



**The Abdus Salam
International Centre for Theoretical Physics**



1833-45

**Workshop on Understanding and Evaluating Radioanalytical
Measurement Uncertainty**

5 - 16 November 2007

Nuclear emergency preparedness and response in Italy.

Paolo ZEPPA
*APAT - Agenzia Protezione Ambiente e Servizi Tecnici
Via Branconi Vitaliano 48
00144 Roma
ITALY*

Nuclear Emergency Preparedness and Response in Italy

Paolo Zeppa

Nuclear Activities Control Service

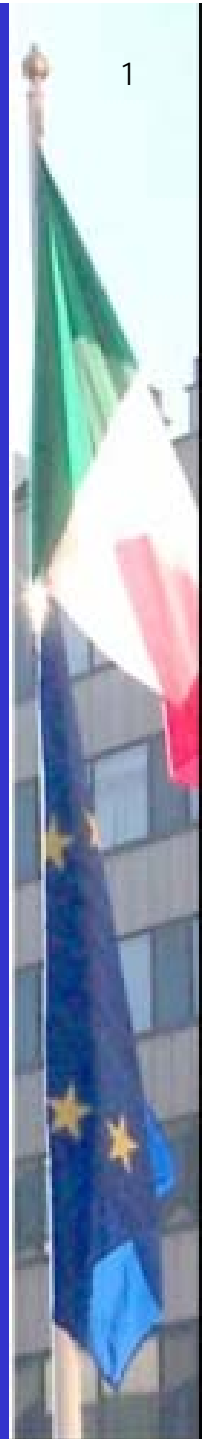
Emergency Coordination Unit



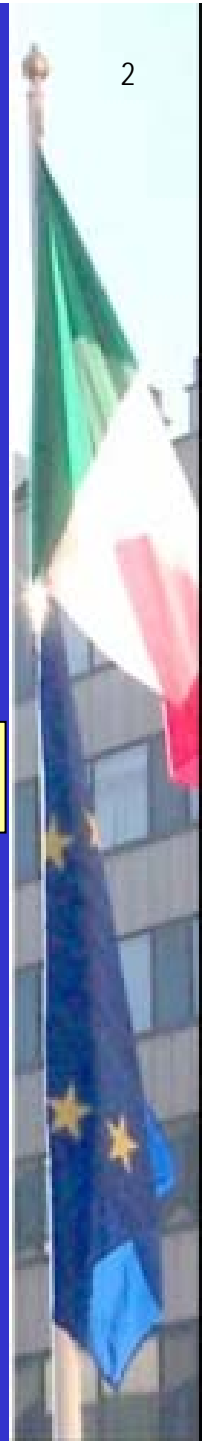
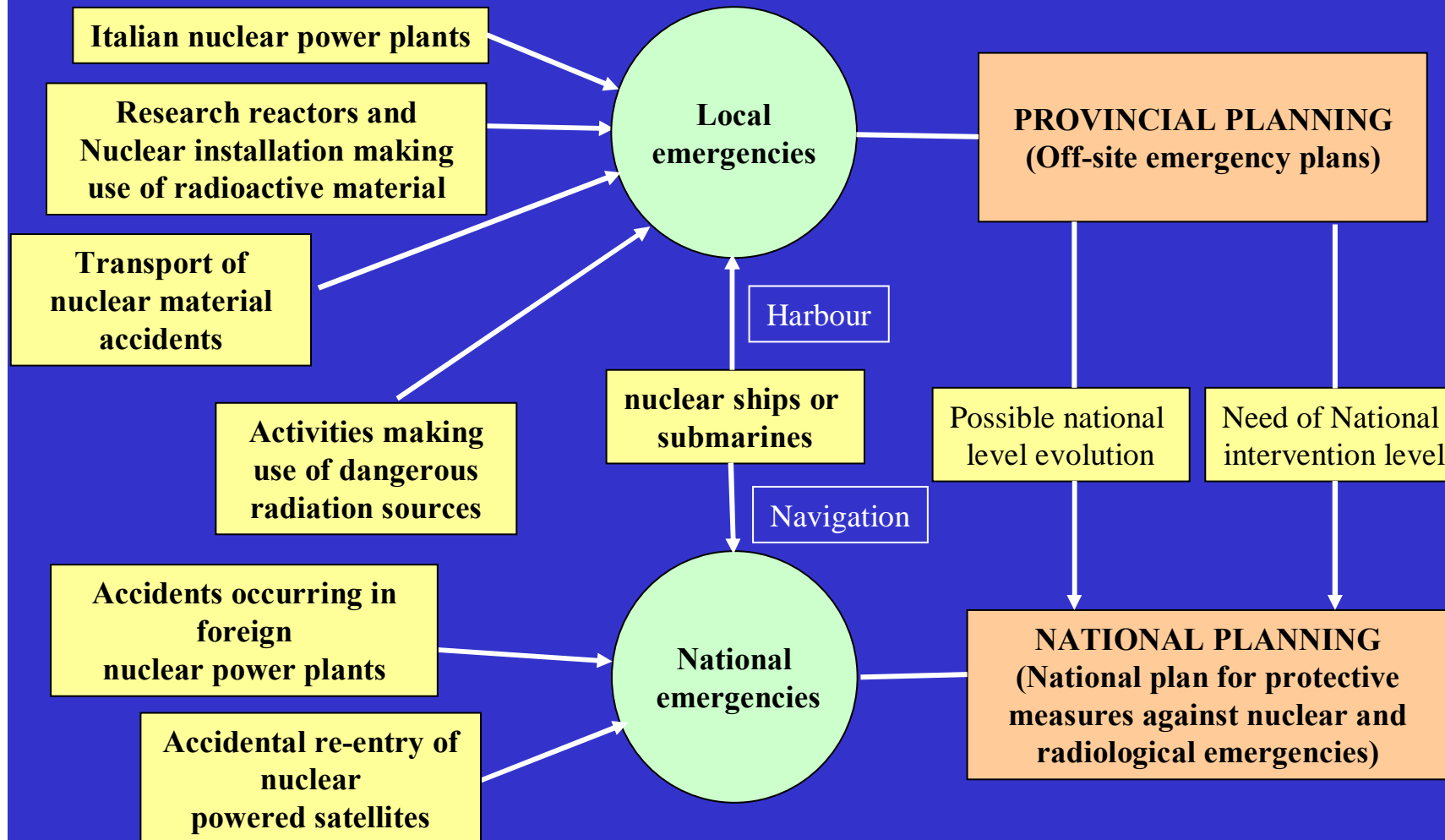
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Nuclear risks and emergency planning in Italy



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Nuclear risks and emergency planning in Italy

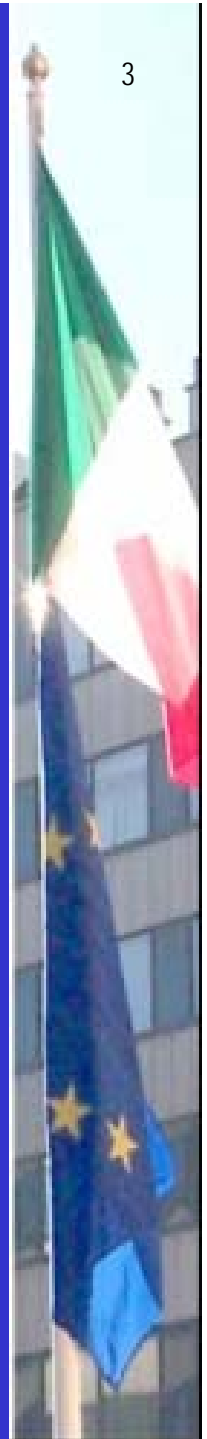
- The plans are under the responsibilities of local authorities (Prefectures)
- At present there are about 11 plans (respectively related to 4 NPPs under decommissioning, 3 old fuel treatment and fabrication installations, 4 research reactors under operation)
- Several plans related to the presence of nuclear submarines in ports are under revision
- The plans are established with the support of a Committee, established at province level, and following a review process involving APAT and the National Commission on Nuclear Safety and Radiation Protection)



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Nuclear risks and emergency planning in Italy

Most relevant countermeasures envisaged by the off-site plans are:

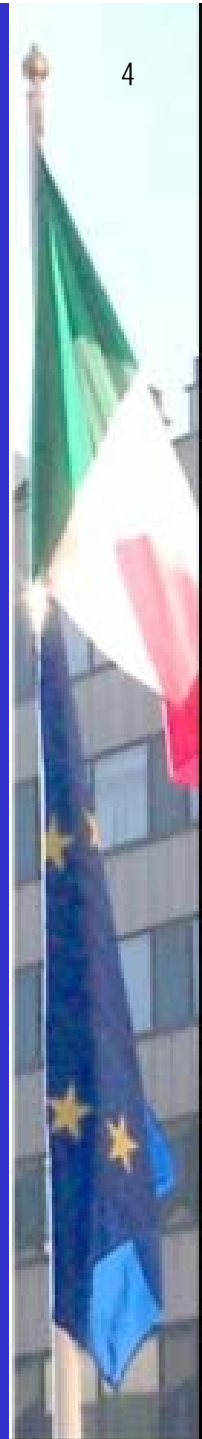
- Environmental monitoring in the range of a few kms
- Banning of exposed foods in the range of a few kms
- In the case of one research reactor Iodine Prophylaxis is envisaged (a few hundred metres)



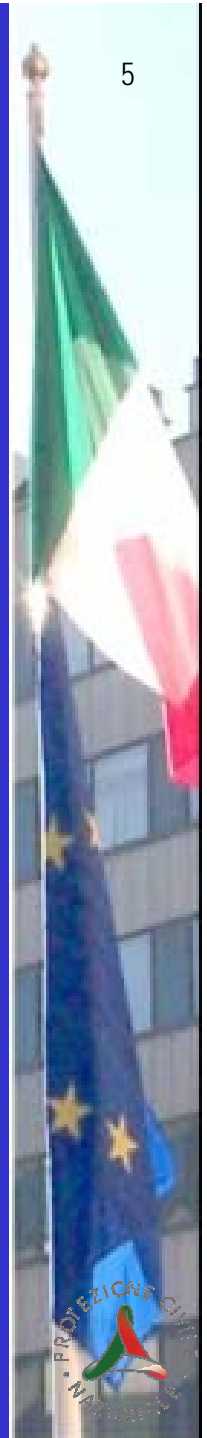
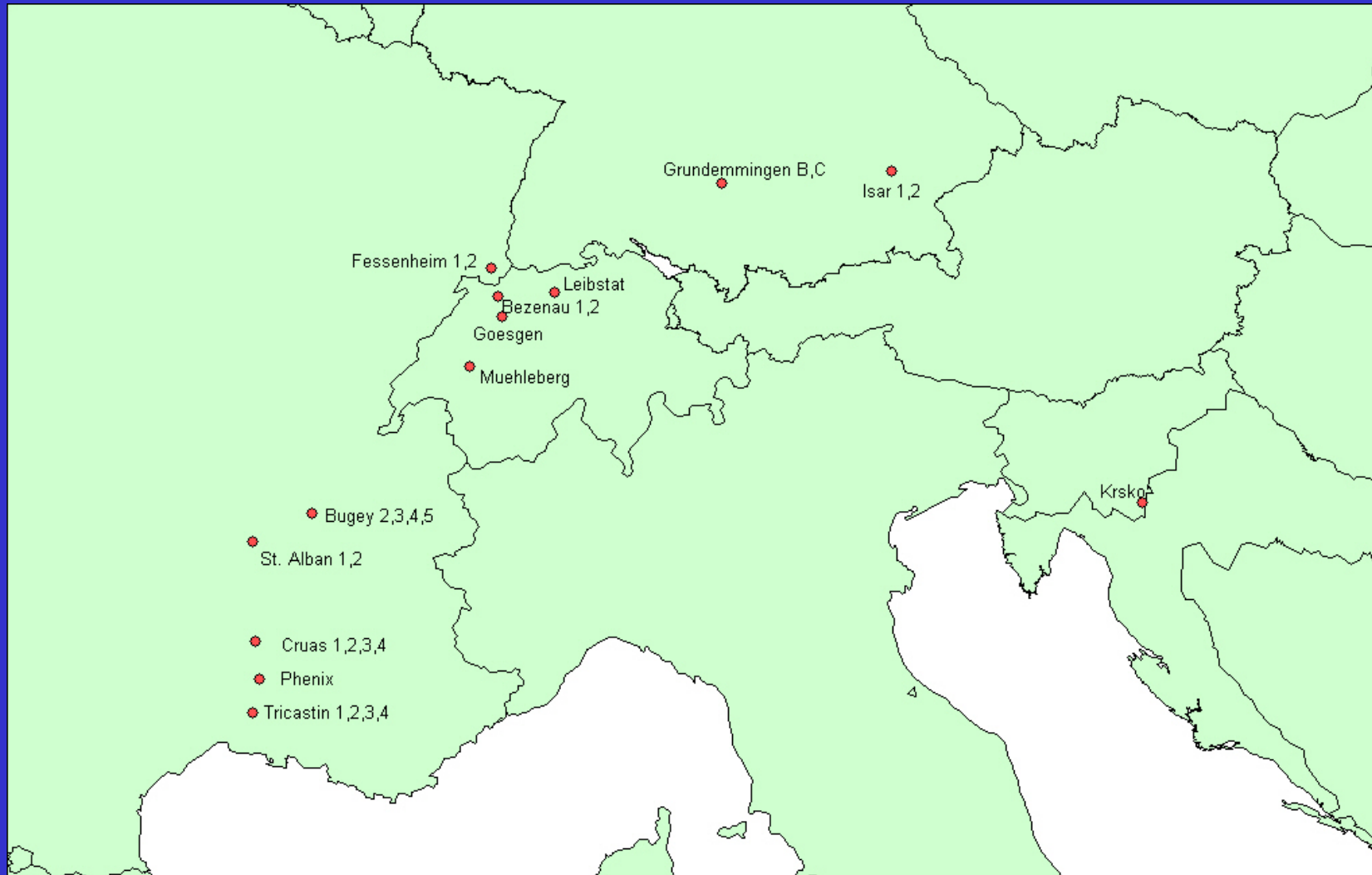
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NPP's close to Italian border



National Emergency - Key Capabilities

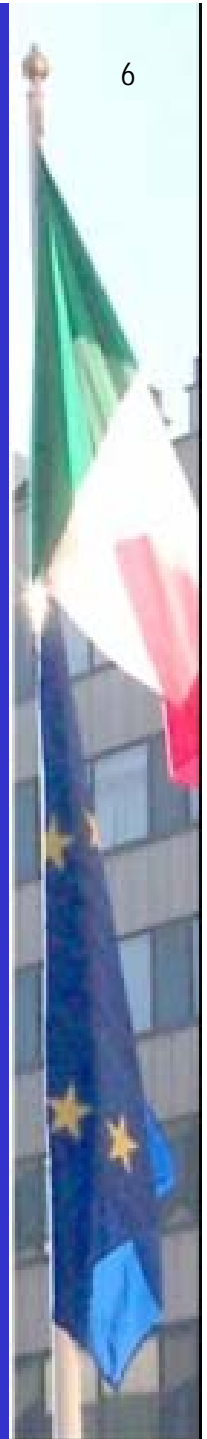
- Prompt information about the event
- Early warning on the presence of radioactive contamination
- Forecast of weather conditions and radioactive plume diffusion
- Radiation measurements on environmental and food chain samples (radiometric characterization of the environment)
- Estimation of radiological consequences to the members of the public



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APAT role and competencies in nuclear and radiological emergencies

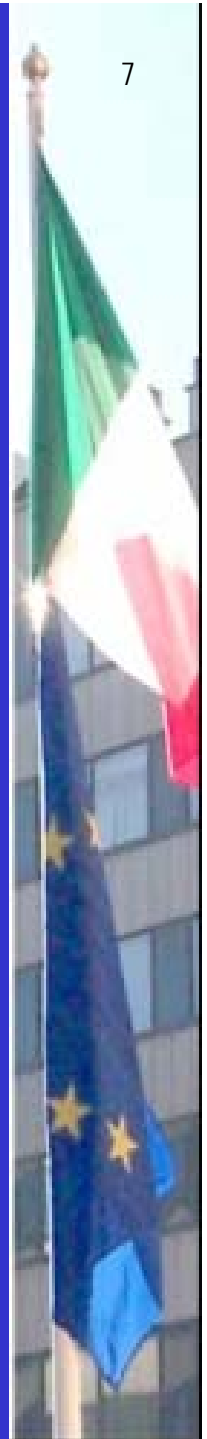
- Technical body supporting local and national Authorities in the definition of the technical bases and in the preparation of emergency planning (on the basis of advise of National Committee for Nuclear Safety and Health Protection)
- Provide technical support to local and national Authorities in the response to the different phases of a radiological emergencies, in cooperation with other national and local technical bodies
- Provide technical support to the Ministry of Interior for planning and response to radiological emergencies induced by malicious acts



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APAT role and competencies in nuclear and radiological emergencies

Coordination of the CEVaD Commission (Data elaboration and evaluation Centre)

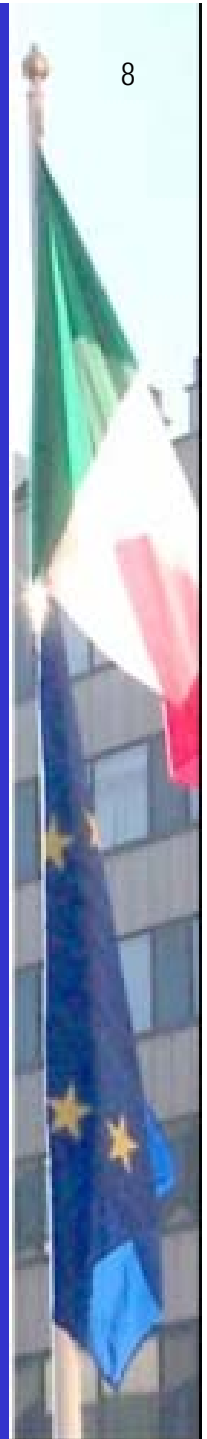
CEVaD is a technical committee providing technical support to the Department of Civil Protection with reference to the decision making process on countermeasures to be undertaken during an emergency requiring the activation of the National Plan.



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CEVaD – Data Processing and Evaluation Centre

It is composed by representatives of different Administrations:

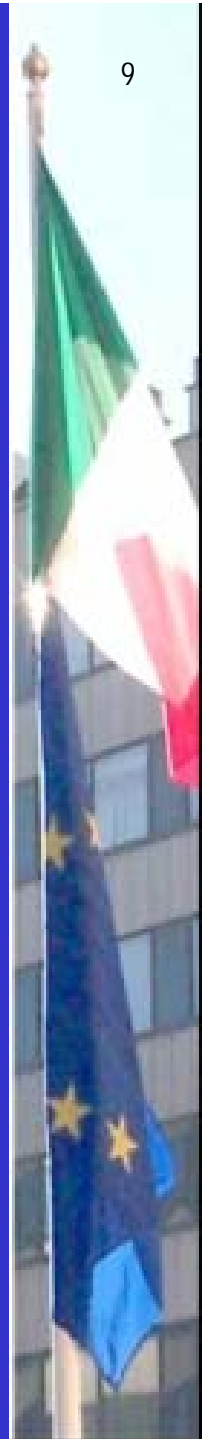
- APAT (coordinates the committee activities and gives technical and logistic support)
- National Institute of Health
- Ministry of Interior - Fire Brigades Corp
- National Meteorological Service
- National Institute for Occupational Prevention and Safety – ISPESL
- Regional representatives (usually from Regional Agencies for Environmental Protection)



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CEVaD – Data Processing and Evaluation Centre

The tasks performed by the Committee concern:

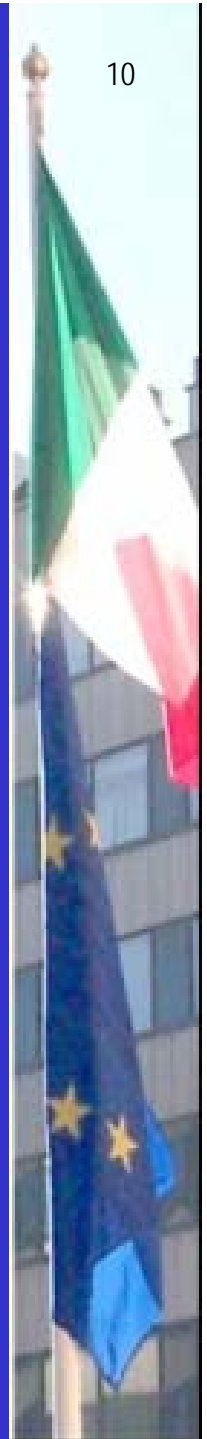
- the evaluation of the information related to the accidental scenario and its possible evolution
- the prognosis of the expected evolution, in time and space, of the radioactive release and of its atmospheric dispersion
- the monitoring of the radioactive cloud arrival and crossing on the national territory
- the assessment of the trend of the radioactive contamination in the environment and food
- the assessment of the health impact and the identification of the countermeasures to submit to the decisional level organization



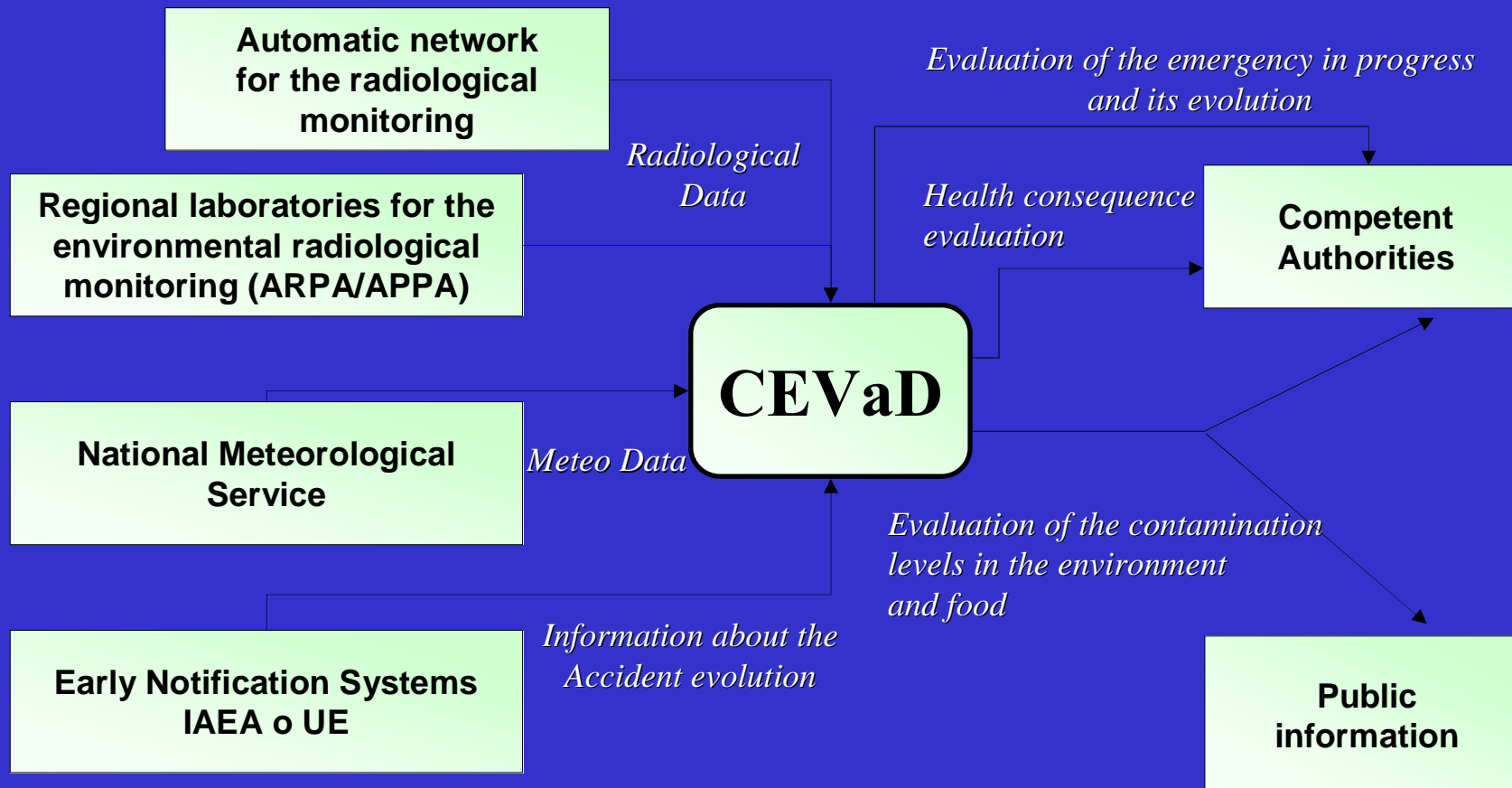
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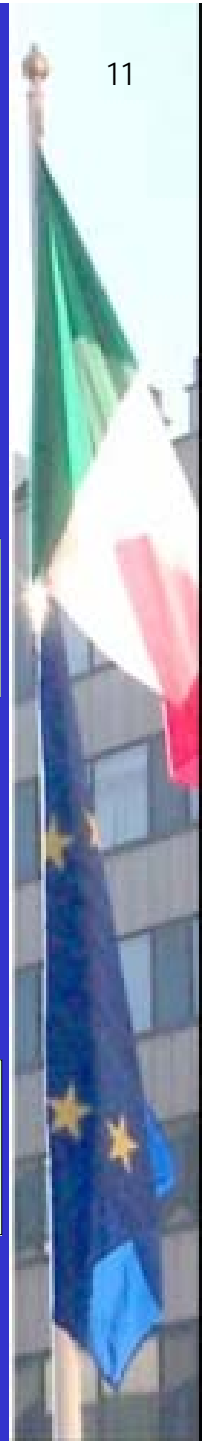
CEVaD Commission tasks



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APAT Emergency Centre CEVaD Room



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APAT’s Integrated Support System to the nuclear emergency management

Main Tasks

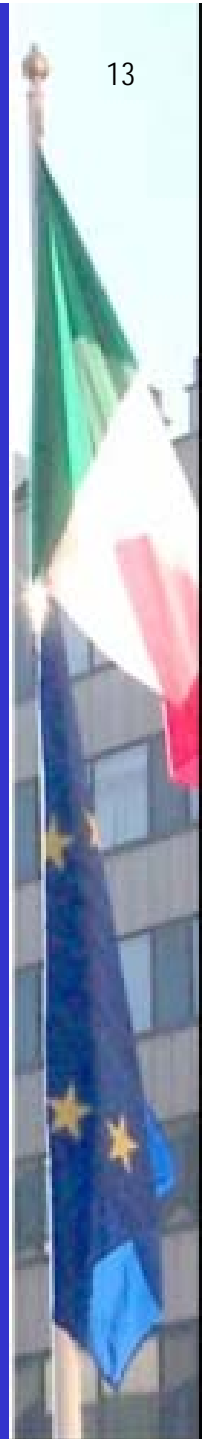
- provide prompt information for reciprocal data exchange among international and national institutions involved in emergency management
- forecast the meteorological condition and estimate the radioactivity diffusion on different geographical scale
- monitor the main access routes of radioactivity to the national territory and give an early warning for the major nuclear accidents
- inform about the actual radiation levels both in an emergency condition and for background routine observation



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APAT’s Integrated Support System to the nuclear emergency management

Functional components

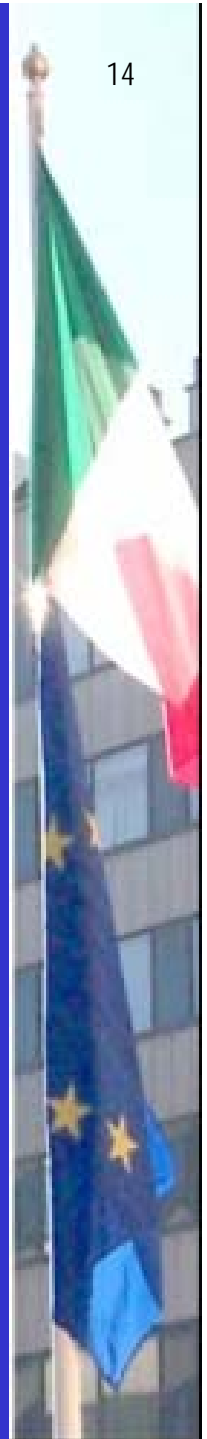
- 24 hours / 7 days on call availability of on duty experts team
- Point of contact for the international early-notification systems of nuclear emergencies
- Computational model for radioactive plume diffusion prognosis, based on real time meteorological data
- Automatic network for radiological monitoring at national scale
- Centralized gathering of radiometric measurements from the Regional Laboratories for the environmental radioactivity
- Measurement data exchange at international level



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International early-notification systems

EMERCON (EMERgency CONventions) is the first international system of early notification, established by the IAEA on the basis of the 1987 Convention on early notification and Convention on assistance

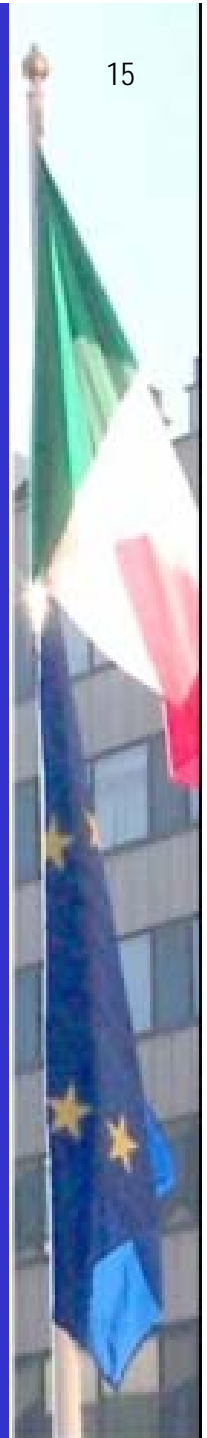
ECURIE (Emergency Community Urgent Radiological Information Exchange) as a system for early notification of nuclear and radiological emergencies within the European Union based on 87/600 European Union Council Decision (1987)



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IAEA - EMERCON

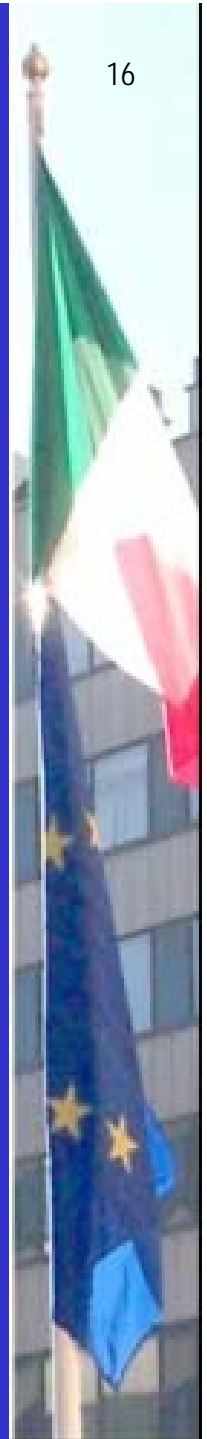
- **National Warning Point – NWP**
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- **National Competent Authority (Domestic events) – NCA(D)**
Department of Civil Protection - APAT
- **National Competent Authority (Abroad events) – NCA(A)**
Department of Civil protection



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European Commission - ECURIE

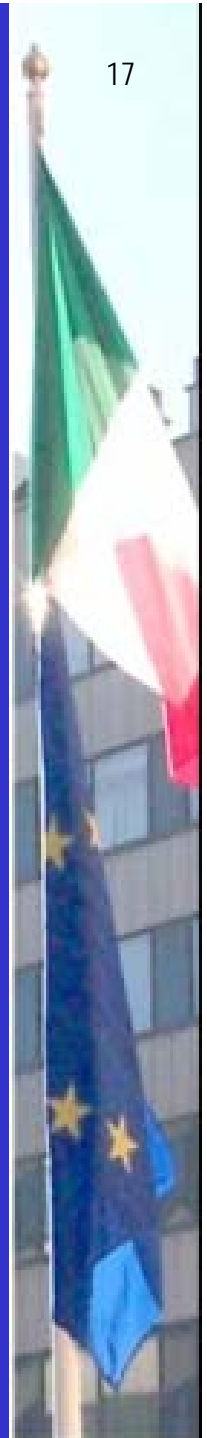
- Each Member State has to establish a **Competent Authority** to transmit notifications and to implement actions consequent to a received notification – For Italy Department of Civil Protection
- Each Member State has to establish a **Contact Point** to receive and send messages, with an official CoDecS station. For Italy APAT
- The European Commission has its CA and CP respectively in Luxemburg and Brussels Offices.



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International early-notification systems ECURIE-CoDecS



ECURIE CoDecS Version 1.3 - Build: 2004-08-16

Message Folder Edit View Settings Options Help

2005-05-19 12:42 UTC

At...	E...	Accident seq. nr.	Date	Type	Level	Originator Serial Nr.	Comment
<input checked="" type="checkbox"/>		LAH SMTP	2005-05-19 05:03	Initial Not.	0	LU.EC TREN H4,1537	
<input checked="" type="checkbox"/>		ISDN SMTP	2005-05-19 04:03	Initial Not.	0	LU.EC TREN H4,1536	
<input checked="" type="checkbox"/>		LAH SMTP	2005-05-18 05:04	Initial Not.	0	LU.EC TREN H4,1536	
<input checked="" type="checkbox"/>		ISDN SMTP	2005-05-18 04:03	Initial Not.	0	LU.EC TREN H4,1535	
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<input checked="" type="checkbox"/>		ISDN SMTP	2005-05-17 04:03	Initial Not.	0	LU.EC TREN H4,1533	
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<input checked="" type="checkbox"/>		ISDN SMTP	2005-05-16 04:03	Initial Not.	0	LU.EC TREN H4,1532	

Accident details

Date: (010)

Country: (011)

Location: (014)

Nature: (020)

Severity - INES: (022)

Start of release: (025)

Type of release: (027)

Monitoring results available: (500) No

Protective measures: (600)

Trajectory forecasts available: (320) No

Development: (024)

Message details

Accident Sequence Nr.:

Class/level: ECURIE EXERCISE / 0

Type of Msg: Init. Notification

From: LUXEMBOURG / ENV C4

Transmission:

Attachment:

Errors:

Dig.Sign.:

Originator:

Status area

Nr. of messages: 8 / 370

Last message: 2005-05-19 05:03

Unread messages: 0

Network:

ISDN:

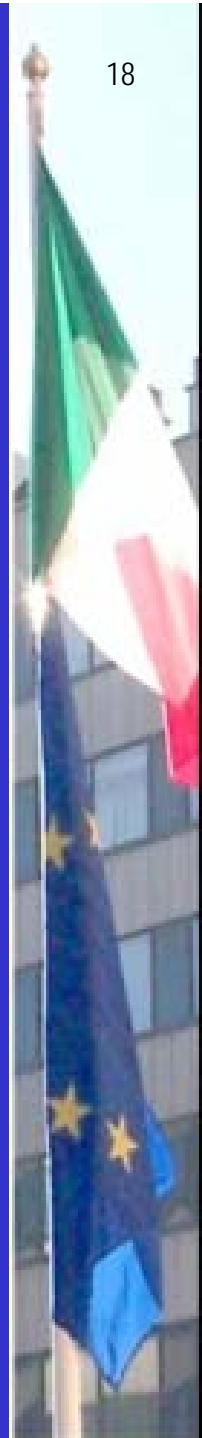
Out Directory:

In Directory:

TelexBox:

AlarmBox:

Diskspace in use: 23 %



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Atmospheric dispersion models - ARIES *Accidental Releases Impact Evaluation System*

Consisting of 3 atmospheric dispersion models

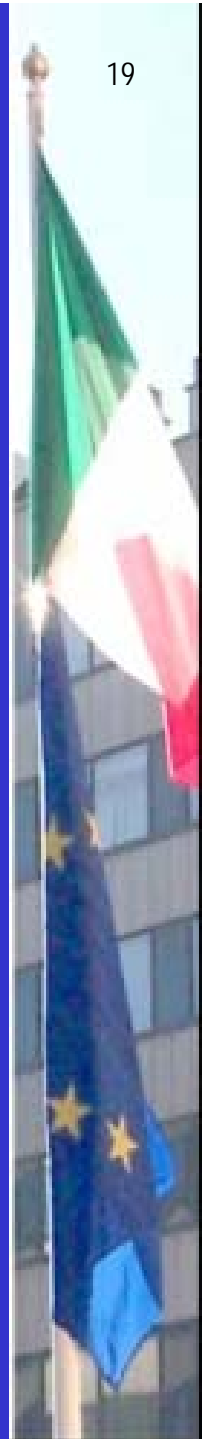
- **APOLLO**: **A**tmospheric **POLL**uant **LO**ng range dispersion
- for long range evaluations –
- **LAPMOD**: **LA**grangian **P**article dispersion **MO**del
- for medium range evaluations
- **TOXFLAM**: - for short range evaluations



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ARIES - Tasks

Real time and prognosis assessment of the evolution of
radioactive releases on different geographic scales



APAT’s Integrated Support System for
nuclear and radiological emergencies

Reference scenarios identification from selected plants



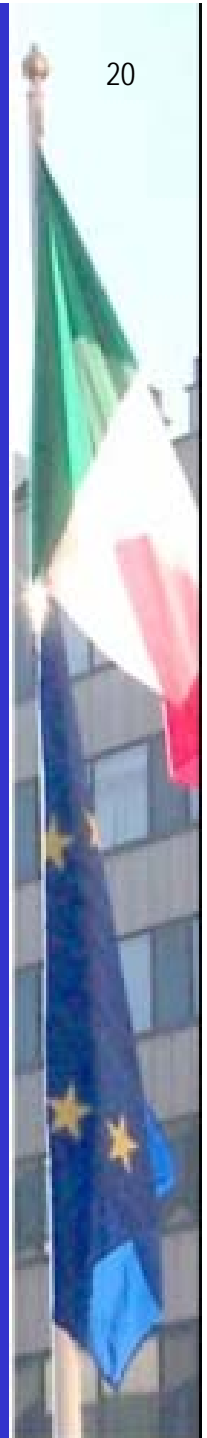
EMERGENCY PLANNING



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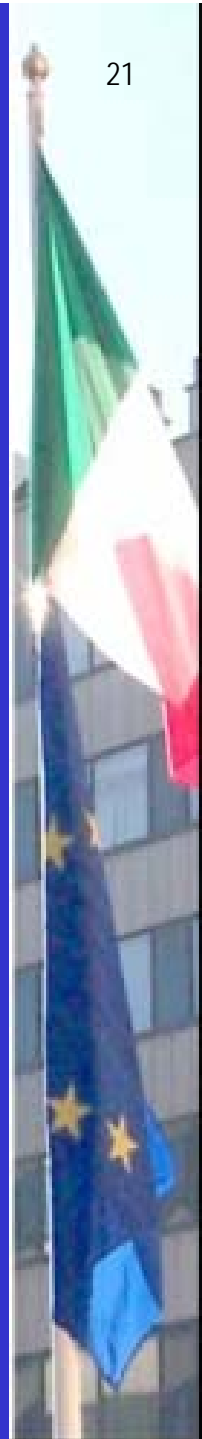
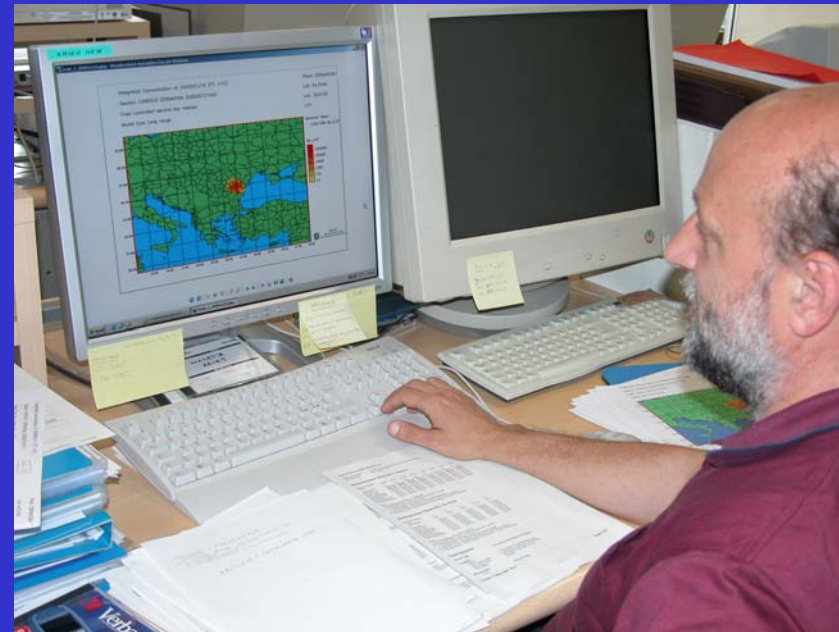
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How ARIES works

1. Acquisition of meteorological data daily provided by CNMCA (Italian Air-Force)
2. Display meteo data
3. Real time calculation of transport and diffusion of radioactive cloud (long and medium range models)
4. Doses calculation for different exposition routes for each radionuclide involved in the release
5. Maps production



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ARIES - APOLLO long range model

Input Data

Meteorological data

ARIES uses forecast meteorological data from the
European Center Medium Word Forecast
(ECMWF) - Reading (UK)
provided automatically by the Italian Air force

- Wind field at surface (x and y components)
- Wind field at 4 pressure levels (1000, 925, 850, 700 Pa) (x, y, z components)
- Geopotential height at 4 pressure levels
- Precipitation (mm)

Geophysical data

- Orography
- Roughness length

Release data

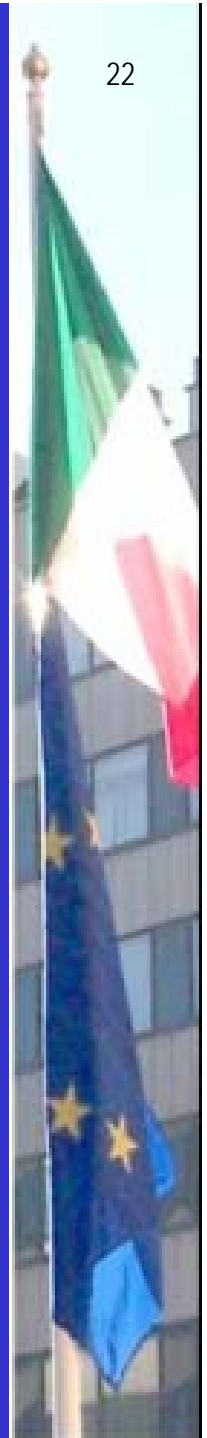
- Release rate (for each nuclide)
- Day and hour of the beginning of release
- Release height



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ARIES - APOLLO long range model

Input Data

GEO data



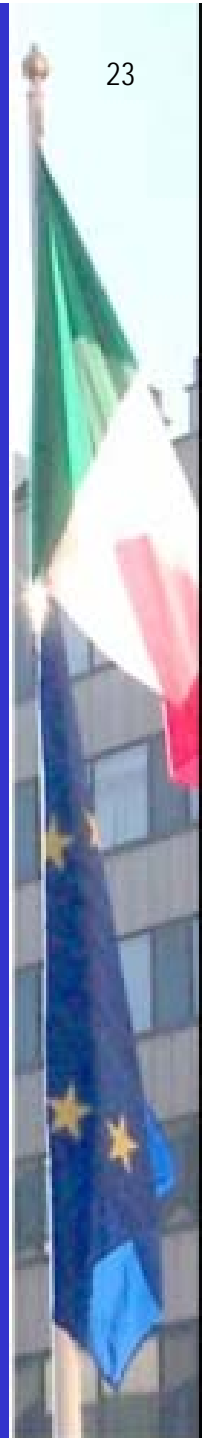
- Coordinates and spacing of meteorological and geographical matrices
- Source point coordinates
- Coordinates and spacing output matrices
- Nuclide properties (deposition rate, half lives)
- Code parameters (simulation length, particle generation, vertical diffusion coefficient, time interval among meteorological data)



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ARIES - APOLLO long range model Output Data

For each nuclide in input the code calculates at required output times:

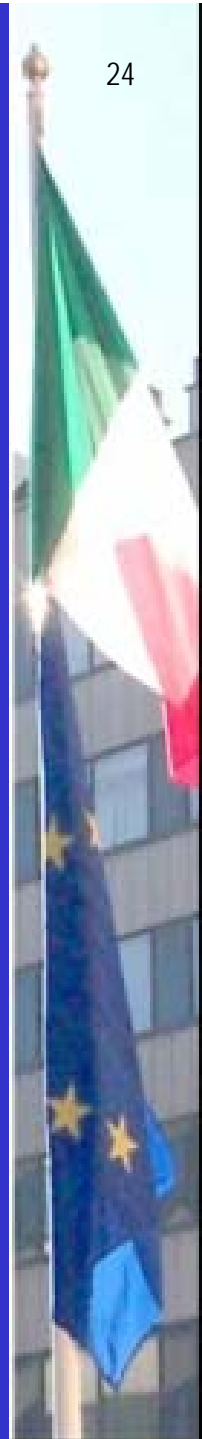
- Instantaneous concentration (Bq/m^3) and time integrated concentration ($\text{Bq}\cdot\text{s}/\text{m}^3$)
- Dry, wet and total (d+w) deposition (Bq/m^2)
- Cloudshine dose (mSv)
- Groundshine dose (mSv)
- Inhalation dose for 3 age classes mSv (effective dose and equivalent dose for thyroid and critic organ)
- Total dose (Cloudshine + Groundshine + Inhalation, mSv)



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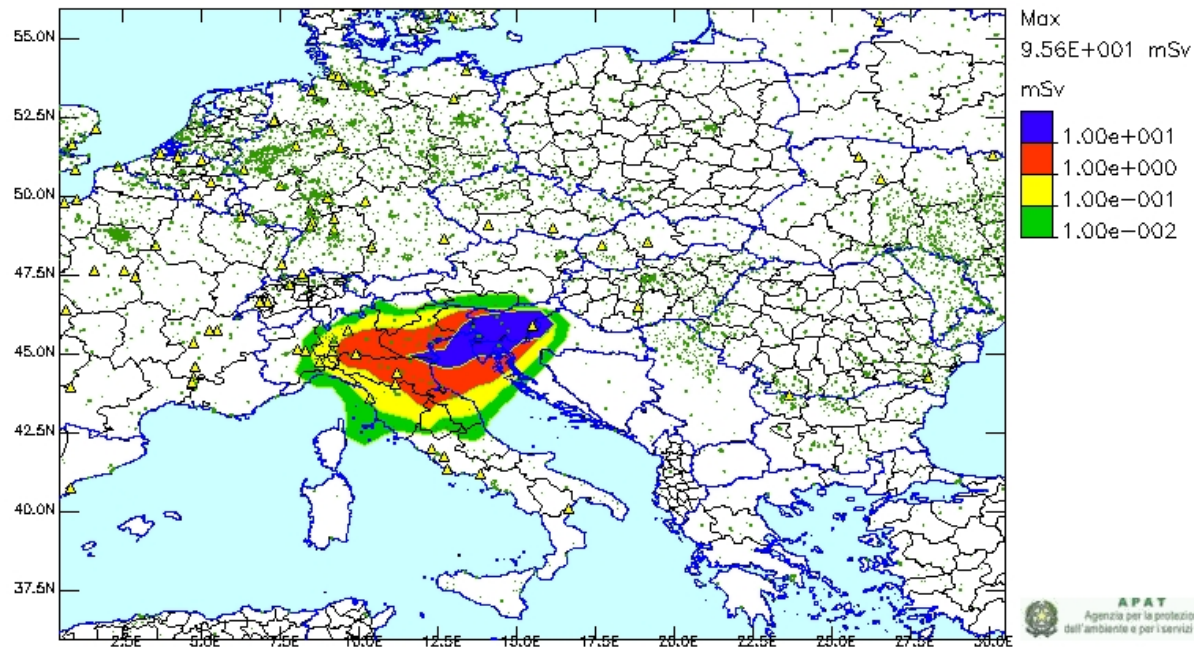
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ARIES - APOLLO long range model Output Map

Dose from inhalation at 20bam (FT: +1488)
Session Piano_dosi_k3
Case I131
Model type Long range

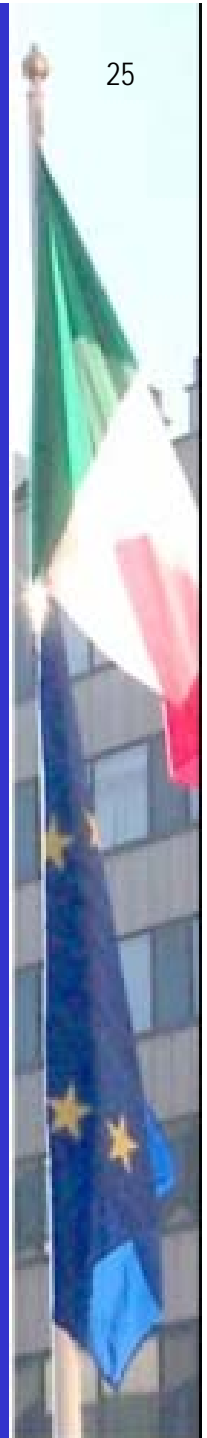
I131
Lon: 15.483E
Lat: 45.967N
Plant: KRSKO



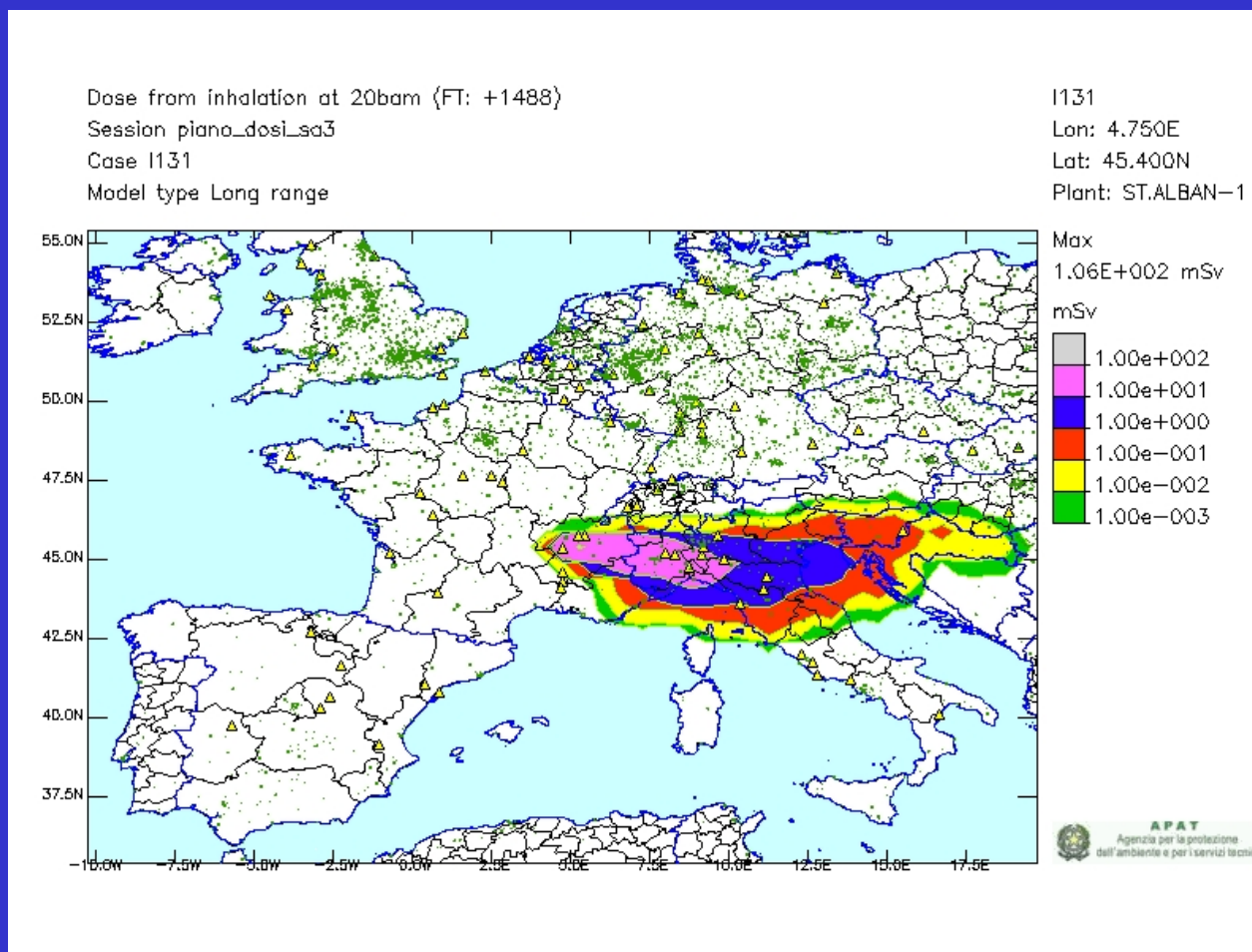
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ARIES - APOLLO long range model Output Map



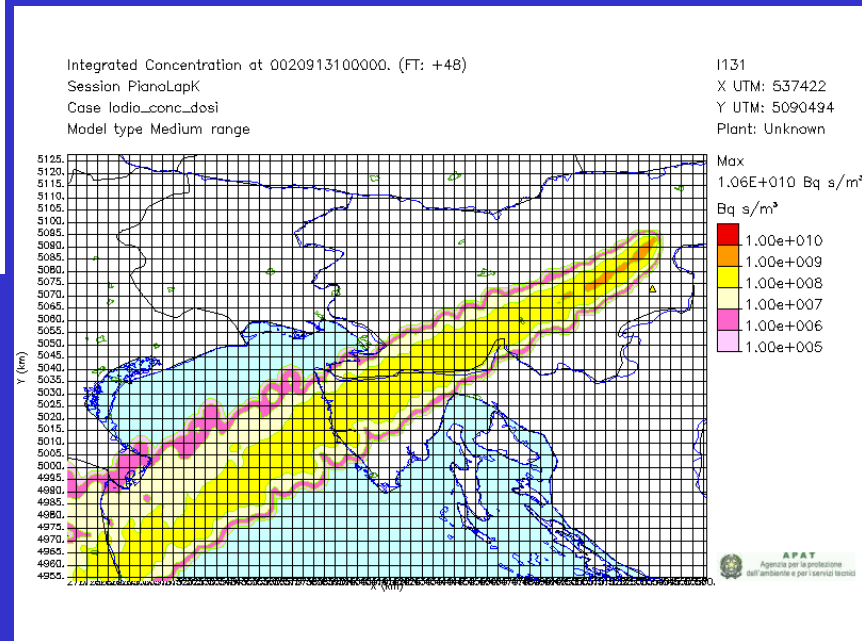
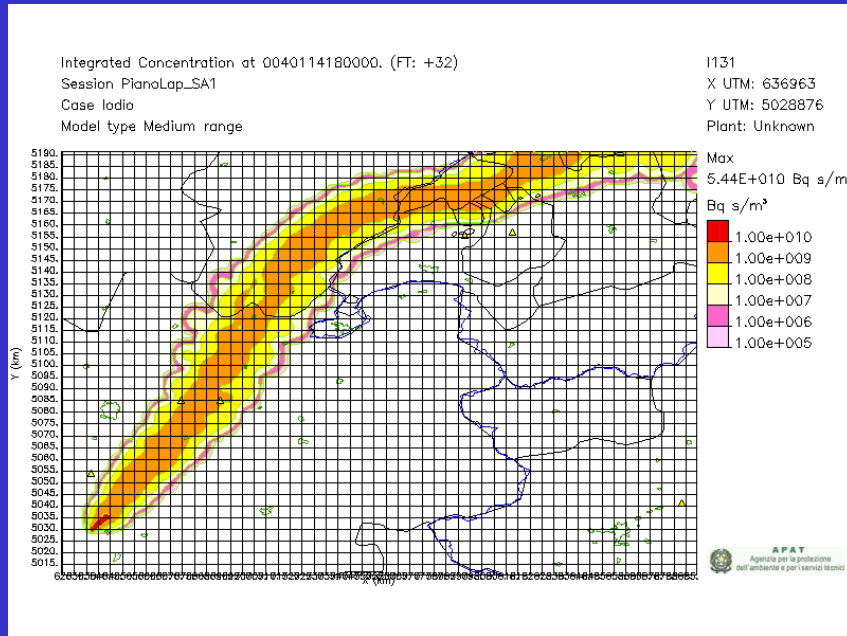
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ARIES - LAPMOD medium range model- Output Map



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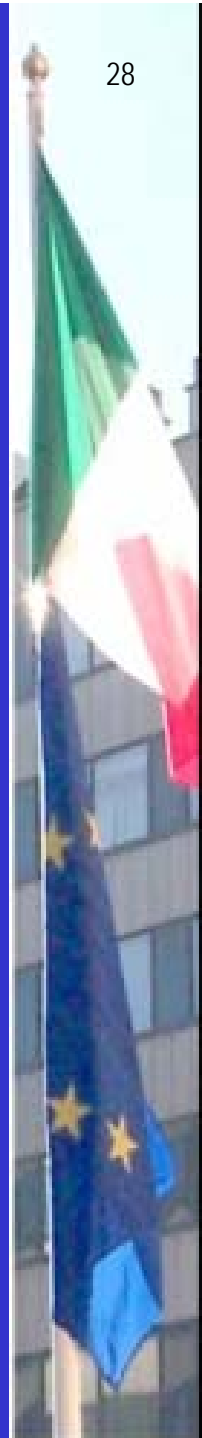
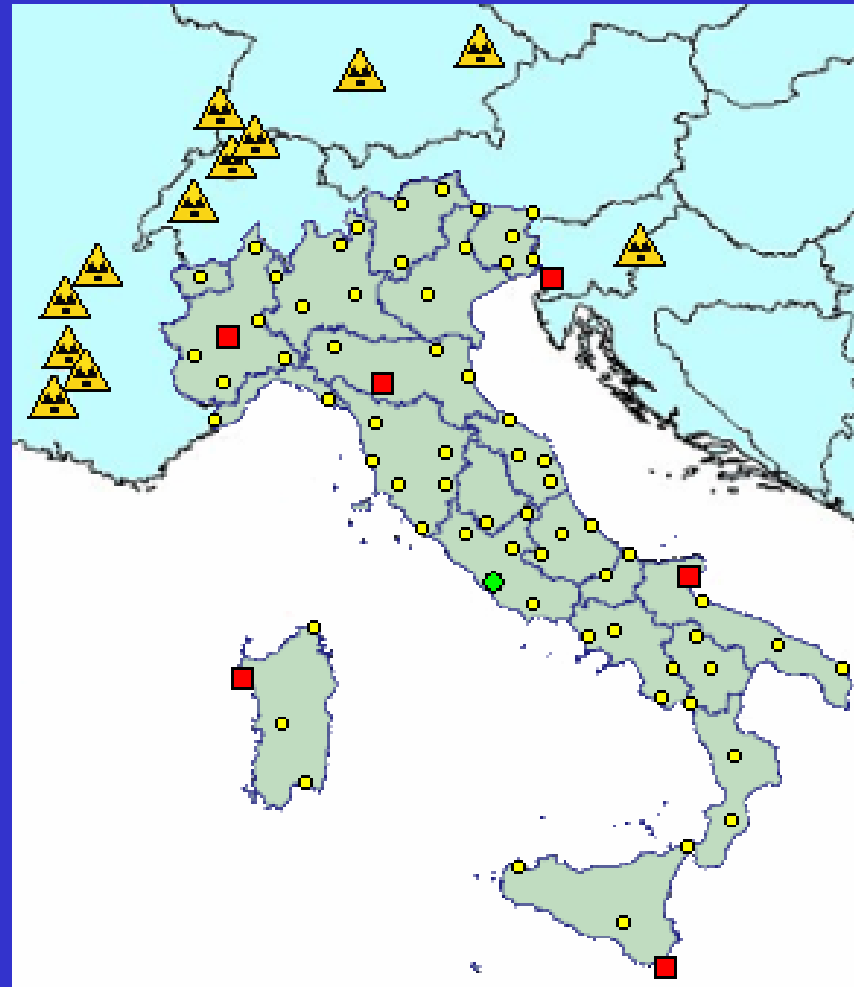
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Automatic networks for radiological monitoring

- confirm the information produced by the international notification systems, in particular when the national territory is involved in the contamination,
- generate an early warning when the data exchange information are not available
- inform about the actual radiation level following the fallout of the radioactivity due to the crossing of the contamination on the national territory



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REM RAD Network



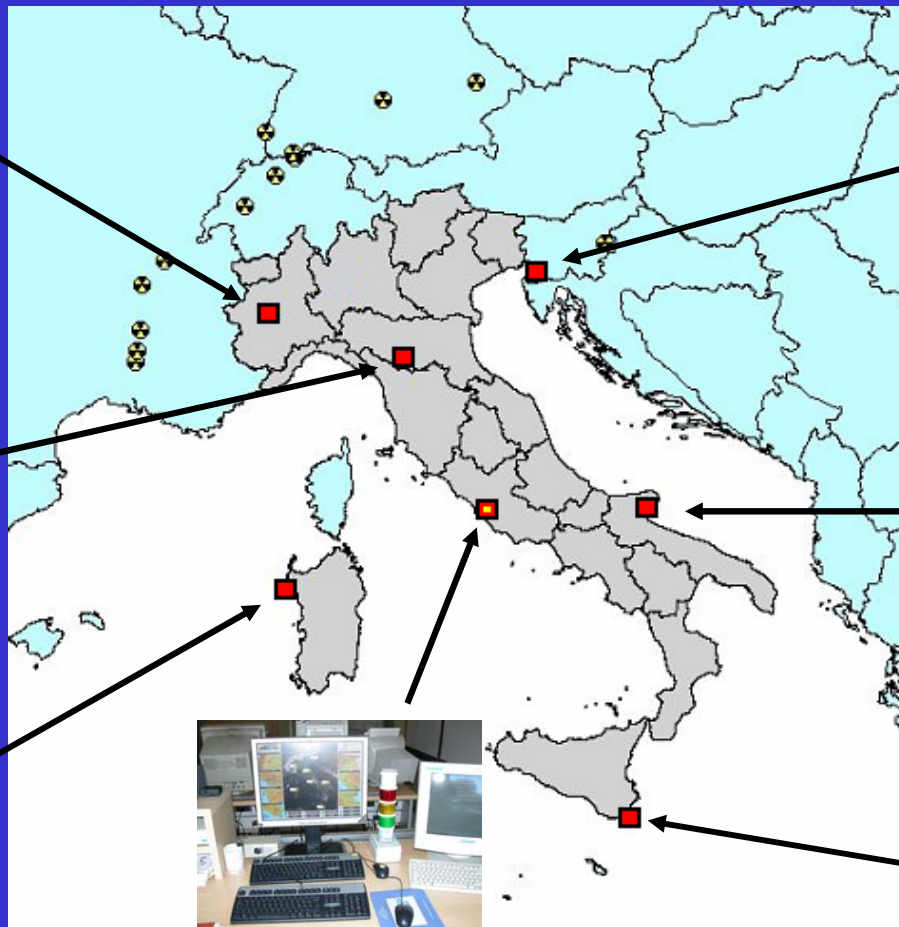
Bric della Croce (TO)



Monte Cimone (2163 mt)



Capo Caccia (SS)



Roma
+
Control Centre



Sgonico (TS)



Monte Sant'Angelo (FG)



Cozzo Spadaro (SR)



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REMRAD Network

Monitoring tasks

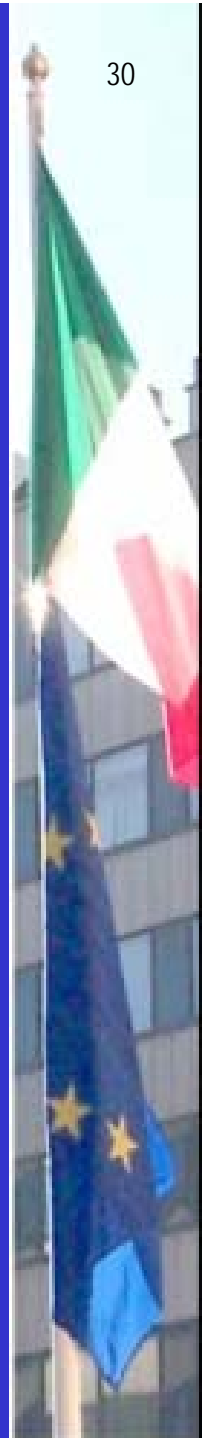
- air particulate sampling on a glass fiber filter tape.
- prompt alpha and beta measurement of both natural and artificial radioactivity component.
- on-line high resolution gamma spectrometry.
- alpha/beta delayed measurement 5 days after the sampling.
- ambient gamma dose rate monitoring.
- measurement of local meteorological parameters.



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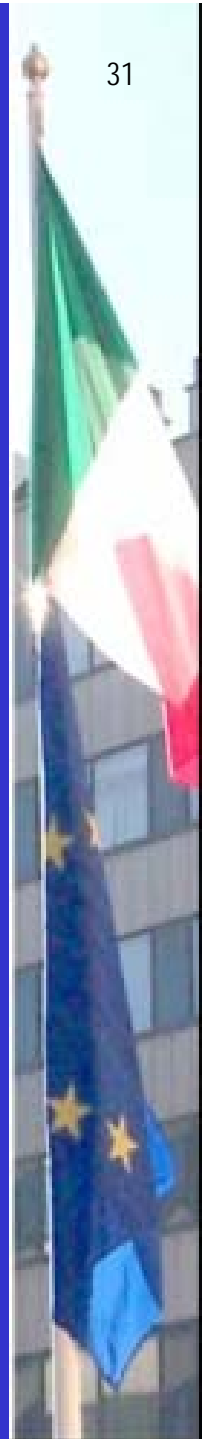
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REM RAD Network Station Components

- sheltering structure
- monitoring unit with sampling and measurement equipment
- station control unit for data collection and transmission, system supervision
- power cabin with UPS and diesel generator
- meteorological kit



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REM RAD Network Monitoring unit



HPGe detector



Multichannel analyser



Electric Cooler



Aspiration pump



α/β detectors



Glass fiber filter



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REM RAD Network *α/β monitoring performances*

- historical data based on 1h measurement time
- renewable moving average every 10 min
- artificial component ranging 0.1- 0.5 Bq/m³ depending on the fluctuation of natural radioactivity,
- delayed measurement about 1 mBq/m³ for alpha and 3 mBq/h for beta component

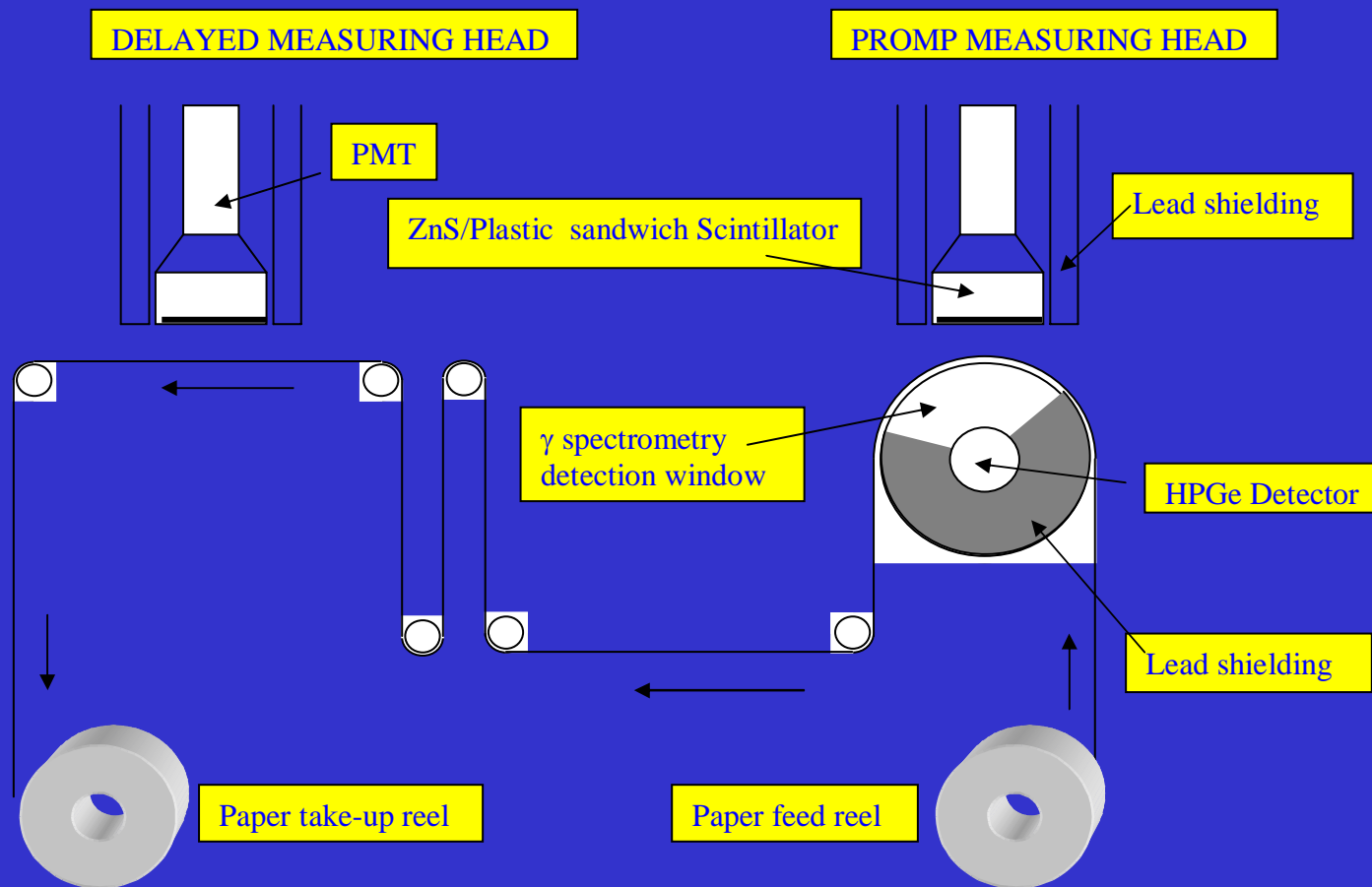


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REM RAD Network Measuring unit



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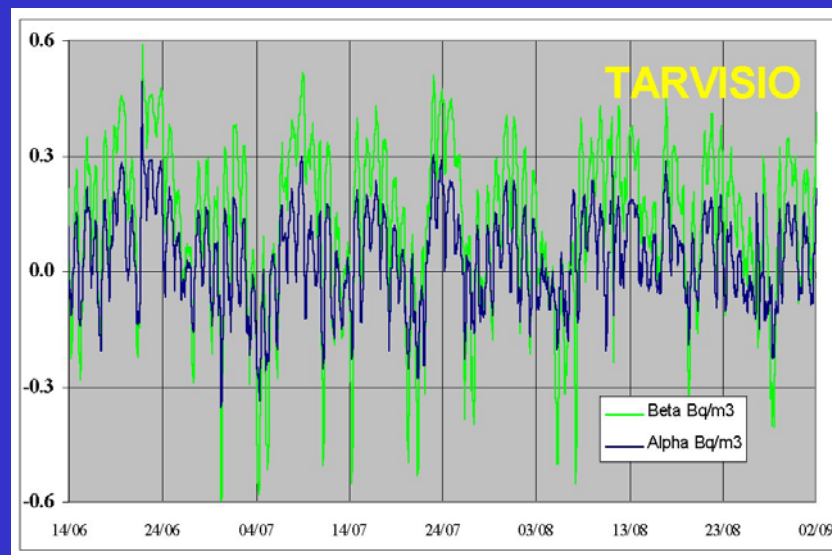
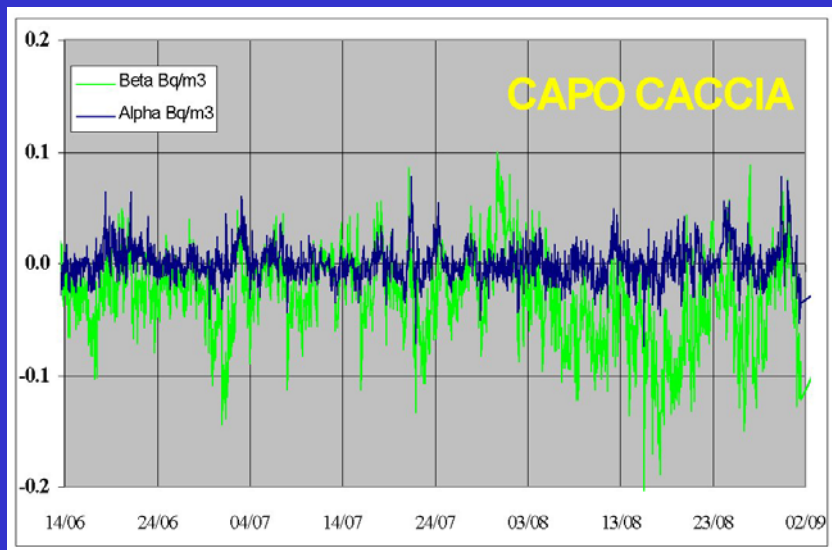
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REM RAD Network

Artificial α/β signal



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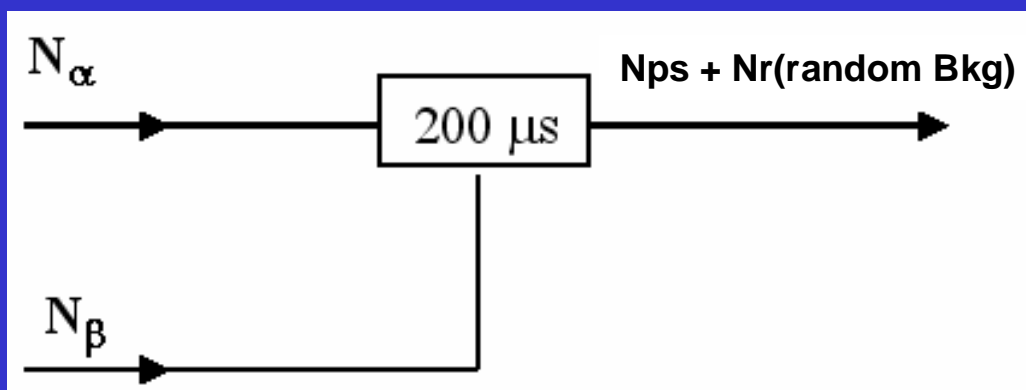
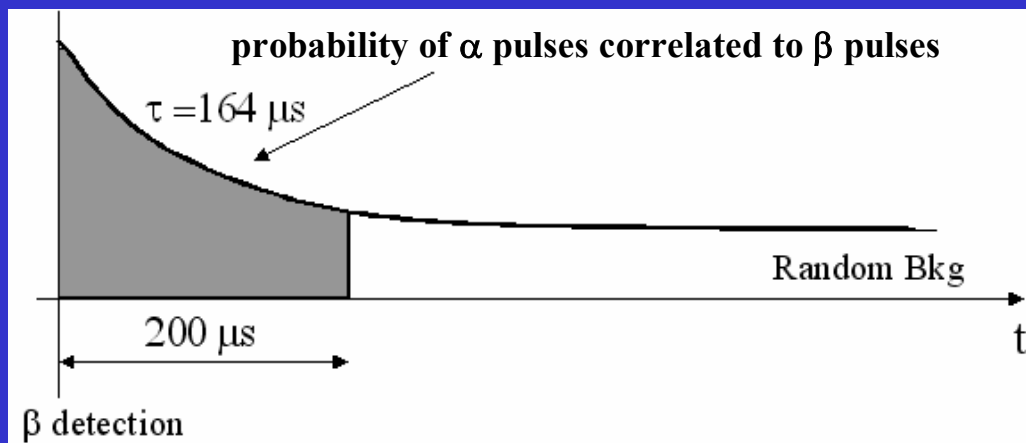
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REM RAD Network

Pseudo-Coincidence Technique



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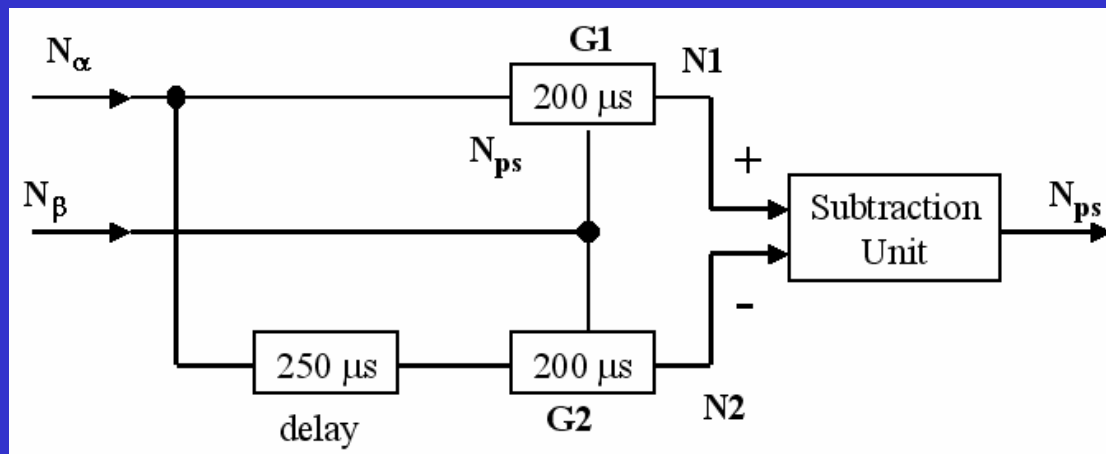
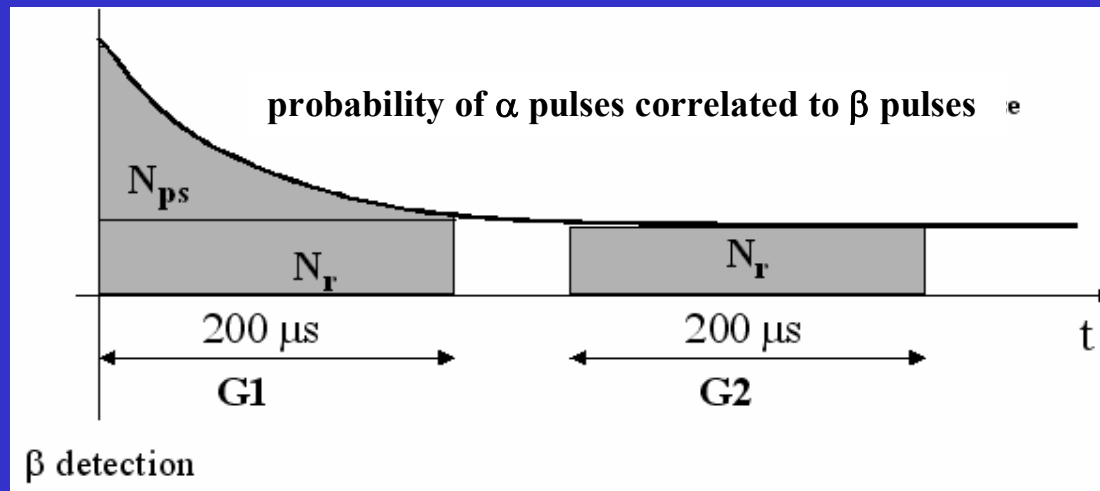
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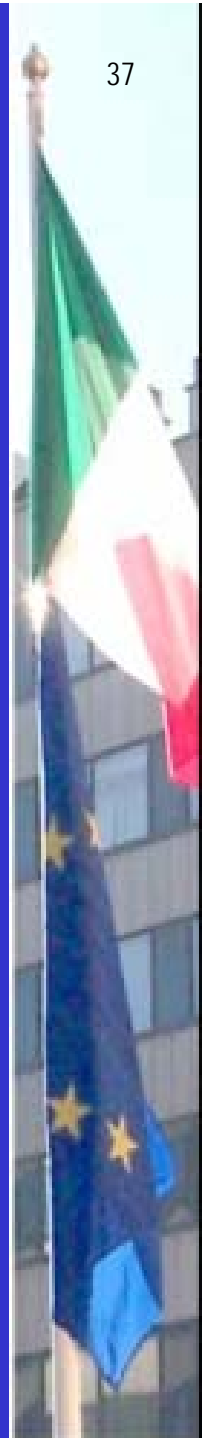
Pseudo-Coincidence Technique



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REM RAD Network

Meteo devices

Meteorological unit composed by a set of meteo devices giving:

- local wind, speed and direction
- temperature
- relative humidity
- barometric pressure
- precipitation intensity



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REMRAD Network

HPGe technical specifications

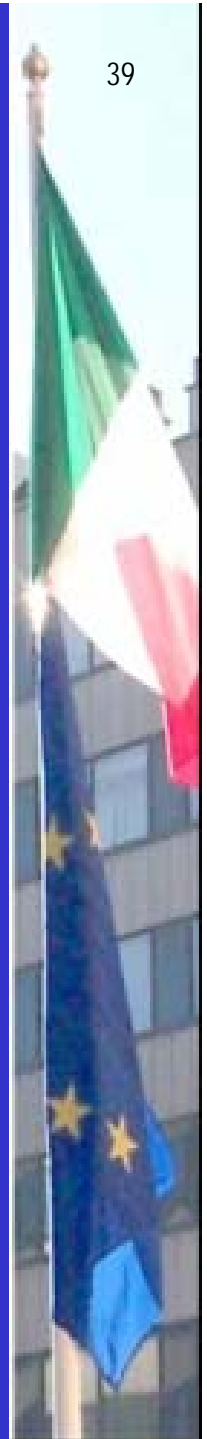
- high purity germanium coaxial detector P type
- typical power supply: 1700 – 3000 V
- efficiency :> 30% (1.33 MeV Co⁶⁰)
- energy range : 40 KeV – 10 MeV
- energy resolution (FWHM) : 2.04 KeV (1.33 MeV Co⁶⁰)
- cooling time: 12 h



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REM RAD Network *Gamma spectrometry*



REM RAD Network

Gamma spectrometry performances

- spectrum and analysis every 2 hours(measurement time)
- daily sum-spectrum and analysis of the 12 spectra (each 2h meas.time)
- MDA referred to Cs¹³⁷:

< 200 mBq/m³ 2h sampling and measure (early-warning)

< 10 mBq/m³ 24h sampling and 2h measure

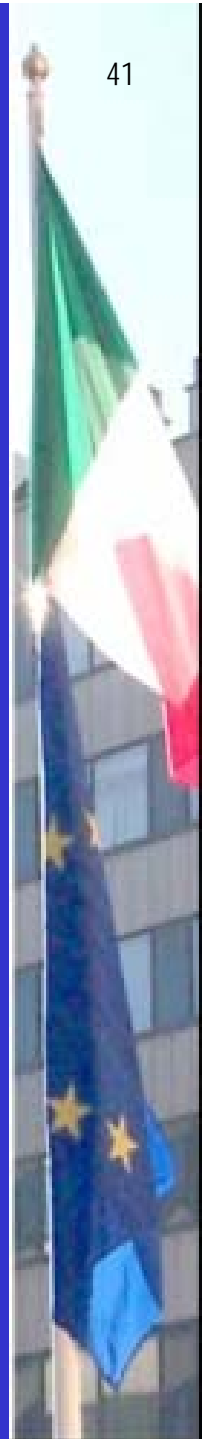
< 5 mBq/m³ 24h sampling and measure (daily spectrum)



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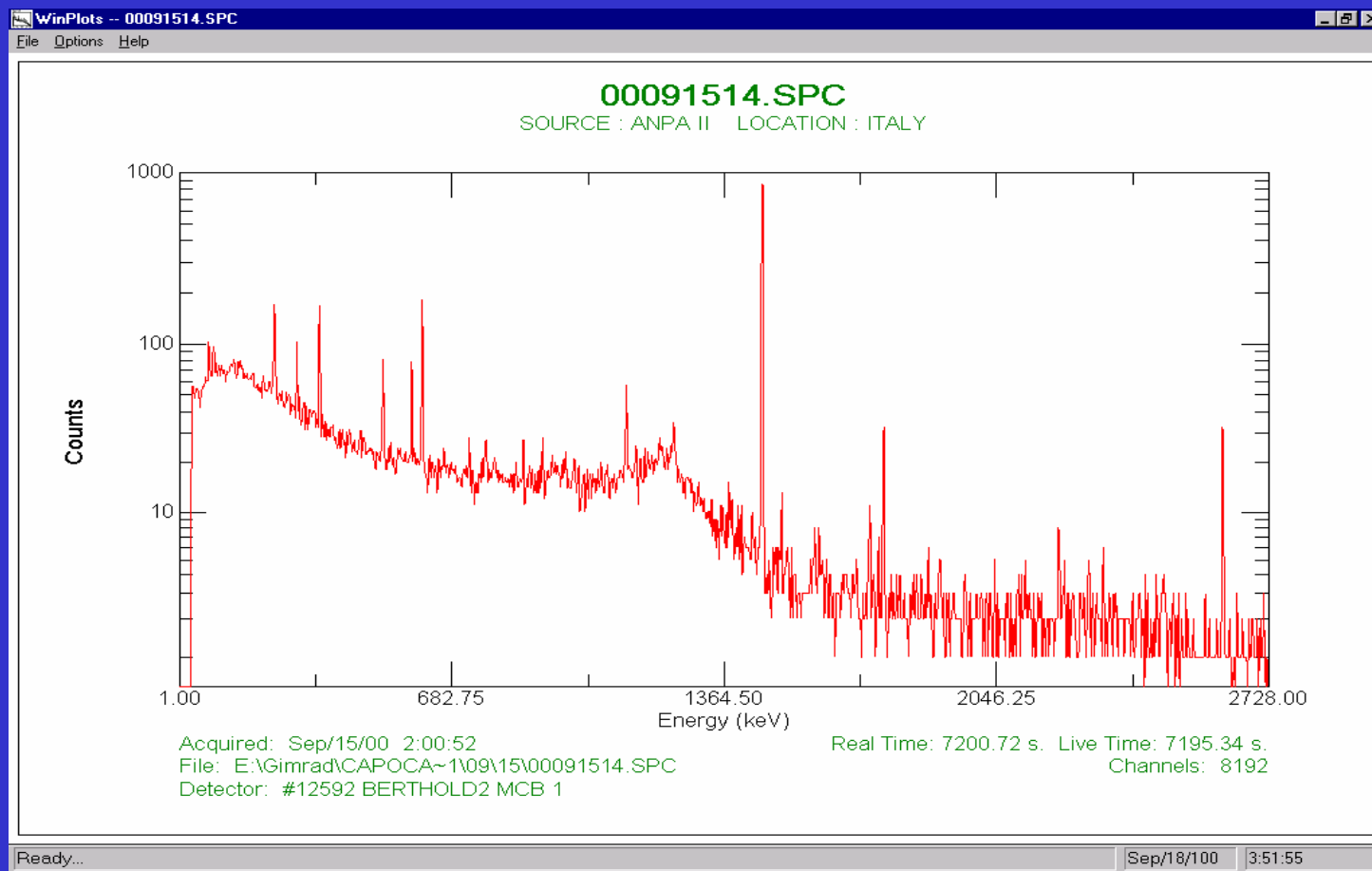
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REM RAD Network

Gamma spectrum



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GAMMA Network



**Control Centre
Roma**



Gamma Station



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GAMMA Network Station equipments

- Three Geiger-Müller counting tubes: 2 large volume low dose tubes - 1 high level tube
- Response range: 10 nGy/h - 10 Gy/h
- Energy range: 40 keV - 1.3 MeV
- Accuracy: 25% LD and 15% HD vs. ^{137}Cs
- Operating temperature: -40°C - $+60^{\circ}\text{C}$
- measurement values in 1 min. intervals
mean values in 10 min. and in 1 hour intervals
- 72h memory and battery autonomy
- rain sensor (Y/N)



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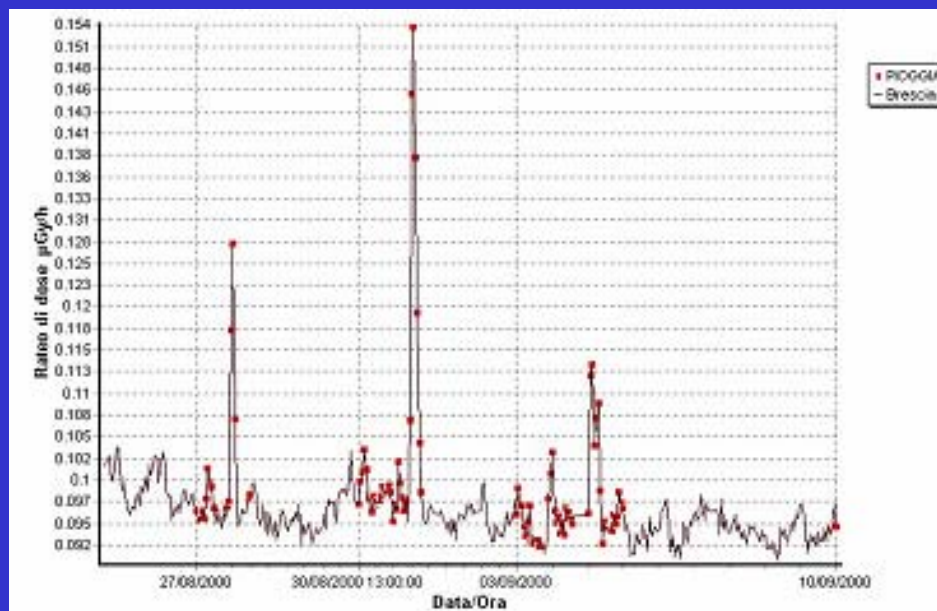
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GAMMA Network

Rain detector

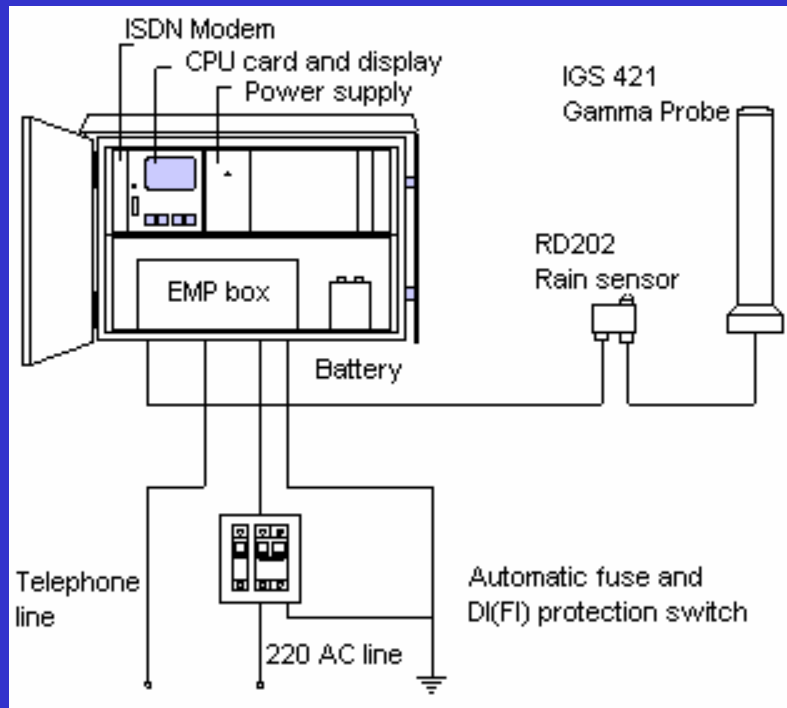


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GAMMA Network Data logger

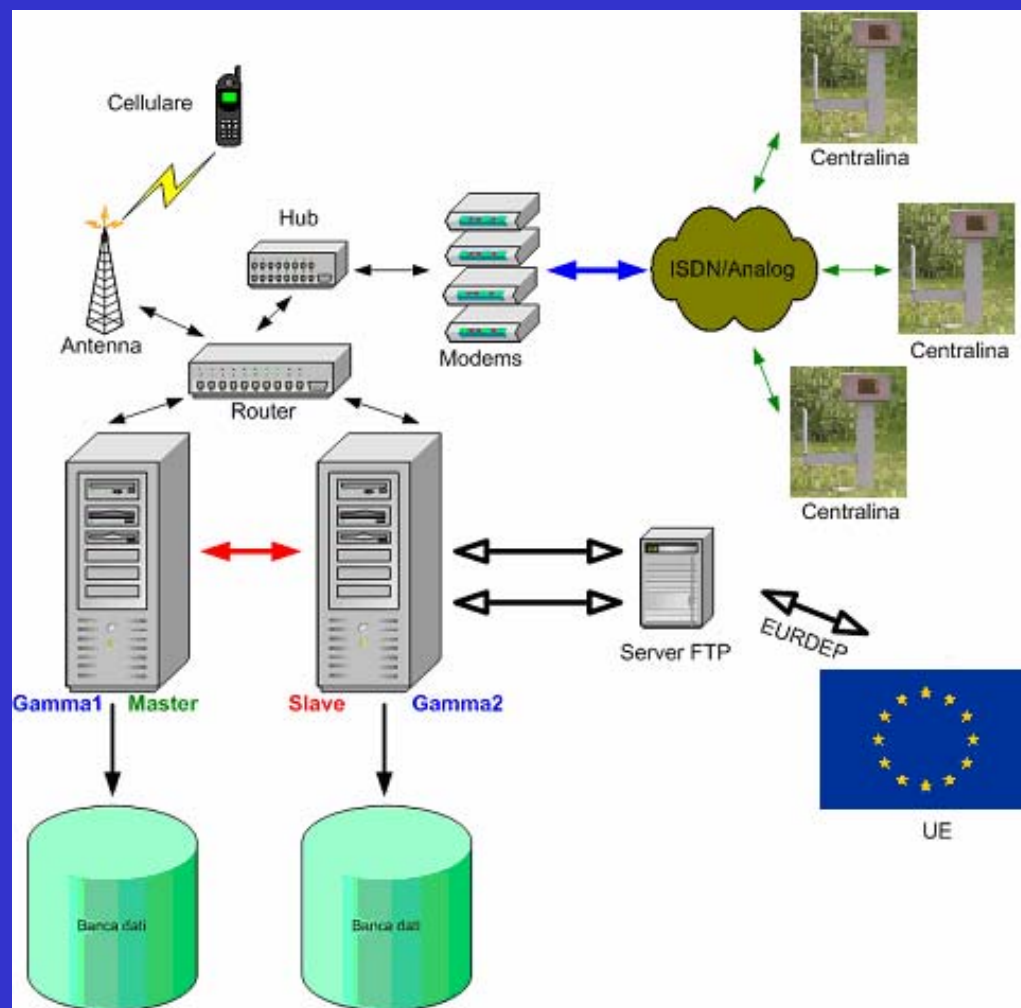


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GAMMANetwork System Architecture



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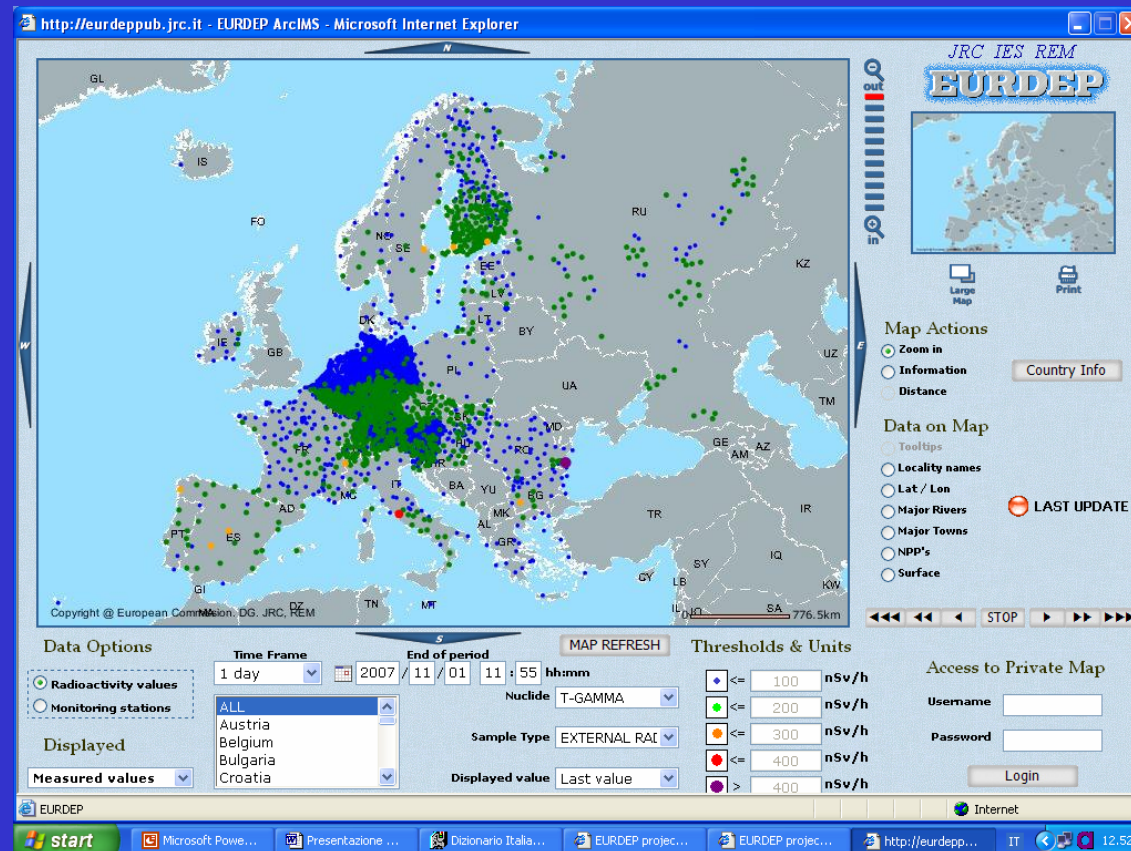
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EURDEP

EUropean Radiological Data Exchange Platform

- Participation of EU member states regulated by Council Decision 87/600 and the Recommendation 2000/473/Euratom.
- 29 European countries
- Routine time: daily
- Emergency : every two hours



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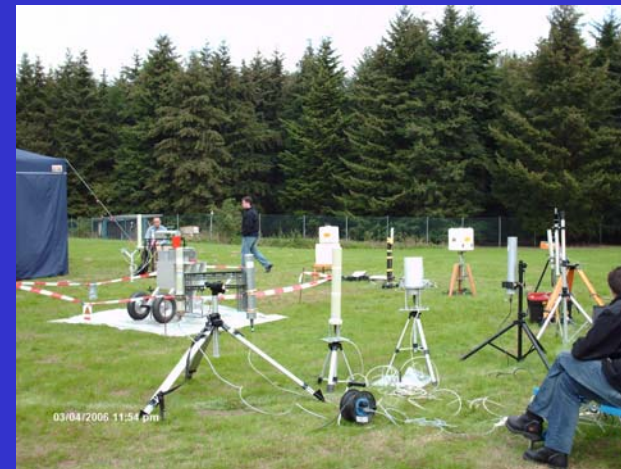
*Third European Intercomparison of
National Early-Warning Network
by
EURADOS WG on Environmental Monitoring
September 2006*



**Asse mine
UDO laboratory
(-490 mt)**



Lake platform



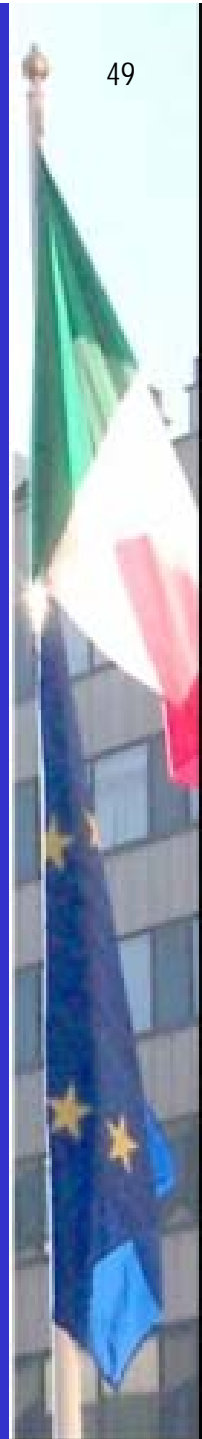
Plum simulation



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APAT Emergency Centre



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Thanks for your attention



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