 220-liter, or 400-liter drums. The gamma station uses a high-resolution detector (HPGe) with state-of-the-art spectrometer. 3 operating modes are available.

The Open-Geometry (IOG) mode is used for characterization of entire drums. Calculation of total activity contained in each drum is based on a weight measurement. The characterization process is fully automatic. The drums are loaded one by one by a feeder on a rotating table to be measured sequentially, without human intervention.

The Segmented Gamma Scan (SGS) mode allows determining the distribution of radioactivity segment by segment. Average density in each segment is determined either using a radioactive Transmission Source (TS) or using density results issuing from X-Ray inspection.

An additional characterization mode with angular resolution (angular-SGS) is available to better determine the distribution of radioactivity inside each drum, and localize hot-spots of radioactivity. Merging X-Ray inspection data with gamma characterization results is another possibility. It allows to make the link between “hot spots” of radioactivity and the type of waste (material or part) hidden inside the drum.



Example of SGS gamma station equipped with a gamma transmission source
(by courtesy of JRC ISPRA)

The Gamma station includes the following subsystems:

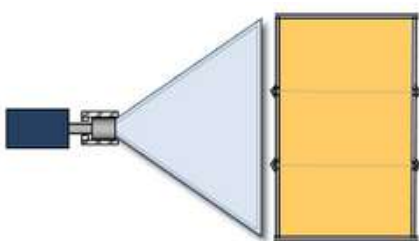
- 1 A transmission source column with shielded holder and pneumatic shutter
- 2 A detector column with HPGe detector and embedded IOG / SGS collimators
- 3 A horizontal movement mechanism for the detector column
- 4 A conveyor with rotating table where the drums are installed
- 5 A local control station with HMI touchscreen

AUTOMATIC MEASUREMENT PROCESS

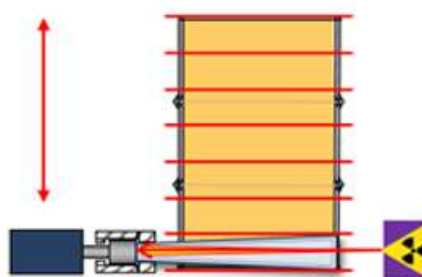
Operation of the gamma station is fully automatic. The operator can select the operating mode (IOG or SGS or angular-SGS...), the number of drums to be inspected, the measurement time or the targeted uncertainty on activity results, etc. The drums are brought one by one to the rotating table of the gamma station.

The gamma measurement system uses an HPGe detector with fast MCA electronics. The spectroscopy software performs acquisition and real-time analysis of energy spectra. All results including raw energy spectra are stored in a database, making possible to reanalyze acquired data with other key parameters. The gamma station is equipped with a local control cabinet for tests and calibration purposes. The local station communicates with a main supervision system that synchronizes all operations.

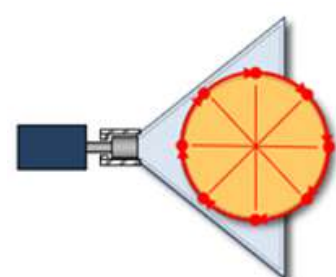
3 Operating modes:



IOG MODE



SGS MODE
(TRANSMISSION AND EMISSION)

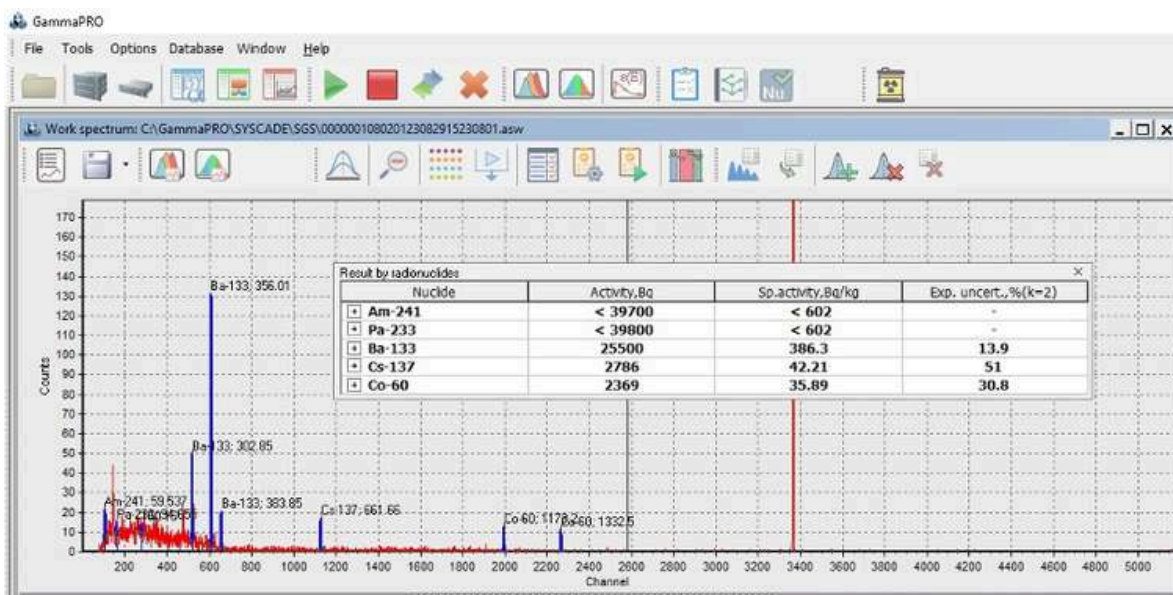


ANGULAR-IOG AND
ANGULAR-SGS MODES

In **IOG** (Integral Open-Geometry) mode, the detector is placed at fixed distance of the drum. A wide view collimator is aligned with the gamma detector. It detects gamma rays coming from the entire height of the drum and a complete rotation is performed during acquisition. The analysis process provides information about the detected radionuclides, their activity levels, the MDA (Minimum Detectable Activity) and measurement uncertainties. The angular mode (**Angular-IOG**) provides additional information about radial source distribution.

The **SGS** (Segmented Gamma Scanning) mode provides information on the distribution of radioactivity over the height of each drum. The detector scans a number of segments (selectable from 3 to 16) using a specific collimator. A SGS measurement consists of two consecutive operations: a Transmission measurement followed by the Emission measurement. A first scan is performed using a Transmission Source (TS) aligned with the gamma detector to evaluate the matrix attenuation in a wide energy range from 50 keV to 3 MeV, segment by segment. The next step is the Emission measurement where the drum is scanned to measure radioactivity emitted by each segment. The automated analysis process provides information on the detected radionuclides in each segment, the activity, the MDA and uncertainty calculations.

The **Angular mode** (Angular-SGS) is another option. It offers additional information about radial source distribution in each segment.



Energy spectrum with identification of radionuclides, measured activity and specific activity

All the energy spectra acquired during the characterization process are stored automatically with information referring to the batch number, drum QR code, date/time, name of operator, mode of operation, and segment ID.

BENEFITS

- Fully automated process
- Selectable analysis modes: IOG mode for quick characterization, SGS and Angular-SGS modes for detailed information on activity distribution inside each drum
- Robust and light design with pre-assembled components for quick commissioning
- Very efficient shielding of the transmission source to avoid impact on the background
- Low power consumption : < 5 kVA
- Quick troubleshooting thanks to accurate indication of failures on HMI screen
- Remote control of the supervision and of the spectroscopy software for technical assistance

SPECIFICATIONS OF THE GAMMA STATION

HPGe Detector	Standard: 40% efficiency with electric cooling or liquid nitrogen cooling
MCA unit	Standard: 16k MCA (digital processing)
Spectroscopy software	"GammaPRO" spectroscopy software with "Syscade" characterization module for automatic acquisition, data processing and activity calculations according to ASTM C1133 standard (SGS mode)
Station characteristics	
• Dimensions	L 4000 x W 2000 x H 2300mm (other configurations on request)
• Weight	< 2000 kg fully assembled
• Power supply	400V 3P+E 50Hz 32A (<3 kVA) / UPS backup 10 minutes
• Measurement range	Standard version for 220-liter drums: 900 mm entire height Also available for 80L & 400L drums
• Shielding	Painted low background lead / copper liner on detector fixed shielding and collimators – tin liner as option
Transmission source column	
• Dimensions	L 400 x W 900 x H 2300mm
• Shielding	Mobile shielding (90 mm thick) – in operation Extra fixed shielding (50 mm thick) for standby position
• Shutter	Pneumatic control (4.0 bar compressed air supply) Automatic closing in case of pressure loss or shutdown
• Source	Eu-152 as standard, activity level: 5 to 10 mCi
Detector column	
• Dimensions	L 2500 x 900 x 2300 mm
• Detector shielding	Fixed shielding (70 mm thick)
• IOG collimator	Fixed configuration (L: 80 mm) with optimized angle, for wide view of the drum
• SGS collimator	Fixed length (L: 200 mm) with adjustable aperture (10 to 55 mm), for SGS scans with reduced crosstalk effects
Conveyor	Loading and unloading mechanisms with "T" shape configuration, using either pneumatic transfer system or motorized rollers. Adapted for 220 liters drums, up to 500 kg Rotating table ensuring uniform drum rotation during measurement processes
Safety	Position sensors and interlocks
Operating conditions	Temperature: 5 to 40°C / Humidity < 80%
Control	Local control using HMI touchscreen for manual positioning of the station components Remote control from supervision system for automatic positioning of the station and processing of all measurement data acquisition, analysis, and results export

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