Joint Summary Report

on Implementation of Annex I - Item 7a) of the Brussels Protocol of 19 November 2001

Working Group on Comparison of Calculations Regarding the Radiological Consequences of BDBA

established according to Item 7 a) of the "Road Map" of the “Brussels Agreement”

Czech State Office for Nuclear Safety

Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management

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1 INTRODUCTION AND OBJECTIVE OF THE JOINT SUMMARY REPORT

The Republic of Austria and the Czech Republic have, using the good offices of Commissioner Verheugen, reached an accord on the “Conclusions of the Melk Process and Follow-up” (hereinafter “Brussels Protocol”) on 29 November 2001.

In Annex 1 to the Brussels Protocol, seven items relating to nuclear safety of NPP Temelín have been formulated with the aim of making possible an effective “trialogue” follow-up in the framework of the bilateral Agreement between the Government of Austria and the Government of the Czech Republic on Issues of Common Interest in the Field of Nuclear Safety and Radiation Protection. Individual items are linked to:

- Specific objectives set in the licensing case for NPP Temelín;
- Description of present status and future actions foreseen by the licensee and SÚJB, respectively.

Each of the seven items is followed according to a work plan agreed at the Annual Meeting organised under the pertinent Czech-Austrian Bilateral Agreement. Besides, a “Road Map” regarding the monitoring on the technical level has been elaborated and agreed upon by the Deputy Prime Minister and Minister of Foreign Affairs of the Czech Republic and the Minister of Agriculture, Forestry, Environment and Water Management of the Republic of Austria on 10 December 2001 as foreseen by the Brussels Protocol.

The “Road Map“ is based on the following principles, among others:

- *The implementation of activities enumerated in Annex I and II of the “Brussels Protocol” will be continued to ensure that comprehensive material is available for the monitoring activities set out in the “Road Map”.*
- *As a general rule the regular annual meetings according to Art. 7(1) of the bilateral Agreement between the Government of Austria and the Government of the Czech Republic on Issues of Common Interest in the Field of Nuclear Safety and Radiation Protection will serve to address questions regarding nuclear safety in general, in particular those issues which – according to Chapter IV of the Conclusions - have been found, due to the nature of the respective topics, suitable to be followed-up in the framework of this Bilateral Agreement.*
- *In addition, specialists’ workshops and topical meetings will take place, organised as additional meetings according to Art. 7(4) of the bilateral Agreement between the Government of Austria and the Government of the Czech Republic on Issues of Common Interest in the Field of Nuclear Safety and Radiation Protection, as set out in the “Road Map”.*

One of the items, item No.7 “Severe Accidents Related Issues”, of Annex I, covers aspects of effective prevention and mitigation of the consequences of beyond design basis accidents (severe accidents).

To foster mutual understanding for the topic, two lines of activities were agreed to be followed within the framework of the bilateral agreement:

a) A Working Group on comparison of calculations regarding the radiological consequences of BDBA with a view to harmonise the basis for emergency preparedness will be established.

b) The exchange of information related to SAMG will include a discussion of the analytical basis as well as of corresponding software and hardware measures.

The "Road Map" specified that a topical meeting would be held in the first half of 2002 regarding Item No.7 "Severe Accidents Related Issues - a)". The objective of this meeting is to establish a Working Group on comparison of calculations regarding the radiological consequences of BDBA (hereinafter "Working Group"), performed by models and codes used in the Czech Republic and in Austria, with a view to harmonising the basis for emergency preparedness. The "Road Map" further specified that the "Regular Bilateral Meeting" scheduled for the 2nd half of 2003 would "*include a presentation and discussion on the results of the Working Group on comparison of calculations regarding the radiological consequences of BDBA (Item 7a)*".

Actually, the first "unscheduled" meeting on the "severe accidents" topic was held in Prague on 6 September 2001. At the meeting, both delegations agreed to establish a Working Group and to organise workshops on comparison of codes for radiological consequences evaluation.

All together the Working Group, after its official establishment, met four times, twice in Vienna and twice in Prague.

The objective of this Joint Summary Report, approved by the Czech and the Austrian side, is to describe and evaluate all the activities of this Working Group, summarising the achievements of each individual step of the agreed work programme based on the conclusions of the four workshops.

Chapter 2 gives an overview of the Working Group activities. Chapter 3 summarises the main features of the computer codes and models of both sides used in the Working Group for assessing the radiological consequences of BDBA.

A more detailed overview of the content and the results of the Working Group's programme, which was divided into three steps, is presented in Chapters 4 to 6. Chapter 7 provides an overview of the emergency procedures to be applied in case of radiological accidents in both countries.

The concluding statement in Chapter 8 summarises the main conclusions of the activities of the Working Group regarding Item No.7a) and gives an outlook on future co-operation envisaged in the area of emergency preparedness within the framework of the bilateral agreement and new arrangement between the State Office for Nuclear Safety and the Federal Ministry of Agriculture and Forestry, Environment and Water Management, Radiation Protection Division (concluded on 10 March 2004) with a view to harmonise the basis for emergency preparedness in both countries.

2 OVERVIEW ON WORKING GROUP ACTIVITIES

According to an agreed working programme elaborated at the first topical meeting in Vienna in May 2002 for implementation of Item 7a) of the “Road Map” of the Brussels Protocol, three further Working Group (WG) workshops were organised. Presentations were given by both sides, clarifications and in-depth discussions followed each topic. Both delegations provided transparencies and background information in hard copy, on CDs and by a common information platform (CIRCA) developed under the European Commission IDA programme.

In the last WG workshop in October 2003, the WG considered its activities within STEPs I-III to be closed successfully. Summarising the WG activities, the WG agreed that the co-operation of Czech and Austrian experts in assessing the radiological consequences of BDBA was very effective and useful for both sides. Both sides expressed their strong belief that this bilateral co-operation which started so successfully would continue in the future.

First Topical WG Meeting in Vienna, May 14-15th, 2002

In the first topical WG meeting in Vienna, 14-15 May 2002, presentations of models for dispersion and dose calculations (computer codes) in the Czech Republic and in Austria were given and an agreement between the delegations was reached on a draft work programme of model comparisons, as well as a provisional timetable for the next steps of the WG (see Annex A1).
Three subgroups were established with the purpose of running the models as agreed in the work programme and to interpret and summarise the results of the comparisons:

- Subgroup 1 with the task of “Benchmarking for radiological consequences”
- Subgroup 2 for “Real-time meteorological long-distance modelling” and
- Subgroup 3 focusing on “Food chain” aspects

Austria suggested setting up a common information platform (CIRCA) developed under the European Commission IDA programme, with access limited to a defined group of persons to exchange information and documents. The delegations agreed to make use of this tool.

WG Programme

The main objective for the WG activities according to the Temelín “Road Map“ Item 7a) was the comparison of calculations regarding the radiological consequences of BDBA performed by different models and codes used in the Czech Republic and in Austria with a view to harmonise the basis for emergency preparedness. A draft work programme for realising this objective was set up in the first topical WG meeting (see also Annex A1).

In STEP I - "*Benchmarking for Radiological Consequences,*" four tasks of subgroup 1 were formulated:

- STEP I.1: Code inter-comparison for scenarios with an UK source term (Report NRPB-M152, 1988) and German meteorology as suggested by the Czech side with the following computer codes: COSYMA (Czech Republic and Austria), RTARC and ESTE (Czech Republic)
- STEP I.2: Code inter-comparison for scenarios with a source term prepared by the ARCS Seibersdorf research (ARCS) for WWER 1000 with simple deterministic calculations for a range of meteorological and release scenarios with the computer codes COSYMA (Czech Republic and Austria), RTARC and ESTE (Czech Republic)
- STEP I.3: Comparison of existing dispersion calculations which were made for the licensing of Temelín NPP by the models HERALD and HAVAR for one or more emission scenarios and different meteorological conditions used in the Temelín Safety Analysis Report with calculations performed by COSYMA.
- STEP I.4: Comparison of "worst case" meteorological conditions

STEP II - "*Real-time Meteorological Long-distance Modelling*" was divided in two main activities:

- STEP II.a – *Comparison of Real-time Meteorological Long-distance Modelling*: Comparisons of dispersion calculations performed with the operative models of the meteorological services of both countries, the Czech Hydrometeorological Institute (CHMI) and the Austrian Central Institute for Meteorology and Geophysics (ZAMG), was planned. This exercise replaced the originally envisaged STEP II.a, to join the ENSEMBLE exercises within the 5th Research Framework Programme of the EC.
- STEP II.b - *Realistic Case Studies (real-time and/or a-posteriori)*: Comparison of results of calculations used codes: ESTE, PTM, TAMOS, FLEXPART, OECOSYS for two selected weather situations, which would transport radionuclides from a hypothetical release at Temelín NPP into the Czech Republic and into Austria. Calculations of volume concentration, deposition, food stuff contamination, doses (partly including ingestion) and averted doses were planned. Not all models had to produce all endpoints, but concentrations and depositions were the minimal requirements for all models.

In STEP III - "*Food Chain - Case Studies*" - a comparison of the codes routinely used by Czech and Austrian sides for calculations of food chain contamination and discussion of criteria for counter measures implementation, especially for long-term counter measures, was planned.

WG Meeting in Prague, September 10-11th, 2002

A comparison of calculations performed in the framework of STEP I.1 and STEP I.2 was presented and differences in the results were analysed. Information on parameters and definitions used by ESTE and RTARC was supplied by the Czech side. Extensive comparisons of the models HERALD (older code) and HAVAR (newer code) as used for design and licensing purposes with PC-COSYMA according to STEP I.3

were presented by the Czech side. Additional background publications on these models were made available.

Apart from the discussion of dose factors, which had been deferred to STEP III, all tasks of STEPs I.1, I.2 and I.3 were finalised.

Concerning STEP II.a, CHMI and ZAMG presented information on comparisons of dispersion calculations with their operative models - an exercise which replaced the envisaged STEP II.a, as the CHMI model domain does not permit participation in the ENSEMBLE exercise. The representative of CHMI indicated, however, that they consider participating in any ENSEMBLE exercises which have source sites within the domain covered by their dispersion model.

The Austrian side presented "worst case" scenarios regarding meteorological conditions (STEP I.4). The practicality of the use of "worst case" conditions for calculations was discussed. It was agreed that the Austrian side would continue with these calculations and put the results on the CIRCA information platform. Additionally, it was agreed that the Austrian side might come back to this item at an appropriate moment, depending on the results of other “Road Map“ events.

Regarding the realistic case studies of STEP II.b, it was agreed to choose a source term from the RODOS library and to use the weather situations of STEP II.a. It was planned to fix all basic assumptions, boundary conditions and intended results, and make them available via CIRCA information platform before the inter-comparison exercise. The following models participated in the exercise: TAMOS, OECOSYS, FLEXPART, PC COSYMA, RTARC/PTM, RODOS/MATCH, HAVAR, ESTE.

The WG took note of the presentations of the Czech and Austrian participants on emergency management (see Annex A10). Taking these presentations into account, it was agreed that in STEP III - "*Food Chain*" – sub-group 3 will focus on the activities of comparison with dose codes routinely used by both sides.

The minutes of the WG meeting and its attachments can be found in Annex A2.

On November 8, 2002, an unscheduled meeting was held in Prague. At the meeting, a more detailed programme of STEP II.b activities was developed, and subsequently in December 2002, the Source Term 2 of scenario 2 from the RODOS library was approved by both sides as the input for Realistic Case Studies performed within STEP II.b (see Annexes A6).

WG Meeting in Vienna, April 28-29th, 2003

The discussion of dose-risk factors related to STEP I.3 was addressed in the item “Food Chain" of the agenda of this WG meeting. The Austrian participants presented results of the "worst case" calculations as agreed in STEP I.4 via the CIRCA information platform. It was agreed that the Austrian side might come back to this item at an appropriate moment depending on the results of other “Road Map“ events. The WG considered STEP I to be closed.

Final results of the comparison of real-time emergency response models with two case studies in the framework of the co-operation of ZAMG and CHMI were presented according to STEP II.a (see Annex A7).

In the framework of STEP II.b - "Realistic Case Studies" - different codes performed dispersion and dose calculations based on realistic meteorological cases with historical input data (prognostic or diagnostic data). The results of the calculations were presented and a comparison was made by both sides. Geographical information and several model parameters were exchanged and also agreed upon prior to the workshop.

The results of TAMOS and FLEXPART calculations and a comparison of FLEXPART and PC-COSYMA calculations were presented by the Austrian participants. The Czech representatives compared the long-range models RODOS/MATCH and RTARC/PTM, and the Austrian side used the PC-COSYMA code for comparison, too.

To sum up, in-depth discussion of the findings of the calculation comparisons within STEP II.b lead to a principal understanding of the differences of the Austrian and the Czech results. However, the results both sides obtained with PC COSYMA are in very good agreement. Apart from a joint summary note of conclusions of the STEP II.b exercise after the workshop, the WG considered STEP II to be closed.

Within STEP-III food chain aspects and counter measures were discussed. The Austrian side presented parameters and assumptions of the OECOSYS code for food chain calculations and the Czech side of the HAVAR code. The results for the ingestion dose calculated at the points of comparison (according to STEP II.b) and suggested counter measures on the basis of the results of STEP II.b dose calculation were summarised and discussed by the WG. In addition, the regulatory basis for urgent protective measures and precautionary protective measures was briefly summarised.

As a result of this workshop, the Austrian side was convinced to implement a computer code taking into account local weather conditions - beside the long- range computer code (TAMOS) already in use - for improving emergency management in Austria. Therefore, Austria asked the Czech Republic to supply Austria with the weather data from the NPP site and to transmit to Austria preliminary estimates of the release data based on the ESTE system. It was agreed to address this issue in the framework of the bilateral agreement. It was further agreed to test this new arrangement in the framework of joint exercises.

Finally, it was agreed to elaborate a joint summary of the entire item 7a attaching a full documentation of all important contributions and presentations after closing STEP III. In Annex A3, the Minutes of the Workshop can be found. Annexes A5, A7-A9 of this report contain the important WG workshop presentations.

Joint Presentation at the International Symposium on Off-Site Nuclear Emergency Management, Salzburg, 29th September - 3rd October 2003

As agreed in the WG meeting in Vienna, April 28-29th, 2003, a joint presentation of the main results of the "Road Map" 7a activities was prepared and presented at the International Symposium on Off-Site Nuclear Emergency Management, Salzburg, 29th September - 3rd October 2003. An extended abstract of this presentation can be found in Annex A11 of this report. The conference paper will be published in the proceedings of the Salzburg Symposium in a special volume on "Radiation Protection Dosimetry" in 2004.

WG Meeting in Prague, October 9, 2003

In a common review of the process, both sides underlined the fruitful co-operation of the Working Group, both during the presentations and discussions of the results at the workshop and in the phase of performing calculations and preparing results for comparison before the workshop. The Czech side appreciated the installation of a common information platform, CIRCA, provided by Austria in June 2002. Both sides considered this platform a very fruitful and effective tool and therefore intended to use it for future co-operation and exchange of views. Both sides agreed on a table of contents for a Joint Summary Report and a time schedule for the finalisation of this report (see also Annex A4).

Within the framework of STEP-III, food chain aspects and counter-measures were discussed. Both sides presented elaborate calculations based on an agreed working programme for comparison of calculated doses and suggested protective counter-measures. The WG considered its activities within STEPs I-III to be closed successfully.

The Czech representatives presented information on the development of new tools for SÚJB for decisions regarding counter-measures. Both sides exchanged information on the current status and further developments of their Radiation Monitoring Networks.

Regarding future co-operation, both sides agreed that in terms of a planned Bilateral Arrangement on data and information exchange in case of a radiation accident, the following data are expected to be exchanged:

- Actual weather conditions at the point of radionuclide release,
- Radionuclide air concentration and deposition forecasts based on weather models obtained by both parties,
- Forecasts of the course of the accident and its potential radiological consequences based on actual weather data and calculations from ESTE, HAVAR and other codes used by the Czech competent authority (in the future to be transmitted to the Austrian competent authority),
- Forecasts of radiological consequences based on prognostic weather predictions and calculations from TAMOS, OECOSYS and other codes used by the Austrian competent authority (in the future to be transmitted to the Czech competent authority),
- Territory and food chain monitoring results obtained by the Radiation Monitoring Networks of both parties.

The Bilateral Arrangement between State Office for Nuclear Safety and Federal Ministry of Agriculture and Forestry, Environment and Water Management, Radiation Protection Division on data exchange concluded on 10 March 2004 is attached (see Annex A12).

According to the presentation and discussion at the Panel Session of the International Symposium on "Off-site Nuclear Emergency Management" held in Salzburg, 29th September - 3rd October 2003, the Czech-Austrian bilateral co-operation together with the bilateral co-operation with other countries could be the basis for a regional co-operation in emergency preparedness in Central Europe. The EURANOS project of the EU 6th Research Framework Programme provides a pragmatic opportunity to find out how such co-operation would function. It is assumed that the RODOS system will gradually become a quasi-standard used to assess the potential radiological consequences, and to inform the decision-making process. During the EURANOS project, therefore, the various mechanisms for the data exchange can be tested and evaluated. Based on these regional activities both sides proposed to intensify regional co-operation demonstrating its feasibility by using RODOS as an infrastructure.

Annual Bilateral Meetings on Issues of Common Interest in the Field of Nuclear Safety and Radiation Protection, 2002 and 2003

During both bilateral meetings under the Agreement between the Government of the Republic of Austria and the Government of the Czech Republic on issues of common interest in the field of nuclear safety and radiation protection, 2002 and 2003, an overview on the activities of the "Road Map" 7a) Working Group on comparison of calculations regarding the radiological consequences of BDBA was presented.

3 OVERVIEW OF CODES AND MODELS INVOLVED

Following computer codes and models were involved in activities of the Working Group:

On the part of Austria:

- TAMOS
- FLEXPART (Version 4.0 and 5.0)
- OECOSYS
- PC-COSYMA / COSYMA Main Frame

On the part of the Czech Republic:

- HAVAR
- HERALD
- RTARC
- RODOS-MATCH
- PTM
- ESTE
- PC COSYMA

In the following, a short overview of the used models and computer codes is given.

TAMOS emergency response model

Main developer of the TAMOS emergency response modelling system is the Austrian Central Institute of Meteorology and Geodynamics (ZAMG) (Pechinger et al, 2001). TAMOS includes a trajectory model (FLEXTRA) and a long-range dispersion calculations model FLEXPART Version 2.0 (Stohl et al, 1998). The TAMOS system is used for real-time prognoses for nuclear and radiological emergencies. FLEXPART is a Lagrangian particle diffusion model.

As input data forecasts of the European Centre for Medium-Range Weather Forecasts (ECMWF) are used. At ZAMG, the ECMWF-forecasts are operationally available for the domain of Europe with a horizontal resolution of 1 degree (i.e. approximately 125 km NS, 71 km EW) and on 36 model levels up to 12 km height. The forecasts (up to 84 hours in steps of 6 hours) are operationally updated once a day. Based on this meteorological input FLEXPART calculates air concentrations and depositions (dry and wet) for several radionuclides. FLEXPART also takes into account the radioactive decay. The TAMOS system is installed at ZAMG and at the Div. for Radiation Protection, BMLFUW.

FLEXPART Versions 4.0 and 5.0 (Flexible Particle Dispersion Model)

FLEXPART has been developed and updated by the Austrian Institute of Meteorology and Physics of the University of Agriculture and the Technical University of Munich by A. Stohl and others (Stohl et al, 1998). FLEXPART 4.0 and 5.0 are updated versions of the FLEXPART model used as a long-range dispersion model in the Austrian TAMOS emergency response system. The versions differ in details of turbulence parameterisation, backward calculation capabilities etc. FLEXPART is used by the Austrian Institute of Meteorology and Physics of the University of Agriculture, ZAMG, and other institutions.

OECOSYS-System

OECOSYS is based on the German ECOSYS system developed by the German GSF and updated several times (Mueck et al, 1992). Concerning models and parameters, the latest ECOSYS Excel version 1.4 is practically identical with the FDMT module of the RODOS system. Different ECOSYS versions have been adapted by ARCS Seibersdorf research to the Austrian specific radio-ecological situation. Three radio-ecological regions have been defined with different plant growth and harvest dates. Among other factors, the feeding behaviour of animals for food production and the average Austrian consumption rates for various foodstuffs have been customised. Based on input parameters characterising the contamination of the environment (TAMOS results or measurements), OECOSYS determines different dose types resulting from all relevant pathways of exposure after a radiological accident (cloud shine, ground shine, inhalation, ingestion and skin contamination). The most complex modelling, for which many radio-ecological parameters and assumptions are necessary, is the modelling of the ingestion dose and the contamination of feeding and foodstuff.

OECOSYS based on ECOSYS for Excel Versions 1.2 and 1.4 are used by the ARCS Seibersdorf research and the Div. for Radiation Protection of BMLFUW for radiological and dose assessments and planning of emergency response in case of nuclear and radiological emergencies.

PC-COSYMA

A code for assessing radiological impact of nuclear emergencies (time-integrated concentration in air, ground contamination, short-term doses, long-term doses from different pathways, morbidity, mortality and impact of counter measures), COSYMA was developed with partial support from the EC Radiation Protection Research Programme (see Jones et al, 1995). The code system was principally developed by FZK (Germany) and NRPB (UK) but with significant inputs from a number of other contractors within the EC-MARIA (Methods for Assessing the Radiological Impact of Accidents) research programme. The first version of the system was released in 1993; a revised and extended version is available.

PC-COSYMA can be used for deterministic or probabilistic assessments. Deterministic assessments give detailed results for a release in a single set of atmospheric conditions. Probabilistic assessments take account of the full range of atmospheric conditions that may be experienced and their respective frequencies of occurrence.

COSYMA Main Frame Version

COSYMA Main Frame is very similar to PC-COSYMA but provides a higher flexibility concerning the model input and output and has integrated a long-range dispersion module. The FORTRAN source code is available. The COSYMA main frame version runs on Unix computers. However, PC-COSYMA is more user-friendly because the Main Frame Version of COSYMA has no graphical user interface.

ESTE

ESTE ETE (NPP Temelín) and ESTE EDU (NPP Dukovany) codes are implemented at SÚJB and serve as basic support instruments for the emergency staff in case of a nuclear incident and accident. The code can be used on-line in automatic mode if it is connected to the source of necessary data or can be operated manually by the user without need of on-line connection to data source. The code can be used as training instrument for emergency response staff. The code identifies symptoms of initiating events, such as "coolant release to the containment", "release from primary to secondary circuit", "release to service water or intermediate circuits". The code identifies symptoms of coolant boiling, of the core uncovering and core damage. The main aim of the code in the pre-release phase is to predict (more or less conservatively expected) release to the atmosphere (projected source term) and to generate maps and tables with predicted avertable doses in the vicinity of the plant. The main aim of the code in the release phase is to estimate the real release into the atmosphere, to estimate the time of the beginning of the real release and to answer the question whether the release continues or is interrupted. Impacts of real release to the environment are continually assessed and displayed on the maps. The movement of the plumes in the vicinity of the plant is continually simulated. Air concentrations and depositions are calculated (in current version of the code) by a segmented Gaussian plume model. Trajectories of plumes consist of a series of straight line segments. It allows for hourly changes (in case of prediction of impacts) or for 15 minutes changes (in case of assessment of actual current impacts) of meteorological conditions. The model assumes that meteorological conditions (actual or predicted) at the plant represent conditions of the whole region in the vicinity of the plant. Prediction of meteorological conditions for the next 24 h is taken from meteorological prognosis. Impacts are calculated (in current version of the code) up to the distance of 40 km. ESTE code is developed by ABmerit Engineering Services, Trnava.

RTARC

RTARC is Real Time Accident Release Consequences Code. It uses the Gaussian plume dispersion model. The recommended area of use is near range (up to 40 km). A conservative approach is used in RTARC, which means that doses are calculated from the concentrations on the height of the plume axis. The code allows a prediction of the radiation situation. Predefined source terms based on accident scenarios are implemented in RTARC. The code allows an assessment and representation of zones for receipt of protective actions. RTARC is developed by VUJE Trnava. Code RTARC has been used in the licensing process of Temelín and Dukovany NPP as a tool for emergency zone planning evaluation and determination. A version of RTARC for the Dukovany NPP is implemented and used by SUJB (RTARC 4.5 GIS).

PTM

Model PTM stands for Puff Trajectory Model. PTM is a Lagrangian dispersion model. The model uses a numerical method of finite differences for vertical diffusion description. Lateral diffusion is modelled by sigma parameter of Gifford. The model allows a calculation of up to 100 nuclides of the reactor inventory. It is part of the RTARC system developed and used by VUJE, Trnava, for the modeling of dispersion for medium and long distances.

RODOS-MATCH

RODOS stands for real-time online decision support system. It is a European system for decision support in emergency situations after release from a nuclear facility. It allows for local/ regional /national/ European scales of calculations. It allows all types of counter-measures. RODOS has two operational modes: interactive and automatic. Model MATCH is part of Long Range Model Chain of the RODOS system. MATCH stands for Mesoscale Atmospheric Transport and Chemistry modelling system – the nuclear emergency version of the SMHI model. MATCH is a Eulerian dispersion model, initiated with a particle model. Output data from MATCH have only graphical form and WMO GRID format files. MATCH allows calculation for only 5 nuclides (Cs-137, Ba-140, I-131, Xe-133, Kr-85) and inert gases. The RODOS system is implemented in an off-line version and used by SUJB.

HAVAR

Code HAVAR is an off-line analytical instrument and has been used for impacts assessments analyses in Temelín NPP safety reports. It allows an interactive mode of operation. It uses the Gaussian model of plume dispersion. HAVAR allows for the use of the segmented Gaussian plume model or semi-box model that makes it possible to apply various formulas for plume rise. It allows for analyses of terrain roughness and usage factors in case of doses from food chains. Contamination of terrestrial food chains is assessed by the concentration factor method. It allows dynamical modelling of food chain transfer. User and developer of the HAVAR code is NRI Rez – Division Energoprojekt Praha, and Mr. Petr Pecha.

HERALD

HERALD is an updated version of an older mainframe computer code for calculation of doses from airborne releases for design purposes and safety assessment studies. Code HERALD is an off-line analytical instrument and has been used for impact assessment analyses in Temelín NPP safety reports. It uses the Gaussian model of plume dispersion combined with a box model. HERALD allows the application of various dispersion coefficient formulas. It makes possible very extensive calculation of decay series. The code implements its original model for calculations of dry deposition velocities as a function of terrain roughness and stability of atmosphere. It allows for analyses of influence of aerosol size spectrum on dry deposition velocities. It allows applying correction for removal of soil contamination by natural processes. The code uses the concentration factor method for assessment of dose from terrestrial food chains. User and developer of the HERALD code is Škoda Plzeň.

4 STEP I - COMPARISON FOR SHORT- TO MEDIUM-RANGE TRANSPORTS

Assumptions and Description of Calculations for STEP I.1 and I.2

STEPS I.1 - I.2 were defined in the working programme elaborated at the first topical meeting in May 14-15, 2002 in Vienna. The objective for STEP I.1 and I.2 activities was to exchange information on different short- to medium-range models and codes and to enhance mutual understanding for these issues. Therefore, it was planned to

- perform calculations for a large number of different situations with as many of the models as possible (Czech Republic: RTARC, PC COSYMA, ESTE (ZDC), Austria: PC COSYMA),
- to exchange information concerning the nature of the models/codes, model parameters, etc.,
- jointly discuss the results of the comparative calculations with an identification of the causes for possible differences.

For the comparison of calculations in STEP I.1, the Czech experts prepared four deterministic meteorological scenarios and one probabilistic meteorological scenario covering a basic set of meteorological conditions. The source term given by the Czech experts was taken from a severe accident scenario developed within a study for UK source term (Report NRPB-M152, 1988).

For STEP I.2, Austrian experts proposed different deterministic scenarios with a larger variability in the meteorological conditions, including non-stationary precipitation and different release parameters.

Results and Conclusions for STEP I.1 and I.2

The calculations performed in the framework of Step I.1 and Step I.2 were presented and discussed in the WG meeting in Prague, September 2002. Additionally, detailed background information on the models PC-COSYMA, RTARC and ESTE was exchanged.

The WG meeting in Prague in September 2002 showed that PC-COSYMA calculations performed by both sides were practically identical. The ESTE (formerly ZDC) results are within one order of magnitude of PC-COSYMA results. Differences arising are mainly due to source height differences. The model RTARC shows greater differences of a more complex nature (higher as well as lower values). One of the reasons is the assumption of significantly different wash-out rates.

Assumptions and Description of Calculations for STEP I.3

In STEP I.3, extensive comparisons of the models HERALD (older code) and HAVAR (newer code) which have been used for design and licensing purposes with PC-COSYMA were planned.

Results and Conclusions for STEP I.3

The results of STEP I.3 were presented by the Czech representatives at the WG meeting in Prague, September 2002. Despite of considerable differences in calculated air volume concentrations and depositions of HAVAR, HERALD and PC-COSYMA, the resulting doses were similar. These differences were discussed and found to be partly due to different parameter choices in the models and partly due to specific input data requirements and options in the models.

Assumptions and Description of Calculations for STEP I.4

According to STEP I.4 of the working programme, "worst case" calculations regarding meteorological conditions were performed by Austrian experts.

Results and Conclusions for STEP I.4

Austrian experts presented “worst case” calculations at the WG meeting in Prague, September 2002. The practicality of the use of these "worst cases" was discussed, and the Czech representatives explained that results of such "worst case" calculations would not show remarkable differences compared to those calculations already made in STEP I.1 and STEP I.2. It was agreed that Austria should continue these calculations and present the results on the CIRCA information platform. Additionally, it was agreed that Austria might come back to this item at an appropriate moment depending on the results of other “Road Map“ events.

5 STEP II METEOROLOGICAL LONG-DISTANCE MODELLING

5.1 STEP II.a - Comparison of Long-Range Transport and Dispersion Models

Assumptions and Description of Calculations

In the framework of the WG on "Comparisons of Calculations Regarding the Radiological Consequences of BDBA", Step II.a "Real-time long-distance modelling" experts from the Czech Hydrometeorological Institute (CHMI) and the Austrian Central Institute of Meteorology and Geodynamics (ZAMG) inter-compared their operational emergency response model results for nuclear accidents. Both institutions use state of the art dispersion and meteorological models. CHMI uses the Eulerian dispersion model (MEDIA), fed by the meteorological forecasting model ALADIN; ZAMG runs the Lagrangian particle dispersion model FLEXPART linked with the ECMWF meteorological forecasting model.

Two case studies for two historical dates were performed. Time-integrated concentration fields and total deposition fields following the WMO guidelines were compared.

Results and Conclusions

The final results of the comparison of real-time emergency response models with two case studies in the framework of the co-operation of ZAMG and CHMI were presented according to STEP II a at the WG meeting in Vienna, April 2003. The main conclusion was that taking into account the differences in the dispersion model types (Eulerian model MEDIA versus Lagrangian model FLEXPART) and the differences in meteorological input for the dispersion calculation (ALADIN versus ECMWF), the results of both models - CHMI and ZAMG - were largely similar. Both codes produce similar concentration and deposition patterns of the same order of magnitude. This is very good correspondence with regard to the experienced differences within the international model inter-comparison exercises of the EC-ENSEMBLE project (see Annex A7).

5.2 STEP II.b Realistic Case Studies

Assumptions and Description of Calculations

Within the framework of STEP II.b, *"Realistic Case Studies,"* different codes performed dispersion and dose calculations based on realistic meteorological cases with historical input data (prognostic or diagnostic data - see Step II.a). The objective of STEP II.b was to compare weather modelling, radionuclide air concentrations, ground deposition and foodstuff contamination in real time and/or posterior in the relevant part of Europe following a hypothetical accident at the location of the Temelín NPP. The calculations were made on the basis of a wide range of models and real cases of weather situations. As input for the calculations, it was agreed to choose an accident scenario and the corresponding release parameters from the RODOS source term database (Savushkin, et al, 1998) (see Annex A6).

The following geographical and other model parameters and assumptions were exchanged and agreed upon:

- Common calculations of the relevant radiological parameters for two sites/points within the Czech territory and two sites/points on the Austrian territory, including the comparison of radiation protection measures (disaster response measures, precautionary protection measures and measures in the field of agriculture and nutrition) to be applied in those locations by the Czech and Austrian parties in case of a real emergency,
- Dose codes routinely used by the Czech (COSYMA, ESTE, RTARC/PTM, HAVAR) and Austrian (TAMOS, OECOSYS, FLEXPART) parties to calculate the food chain contamination,
- Methodology of comparison.

Results and Conclusions

Differences in the results of TAMOS and FLEXPART and long range models RODOS/MATCH and RTARC/PTM calculations, presented by both side, are mainly due to differences in the dispersion model performance as well as in the chosen input/output grid.

It should be emphasised that even in this more complex STEP II.b exercise, the results obtained by both sides with PC-COSYMA are in very good agreement, as was the case in previous STEPs.

An important conclusion of the model/code comparison is that the advantage of Euler models (such as RODOS-MATCH) lies in a relatively precise determination of contaminated areas, whereas the advantage of Lagrangian models (TAMOS, FLEXPART, RTARC/PTM etc.) lies in a relatively reliable estimation of dosimetric quantities.

According to the main conclusions of the Workshop in Vienna, in April 2003, the in-depth discussion of the findings of the calculation comparisons within STEP-II.b lead to a principal understanding of the differences of Austrian and Czech results. Different meteorological input data (prognostic data from ECMWF and ALADIN and diagnostic data from the Temelín meteorological station) are considered to be the main source of differences in the results of the dispersion and dose calculations.

6 STEP III FOOD CHAIN

Under STEP III, food chain aspects and counter-measures after a nuclear and radiological emergency were discussed in two WG meetings in Vienna, April 2003, and in Prague, October 2003.

Assumptions and Description of Calculations of STEP III Presented in Vienna, April 2003

STEP III activities within the WG meeting in Vienna, April 2003, used the input of STEP II.b results for two meteorological scenarios and compared the ingestion doses at the four comparison sites as (already) agreed in STEP II.b.

The following codes and models were involved in the inter-comparison calculations: OECOSYS (Austria), PC-COSYMA, ESTE and HAVAR (Czech Republic).

Results and Conclusions of STEP III Presented in Vienna, April 2003

Owing to the different meteorological input data (historical forecasts of ECMWF, ALADIN and diagnostic historical wind fields from the NPP site), some of the results of the dispersion calculations using different codes and models at the four chosen points (see STEP II.b) deviated considerably, as already stated in Chapter 5.2. This fact was also reflected in the results for doses, different pathways, in the food chain results and the counter measures necessary to mitigate consequences of the hypothetical accident at the four points used for comparison. Therefore, the WG considered the different meteorological input data of crucial influence on activity and dose calculations.

In order to compare only the codes and models for the calculation of doses (focusing on ingestion doses and avertable dose) and the proposed counter measures without the impact of different dispersion calculation results, the development of a general work programme for dose comparison by both sides was proposed. According to this working programme, the Austrian side selected meteorological input data (with and without precipitation) for one out of the four comparison points for the dose comparison, including the calculation of averted dose and counter measures for food stuff (using intervention levels recommended by EURATOM) before the next WG meeting.

Assumptions and Description of Calculations of STEP III Presented in Prague, October 2003

As agreed in the WG meeting in Vienna, April 2003, assumptions for dose assessment comparison exercise within STEP III had been fixed prior to the Working Group meeting in Prague, October 2003. The PC-COSYMA results from the meteorological dispersion calculations of STEP II.b were used as a common starting point.

The main objective of STEP III was a comparison of dose assessment tools for all pathways including ingestion and food chain, starting from pre-defined dispersion calculation results, as well as a comparison of precautionary and protective counter-measures including evaluation of averted dose by implementing the counter-measures. The following codes and models were involved: OECOSYS (Austria), PC-COSYMA and ESTE (Czech Republic).

Results and Conclusions of STEP III Presented in Prague, October 2003

Both sides presented their calculations performed according to the agreed work programme and compared calculated doses and proposed precautionary and protective counter-measures. The in-depth discussion of the findings of comparison calculations led to principal understanding of Austrian and Czech results. The results for different doses determined by OECOSYS and PC-COSYMA at the points of comparison maximally deviated by one order of magnitude, even if ingestion doses were considered. The deviation in the results is caused by different parameters assumed in the dose assessment (such as location factors, food consumption rates, etc.).

7 EMERGENCY PROCEDURES

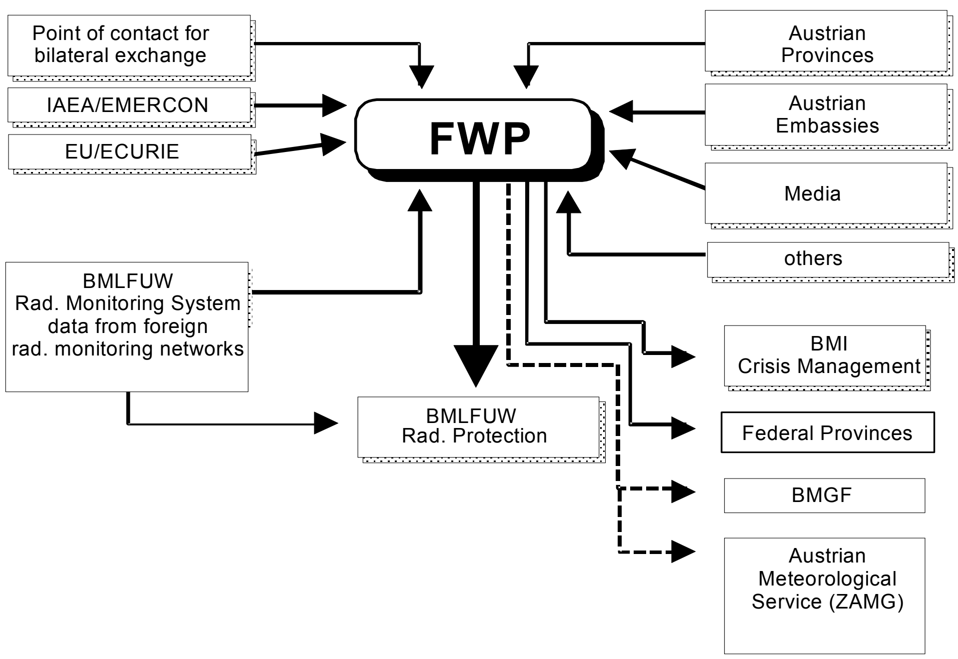
7.1 Emergency Procedures in Austria

7.1.1 Organisational Aspects

Austrian institutions and their responsibilities in the field of radiation protection are listed in the following:

- Federal Ministry for Agriculture, Forestry, Environment and Water Management (BMLFUW) – Div. for Radiation Protection: General aspects of radiation protection and emergency preparedness
- Federal Ministry for Health and Women (BMGF) – Division for Radiation Protection: Radiation protection in the field of medicine, food monitoring and preparations for potassium-iodine blocking
- Federal Ministry for Interior (BMI) – Federal Crisis Management: Co-ordination function in a crisis
- Federal Ministry for Interior – Federal Warning Point (FWP): National and international contact point (24h), information distribution.
- Federal Provinces: Responsible for implementation of precautionary and protective counter measures
- Other Federal Ministries: Responsible for specific radiation protection aspects

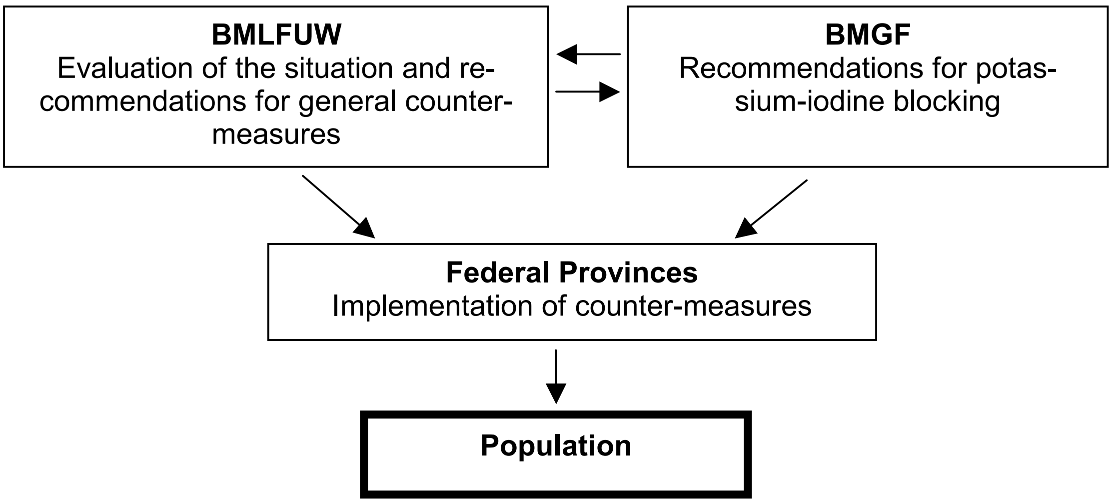
The following figure provides an overview of the information pathways for international notification and institutions involved:



7.1.2 Legislative Basis

The Austrian Radiation Protection Act, amended in 2002 (Rad. Protection Act, 2002), is the legislative basis for the large-scale environmental radiation monitoring in Austria by BMLFUW, including the Austrian Early Warning System and the laboratory-based surveillance network. Based on the Austrian Radiation Protection Act, BMGF has the responsibility for large-scale radiation monitoring of foodstuffs. Furthermore, according to the Austrian Radiation Protection Act, the BMLFUW has to operate a decision support system and has to recommend precautionary and protective measures during a radiological large-scale emergency. The implementation of the counter-measures is administered by the Austrian Federal Provinces.

The implementation of counter measures is presented in the following figure:



The basis for the intervention criteria for precautionary and protective measures is the Austrian "Guidelines for Implementation of Protective Measures in Case of Large-Scale Radioactive Contamination" (Rahmenempfehlungen, 1992). The criteria for iodine blocking have been adjusted in the meantime in accordance with the recommendations of the WHO of 1999.

7.1.3 Criteria for Evaluation of the Radiological Situation and Implementation of Counter-Measures

According to international criteria, the safety significance of radiation events and its consequences are evaluated. Among others, the INES scale (IAEA, 2001) and the classification according to the EMERCON User Manuals (IAEA, 2002) are applied.

In compliance with the Austrian "Guidelines for Implementation of Protective Measures in Case of Large-Scale Radioactive Contamination" (Rahmenempfehlungen, 1992), the potential radiological consequences of an event for the Austrian population are classified in five levels according to the yearly potential dose:

- Level 0 with a potential dose < 0.5 mSv
- Level I with a potential dose 0.5 to 2.5 mSv
- Level II with a potential dose 2.5 to 25 mSv
- Level III with a potential dose 25 to 250 mSv
- Level IV with a potential dose > 250 mSv

For each level, different precautionary and protective measures are recommended. The Austrian emergency procedures (Annex A11) give an example of countermeasures. As mentioned above, the criteria for iodine blocking have been adjusted in the meantime in accordance with the recommendations of the WHO of 1999. Concerning precautionary and protective measures for foodstuffs and feedstuffs, the intervention criteria in Austria are in compliance with the EURATOM Directives of the EC (87/3954/EURATOM, 89/2218/EURATOM, 90/770/EURATOM). The most important pre-planned urgent counter-measure is the storage of iodine tablets in public nursery schools, schools, and pharmacies.

7.1.4 Systems for Evaluation of the Radiological Situation

According to the Radiation Protection Act, the BMLFUW is responsible for evaluating the situation in case of a large-scale radiation accident. Apart from the information exchanged bilaterally with the neighbouring countries and international institutions (such as ECurie of the EC or Emergency Response Center of the IAEA), the evaluation of potential consequences of radiation emergencies is based on two main systems:

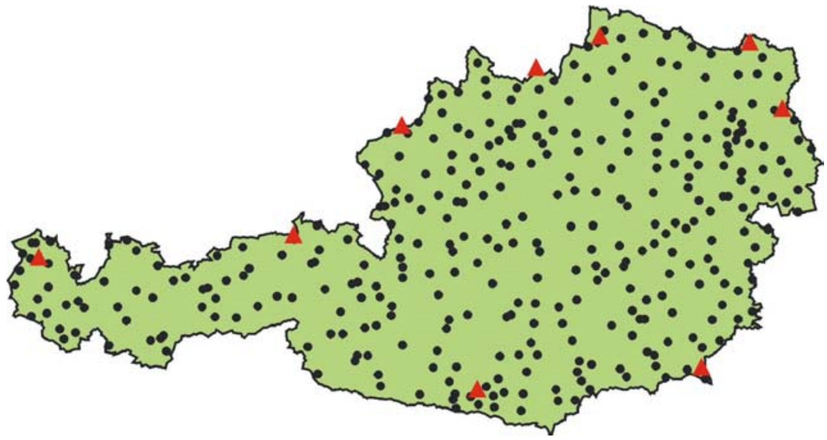
<u>The Austrian Radiation Monitoring System and the Laboratory-Based Surveillance Network:</u>

The Austrian Radiation Monitoring System integrates different systems:

- Austrian Gamma Dose Rate Monitoring System with 336 gamma probes
- Austrian Air Monitoring System with 9 automatic air monitors in Austria and 3 in neighbouring countries
- Real-time data from the bilateral data exchange with the neighbouring countries
- Data from the European EURDEP data base

The activities of the Austrian Laboratory-Based Surveillance Network involve routine monitoring of different environmental media and foodstuff. In emergency situations, the procedures are predefined according to a measurement and sampling plan for radiation emergencies.

The following figure shows the different measurement sites of the Austrian Radiation Monitoring System:



●...gamma dose rate probes, Δ….air monitoring stations

Prognostic and Decision Support Systems

The following prognostic systems are used by BMLFUW for evaluating the radiological situation:

- TAMOS (Teil-Automatisches-Wetter-Erfassungs-System Model System)
- OECOSYS

Both systems were involved in the comparison exercises of the Temelín „Road Map“ 7a) Working Group. In Chapter 3 of this report, a short overview on these systems is given.

Two decision support systems, ESTE and RODOS (Real On-line Decision Support System for Off-Site Emergency Management), are currently implemented at BMLFUW. Both will start with the (trial) operation in 2004. ESTE is described in Chapter 3 of this report. With the implementation of RODOS and ESTE, an intensified data exchange between the decision support systems in different countries will be possible. RODOS will integrate TAMOS and OECOSYS systems.

7.2 Emergency Procedures in the Czech Republic

7.2.1 Legislative Basis

The Act on Crisis Management (Act No. 240/2000 Coll.), the Act on Integrated Rescue System (Act No. 229/2000 Coll.), and implementing regulations are the general basis for crisis management in the Czech Republic.

The Atomic Act (Act No. 18/1997 Coll., as amended) and its implementing regulations provide the legal basis for licensee operating NPPs and for the State Office for Nuclear Safety as Regulatory Authority responsible for the state supervision of nuclear safety, radiation protection, physical protection and emergency preparedness.

7.2.2 Organisational Aspects

In the Czech Republic, emergency preparedness and crisis management in case of radiation accidents are part of the governmental system of emergency preparedness and crisis management.

The Czech Republic´s institutions and their responsibilities in the field of emergency preparedness for radiation accidents are listed in the following:

A) General

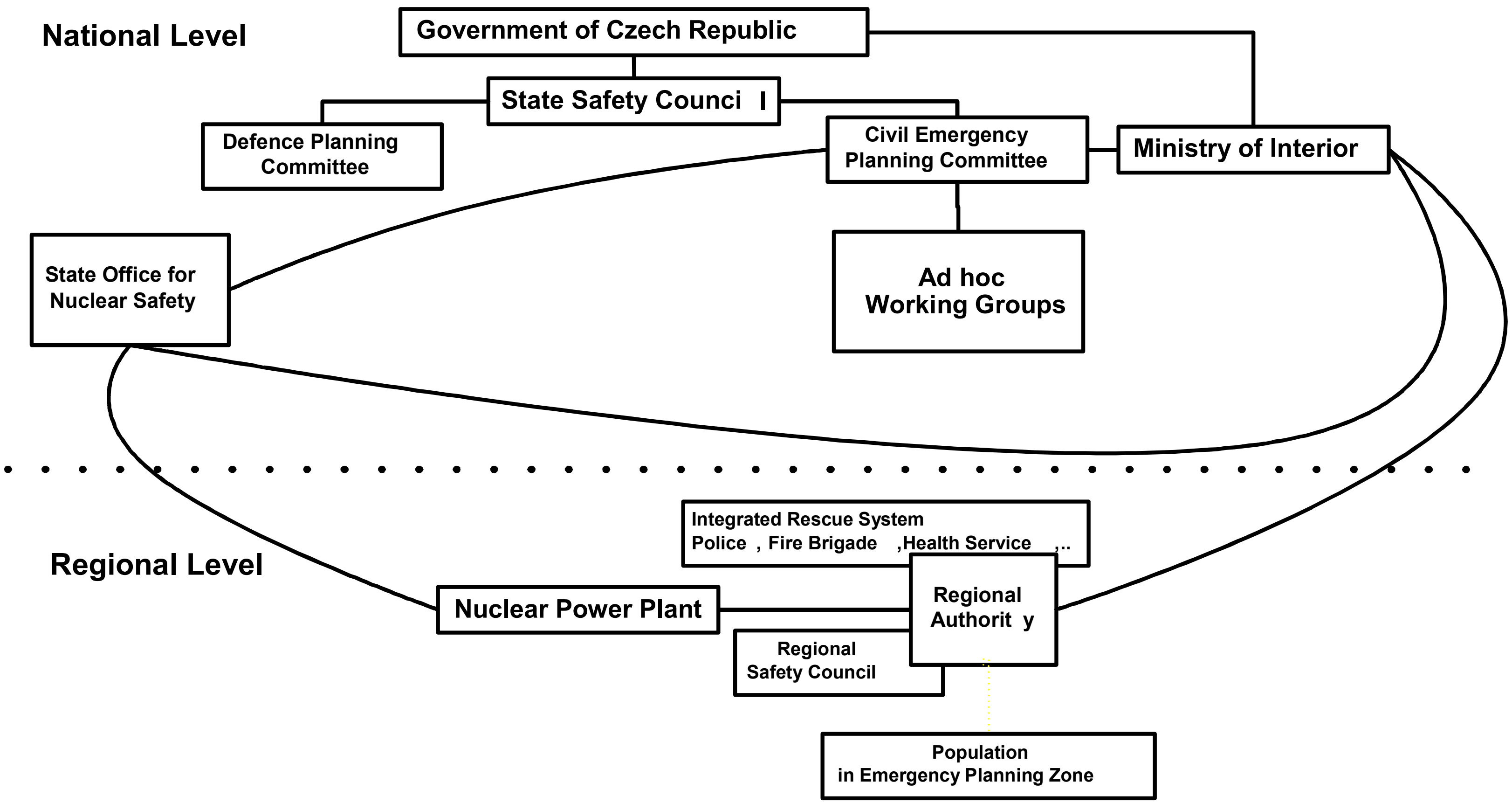
- Government
  - ➢ State Safety Council
    - o co-ordination and central management of all type of crisis situations
- Ministry of Interior – General Directorate of Fire Rescue Brigade
  - ➢ Central Crisis Staff/Civil Emergency Planning Committee – composed of representatives of all ministries and institutions responsible for planning, preparedness and management of crisis situations
  - ➢ Integrated Rescue System
    - o co-ordination of planning, preparedness and management of all non-war crisis situations by governmental and resort plans
- Local (regional) Authorities
  - ➢ Regional Safety Councils
  - ➢ Regional part of Integrated Rescue System
  - ➢ Regional Crisis Staff
    - o co-ordination of planning, preparedness and management of regional-scale crisis situations according to regional plans (and off-site emergency plan if NPP is operating in given region)
    - o responsibility for implementation of counter-measures adopted to protect people during emergency situation

B) Specific to the radiation accident:

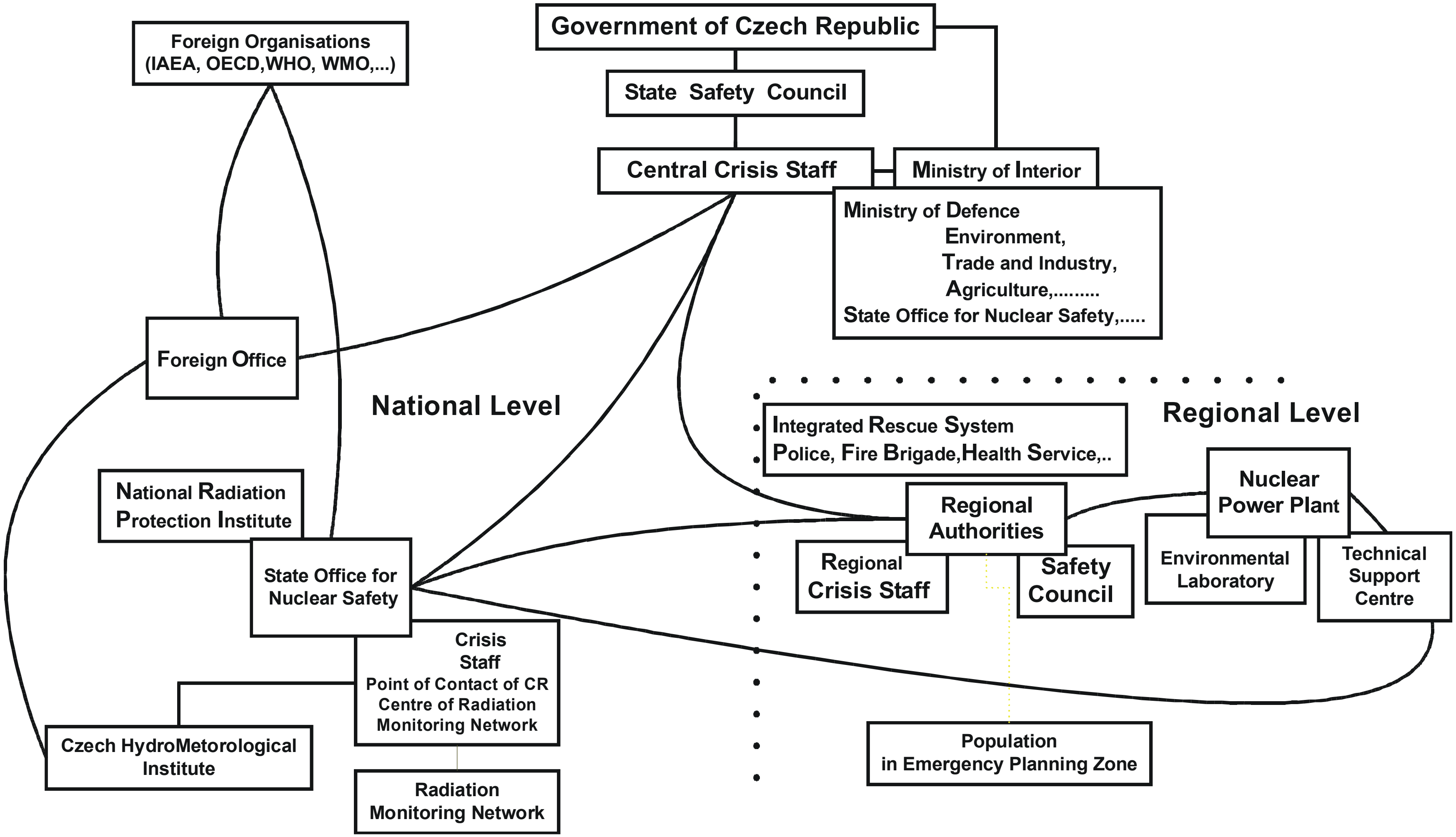
- State Office for Nuclear Safety
  - supervision of emergency preparedness
  - management of a national Radiation Monitoring Network (RMN)
  - based on evaluation of results obtained by the RMN proposals on counter-measures, which should be implemented in case of radiation accident and addressed to the principals of the affected territory (region)
  - on-site emergency plan in relation to off-site emergency plan approval
  - determination of emergency planning zone (EPZ)
  - national and international contact point (24 h) for radiological emergencies
  - co-operation with other ministries and state administration bodies
- Utilities/licensees - ČEZ, a.s., - NPP Dukovany and ČEZ, a.s. – NPP Temelín
  - ensuring of nuclear safety, radiation protection, physical protection and emergency preparedness
  - existence of approved on-site emergency plan
  - proposing EPZ
  - providing population in EPZ with KI pills
  - notifying
  - warning
  - mitigation
  - monitoring
  - informing
  - exposure limiting
  - co-operation in EPZ
  - on-site counter-measures

The following figures present an overview of the Czech Republic´s emergency preparedness structure:

Emergency Preparedness



Crisis Management



7.2.3 Criteria for Evaluation of the Radiological Situation and Implementation of Counter-measures

The general objectives of emergency planning are to:
- reduce the risk or mitigate the consequences of the accident at its source
- prevent serious deterministic health effects (DHE)
- reduce the likely stochastic health effects (SHE) as much as reasonably achievable.

The first objective is the responsibility of the NPP operator, i. e. of the licensee. The next two objectives are the combined responsibility of the NPP operator and off-site responsible regional (or state) authorities, Integrated Rescue System, etc.

Unusual events are classified into three decrees used by NPP:

An unusual event of the 1st degree results or can result in:
- exposure of workers above limits,
- inadmissible release of radioactive substances into workplaces,
- release into environment has not occurred.

Event has limited local character - for its solution, there are sufficient forces, means, and tools available for the NPP shift.

An unusual event of the 2nd degree results or can result in:
- significant exposure of workers or other persons,
- release of radioactive substances into environment above limits but does not require implementation of protective measures for people.

Activation of intervening persons of licensee is expected - for control, mitigation of event consequences; sufficient forces, means, and tools of licensee or its contractors are supposed.

An unusual event of the 3rd degree results or can result in:
- significant release of radioactive substances into the environment requiring implementation of urgent measures for the protection of people,
- off-site emergency plan or district emergency plan are activated.

Event requires activation of intervening persons according to off-site or district emergency plans.

The reduction of both personal and environmental exposures during a radiological emergency shall be applied by the following protective measures:
- urgent counter-measures involving sheltering, stable iodine administration, and evacuation; and
- recovery counter-measures involving relocation, control of radionuclide-contaminated foodstuffs and water, and control of radionuclide-contaminated fodder.

The counter-measures in radiological emergencies shall always be implemented if they are justified by a greater benefit compared to the costs and damage caused by emergencies, and they shall be optimised in their form, scope and duration to bring the most reasonably achievable benefit as possible.

As a basic guidance for deciding on the implementation of counter-measures, guidance levels shall be applied which reflect the current status of knowledge and international experience, so that a given counter-measure entails greater benefit than damage. For particular radiation activities and ionising radiation sources to which a risk of radiological emergency is related, the intervention levels specific for a given radiation activity or a ionising radiation source shall be set out in emergency plans based on the optimisation of radiation protection and the data specific to each particular event.

7.2.4 Urgent Counter-measures

An urgent counter-measure shall always be considered reasonable if the expected exposure of an individual might directly lead to his and her health damage. Hence, the counter-measures will always be taken if it is expected that absorbed doses might, for any person, exceed the levels given in Table 1 over less than 2 days.

Table 1
The levels at which, if exceeded, the intervention should be performed under any circumstances

Organ. Tissue	Projected absorbed dose to the organ or tissue in less then two days [Gy]
Whole body	1[a])
Lung	6
Skin	3
Thyroid	5
Lens	2
Gonad	1

a) A possibility of direct fetus damage for the projected doses higher than about 0.1 Gy must be taken into account during justification and the optimisation of intervention level for early counter-measures

If a counter-measure has the potential of averting or reducing exposure of the critical population group, exceeding the low guidance level of the intervention interval given in Table 2 (for evacuation), the implementation of counter-measures shall be considered with respect to its scope, feasibility, costs and possible consequences; if the upper guidance level is exceeded, the counter-measures shall be implemented.

Table 2
The guidance levels of intervention levels for urgent counter-measures

Counter-measure	Dose interval	
	Effective dose	**Equivalent dose in the individual tissues, organs**
Sheltering, Iodine prophylaxis	5 mSv to 50 mSv	50 mSv to 500 mSv
Evacuation of people	50 mSv to 500 mSv	500 mSv to 5000 mSv

To implement and evaluate the scope of urgent counter-measures, the following guidance levels shall be followed as a specifying guidance:

- for sheltering, an averted effective dose of 10 mSv for a period of sheltering equal or shorter than 2 days;
- for stable iodine administration, an averted committed equivalent dose of 100 mSv in thyroid gland induced by iodine radioisotopes; and
- for evacuation, an averted committed effective dose of 100 mSv over a period of evacuation not longer than 1 week.

7.2.5 Recovery Counter-measures

For recovery counter-measures, the guidance levels for intervention levels are given in Table 3. Projected effective or equivalent doses which, if the corresponding remedial measures are not implemented, would be received from all pathways of external exposure, radionuclide intake by inhalation and ingestion over the first year after the radiation accident, as well as the control of contaminated foodstuffs and water only due to radionuclide intake by ingestion over the first year after the radiation accident, shall be compared to these guidance levels.

Table 3
The guidance levels of intervention levels for recovery counter-measures

Counter-measure	Dose interval	
	Effective dose	**Effective dose in individual tissues, organs**
Regulation of radionuclides contaminated foodstuffs, water, feedstuff	5 mSv to 50 mSv	50 mSv to 500 mSv
Relocation of people	50 mSv to 500 mSv	------

To make a decision on relocation, the following guidance levels of intervention levels shall be accepted as a specifying guidance:

- for commencement of a temporary relocation, an averted effective dose shall be 30 mSv for a period of 1 month;

- for termination of the temporary relocation, a projected effective dose shall be 10 mSv for a period of 1 month. If it is proved within 1 up to 2 years that the total effective dose within 1 month shall not drop below the intervention level for the termination of temporary relocation, permanent relocation shall be considered;
- for permanent relocation, the projected lifetime effective dose shall be 1 Sv.

For the control of foodstuffs production and import, and the introduction of foodstuffs into the market according to special legislation, maximum permitted levels of radioactive contamination of foodstuffs and feedingstuffs are given in Table 4.

Table 4
The maximum permitted levels of radioactive contamination for foodstuffs and feedstuffs in case of radiological emergency[1]

Radionuclide	**Maximum permitted levels for foodstuffs during radiation emergency situation [Bq/kg] or [Bq/l]**				
	Baby foods[2]	**Dairy-produce**	**Liquid food-stuff**	**Minor Food-stuffs[3]**	**Other foodstuffs except minor foodstuffs**
Isotopes of strontium, notably Sr-90	75	125	125	7500	750
Isotopes of iodine, notably I-131	150	500	500	20000	2000
Alpha- emitting isotopes of plutonium and transuranium elements, notably Pu-239 a Am-241	1	20	20	800	80
All the other radionuclides of half-life greater than 10 days, notably Cs-134 a Cs-137, except H-3, C-14, K-40.	400	1000	100	12500	1250

[1] Decree No. 307/2002 Coll. on Radiation Protection, Annex 7, Tab. 4 and Decree No. 194/1996 Coll., Art. 3

[2] Decree No. 23/2001 Coll. establishing kinds of foodstuffs intended for special nutrition and methods of their using

[3] List of minor foodstuffs is given in tab. 6 of Annex 7 to Decree No. 307/2002 Coll.

Radionuclide	**Maximum permitted levels of radioactive contamination (^{134}Cs and ^{137} Cs) of feedstuffs during radiation emergency situation [Bq/kg] or [Bq/l]**				
Animal	Pig	Poultry, lambs, calves	Others		
Level	1250	2500	5000		

7.2.6 Systems for Evaluation of the Radiological Situation

According to the Atomic Act the SUJB is responsible for evaluating the radiation situation in case of a radiation accident and for preparation of recommendations of-counter-measures (see sub-Chapter 7.2.2).

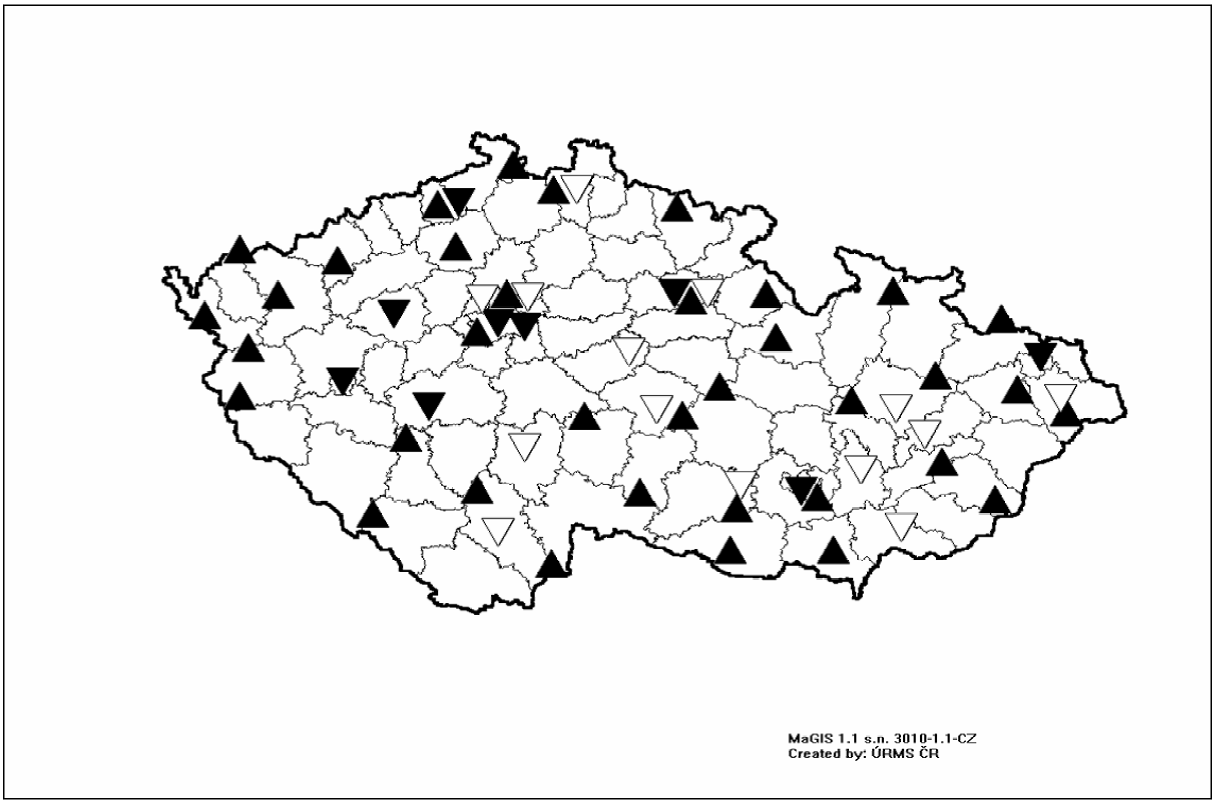
In case of a Czech NPP radiation accident, SUJB will receive all relevant technological, meteo- and radiation situation data from the NPP. These data, together with other data from RMN and CHMI calculated trajectories, will be input data for evaluation of the radiation situation and for preparing the recommendations of counter-measures.

In case of a radiation accident abroad, SUJB will work with the information exchanged bilaterally with the neighbouring countries and international institutions (via IAEA system ENATOM or via EU system ECURIE).

The evaluation of potential consequences of radiation emergencies will be based on the following systems - ESTE, Information System of RMN (IS RMN), Catalogue of Counter-measures; these tools are prepared for the SUJB Crisis Staff basic use. Other systems implemented at SUJB (i.e.: InterRas, COSYMA) could be used, but by specialists who are not regular members of Crisis Staff shifts. (For ESTE see Chapter 3).

The programme IS RMN is a SW tool which works with the data collected from the RMN, namely with the data from Early Warning Network (EWN).

The following figure shows where EWN monitoring points are situated in the Czech Republic.



Data from the EWN´s monitoring stations are displayed on the SURO web site (www.suro.cz) as well. Three levels of radiation distinguished by different colours can be indicated. For a normal radiation situation at the point of the monitoring station, the colour a green is used; yellow is used for higher (investigation) level of radiation, and, finally, red colour for intervention level (upper than 500 µSv/h).

The Catalogue of Counter-measures is a printed tool containing both the basic information about possible counter-measures and instructions on how to prepare a recommendation for counter-measures in case not all input data or on-line data is available.

8 CONCLUDING STATEMENT

Summarising the outcome of the Working Group on comparison of calculations regarding the radiological consequences of BDBA established with a view to harmonising the basis for emergency preparedness in accordance with Item No.7, “Severe Accidents Related Issues - a)” of Annex I of the “Brussels Protocol”, both partners conclude that the co-operation has been very successful and that within the last two years, 2002 and 2003, a large number of activities have been performed.

At the first meeting in Vienna, May 2002, a Working Group was set up and a work programme was agreed upon. Detailed comparison calculations in the field of assessing the radiological consequences were made and discussed in three additional Working Group meetings. The introduction of a common information platform, CIRCLE, provided by the Austrian side in June 2002, allowed a quick and prompt exchange of information and results in the meantime.

The codes and models used in both countries in case of nuclear or radiological accidents and in the field of emergency preparedness were compared in different exercises. The assumptions and model parameters were discussed in detail and background information on the models and codes was exchanged. The emergency procedures in both countries were presented and the criteria for implementing different precautionary and protective (short- and long-term) measures were compared.

A basis for mutual understanding of procedures and codes used in emergency situations was created by the WG activities and the intensive information exchange has already had a very positive impact on the emergency preparedness in both countries. Furthermore, the results and the experience gained could be a basis for further harmonisation in the field of emergency management in both countries. Based on the results and conclusions of discussions, both sides consider activities within STEPs I-III to be brought to a successful close.

As one of the main outcomes of the WG activities, a programme for future bilateral and regional co-operation in the field of emergency preparedness and emergency management is being developed by SUJB and BMLFUW. These common future activities include an intensified data and information exchange and co-operation between both emergency centres. In terms of a bilateral agreement and mainly under the newly signed Arrangement (see Annex 12), the following data are expected to be exchanged:

- Actual weather conditions at the point of radionuclide release,
- Meteorological prognoses for dispersion calculations (extracted from TAMOS),
- Radionuclide air concentration and deposition forecasts based on weather models obtained by both parties,

- Forecasts of the course of the accident and its possible radiological consequences based on the actual weather data and calculations of ESTE and HAVAR codes,
- Forecasts of the possible radiological consequences based on prognostic weather predictions and calculations from TAMOS, OECOSYS,
- Territory and food chain monitoring results using the radiation monitoring networks of both parties.

Furthermore, it is envisaged that both countries will co-operate regarding relevant topics included in the European Union's 6th Research Framework Programme. Both parties agree that the RODOS system will gradually become a quasi-standard used to asses the potential radiological consequences and inform the decision-making process. The last but not least field of co-operation shall be the exchange of emergency planning experts in the Crisis Centres of both countries.

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ABBREVIATIONS LIST

ALADIN	Limited-area weather forecast model used by meteorological services in CR, Austria, and other central-European countries
ARCS	Austrian Research Centres Seibersdorf
BDBA	Beyond Design Basis Accidents
BMLFUW	Austrian Federal Ministry of Agriculture, Forestry Environment and Water Management
CHMI	Czech Hydrometeorological Institute
CIRCA	Common information platform developed under the European Commission IDA programme, installed and operated by the Austrian Federal Environment Agency
ECMWF	European Centre for Medium-Range Weather Forecasts
ENSEMBLE	Research project of the 5th research framework programme of the EC for comparision of long-range dispersion codes
EPZ	Emergency Planning Zone
ESTE	Dispersion analysis and dose assessment code. See also Chapter 3 of this report
EWN	Early Warning Network
FLEXPART	A Lagrangian particle dispersion model for medium- to long-range transport, developed at IMP and used also at ZAMG (part of TAMOS). See also Chapter 3 of this report.
FLEXTRA	A trajectory model for medium- to long-range transport, developed at IMP and used also at ZAMG (part of TAMOS). More information at http://www.forst.tu-muenchen.de/EXT/ LST/METEO/stohl/flextra.html.
GSF	Forschungszentrum für Umwelt und Gesundheit, GmbH Ingolstädter Landstraße 1, D-85764 Neuherberg. (German research centre for environment and health)
HAVAR	Dispersion analyses code. See also Chapter 3 of this report.
HERALD	Dispersion analyses code. See also Chapter 3 of this report.
IAEA	International Atomic Energy Agency
IMP	Institute of Meteorology and Physics, University of Natural Resources and Applied Life Sciences Vienna
MATCH	Model of Atmospheric Transport and Chemistry, developed by the Swedish meteorological service, used in the Real-time On-line Decision Support System (RODOS) code. See also Chapter 3 of this report.
NPP	Nuclear Power Plant
OECOSYS	Dose assessment and radio-ecological code. See also Chapter 3 of this report.
PC COSYMA	Dispersion analyses code. See also Chapter 3 of this report.
PTM	Lagrangian Puff Trajectory Model, dispersion analyses code. See also Chapter 3 of this report.

RTARC	Dispersion analyses code. See also Chapter 3 of this report.
RMN	Radiation Monitoring Network
SAMGs	Severe Accident Management Guidelines
SUJB	State Office of Nuclear Safety
TAMOS	Emergency response modelling system is the Austrian Central Institute of Meteorology and Geodynamics. See also Chapter 3 of this report.
WG	Working Group on comparison of calculations regarding the radiological consequences of Beyond Design Basis Accidents established under Item 7a of Annex I to the "Brussels Protocol"
ZAMG	Zentralanstalt für Meteorologie und Geodynamik, Central Institute of Meteorology and Geodynamics

ANNEXES

A1 Minutes Workshop May 2002

A2 Minutes Workshop September 2002

A3 Minutes Workshop April 2003

A4 Minutes Workshop October 2003

A5 Results STEP I

List of Czech presentations summarizing results within STEPI:

1. Comparison of Calculations performed with UK4 Source Term, STEP I -1, P. Čarný
2. Comparison of the codes PC COSYMA and RTARC, J. Duran, M. Pospisil
3. Comparison of Calculations performed with Austrian Source Term, STEP I -2, P. Čarný
4. Comparison of Calculations performed with HERALD, HAVAR with Results of PCCOSYMA, STEP I -3, P. Čarný
5. Technical description of LB – LOCA (HERALD, HAVAR and PC-COSYMA comparson), M. Sýkora
6. Comments to calculations made with HERALD, HAVAR and COSYMA, J. Horyna
7. Programme code HAVAR, P. Pecha, E. Pechová
8. Computer Code Qualification in the Czech Republic, A. Miasnikov

List of Austrian presentations summarizing results within STEPI:

1. Comparison of calculations with PCC by the Austrian and Czech side, Step I-1, A. Wenisch
2. Comparison of calculations with PCC, RTARC and ZDC, STEP I-2, P. Seibert, A. Frank, H. Kromp-Kolb, A. Wenisch
3. Methodolgy for the selection of „Worst Case“ Scenarios, Step I – 4, P. Seibert, H. Kromp-Kolb

A6 Protocol of coordination meeting at SUJB, Prague, 8 November 2002 and Arrangement on Source Term Realistic Case Studies of STEP II.b

1. Protocol of the short meeting at SUJB, 8th Nov. 2002, Prague, regarding the next steps for workpackage STEP II, of Item 7a, “Roadmap Temelin”
2. Arrangement on Source Term for Realistic Case Studies of STEP IIb
3. Assumptions and conditions for exercise STEP II b), P. Čarný

A7 Results STEP II.a

1. Real time meteorological long distance modelling, Comparison of Czech and Austrian outputs, J. Kalibera
2. Results of the Cooperation between ZAMG, Vienna, and CHMI, Prague, on "Real-time meteorological Long distance Modelling", Step II, a – Subgroup 2, U. Pechinger
3. Comparison of Real-Time Models for Nuclear Accidents, U. Pechinger, M. Langer, H. Vondráčková, J. Kalibera, M. Janoušek

A8 Results STEP II.b

List of Czech presentations summarizing results within STEPII.b:

1. Step IIb Realistic Case Studies, Introduction, J. Horyna
2. STEP II B, Results: este and PC Cosyma, P. Čarný
3. Calculation with the RODOS/MATCH model for the STEP II.b, J. Duran, M. Pospisil
4. Lagrangian Puff-Trajectory Model, J. Duran, M. Pospisil
5. Dietary consumption data for estimation of ingestion dose, J. Hůlka

List of Austrian presentations summarizing results within STEPII.b:

1. Calculations with Flexpart and PC COSYMA for "Realistic case studies", Temelin Roadmap II.b, P. Seibert, A. Frank, A. Wenisch
2. Step II b: TAMOS / OECOSYS Results, P. Hofer

A9 Results STEP III

List of Czech presentations summarizing results within STEPIII:

1. STEP II B, Protective measures, P. Čarný
2. STEP III, Summary of the STEP III results achieved by the Czech side - doses and approach to protective measures, P. Čarný
3. Food Chain and Counter Measures, I.Malátová, J.Hůlka

List of Austrian presentations summarizing results within STEPII.b:

1. OECOSYS, Foodpaths and Parameters, G. Sdouz
2. Step III: OECOSYS Ingestion Dose and Urgent Protective Measures, P. Hofer
3. Step III: Assumptions and OECOSYS Results, P. Hofer
4. Step III: OECOSYS Ingestion Dose, Food Chain and Counter Measures, P. Hofer

A10 Presentations on Emergency Procedures in Czech Republic and in Austria

Emergency preparedness in Czech Republic:

1. Emergency Preparedness, V. Starostová
2. Computer Codes used at the ERC, H. Rutová
3. Computer Codes used at the ERC, H. Rutová, V. Starostová

Emergency preparedness in Austrian Republic:

1. Nuclear Emergency Procedures in Austria, An Overview, J. Hohenberg

A11 Joint paper for the International Symposium on Off-Site Nuclear Emergency Management at Salzburg (29th September to 3rd October 2003)

A12 Arrangement between State Office for Nuclear Safety and Federal Ministry of Agriculture and Forestry, Environment and Water Management, Radiation Protection Division, of 10 March 2004