Environmental Radiation Monitoring in Chernobyl Exclusion Zone

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ДСП «ЕКОЦЕНТР»

Three Questions We Must Answer Today

WHAT

HOW to monitor?

WHY

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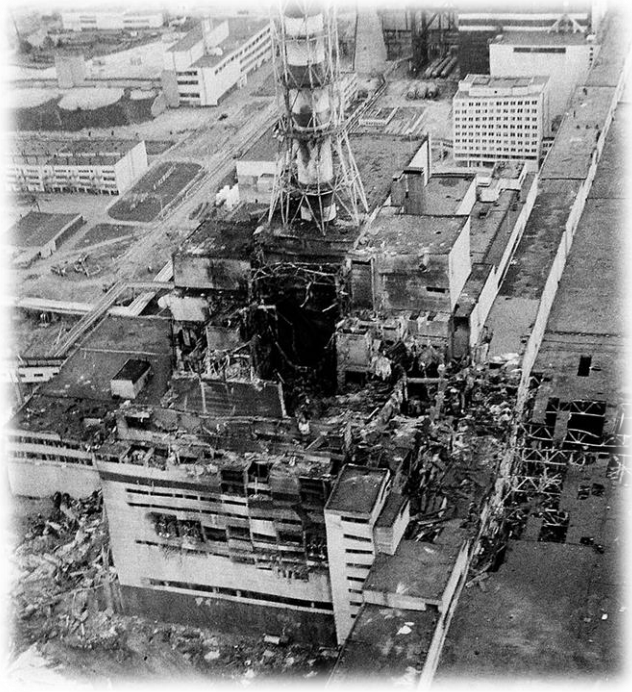
26/04 1986



The Shelter

New Safe Confinement (NSC)

Chernobyl accident:
Technogenic
Humanitarian
Environmental

Consequences:
Social
Economic
Political

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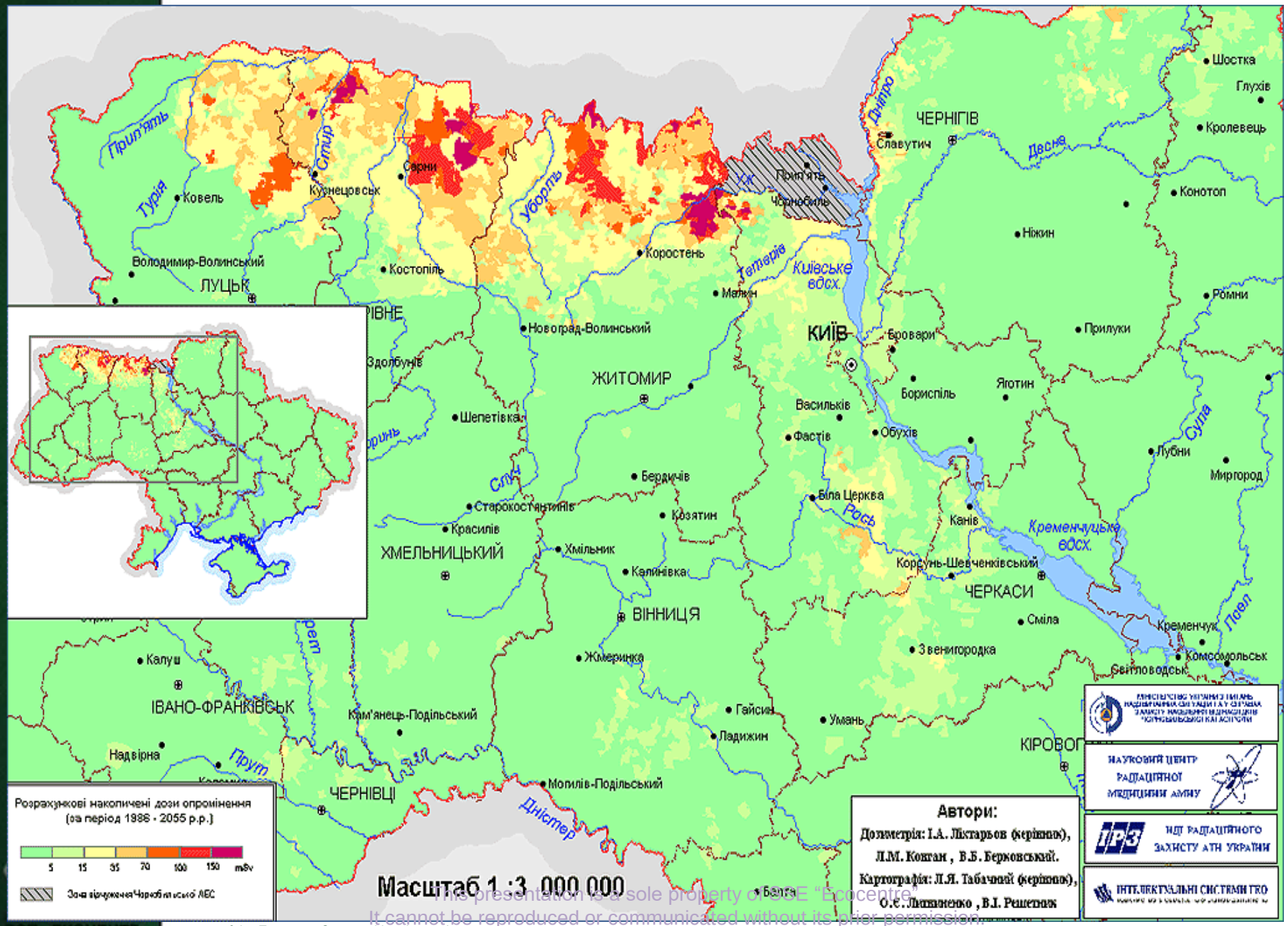
WHAT TO MONITOR?



of the European Communities, Luxembourg

Chernobyl Exclusion Zone today

Tokyo: 2188 sq. km

Luxembourg: 2586 sq. km

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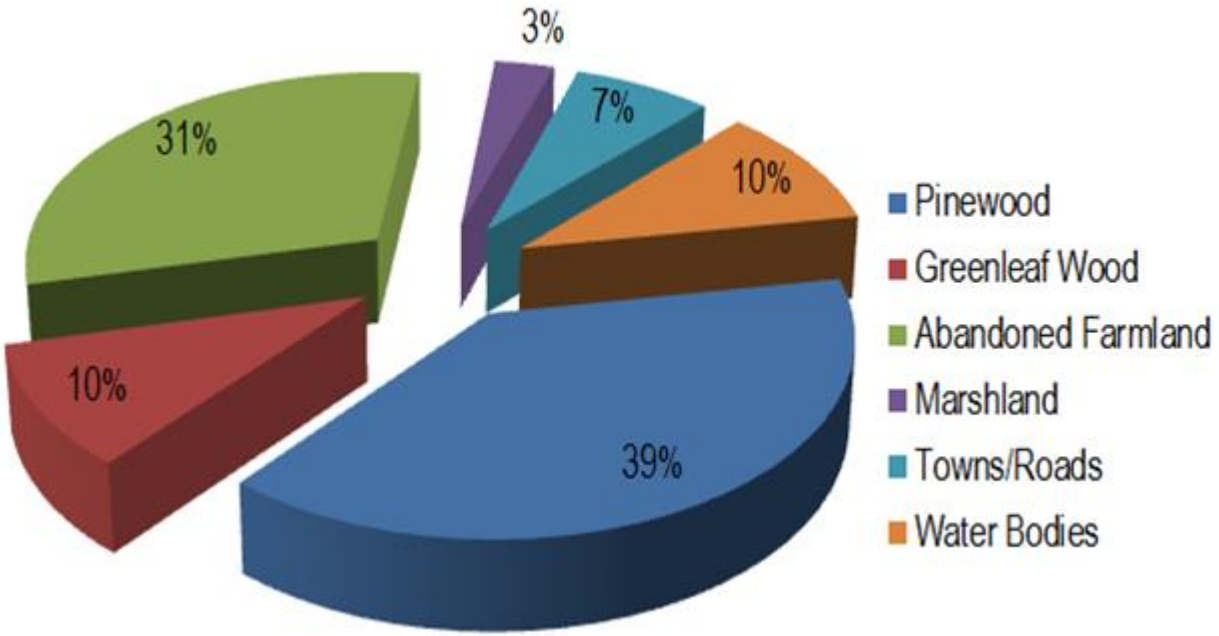
Chernobyl Exclusion Zone today



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Chernobyl Exclusion Zone today

Barrier function of ChEZ is realized through...

Natural objects

Geological environment, vegetation cover

Artificial objects

RAW storage/disposal facilities

Artificial processes

Control of technogenic transportation of RN, water protection measures etc.

The town of Chernobyl

ヨモギ

http://www.nature.com/

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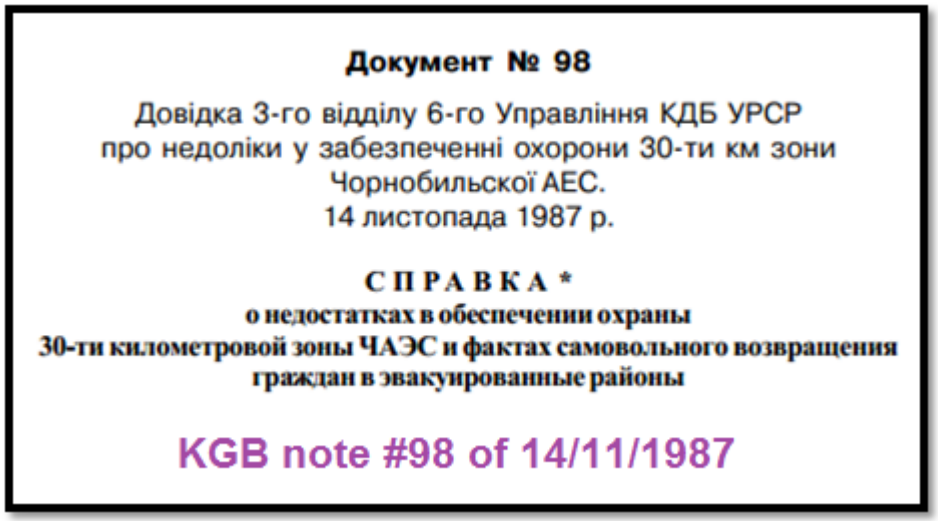
Self-settlers (returnees)



Документ № 98

Довідка 3-го відділу 6-го Управління КДБ УРСР
про недоліки у забезпеченні охорони 30-ти км зони
Чорнобильської АЕС.
14 листопада 1987 р.

СПРАВКА *
о недостатках в обеспечении охраны
30-ти километровой зоны ЧАЭС и фактах самовольного возвращения
граждан в эвакуированные районы

KGB note #98 of 14/11/1987

1038 people returned to ChEZ (14 villages):

- Inability to accept new lifestyle;
- Concerns about their property;
- Lack of understanding of radioactivity and consequences of exposure to radiation;
- Lack of regulation.

Residence in ChEZ is considered illegal since 1991

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Self-settlers (returnees)

http://chornobyl.in.ua/

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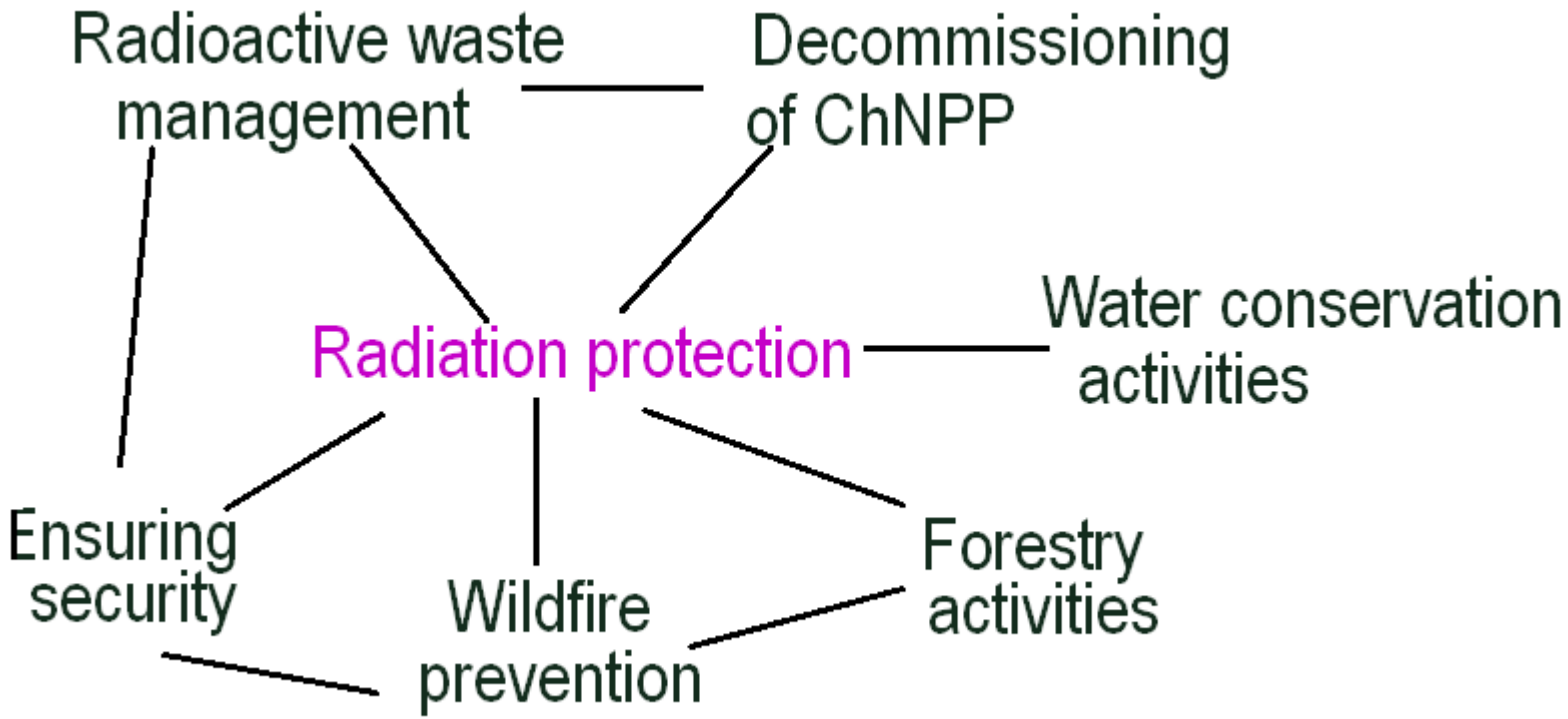
Activities in ChEZ



HOW TO MONITOR?

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System establishing

Radiation Environmental Monitoring = data collecting + data processing + data transfer + long-term storage and analysis of data + prognosing + making recommendations for managerial decision-making

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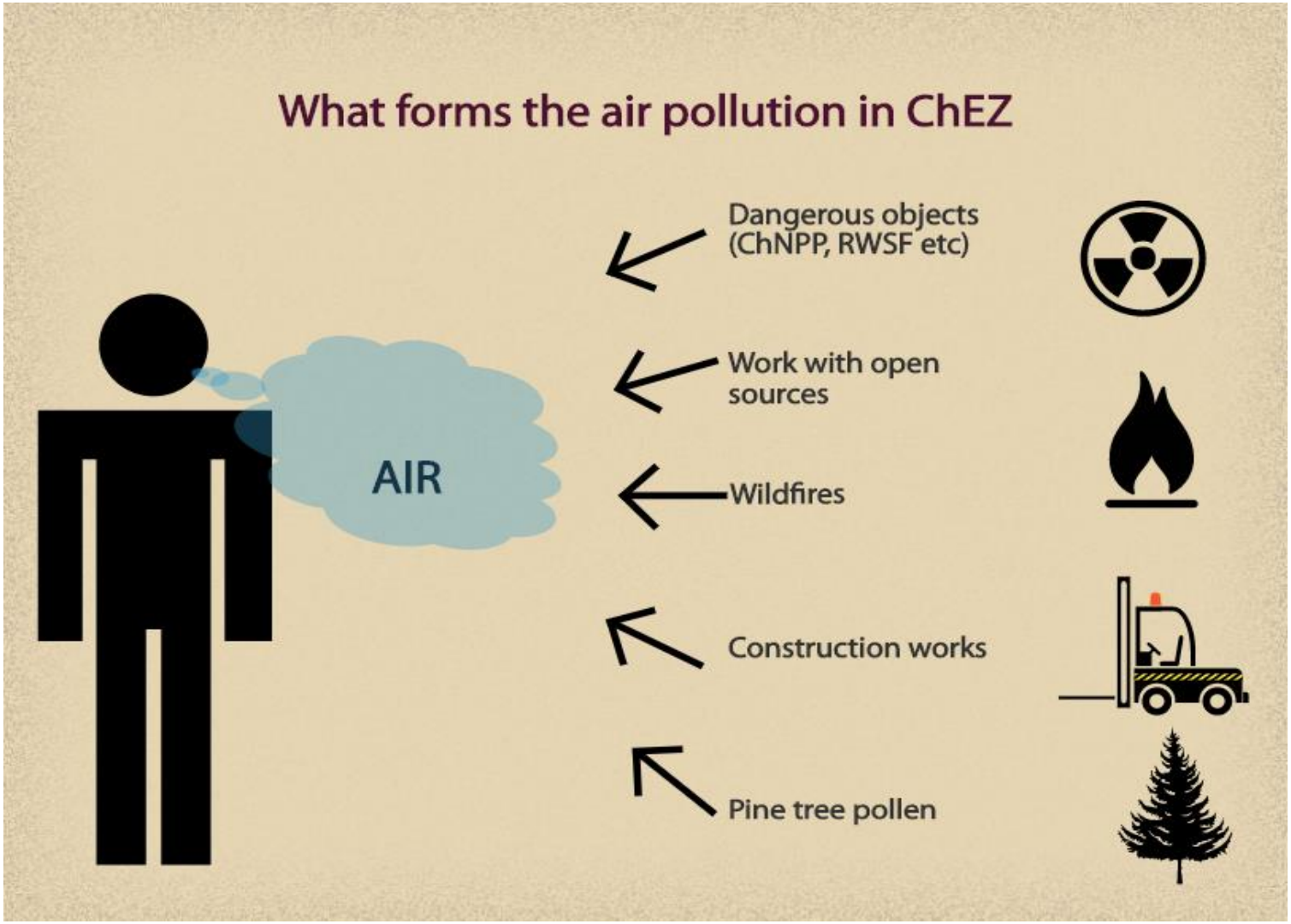
System establishing



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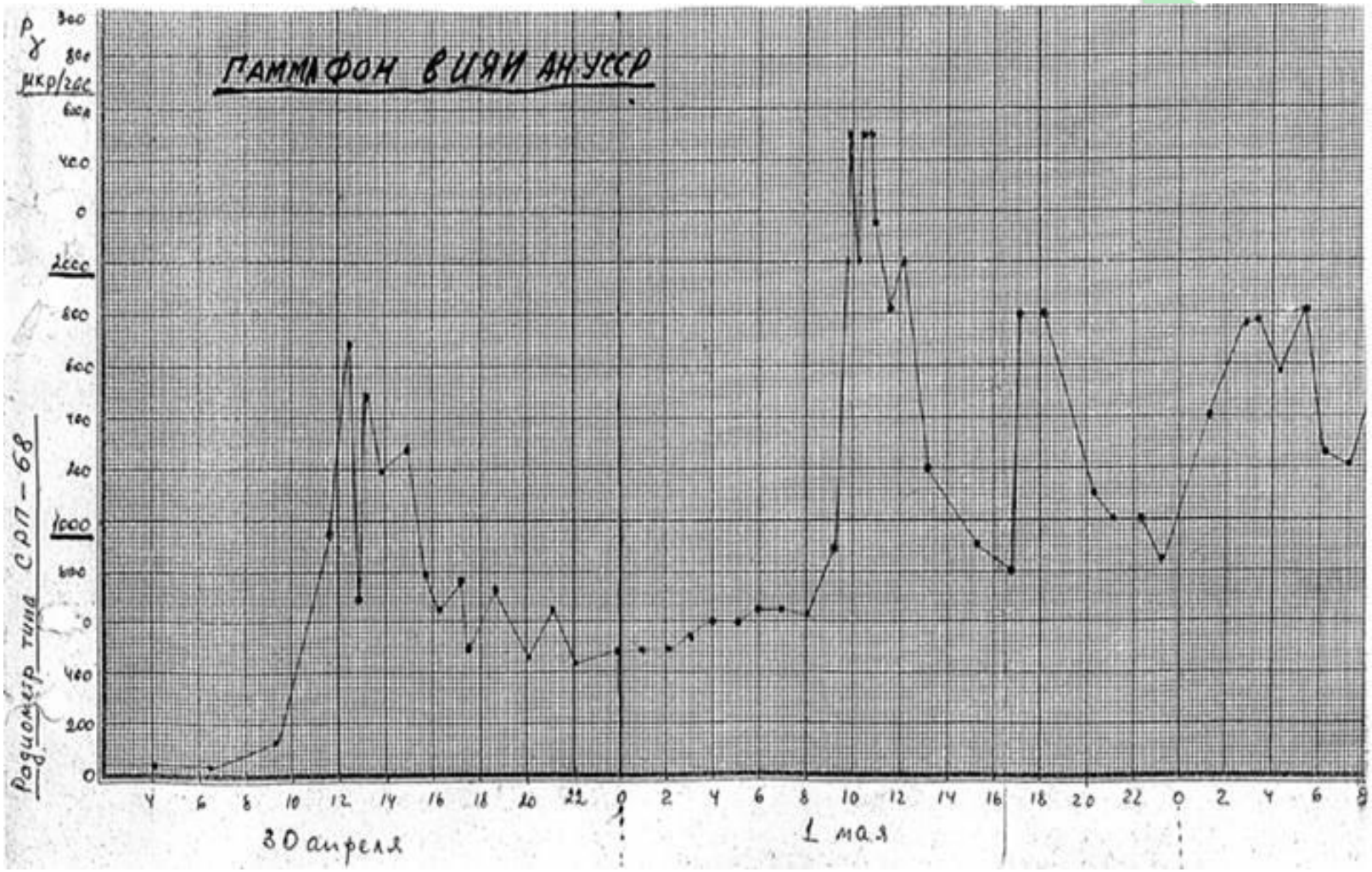
System establishing



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Monitoring Schedule

A document which determines:

- The objects covered under REM;
- Places of sampling/field measurements;
- Scope and frequency of REM;
- Types of measurements/parameters;
- Sampling & measurement methodologies

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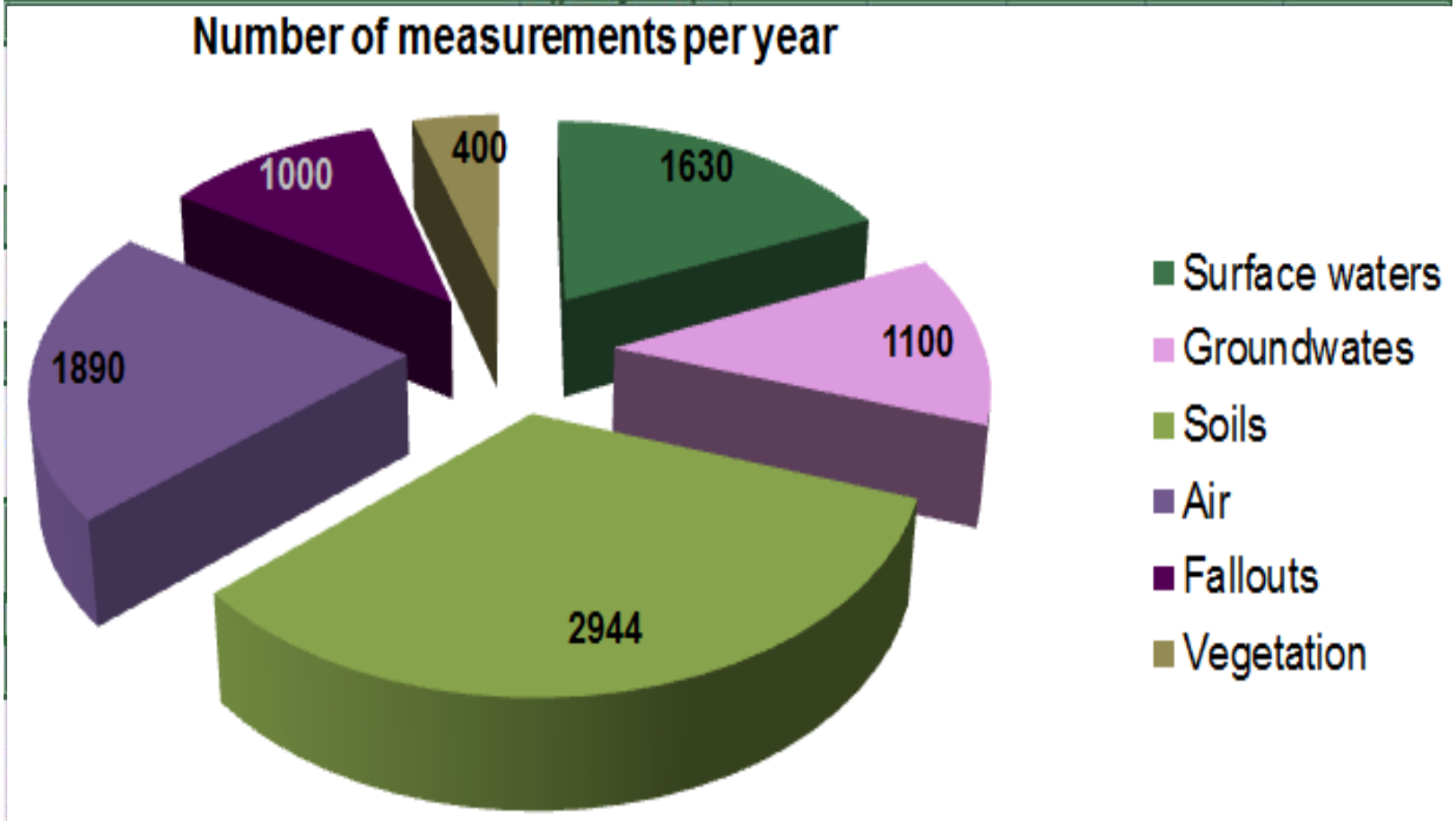
Object	No. of samples (per year)	No. of measurements				
		^{137}Cs	^{90}Sr	ΣPu	^{241}Am	TOTAL



Grass (pasture-lands)						
Backyards						
TOTAL for self-settlers	128	128	128	23	23	302
Water biocenosis						
TOTAL	4362					9839

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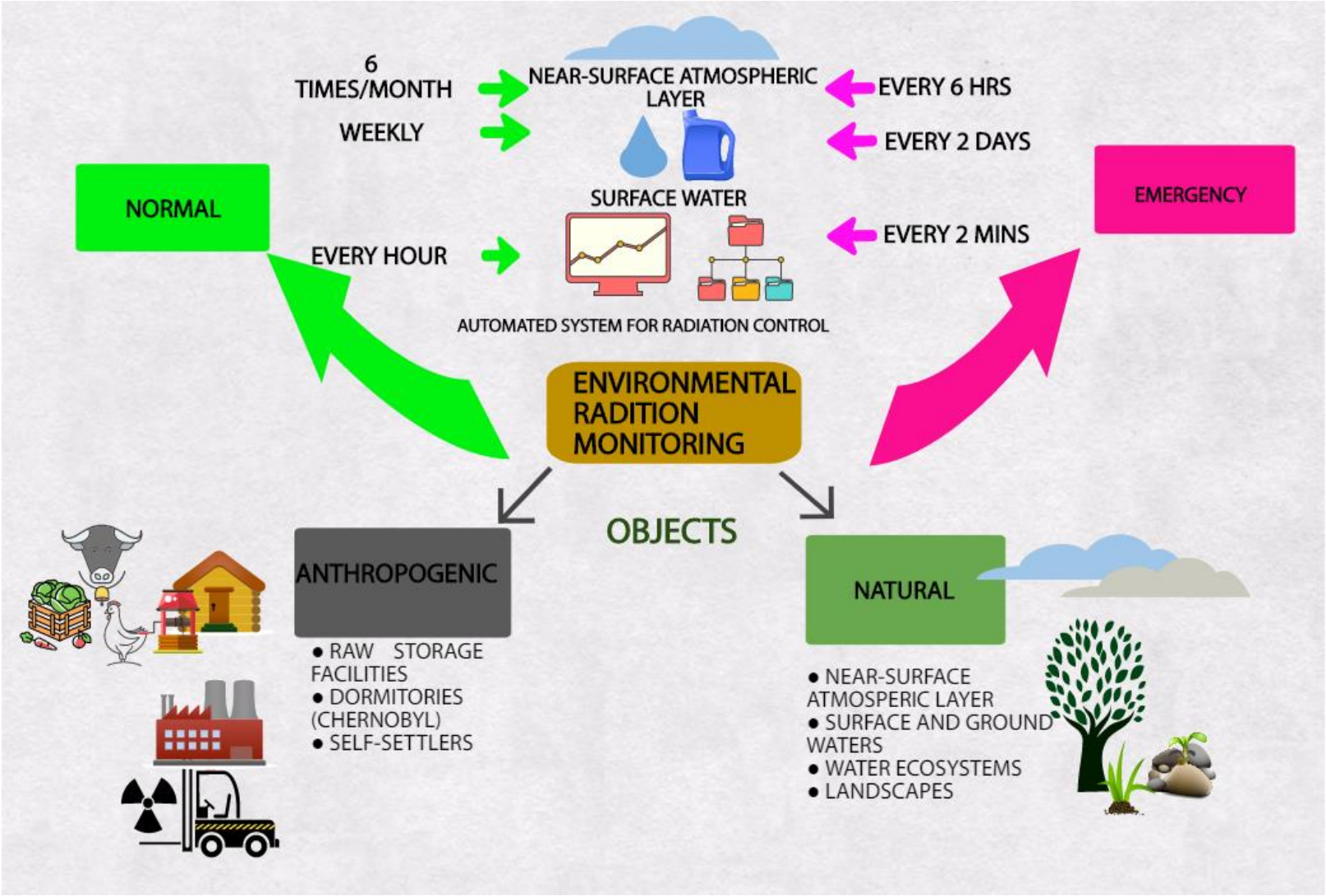
Monitoring structure and modes



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Monitoring capacity

Surface Water

- 645 samplings;
- 1630 measurements

Groundwater

- 138 boreholes;
- 2 water supply points;
- 680 samplings, 1100 measurements.

Soil

- 1096 samplings
- 2944 measurements

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Monitoring capacity

Air

- 9 stationary aspirating systems in the far field; 900 samplings, 1890 measurements per year
- 26 plates to collect the fallouts;
- 600 samplings, 1000 measurements per year

Vegetation

- 213 samplings per year
- 394 measurements per year

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Components of monitoring

- Ongoing measurements
- Sampling and field measurements
- Laboratory measurements
- Data analysis & reporting

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Ongoing measurements

Automated system for radiation control




System for non-proliferation control




Monitoring stations

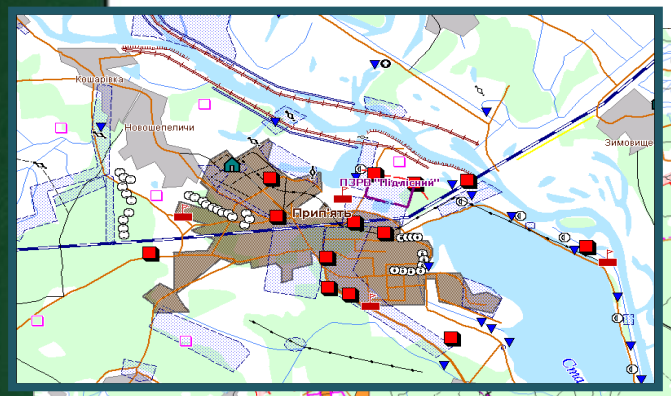


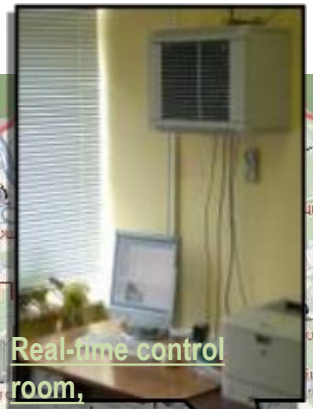
Схема розміщення спостережних свердловин

Схема розміщення пунктів радіаційного контролю в районі ПЗРВ "Буряківка"

Схема розміщення пунктів радіаційного контролю в районі ПЗРВ "Підлісний"

Automated system for radiation control and early warning

Dibrova Radiation Checkpoint



Real-time control room,

ЧАЕС

Dytiatki Radiation Checkpoint

Paryshiv Radiation Checkpoint

Sampling

Air Sampling

Groundwater level measurement

Groundwater Sampling

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Sample preparation*

Object	Before sample preparation	After sample preparation
GROUNDWATER		
VEGETATION	 	
WATER BIIOCENOSIS		

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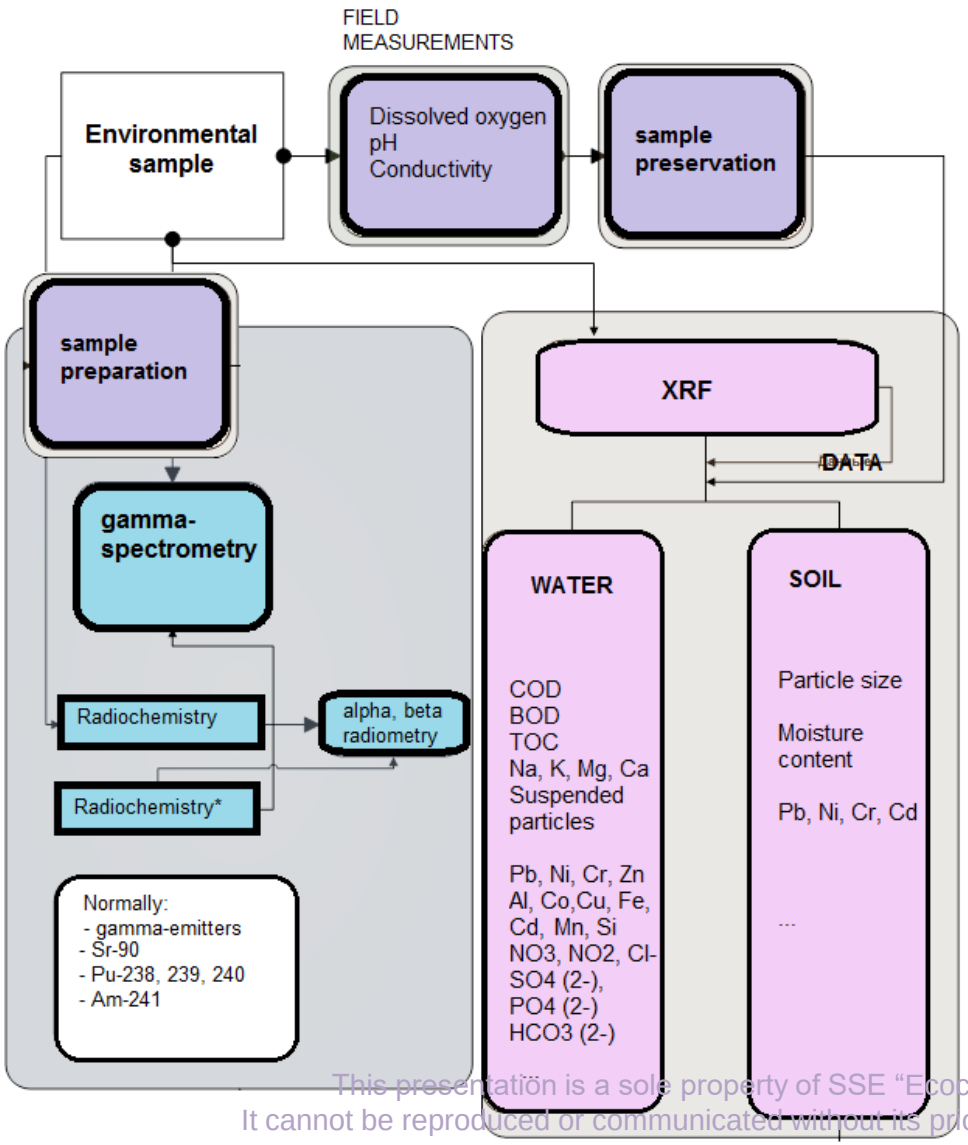
Laboratory measurements



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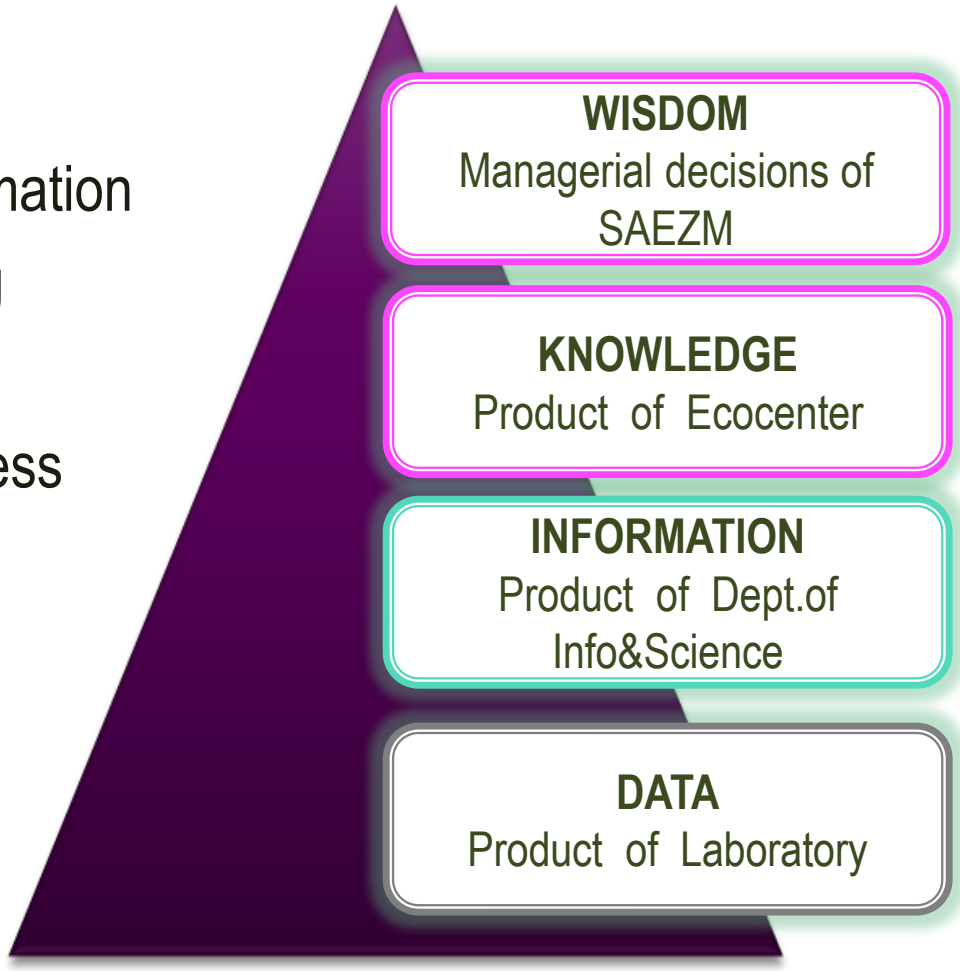
Data analysis

- Providing on-line information
- Modeling & prognosing
- Decision making
- Raising public awareness



DEVELOPMENT OF NEW, PRACTICAL KNOWLEDGE = WHY TO MONITOR

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What kind of knowledge can be created?

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1. Data for Radiation Mapping

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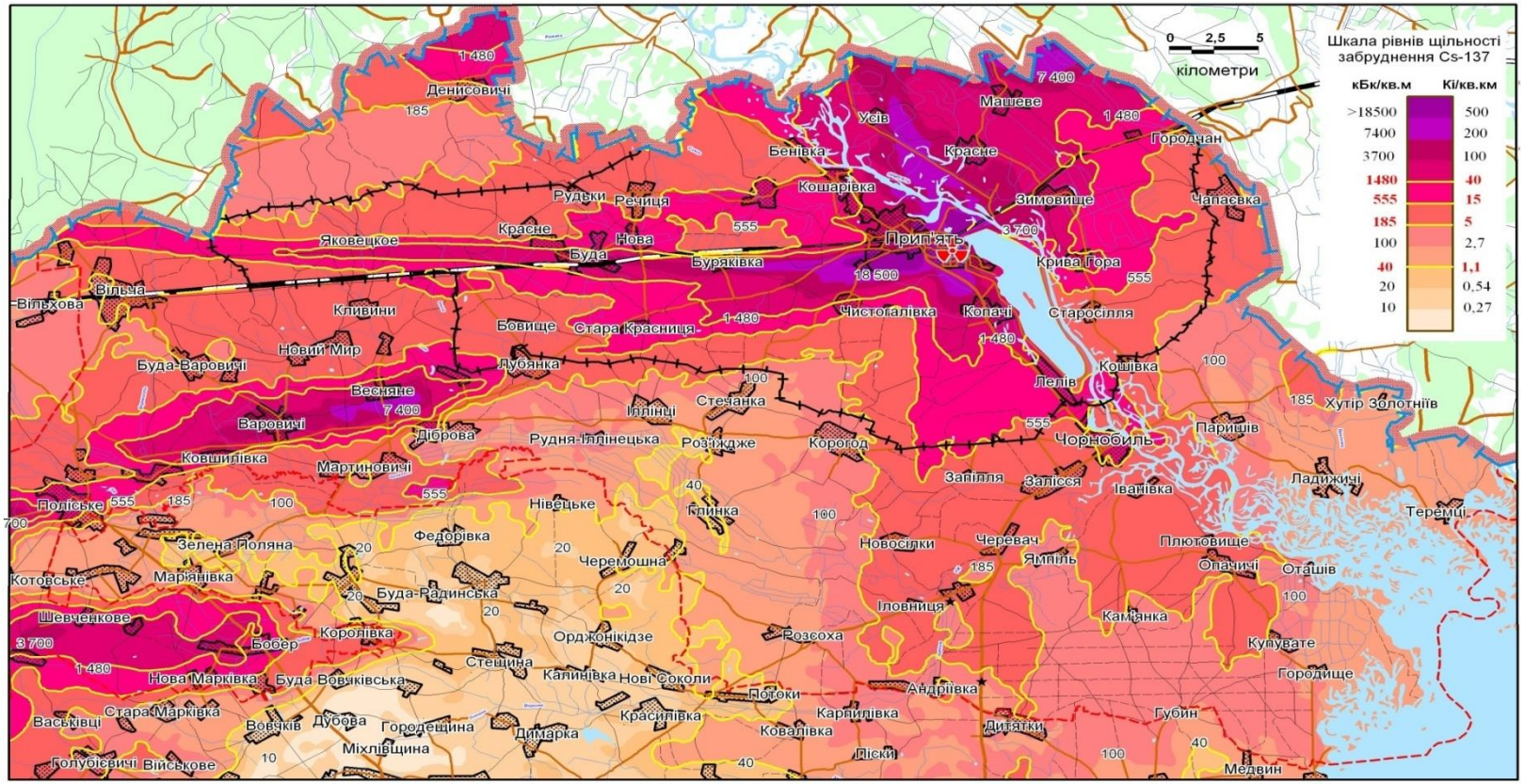
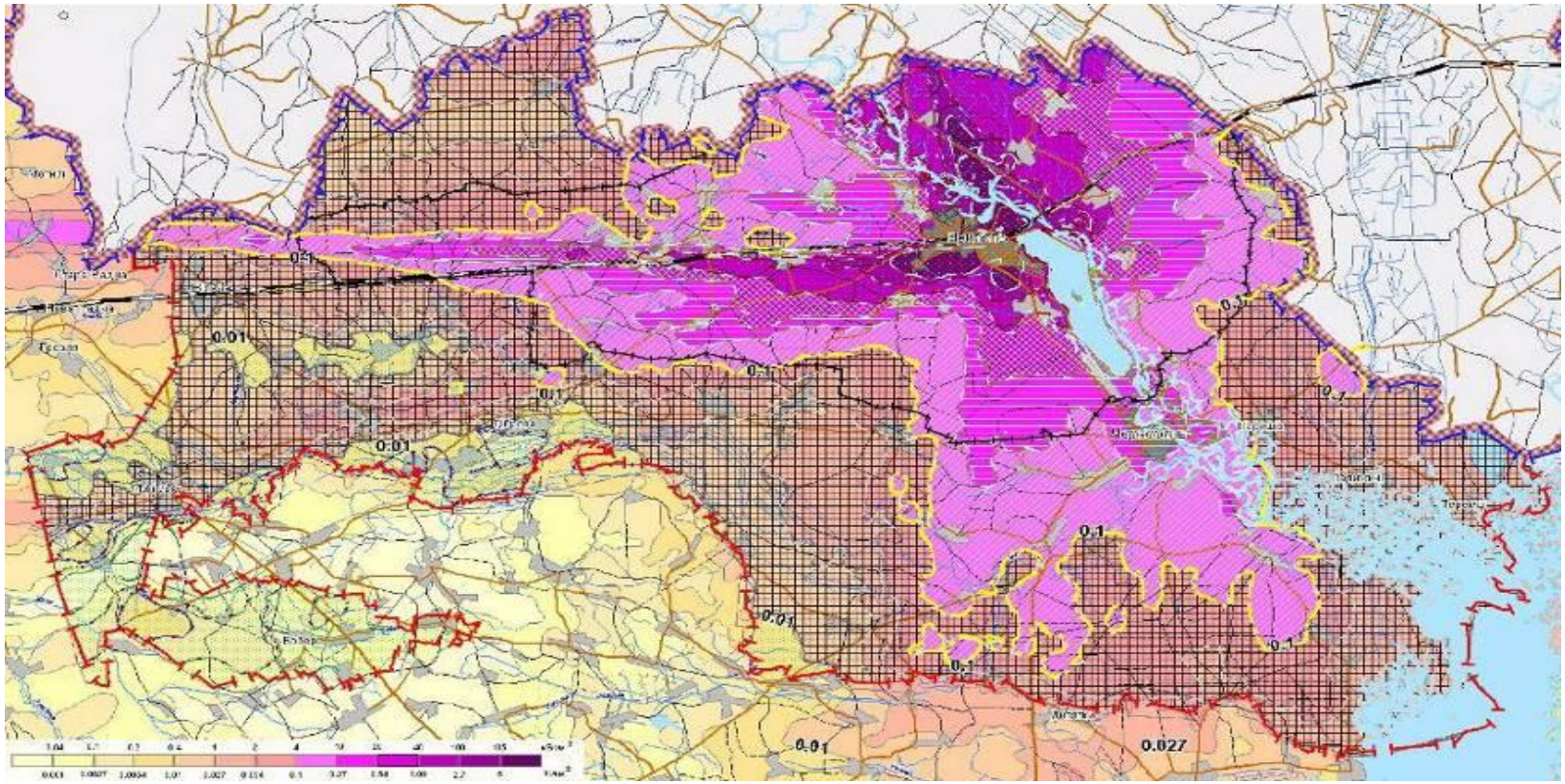
Contamination of ChEZ by Cs-137



Contamination of ChEZ by Pu isotopes



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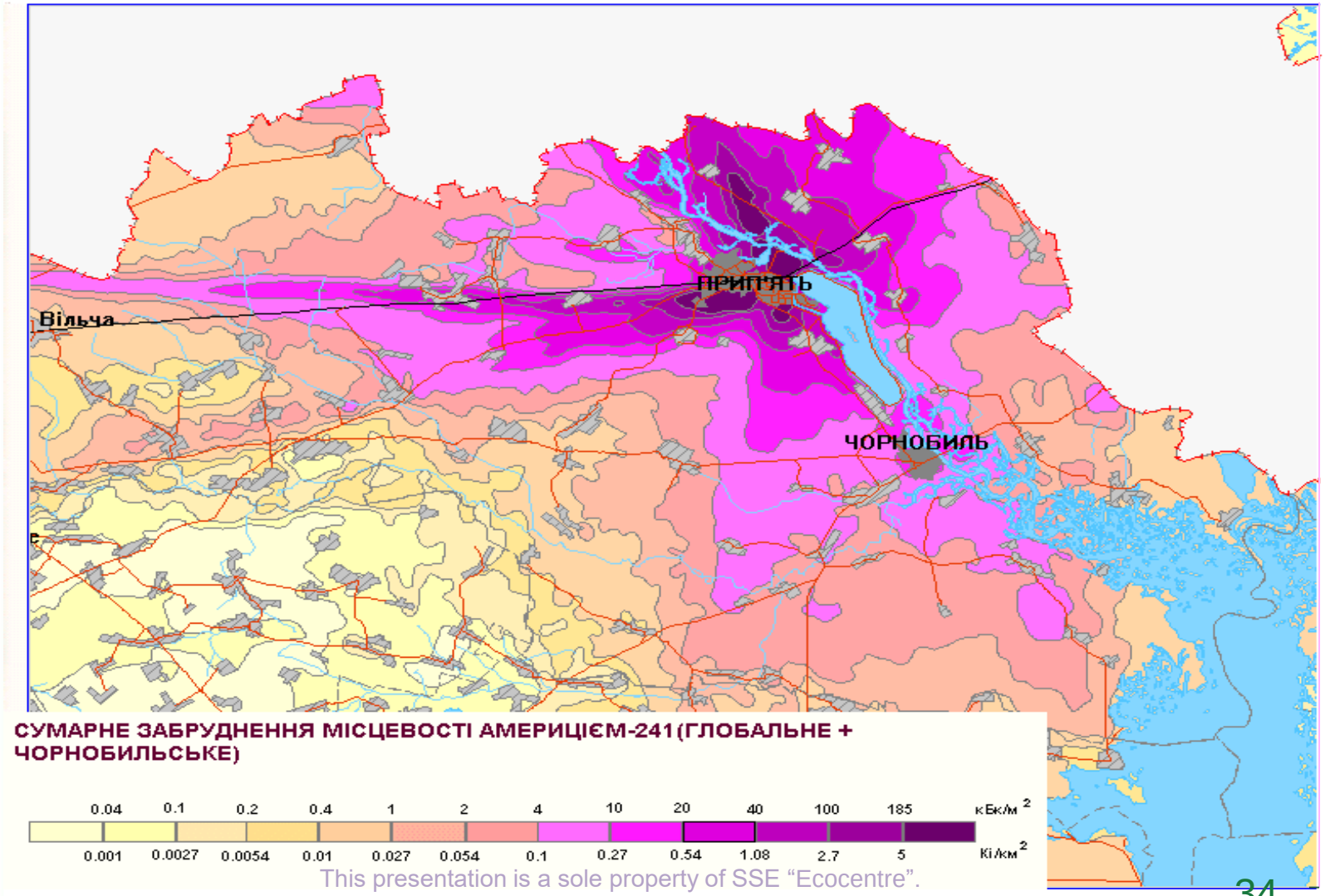
Predicted contamination of ChEZ by Am-241 in 2056



2. Assessment of RA contamination

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Balance of radioactivity in various objects of ChEZ

Object	Activity, n×10^{15} Bq			
	TOTAL	^{137}Cs	^{90}Sr	TUE
Territory of ChEZ	8.13	5.5	2.5	0.13
Cooling pond	0.22	0.19	0.03	0.002
RAW Disposal facility	5.49	3.6	1.8	0.09
RAW Temporary storage facility	2.14	1.4	0.7	0.04
TOTAL	16	10.7	5	0.26
The Shelter	340	190	145	4.5

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Contamination of products consumed by self-settlers (returnees)

Product	Permissible activity of radionuclides, Bq/kg		Excess contamination (times)	
	^{137}Cs	^{90}Sr	^{137}Cs	^{90}Sr
Potatoes	60	20	8	20
Other vegetables	40	20	6	140
Fruit	70	10	2	18
Fish from river Pripyat	150	35	30	12
Fresh mushrooms	500	50	1000	80
Bush meat	400	40	220	15

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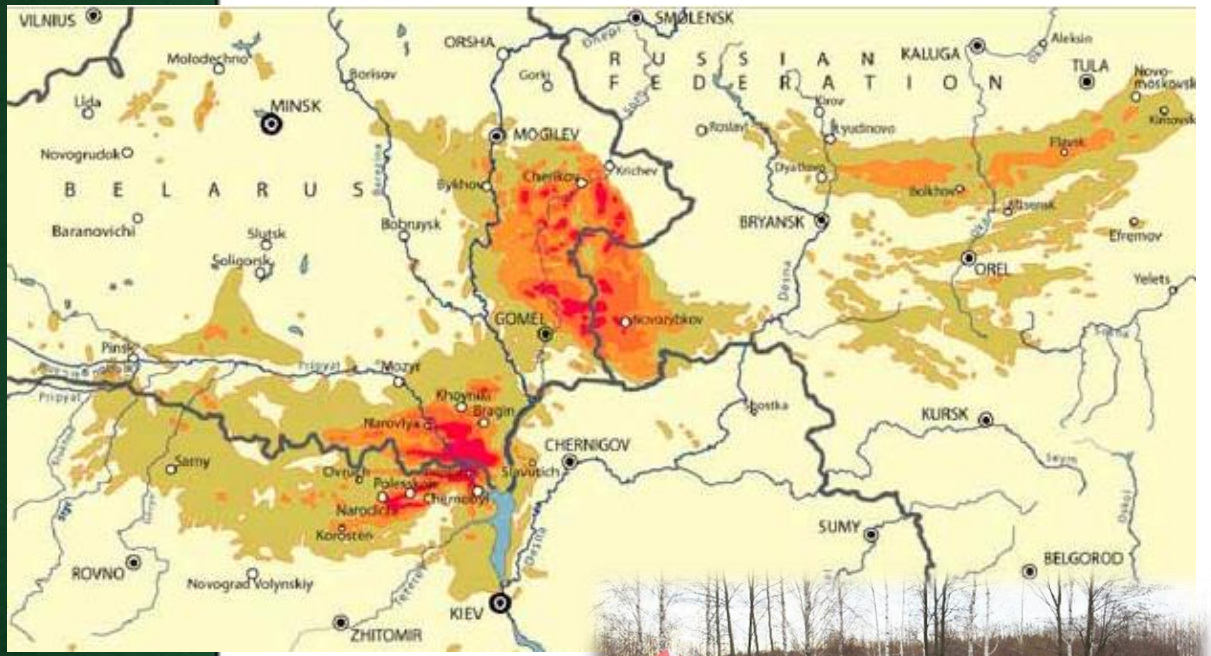
3. Risk Assessment and Safety Assurance

Risk assessment

Source of exposure	Max.individual dose, mSv/yr	Max. collective dose, man-mSv/yr	Probability, year^(-1)	Index of radiation hazard, mSv/yr
Water transport of RN	2	250	0.25	62
Personnel exposure (routine work)	1.8	25	1.0	25
Radiation accident at NSC	2000	200	0.01	2
Technogenic transport of RN	1.4	1.2	1.0	1.2
Unauthorized food consumption in ChEZ	25	100	0.01	1.0
Air transport of RN	0.2	3.0	0.2	0.6

Demarcation of the Ukraine-Belarus State border



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Demarcation of the Ukraine-Belarus State border

Действия при обнаружении ИИИ:

1  2  3 

Действия при пожаре:

1  2  3 

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4. Obtaining Information about Nuclear Incidents

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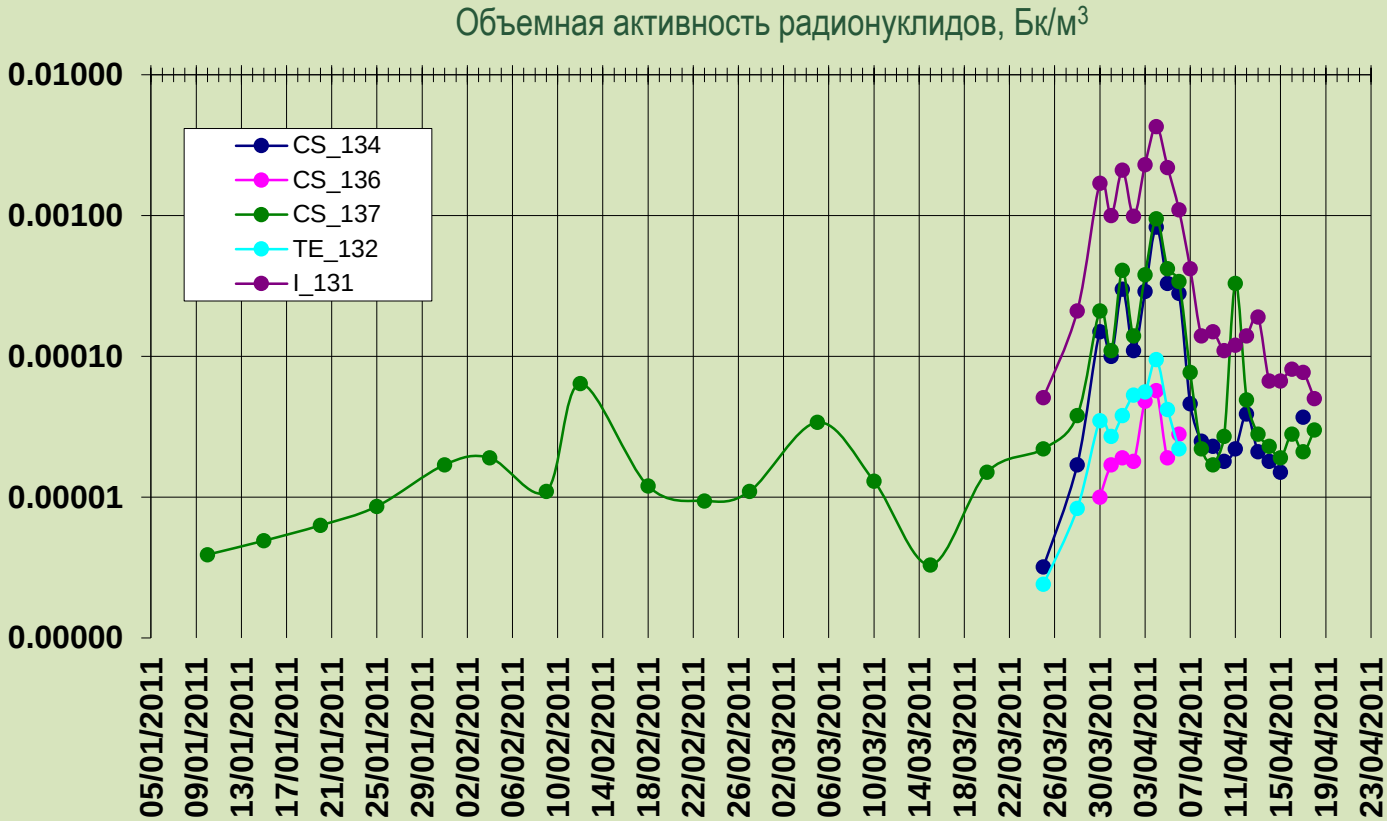
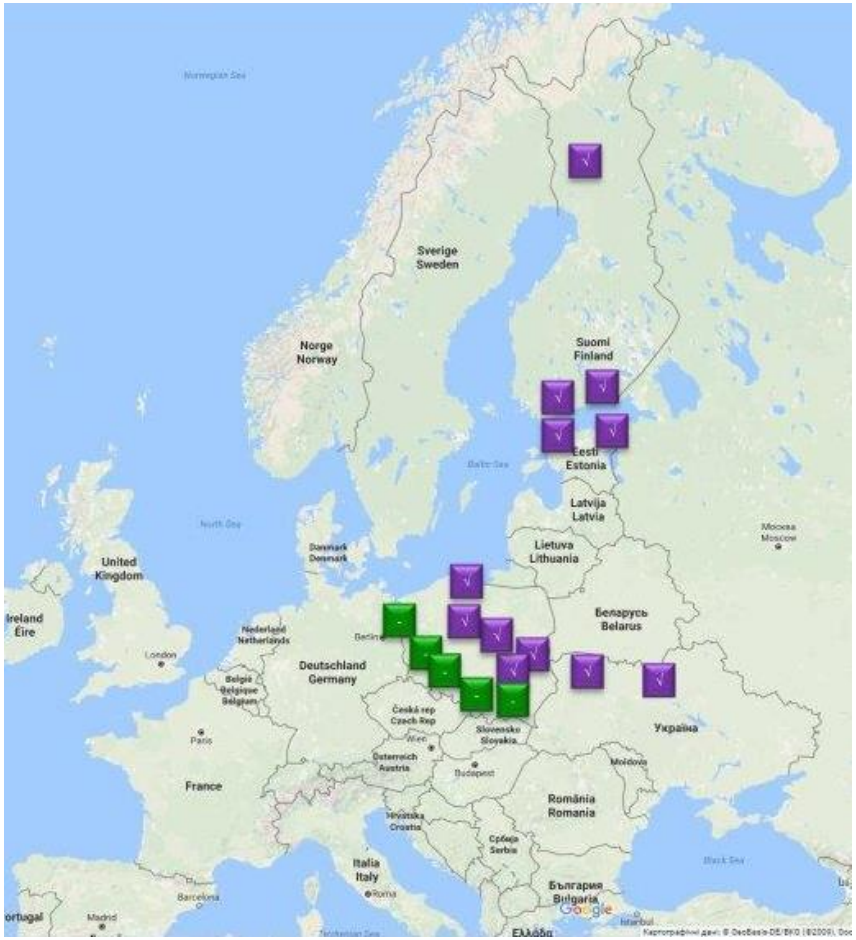
Fukushima Accident in March, 2011



Europe, October 2016



- I-131 detected in the near-surface atmospheric layer.
- 25th October: Norwegian Institute for Energy Technology reported a small leakage of radioactivity from Halden Research Reactor

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Conclusion

- ChEZ is an open area source of radiation with a specific distribution of radionuclides.
- Personnel working in ChEZ is exposed to a potential radiation risk.
- Environmental radiation monitoring is a complicated system involving considerable amount of resources.
- Environmental radiation monitoring is a vital part of radiation safety not only for EZ, but also for the whole country.
- Observing the trends is only one of the many tasks of the environmental radiation monitoring.

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Thank you for your attention!
Questions?

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