

**4th Combined Meeting of the IAEA's Programme on
Environmental Modelling for RAdiation Safety (EMRAS)
IAEA Headquarters, Vienna, 6–10 November 2006**

THEME 1: Radioactive Release Assessment

Working Group 3

**The Chernobyl I-131 release: model validation and assessment of the
countermeasure effectiveness working group**

Paweł Krajewski

(EMRAS Iodine Working Group Leader)



**Centralne Laboratorium Ochrony Radiologicznej
Warszawa
Central Laboratory for Radiological Protection**

EMRAS Iodine Working Group

Background

IWG continues some of the more traditional work of the previous international programmes that have been aimed at increasing confidence in methods and models for the assessment of radiation exposure related to the environmental releases.

the IAEA's Validation of Model Predictions (VAMP)

the IAEA's BIOMOVS

the BIOMOVS II* (Biospheric Model Validation Study)

the IAEA's BIOMASS (BIOsphere Modelling and ASSessment)

terminated in 2001

*** supported by organisations from Canada, Spain and Sweden.**

EMRAS Iodine Working Group

The activities of EMRAS ^{131}I Working Group are targeted primarily at evaluation of the predictive capability of environmental models, notably in relation to the impact of released radioactivity on thyroid exposure via inhalation and ingestion pathways.

EMRAS Iodine Working Group

The IWG activities are focused on several main tasks:

- i) collection of measurement data sets, quality check of input and measurement data and evaluation of appropriate standard scenario for model validation purposes,**
- ii) model runs and comparison of outputs with the independent data sets, once carrying out blind test models calculations (without disclosing observed data)**
- iii) perform evaluation of predictions discrepancies and identification of the most important sources of bias and uncertainty.**

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main targets of IWG

- **check models performance in dose reconstruction in case when ^{137}Cs (^{129}I) tracer is used for estimation of ^{131}I deposition**
- **check models applicability to countermeasure response**

countermeasures

- **administration of stable iodine**
- **limitation of fresh milk consumption**
- **restriction of cows pasturing**

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ADDITIONAL ASPECT OF IWG ACTIVITY

Numerous reports have confirmed an increasing number of cases of thyroid cancer, particularly in the most heavily contaminated regions of Ukraine and Belarus, but also in Russia.

Also, in other countries epidemiological studies have been carried out and adequate measurements data sets of most important environment components are available.

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ADDITIONAL ASPECT OF IWG ACTIVITY

The credible assessment of thyroid doses (including their statistical distribution for critical groups of population) in areas affected by release of radioiodine is gaining the special significance because:

confirmation that special medical aid to the population and measures of social protection is required,

to provide the reliable information to the society or to carry out the accurate epidemiological research.

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MEETINGS

1st Combined Meetings at the Agency Headquarters in Vienna

- **1st IWG Meeting** **1-5 September, 2003**

- **2nd IWG Meeting**

held at the CIEMAT, MADRID, SPAIN, 31 May to 2 June 2004

2nd Combined Meetings at the Agency Headquarters in Vienna

- **3rd IWG Meeting** **8-11 November, 2004**

- **4th IWG Meeting**

**(held at the Headquarters of the National Atomic Energy Agency PAA,
WARSAW, POLAND, 29-31 August 2005)**

3rd Combined Meetings at the Agency Headquarters in Vienna

- **5th IWG Meeting** **21 - 25 November, 2005**

- **6th IWG Meeting**

**(held at National Radiation Protection Institute,
PRAGUE, CZECH REPUBLIC, 6-9 June 2006**

4rd Combined Meetings at the Agency Headquarters in Vienna

- **7th IWG Meeting** **6 - 10 November, 2006**



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MILESTONES

- before 1st EMRAS meeting (1-5 September 2003)



Questionnaire to identify participants of potential working group and to identify suitable data sets and models for testing

9 modellers

10 scenarios proposals

1st Combined Meetings at the Agency Headquarters in Vienna
 ● **1st IWG Meeting** **1–5 September, 2003**

SCENARIO D (draft)

131 I Validation of environmental models
using data from Chernobyl fallout in the Plavsk agricultural area

PLAVSK Scenario (Chernobyl)

Irina Zvonova
Institute of Radiation Hygiene
Federal Scientific Center for Radiation Safety
Moscow, Russia

blind test exercise
(when measurements data remained unknown to participants)

models predictions evaluation
(2nd run, summary)

TESTING AND VALIDATION OF DOSIMETRY MODELS USING DATA FROM CHERNOBYL ¹³¹I FALLOUT IN THE PLAVSK AGRICULTURAL AREA

Intermediate report of ¹³¹I Working Group on the model validation and assessment of the countermeasure effectiveness of the Environmental Modelling for Radiation Safety Programme (EMRAS)

2nd Combined Meetings at the Agency Headquarters in Vienna
 ● **3rd IWG Meeting** **8–11 November, 2004**

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MILESTONES

SCENARIO P *(draft)*

**Validation of environmental models
using data from Chernobyl fallout in the Plavsk
agricultural area**

Irina Zvonova
Institute of Radiation Hygiene
Mira St.8, 197101 St. Petersburg, Russia
E-mail: irvaz@iz10087.spb.edu

**TESTING AND VALIDATION OF DOSIMETRY
MODELS USING DATA FROM CHERNOBYL ¹³¹I
FALLOUT IN THE PLAVSK AGRICULTURAL AREA**

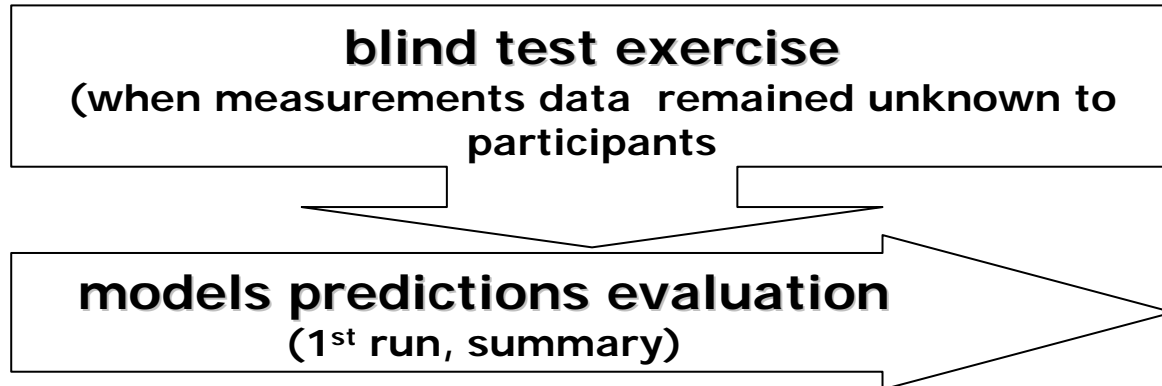
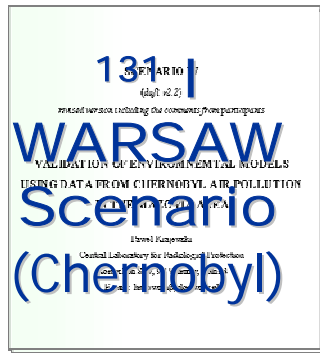
**Intermediate report of ¹³¹I Working Group
on the model validation
and assessment of the countermeasure effectiveness
of the Environmental Modelling for Radiation
Safety Programme (EMRAS)**

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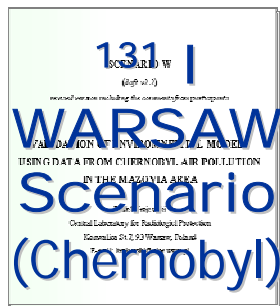
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MILESTONES

2nd Combined Meetings at the Agency Headquarters in Vienna
● 3rd IWG Meeting 8–11 November, 2004



3rd Combined Meetings at the Agency Headquarters in Vienna
● 5th IWG Meeting 21 - 25 November, 2005

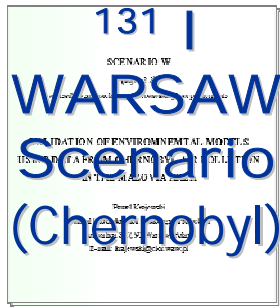


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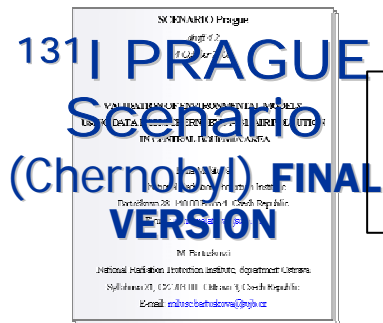
3rd Combined Meetings at the Agency Headquarters in Vienna
 ● **5th IWG Meeting** **21 - 25 November, 2005**



models predictions evaluation
(2nd run, summary)

TESTING AND VALIDATION OF DOSIMETRY MODELS
 USING DATA FROM CHERNOBYL AIR POLLUTION
 IN THE MAZOVIA AREA

2nd Intermediate report of ¹³¹I Working Group on the model validation and assessment of the countermeasure effectiveness of the Environmental Modelling for Radiation Safety Programme (EMRAS)



blind test exercise
(when measurements data remained unknown to participants)

4th Combined Meetings at the Agency Headquarters in Vienna
 ● **7th IWG Meeting** **6 - 10 November, 2006**

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MILESTONES

SCENARIO W

(draft v2.2)

revised version including the comments from participants

**VALIDATION OF ENVIRONMENTAL MODELS
USING DATA FROM CHERNOBYL AIR POLLUTION
IN THE MAZOVIA AREA**

Pawel Krajewski

Central Laboratory for Radiological Protection

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**TESTING AND VALIDATION OF DOSIMETRY MODELS
USING DATA FROM CHERNOBYL AIR POLLUTION
IN THE MAZOVIA AREA**

**2nd Intermediate report of ¹³¹I Working Group on the model
validation and assessment of the countermeasure effectiveness of
the Environmental Modeling for Radiation Safety Programme
(EMRAS)**

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MILESTONES

SCENARIO Prague
draft 4.2
4 October 2006

VALIDATION OF ENVIRONMENTAL MODELS
USING DATA FROM CHERNOBYL I-131 AIR POLLUTION
IN CENTRAL BOHEMIA AREA

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MILESTONES

**All documents are supported by suitable Excel
spreadsheets:**

- **scenarios input data**
- **scenario predictions formularies**
- **evaluations of predictions**

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MILESTONES

**4th Combined Meetings at the Agency Headquarters in Vienna
6 - 10 November, 2006**

- **7th IWG Meeting**

Current activities:

**Final evaluation of WARSAW
Scenario:
full set of predictions
(6 modellers)**

**TESTING AND VALIDATION OF DOSIMETRY MODELS
USING DATA FROM CHERNOBYL AIR POLLUTION
IN THE MAZOVIA AREA**

**2nd Intermediate report of ¹³¹I Working Group on the model
validation and assessment of the countermeasure effectiveness of
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MILESTONES PLANNED

before 5th Combined Meetings at the Agency Headquarters in Vienna
? - ? November, 2007



FINAL REPORT ON PRAGUE SCENARIO

1 2nd run of predictions for Prague, evaluation of results

● 8th IWG Meeting (June in Vienna ???)

1 distribution of the of the draft Report of Prague SCENARIO



DRAFT OF FINAL REPORT ON IWG Activities
full set of 3 Scenarios

(input data, output data, evaluations, recommendations)

5th Combined Meetings at the Agency Headquarters in Vienna
? - ? November, 2007

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Just few examples:

^{131}I | PLAVSK Scenario (Chernobyl)

^{131}I | WARSAW Scenario (Chernobyl)

^{131}I | PRAGUE Scenario (Chernobyl)

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¹³¹I | PLAVSK Scenario (Chernobyl)

The Scenario of the Plavsk agricultural area has provided an excellent opportunity to perform an approximation of ¹³¹I contamination of food-chain and to evaluate thyroid doses for urban and rural population in area on the basis of isotopic ratio ¹³¹I/¹³⁷Cs.

The participants of IWG has been asked to provide uncertainty analysis of thyroid doses when relatively short time of rain during the cloud passage yielded the mixed (dry&wet) and consequently inhomogeneous ¹³⁷Cs deposition and when the time when cows had been put on pasture was not exactly known.

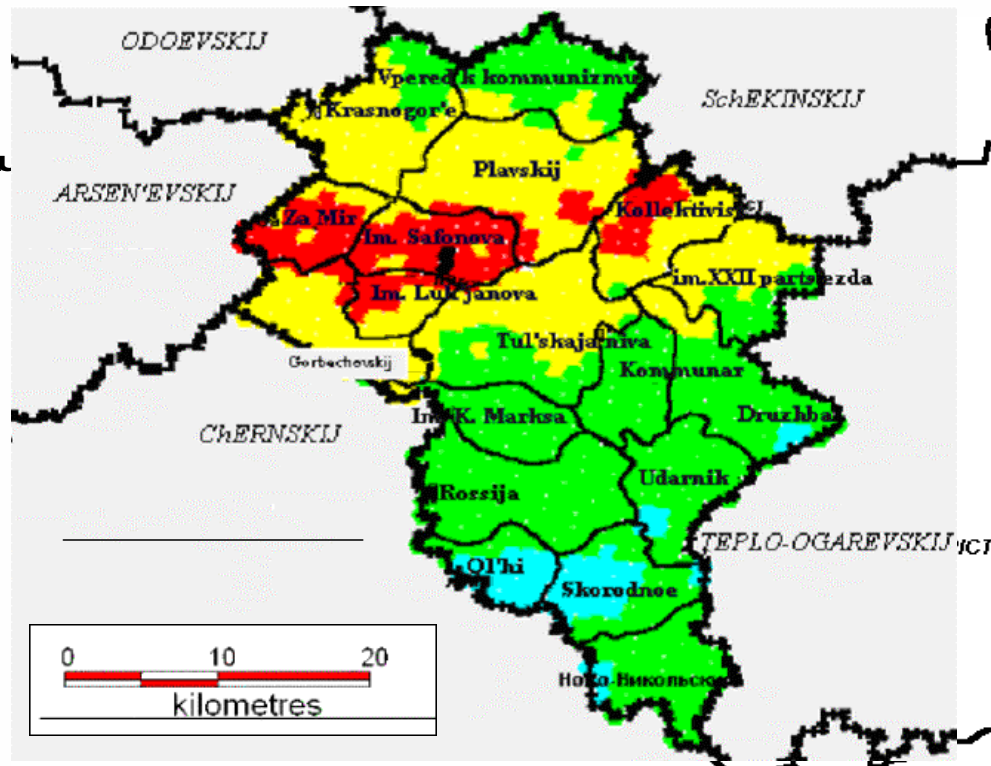
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¹³¹I | **PLAVSK Scenario (Chernobyl)**

40 km width; 60 km high

- 1 Krasnogor'e
- 2 Za Mir
- 3 Im. Safonova
- 4 Plavskij
- 5 Vpered k kommunizmu
- 6 Im. Luk'janova
- 7 Gorbachevskij
- 8 Tul'skaja niva
- 9 Im. K. Marksa
- 10 Rossija
- 11 Kollektivist
- 12 Kommunar
- 13 Druzha
- 14 im.XXII parts'ezda
- 15 Udamik
- 16 Ol'hi
- 17 Skorodnoe
- 18 Novo Nikol'skij



■ >37 kBq/m² ; ■ 37–185 kBq/m²; ■ 185–370 kBq/m²; ■ 370–555 kBq/m²; ■ 555 kBq/m²

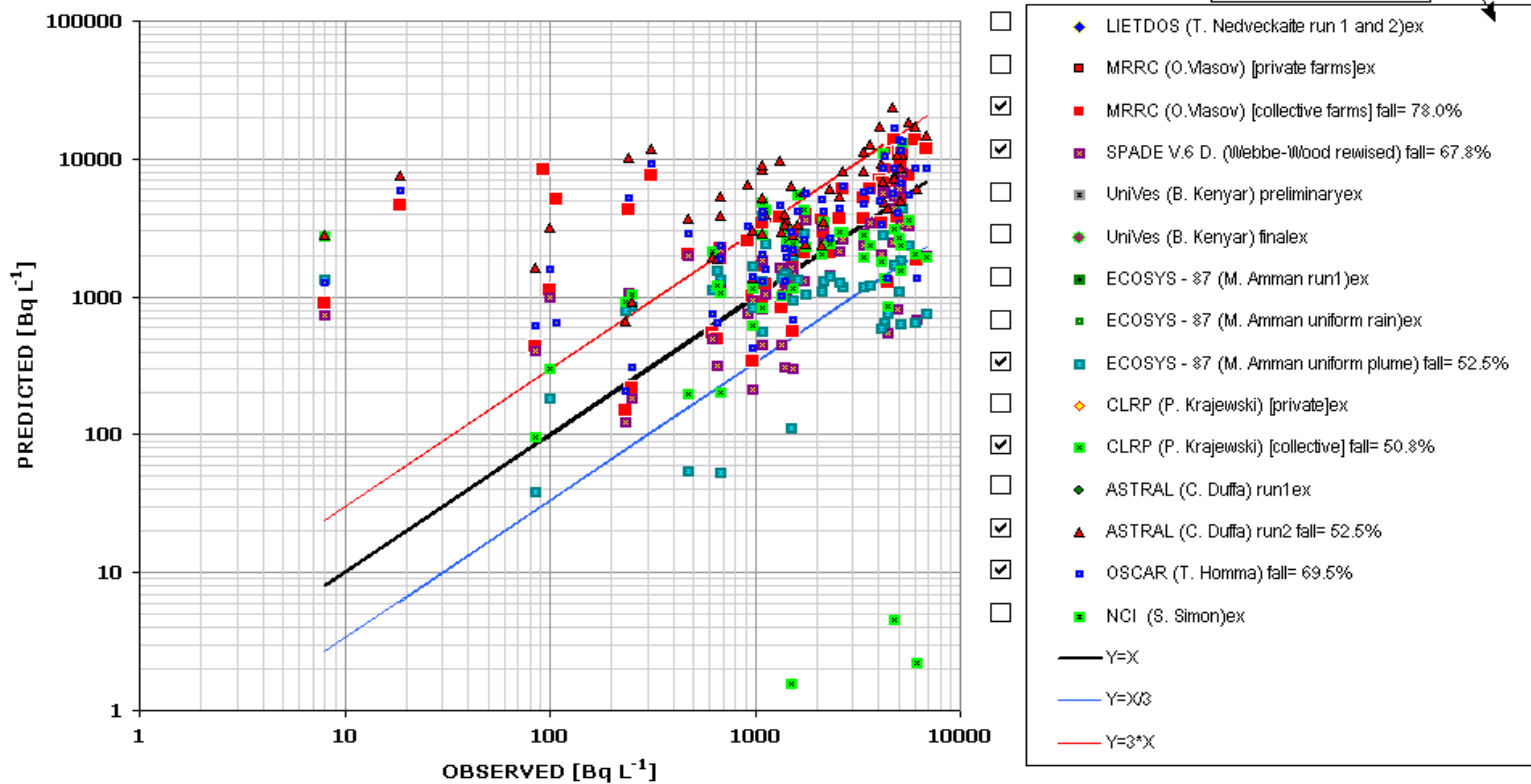
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¹³¹I | PLAVSK Scenario (Chernobyl)

I-131 CONCENTRATION IN MILK (PREDICTED versus OBSERVED)

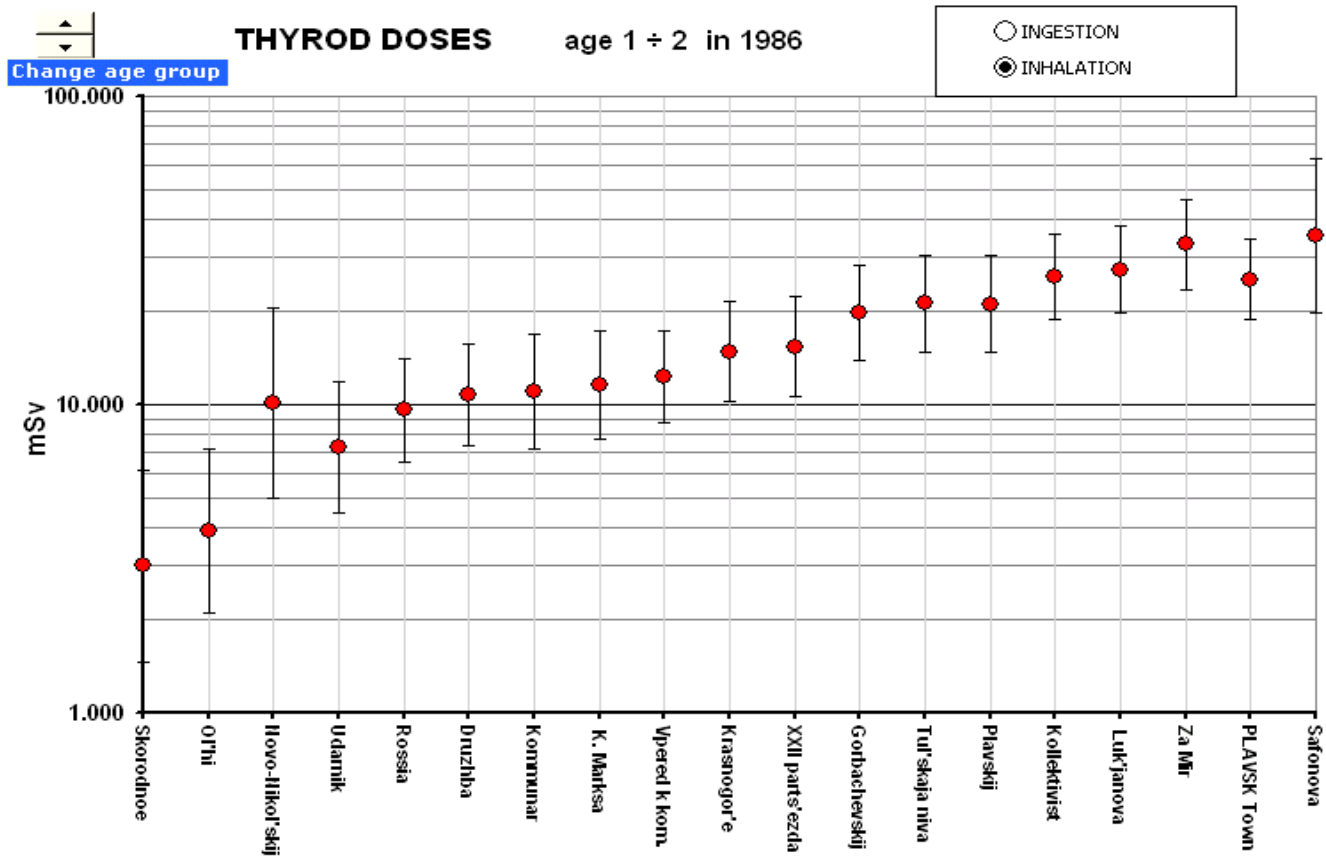
Percentage of predictions that fall in 3*X,X/3 interval



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¹³¹I | PLAVSK Scenario (Chernobyl)



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¹³¹I | PLAVSK Scenario (Chernobyl)

**model of grass interception in a case of mixed (dry&wet)
radioiodine fallout need to be carefully considered.**

**The time when cows have been put on a pasture seems to be the
most important factor of miss predictions of ¹³¹I concentration in milk
and consequently ingestion doses.**

**In general, although IWG was dealing with areas of assessment
modelling for which the capabilities are not yet well established; there is
remarkably improvement in models performance comparing with
previous radioiodine scenarios. Predictions of the various models were
with in a factor of three of the observations, discrepancies between
the estimates of average doses to thyroid produced by most
participant not exceeded a factor of ten.**

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¹³¹I | WARSAW Scenario (Chernobyl)

a versatile assessment of the effectiveness of short-term protective measures that had been applied in the Mazovia province (Poland) in the April 29- 30 to reduce the radioiodine thyroid burden of inhabitants.

These countermeasures included:

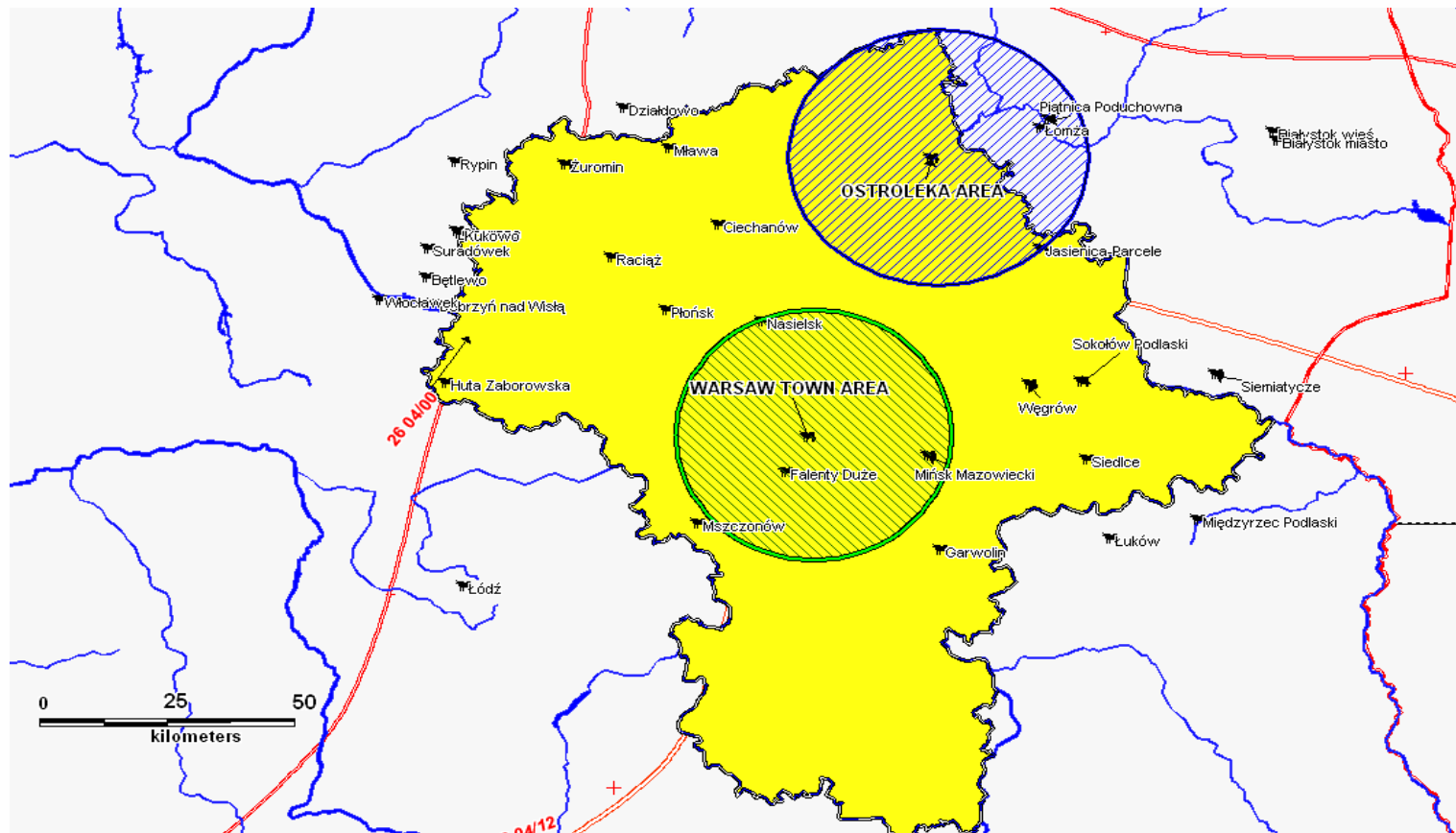
- administration of stable iodine in form of solution
(so called "Lugol liquid") to children and teenagers up to 16 of age,**
- putting grazing animals on stored feed, followed by the banning of
potentially contaminated milk, milk products and leafy vegetables.**

During the time period investigated the result of the such introduced measures was unpredictable.

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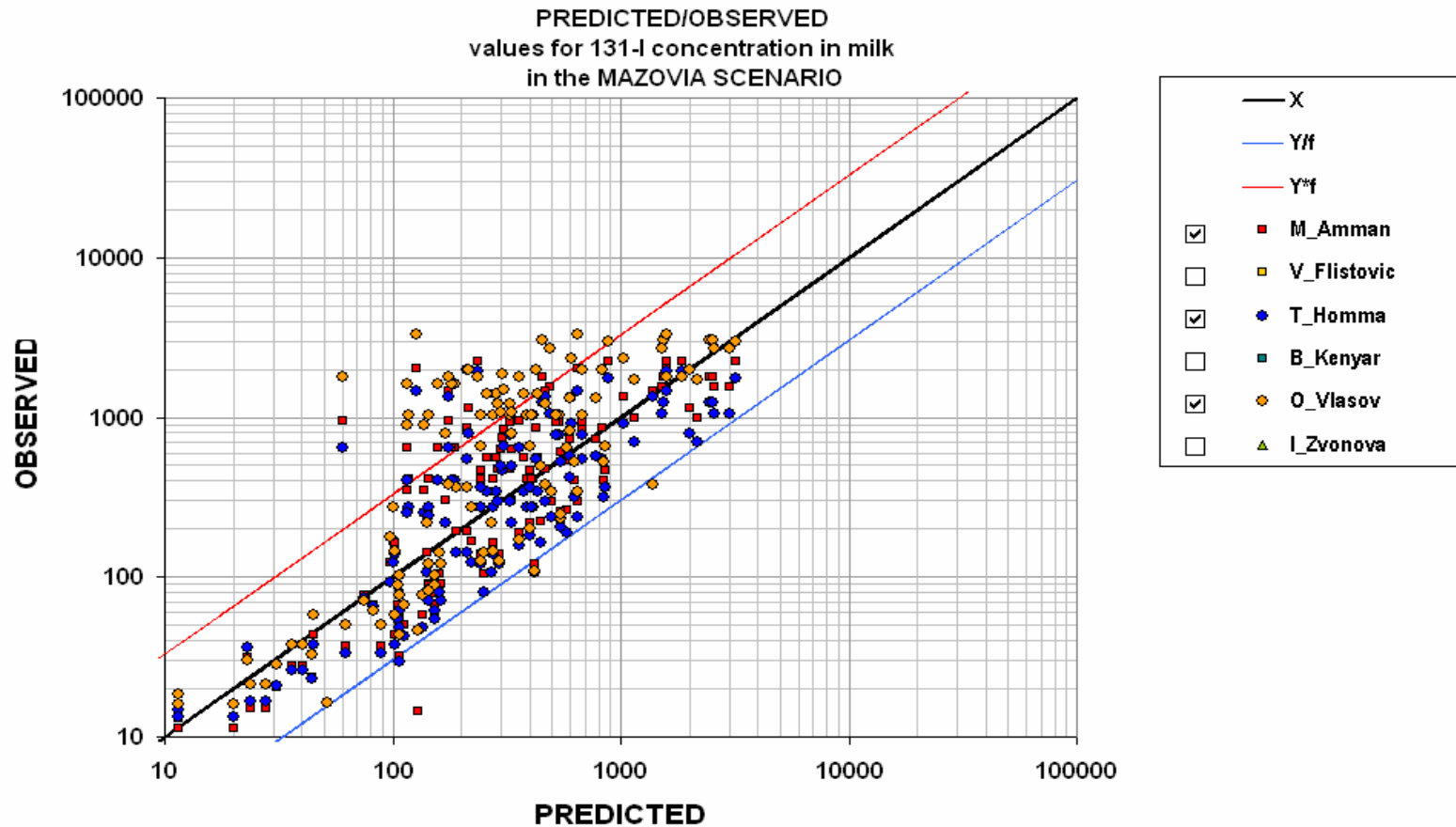
131 | WARSAW Scenario (Chernobyl)



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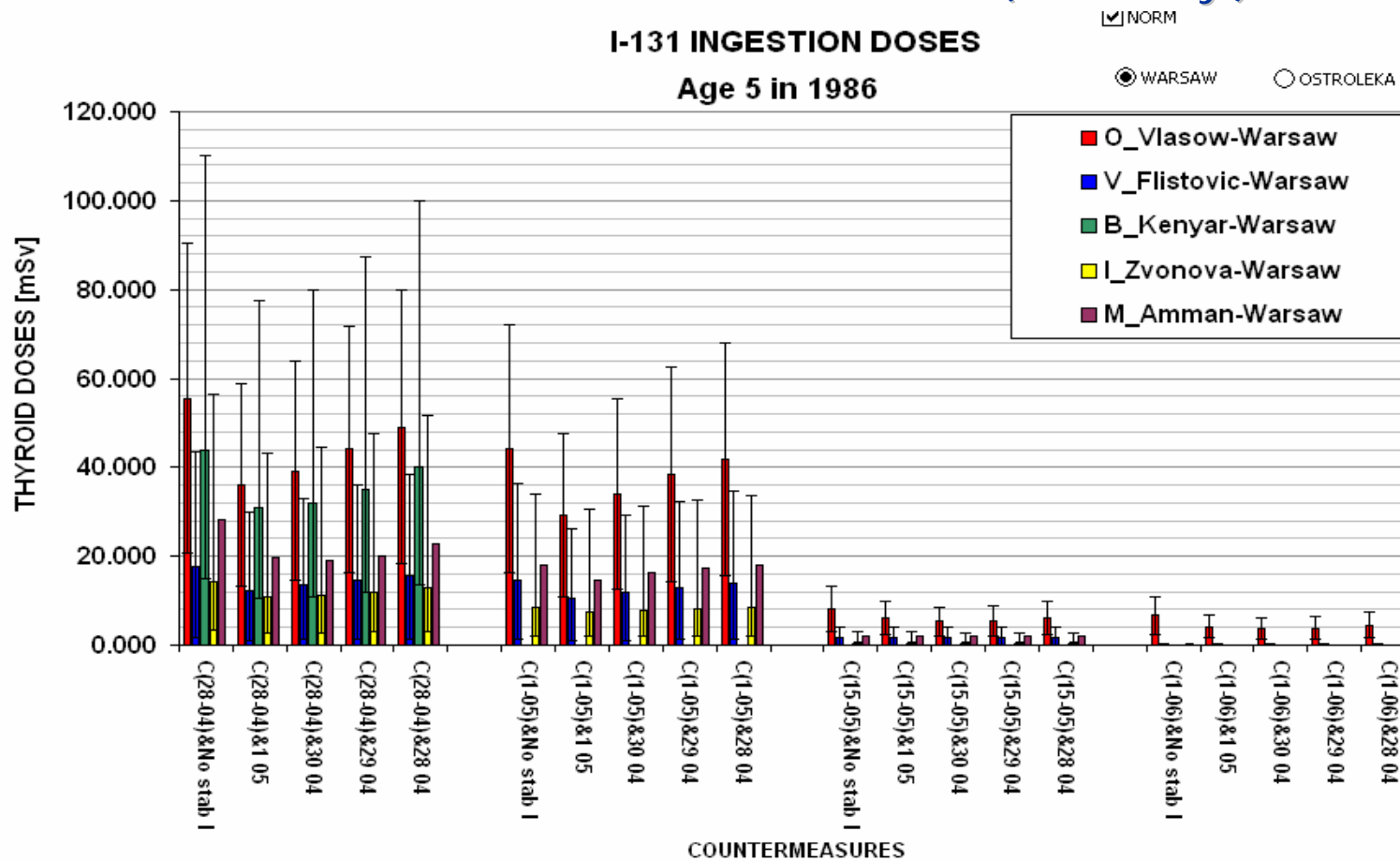
¹³¹I | WARSAW Scenario (Chernobyl)



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131 | **WARSAW Scenario (Chernobyl)**



EMRAS Iodine Working Group

¹³¹I | WARSAW Scenario (Chernobyl)

The participants of IWG has been asked to provide input and sound advice on methodology for evaluation of countermeasures' effectiveness for radioiodine and uncertainty combined with averted dose when several of protective actions are applied. The critical groups of exposure are considered with special attention.

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^{131}I PRAGUE Scenario (Chernobyl)

The third Prague Scenario has been focused on several aspects of the internal ^{131}I dose evaluation in a case when special cow feeding regime is applied.

This regime consists in keeping cows in cowsheds and feeding them by silage mixture.

Irena Malátová

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M. Bartusková

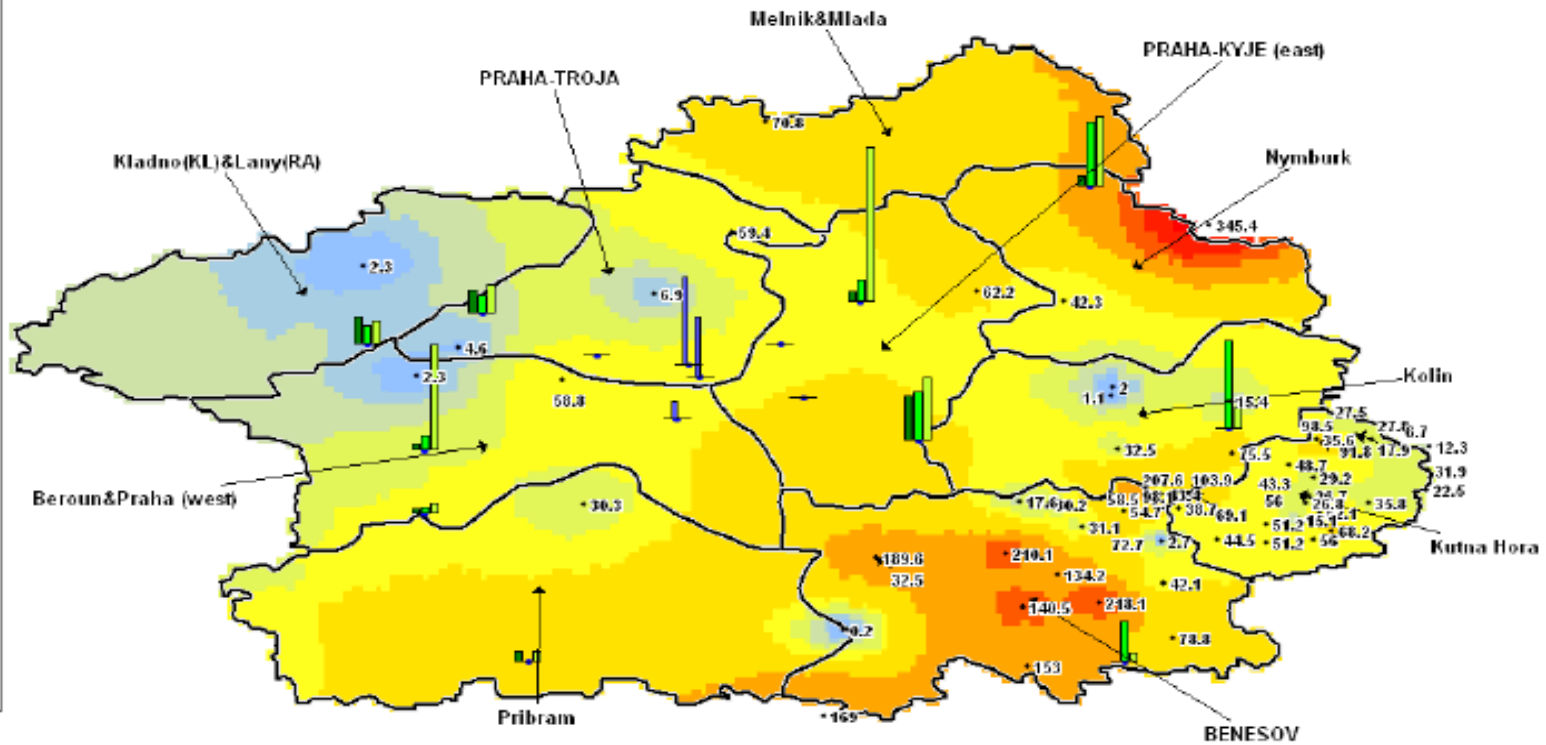
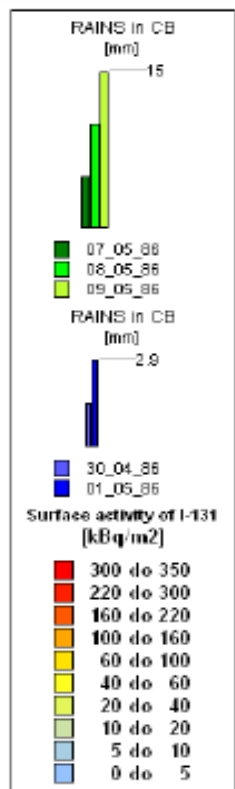
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¹³¹I PRAGUE Scenario (Chernobyl)



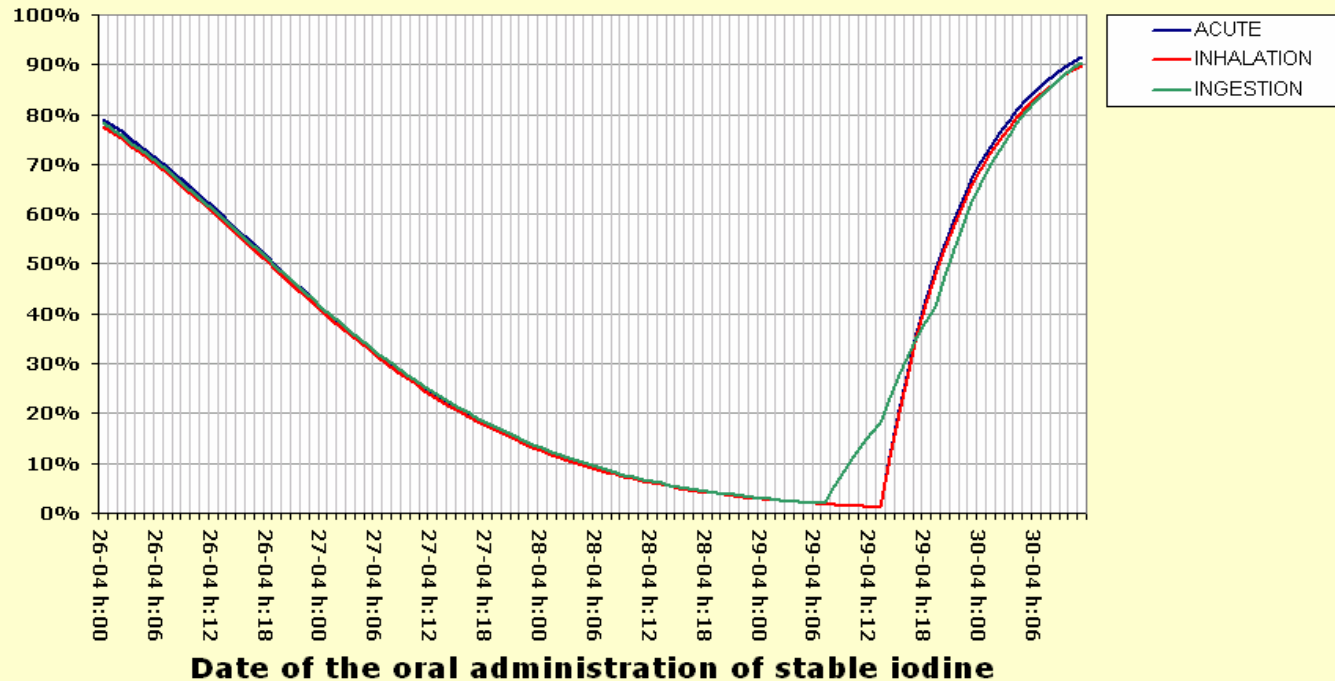
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additional task of IWG

WORKSHEET "THYROID v2.2" (extended!)
SUPPORTED IODINE WORKING GROUP OF EMRAS PROGRAM

Reduction of the Integrated I-131 Thyroid Content
from the oral administration of 60 mg of stable iodine
as a function of time before and after an intake of radioiodine on 29-04 h:12



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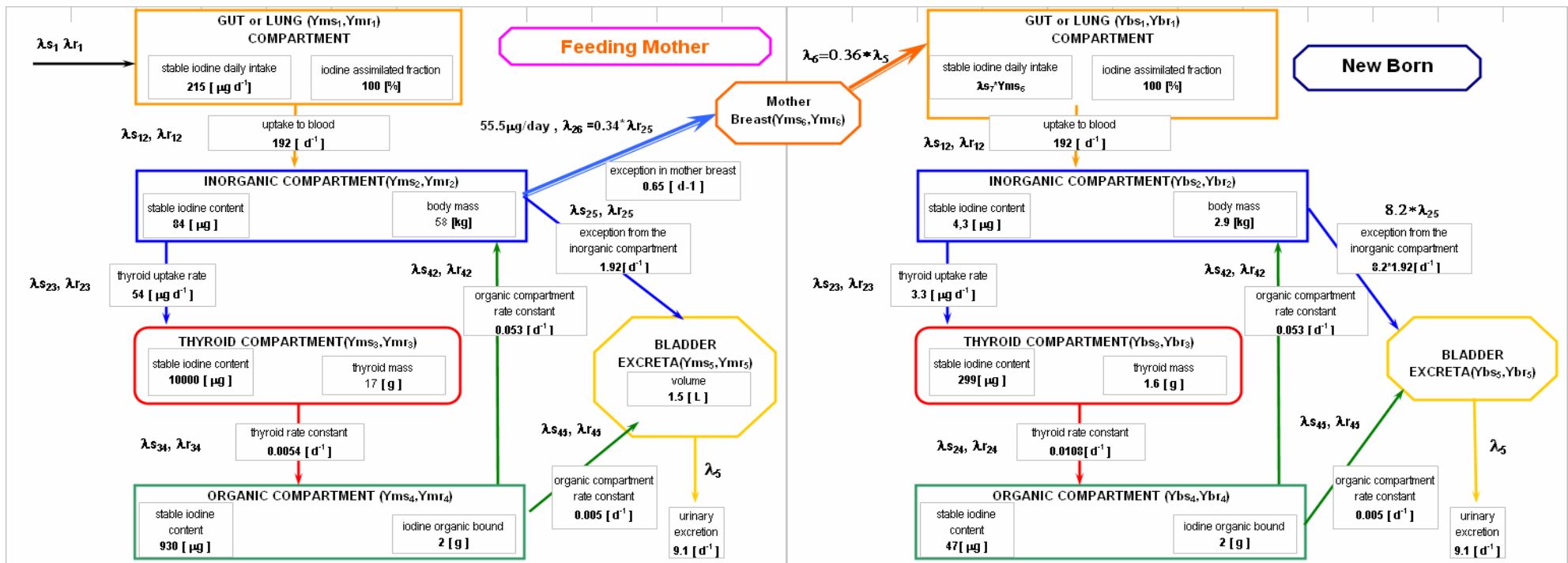
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additional task of IWG

a new born iodine dosimetric model base on:

Johnson, J.R. (1981). Radioiodine Dosimetry. Journal of Radioanalytical Chemistry, 65, 223-238.

proposed and tested by Oleg Vlasov



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Model		Participant Name	Country	Organization
1	LIETDOS	Ms T. Nedveckaite (BIOMASS) PLAVSK, MAZOVIA, PRAGUE	Lithuania	Institute of Physics
2	OSCAAR	Mr T HOMMA (BIOMASS) PLAVSK, MAZOVIA, PRAGUE	Japan	Japan Atomic Energy Agency (JAEA)
3	UniVes	Mr B.Kanyár (BIOMASS) PLAVSK, MAZOVIA, PRAGUE	Hungary	University of Pannonia (former University of Veszprém)
4	CLRP	Mr P. Krajewski (BIOMASS) PLAVSK, MAZOVIA, PRAGUE	Poland	Central Laboratory for Radiological Protection
5	ASTRAL	Ms C. Duffa (New) PLAVSK	France	Institut de Radioprotection et de Sûreté Nucléaire (IRSN)
6	Ecosys-87	Mr M. Ammann (New) PLAVSK, MAZOVIA, PRAGUE	Finland	Radiation & Nuclear Safety Authority (STUK)
7	Plavsk Dose Calculator	Mr S. Simon (New) PLAVSK	USA	National Cancer Institute
8	SPADE V.4.6	Mr D. Webbe-Wood (New) PLAVSK	UK	Food Standard Agency
9	CLIMRAD	O. Vlasov (New) PLAVSK, MAZOVIA, PRAGUE	Russian Federation	Medical Radiological Research Center
10	IRH-model	Irina Zvonova (New) PLAVSK, MAZOVIA, PRAGUE	Russian Federation	Institute of Radiation Hygiene
11	Scenario provider	Irena Malatowa (VAMP) PRAGUE	Czech Republic	National Radiation Protection Institute

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Form B
IAEA-CN-145

Form for Submission of a Paper International Conference on Environmental Radioactivity: From Measurements and Assessments to Regulation

23–27 April 2007, Vienna, Austria

To be sent to the competent official authority (Ministry of Foreign Affairs, national atomic energy authority) for transmission to the International Atomic Energy Agency, Vienna International Centre, Wagramer Strasse 5, P.O. Box 100, A-1400 Vienna, Austria (Telefax No. +43 1 26007)

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Title of the paper: VALIDATION OF DOSIMETRY MODELS AND ASSESSMENT OF THE COUNTERMEASURE EFFECTIVENESS USING DATA FROM CHERNOBYL ¹³¹ I RELEASES		
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4. C. Duffa	INSTITUT DE RADIOPROTECTION ET DE	CADARACHE,
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Mr		
Given name(s) Pawel		

Thanks for your attention

Paweł Krajewski

Most of the IWG documents are on the html analogue of an ftp server:

<http://www-ns.iaea.org/downloads/rw/fileshare/wss/default.asp?lg=a&fd=161>