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Nordic nuclear safety research

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NKS NordDSS – report from workshop on the use of Descision Support Systems

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March 2010

Abstract

Nuclear preparedness and response authorities in the Nordic countries are using decision support systems (DSS) as part of their operational capability. A DSS compile, display and analyse data that makes up the current and future radiological state of an emergency. ARGOS and RODOS are the two most common systems in use in the Nordic region. The aim of of the NordDSS workshop was to gather Nordic and international experts on DSS, and share knowledge and experience. The workshop brought together 22 experts for two days in Copenhagen.

Key words

Nuclear preparedness, Decision support system, ARGOS, RODOS, emergency management systems, GIS

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NKS NordDSS

Nordic Workshop for users of DSS

Copenhagen – 1-2 October 2009

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Contents

Introduction

What is a Decision Support System (DSS)

A common definition of DSS is: "A Decision Support Systems (DSS) is a class of information systems (including but not limited to computerized systems) that support business and organizational decision-making activities. A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from a combination of raw data, documents, personal knowledge, or business models to identify and solve problems and make decisions."[1]

In the domain of nuclear emergency preparedness and response, a DSS refers to systems used to compile, display and analyse data that makes up the current and future radiological state following a radiological accident. This includes dispersion prognosis, measurements and models for assessing the short- and long term consequences of an accident.

There are two major nuclear and radiological DSSs used in Europe today, namely ARGOS and RODOS. Both systems where developed with Chernobyl-type accidents in mind, meaning a release from nuclear power plant into the air, followed by contamination and long term effects. But also new types of threats have received more attention in later years. This includes threats like small nuclear weapons, radiological dispersion devices (RDD). Both systems share many of the underlying models and tools. This includes dispersion model (RIMPUFF), food and dose model (FDM/AgriCP) and urban recovery model (ERMIN).

Objective

The objective of NordDSS was to arrange a workshop for experts on decision support systems in the Nordic countries, and consider the possibility for a future Nordic cooperation on the issue.

The purpose of the workshop was to share national practice and experience on the use of decision support systems such as ARGOS, RODOS and similar systems, during a nuclear crisis and other situations. The workshop should answer questions such as what is the role or status of the DSS within the organization, and how is it implemented to guarantee that it fulfils this role. This includes factors such as technical setup and maintenance, and human factors like training and exercises. What types of analysis are performed and how are results used. What is done to assure that the results are interpreted correctly and how is the uncertainty handled. How are the results communicated to the decision-makers, other responders and the public. How do the decision-makers use these results in combination with other information, to decide upon different countermeasures and actions to protect the population.

The workshop

The workshop was held on 1-2 October 2009 in Copenhagen with Nordic participants from Denmark, Finland, Norway, Sweden and the Faroe islands. In addition international DSS experts where invited to participate and give presentations. In total 22 people participated in the workshop.

[1] Wikipedia

The workshop was organised in three different sessions. First session was dedicated to the use of DSSs in the Nordic countries. Denmark, Finland, Norway and Sweden gave national presentation on the use of DSS in the respective countries. This was followed by a plenary discussion on common issues and possible cooperation. The outcome of this session is a basis for future work, and will be followed up by the Nordic participants.

Second session focused on the international DSS community. Both ARGOS and RODOS are result of cooperation between researchers and experts in Europe, and this cooperation continues to be a driving force for improving and develop DSS. Other non-European countries have implemented DSS. This broadens the user community and introduces new uses of systems that somewhat differs from the European tradition. The session had presentation from five DSS experts showing the use of the systems within their country and organisation.

First part of last session looked at more in-depth use of DSS with a presentation on the implementation of Food Dose Module in Ireland, and use of geographical information systems (GIS) for data presentation. Second half looked at the future of ARGOS and RODOS, and an introduction to the new IRIX data format.

The following chapter contains abstract from the presentations. The presentations them self are available on the NKS web page.

Abstracts

Emergency management is a collaborative effort

Ammann, Michael[1]; Peltonen, Tuomas[1]; Lahtinen, Juhani[1]; Vesterbacka, Kaj[1]; Summanen, Tuula[2]; Seppänen, Markku[2]; Siljamo, Pilvi[2]; Sarkanen, Annakaisa[2]
[1]STUK, Radiation and Nuclear Safety Authority, Finland
[2]FMI, Finnish Meteorological Institute, Finland

Emergency management is a collaborative effort: one team might assess the plant status and make an assessment of the likelihood and magnitude of a release; another team might be in charge of making dispersion calculations with the given release; their results are given to yet another team so that they can plan suitable measurement campaigns; still another team assesses possible health effects and the need for interventions by taking into account the most likely dispersion situation and already available measurement results; and there is a need for coordinating all this effort and communicating to the public, which in turn can only be done successfully if first hand and timely information about the current state of affairs and about likely future developments are readily at hand. Of course collaboration does not stop here (there are many more intra- and inter-institutional needs for information exchange at various political levels) but this does roughly picture the collaboration that is needed at STUK in the niche I am occupying.

The working of all these groups relies on information exchange and on adequate computer support. There are many tools in use today to support the different groups in their various tasks, but there is no one tool (or DSS for that matter) that can do all for all users. Admittedly, RODOS and ARGOS go a long way in supporting many of these tasks, but there are practical obstacles (institutional traditions, user profiles, IT infrastructure, etc) to a one-system-for-all approach.

In Finland we took a somewhat different approach. We are not trying to integrate more and more tools into RODOS (or ARGOS) rather we are trying to integrate RODOS into a newly developed web based platform. The purpose of the platform is to make it easier to exchange information and for all users to be kept up to date with the development of the situation. The platform should bridge the spatial remoteness of expertise (incl. hardware and software) and provide a consistent user interface to tools that could be used before only with special training. In addition, it should provide the different users with their views of the situation and should support the process from source term input, over dispersion and dose assessment, up to the approval of various reports. Although still developed, the platform has been in use in STUK and FMI for roughly a year. So far we have received mainly positive feedback.

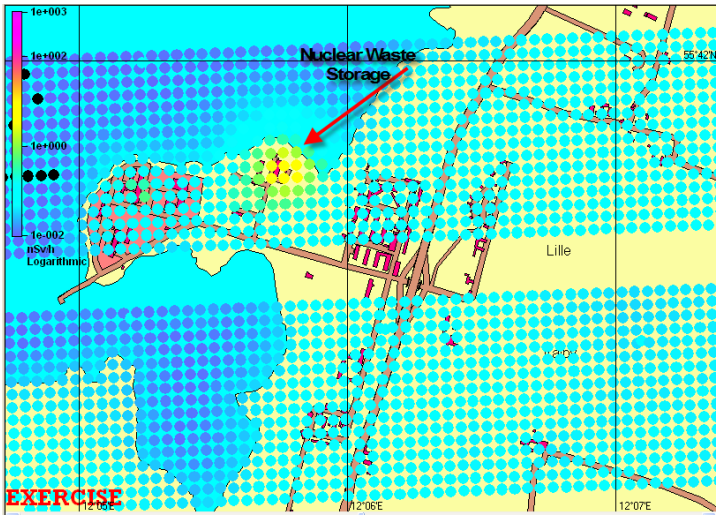
Description of ARGOS 9.0

Steen Hoe, Lotte Juul Larsen, Danish Emergency Management, Denmark

ARGOS is a Microsoft Windows based client server program with a centralised platform (MSQL). ARGOS can be installed in many types of environments from a laptop to large network installations with many clients. With ARGOS 9.0 the final transformation from a nuclear DSS to a CBRN DSS is finalised. The ability to handle many different simultaneous events in different domains has been the target for the development.

Monitoring

ARGOS is highly integrated with radiological monitoring data with focus on AGS and CGS and the fast transfer from instrument to the sophisticated ARGOS SQL data base has high priority. In many counties the ARGOS software is also integrated with permanent monitoring networks. ARGOS supports the EURDEP format for import and exports.



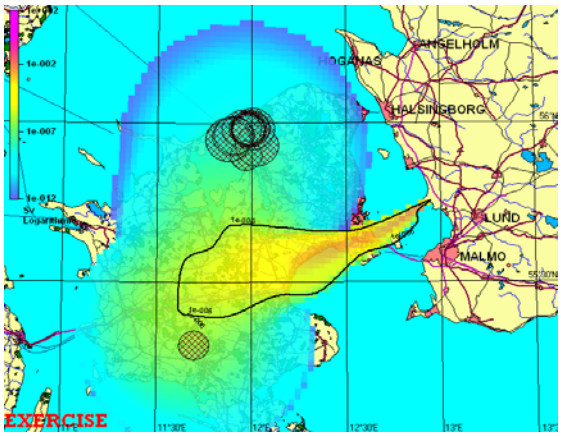
Measurements from helicopter over Risø/DTU

Atmospheric dispersion calculations

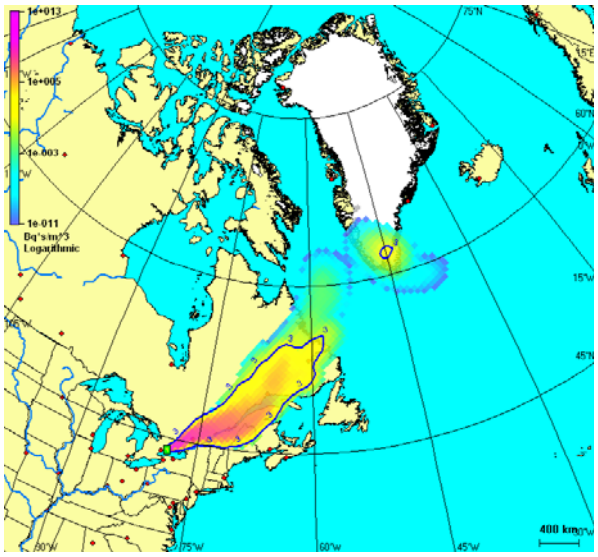
ARGOS covers dispersion from the URBAN environments to the global scale (Interfaced with national long range models).

Local and Mesoscale

The RIMPUFF/LSMC/Hystrix dispersion model can calculate dispersion and radiological doses based on advanced meteorological inputs from NWP models, weather RADAR, local met observations or just very simple inputs.

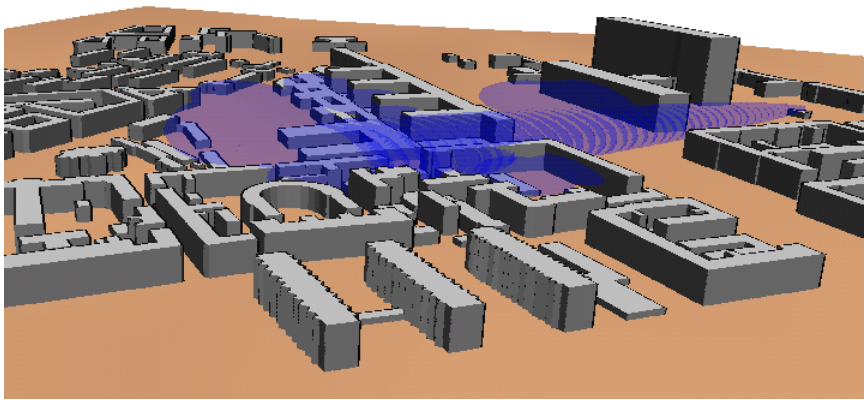


Local and meso scale 1-500km: Inhalationsdose



Simulation of long range dispersion (DERMA from DMI)

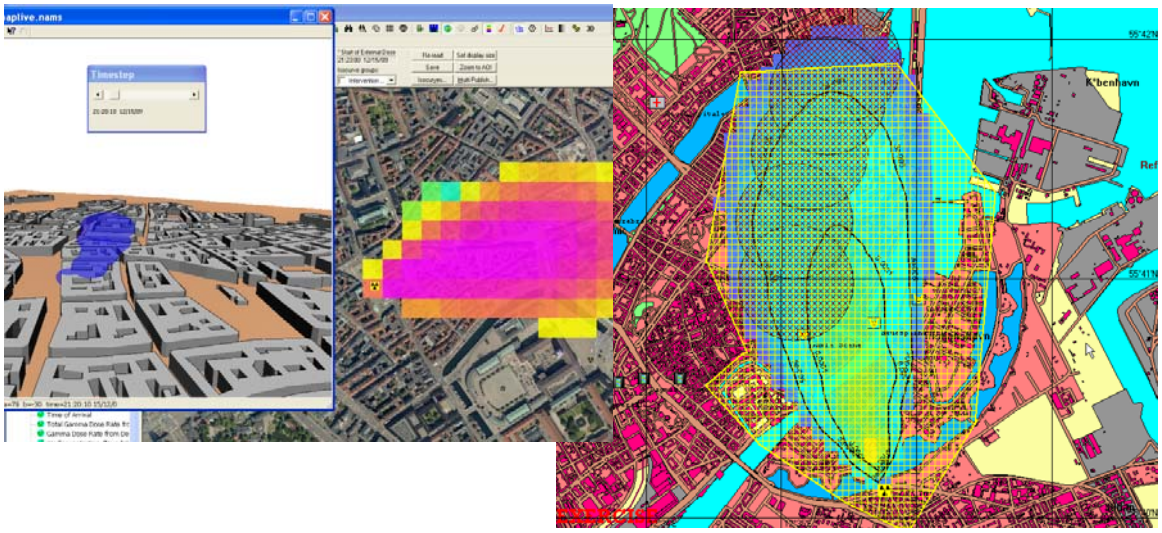
URBAN dispersion modelling (URD from Riso and FOI)



URBAN dispersion with URD – simulated release in Copenhagen

Source modelling in ARGOS

ARGOS 9.0 can not only simulate releases from reactors but also Dirty Bombs and larger detonations can be simulated as well as multiple release points.



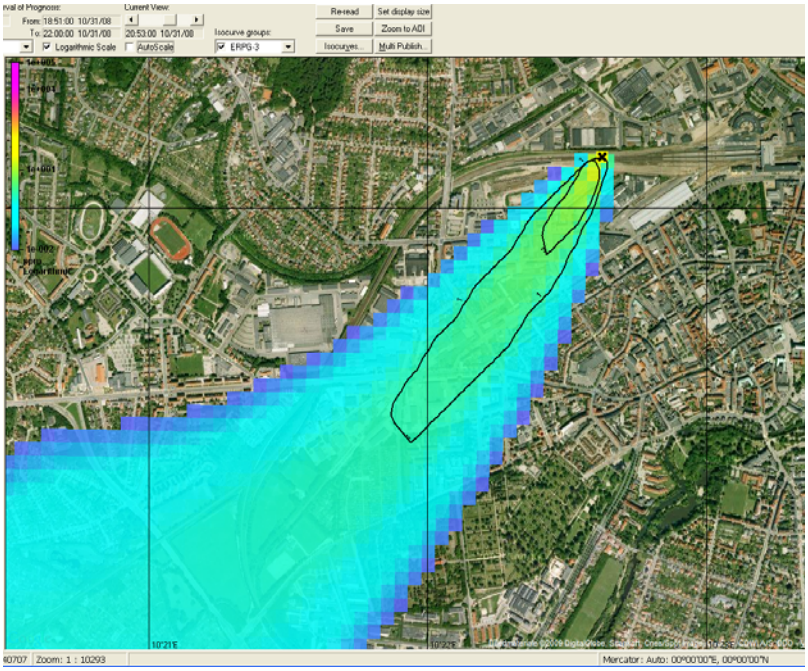
Dirty bomb simulation showed on a Google map

Advanced models for dose calculations

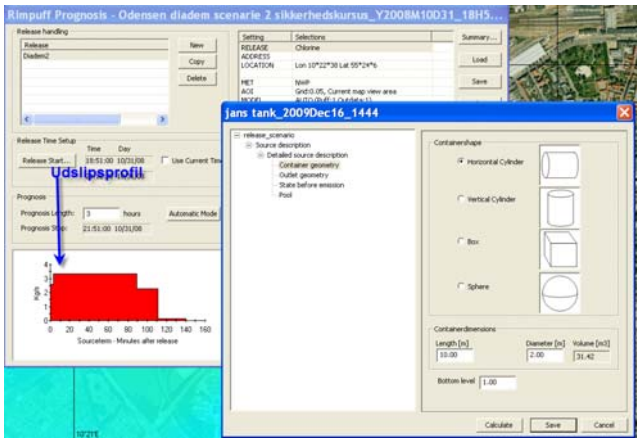
In ARGOS special models for calculation in foods AgriCP (Agricultural Countermeasure Program) and in urban areas (ERMIN (EuRopean Model for INhabited areas)) is implemented. With these models it is also possible to estimate the effects of countermeasures.

Chemical Domain

The Chemical domain is supported in ARGOS with the introduction of source model and heavy gas model and the build in ERPG (The Emergency Response Planning Guideline) areas.



Simulated Clorine release showed on Google map



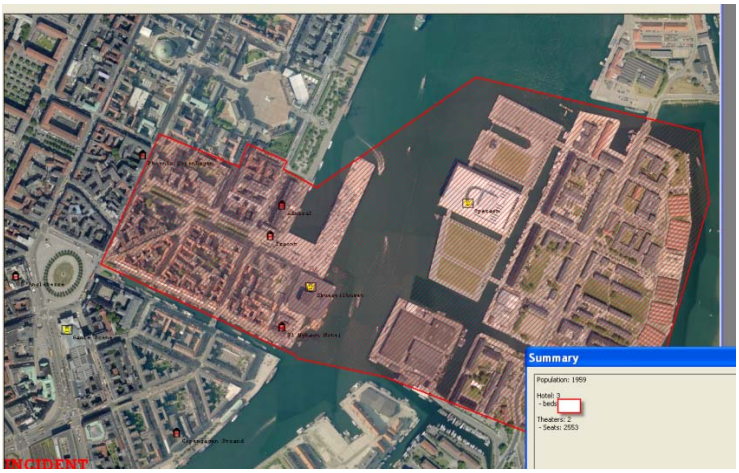
Source model in ARGOS with intuitive user interface.

Biological Domain

The Biological Domain is supported by the dispersion models and the data base structure is prepared for use.

Events and GIS in ARGOS

With the introduction of multiple domains (C, B, R and N) and geographical separated events it became important to focus on parts without loosing the complete overview. In ARGOS 9.0 the introduction of the Event mode solved this paradox. When selecting a special event the user will still have access to Hazard areas created from other events and domains. The events are also linked op to the Canadian IRP (Incident and response platform) web. GIS information like populations, Kindergarten etc can easily be accessed from the ARGOS DB.



Hazard area with a summary showed on Bing Maps, locations with hotels and theatres are showed on the map.

Use of Decision Support Systems at NRPA

Jan Erik Dyve, Norwegian Radiation Protection Authority, Norway

Norwegian Radiation Protection Authority (NRPA) is head of and secretariat for the national nuclear preparedness and response organisation. NRPA tasks and responsibility includes obtaining and process information, prognosis and measurement data. Several decision support systems (DSS) are utilized to assist in these tasks. The most important once are ARGOS DSS for the radiological assessments and Atomberedskap.no for information dissemination.

ARGOS DSS is mainly used for dispersion prognosis and presentation and analysis of measurement data. SNAP, a long range dispersion model operated by The Norwegian Meteorological Institute, is integrated in ARGOS. Model runs can be executed from ARGOS, and afterwards displayed and analysed. Several of the monitoring resources are integrated with ARGOS, including early warning network, mobile measurements teams and airborne systems. Through the EURDEP standard, monitoring data from European countries can be included. NRPA has not implemented any food dose models or models for analysing the long term consequences, but several such models are under consideration.

Atomberedskap.no is a web based information portal used by NRPA to obtain process and disseminate information to the national preparedness and response organisation. Information on an ongoing situation is published on the site, including situation status and a continuous event log. It also hosts national and internal contingency plans and other background documents.

Use of DSS in Germany / what can we expect from RODOS in future?

Florian Gering, BfS, Germany

The use of decision support systems on a federal level in Germany was described in this presentation. The basic tool is IMIS ("Integrated Measurement and Information System"), which includes the two systems PARK and RODOS. While PARK – a national development for BfS from the early 90's – is designed for nuclear accidents far abroad, the area of application of RODOS are nuclear/radiological accidents within Germany and close to the German borders. Both systems are used to assess doses and activities related to intervention levels, PARK can operate in both a prognostic mode based on dispersion predictions and a diagnostic mode based on nation-wade radiation monitoring data. RODOS is primarily used for dispersion prognosis and dose calculations based on these results, the diagnostic mode bases on meteorological measurements as input to dispersion calculations. On-site monitoring data from all German NPP's are permanently fed into the system, together with numerical weather predictions and long-range dispersion calculations from the German weather service. While PARK is only used by the BfS, RODOS is operated in a crisis centre at BfS as service for federal organisations and all German states.

Additionally, an outlook was given on the future use of RODOS in Germany. By spring 2010 the complete re-engineering of RODOS will be finished, resulting in a new Java-based system called JRODOS. The design and development of this new system was strongly influenced by the users of the RODOS system, resulting in a modular and fexible system with standard interface for in- and output. The user interface was completely renewed focussing on easy and safe handling, it is coupled with the core system via a XML-interface, thus e.g. allowing for automatic runs triggered by monitoring systems. Several options for visualization of results have been realised, including reports (with pre-defined layout), results for web servers, in Google Earth format, and also as Web-GIS services. The new features of JRODOS should allow to integrate JRODOS relatively easily within complex emergency systems or tools, thus enabling to use the system either in a stand-alone way or operating it as a service within another application.

Australian use of ARGOS in Radiation Emergency Preparedness

Dr Stephen Solomon, ARPANSA, Australia

The Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) is the Australian Government Radiation Regulator, and it regulates Australian Government use of radioactive material, including the OPAL Research Reactor operated by the Australian Nuclear Science & Technology Organisation (ANSTO). ARPANSA is the Australian National Competent Authority for Radiation Emergencies, Domestic and Abroad for IAEA Emergency Notification and Assistance Conventions, a WHO Collaborating Center for Radiation Protection and member of the WHO Radiation Emergency Medical Preparedness and Assistance Network (REMPAN).

Australian is a federation of States and Territories, and as such has 9 radiation regulation jurisdictions. The States and Territories are responsible for health and welfare of citizens and each maintain their own emergency response organisations . An Emergency Management Australia is the Australian Government that coordinates Australian emergency planning and maintains Commonwealth plans. There are no Nuclear Power Plants in Australia and one single Research Reactor located in Sydney. Australian receives visits from US and British nuclear powered warships (NPW) into both military and civilian ports. There are local, State and National plans covering nuclear emergencies for these facilities. In addition, with the increased concern over malicious use of radioactive material, there are now additional plans covering response to radiological terrorism incidents.

ARPANSA is responsible for promoting national uniformity in radiation protection. The Australian radiation protection framework for the implementation of protective measures is based on ICRP and IAEA guidance. The ARPANSA document Interventions in Emergency Situations Involving Radiation Exposure, Radiation Protection Series No. 7 published in December 2004 provides guidelines on protective actions for the Public and on radiation protection for emergency workers. The RPS7 recommends the use of Intervention Levels and Action Levels, with derived Operational Intervention Levels (OIL) as a means to ensure prompt decisions are made in the event of a radiation emergency. Modelling of releases and rapid assessment of actual environmental contamination are an important part of planning to apply protective actions. ARPANSA maintains specialised radiation assessment teams, with radiation mapping systems, to support the Australian radiation emergency response.

In 2007, ARPANSA with financial support from the Department of Defence (Navy) and Emergency Management Australia (EMA) acquired an Australian ARGOS licence, in order to co-ordinate a national working group to evaluate its suitability for Australian CBRN emergency management. ARPANSA developed a virtual machine ware (VM-Ware) installation of the ARGOS software for distribution to the national Working Group. This distribution included numerical weather prediction data provided by the Australian Bureau of Meteorology (BOM). ARGOS was successfully used for the July 2008 international IAEA ConvEx-3 exercise involving a nuclear power plant release exercise in Mexico, for the modelling of the transport of Xe133 from the OPAL reactor in Sydney to a Noble Gas Monitoring system at ARPANSA in Melbourne, and as part of a Common Operating Picture (COP) Trial involving a simulated nuclear powered warship accident in the Port of Darwin.

Current ARPANSA work with ARGOS has concentrated on implementing the RIMPUFF models for Australian nuclear emergency scenarios (OPAL and NPW emergencies).

ARPANSA now receives daily numerical weather prediction data for Australia and the Asian region from the Australian BOM. ARPANSA has worked with PDC to enhance the GIS outputs from ARGOS, particularly the export of shape files and isolines for use within GoogleEarth. Future work on ARGOS includes the integration of ARGOS products into Australian radiation emergency response system, the implementation and application of FDM for Australian conditions, the integration of Australian field data and gamma mapping data into ARGOS and the establishment of an Australian network of radiation detectors.

ARGOS implementation in Brazil.

Pedro P. Lima-e-Silva

Brazil's ARGOS – as on 28/Sep/2009

Brazil's actual nuclear site is located SE of Brazil, on an extreme complex terrain. It contains almost all features that makes it hard to model properly an atmospheric transported plume, such as sea-land interface, high mountains close, various different terrain roughnesses, and others. This complexity demands a somehow sophisticated model and high resolution data, but these qualities have to be trade off with the need for a fast answer in emergency situations. The country entered the ARGOS consortium on January 2008, and due to a low budget and few people involved, its implementation has been slow, although continuously done. The first hard job was to create a link between institutions, the one in Brazil that delivers the NWP, INPE/CPTEC ("Space Research National Institute"), get the hardware needed, and take the ARGOS people to Brazil to help solve the installations problems. Due to the high complex terrain, also we need to have local meteorological towers data running into Argos to help configure the wind field model and to get specific data, such as precipitation. The main problems and their status are: [i] NWP link, adaptation to Hirlam format, increase resolution, status: in progress; [ii] NWP automatization, status: scheduled to March 2010; [iii] Mapping, status: scheduled to July 2010; [iv] Special Wind field model, to replace LINCOM, status: discussions with Risoe about the better solution to be applied, previewed to be operational early in 2010; [v] Improvements foreseen to 2010: rain radar, additional met towers, relocation of actual met towers, acquisition of DELL Xeon machines to speed up CPU time.

Changes in status today – 04/Mar/2010

[i] DONE;
[ii] in progress;
[iii] Paperwork in progress;
[iv] Tests and negotiation with Risoe in progress;
[v] Rain radar: will be bought at least one equipment; Additional met towers: requirement for the Utility ha been released, they will have sometime to comply; Relocation of actual towers: same as previous; Acquisition of DELL Xeon: in progress.

DSS ARGOS and RODOS within Emergency Management

Ernest Staroń, Radiation Emergency Centre, National Atomic Energy Agency, Poland

The presentation focuses on several aspects that cover the area of emergency preparedness and decision making in the Polish Radiation Emergency Centre (CEZAR). Legal matters including the role of CEZAR in the Atomic Law have been presented followed by specific regulations, duties and responsibilities. A diagram explains the role of CEZAR within the National Emergency Response System. The Decision Support System in CEZAR is based on Argos and Rodos. The use of both programs has been envisaged. The presentation is concluded by a practical application of Argos in decision making in case of an emergency response exercise.

Nuclear Emergency Decision Support System in Canada

Dominique Nsengiyumva, Ph.D., PMP
Head, Technical Assessment Coordination Section, Nuclear Emergency Preparedness and Response Division, Radiation Protection Bureau, Health Canada, Ottawa, ON, Canada

The Nuclear Emergency Preparedness and Response Division (NEPRD) of Health Canada's Radiation Protection Bureau coordinates the Federal Nuclear Emergency Plan (FNEP). The FNEP provides the framework for the multi-departmental federal response to a radiological or nuclear (RN) emergency affecting Canadians at home and abroad. The FNEP also provides the framework for radiological consequence management in support of Canada's National Counter-terrorism Plan, and links to the Canada-United States Joint Radiological Emergency Response Plan.

When the FNEP is activated, an emergency management structure is put in place, consisting of an Executive Group – responsible of decision making and reporting to cabinet, a National Coordinator – in charge of coordinating three groups: the Technical Advisory Group (TAG), the Coordination and Operations Group (COG) and the Public Affairs Group (PAG). The TAG is in charge of assessing the hazard and providing strategic advice to the Executive Group. For this reason, the TAG relies on the Technical Assessment Coordination Section of the NEPRD to use decision support systems (DSS) and provide information from which decision-making is based. The main tools used are: ARGOS (Accident Reporting and Operational Guidance System), E-Map and Geoconference. ARGOS is an expert system used among other functions to model the plume and estimate doses. E-Map is a web based geographic information system (GIS) used to display and share modeling results with the TAG and provide them with the situational picture of the incident. If necessary the geoconferencing application allows non-collocated TAG members to use interactive maps for discussion. Participants can use map pointers and annotate the map and the results of their discussions are saved for further reference.

Data Visualization Using Web GIS Software

Peltonen, Tuomas; Ammann, Michael; Lahtinen, Juhani; Vesterbacka, Kaj
Radiation and Nuclear Safety Authority (STUK), P.O. Box 14, FI-00881 Helsinki, Finland

As the importance of World Wide Web has grown, also different Web GIS applications have become more popular. The performance of modern computers and web browsers have made this development possible. There are a lot of Web GIS programs available nowadays. Some of them are commercial but also open source GIS community is very active.

The major advantage of web-based GIS software is the independency of user equipment. A modern web browser is all you need to access data. There are many web map services available on the Internet and you can visualize the data on the top of different maps. It's also possible to access resources independent of their location. Web environment allows user interaction with maps and production of tailored maps for particular purposes. Web maps, like Google Maps, are so widespread that their use is intuitive. Possible disadvantages of web-based system include similar problems to all the other web-based systems.

Use of open standards is preferred in web environment. The Open Geospatial Consortium, Inc. ® (OGC) is an organization that defines standards for geospatial and location based services. OGC standards are well documented and highly supported by different applications and programming libraries. Examples of open standards include Web Map Service (WMS), Geography Markup Language (GML), and Web Feature Service (WFS) for example.

A Web Map Service (WMS) is a standard protocol for serving georeferenced map images over the Internet. Images are generated by a map server program using GIS data. User (or client program) can define the response format (JPEG, PNG, etc.). Generating maps can be slow and that's why map tiles caching is used to speed WMS responses.

In Finland we have a web application KETALE that integrates different distributed modeling results. Web GIS component is the major part of it. In KETALE we use OpenLayers Javascript library to visualize the data. Data layer is on the top of the map layer. We have our own Mapserver-based Web Map Service (WMS) maps in use but it's also possible to view data on the top of other maps like Google Maps. Because WMS is not restricted to specific site, we also use the same WMS maps in our Dose-rate Monitoring System USVA. Data in KETALE system is stored in numerical format (NetCDF) and Mapserver/Mapscript also generates the data layer images using WMS-like requests with additional parameters.

ARGOS Food and Dose Module Implementation in Ireland

Catherine Organo,Radiological Protection Institute of Ireland, 3 Clonskeagh Square, Dublin 14, Ireland

ABSTRACT (adapted from McGinnity, P., McMahon, C.A., Smith, K.J. & Colgan, P.A. 2008 Prompt Simulation of the Transfer of Radioactivity in the Irish Food Chain following a Nuclear Accident, Radioecology and Environmental Radioactivity Conference, Bergen, Norway)

Due to Ireland's distance from overseas nuclear facilities, ingestion of foodstuffs containing elevated levels of radionuclides is considered to be the most significant potential radiation dose pathway to the population following a large scale nuclear incident with the potential to contaminate a wide area of the country. This exposure could be almost totally prevented by the introduction of appropriate controls on the distribution and consumption of foodstuffs.

To enhance its capability to assess the potential contamination of the food chain and resulting human ingestion doses, the RPII has decided to implement the Food and Dose Module (FDM). This model is based on the ECOSYS-87 radiological simulation model which is well-documented and established in European nuclear emergency management systems. It is operated using the ARGOS nuclear decision support system which has been used by the RPII as its primary tool for technical assessment of, and preparedness for, a nuclear or radiological emergency since 2001. The RPII was the first ARGOS user to adapt this version of FDM for a specific region. FDM simulates the time-dependent transfer of radionuclides to foodstuffs after deposition onto agricultural land and the radiation exposure of people via all relevant exposure pathways via the same processes but offer complementary options for emergency management.

Models simulating the transfer of radionuclides through food chains and the calculation of the potential resultant exposure of the population due to ingestion of contaminated foodstuffs are highly sensitive to the characteristics of the region where deposition takes place. For this reason, many model input parameters have to be adjusted before the model can be applied to a given region. The FDM configuration work to Irish conditions started in 2005 and was completed in 2007. This was done using DBEditor, a utility provided with ARGOS, whereby data can easily be entered into the ARGOS database and modified. Adapted parameters which were sourced and used as input to FDM include livestock feeding regimes at various times of the year; leaf area indices, growth periods, yields and harvest dates for each agricultural crop in every regions; (human) consumption rates for the main domestically produced foodstuffs; administrative regional boundaries; main domestic animal products and their production in each region; and soil types.

This presentation describes how the FDM was adapted for Irish conditions and will show sample outputs from the model to illustrate its integration into emergency technical assessment procedures used during selected exercises. Future developments are also suggested such as the implementation of a countermeasure model within the Irish ARGOS system.

Appendix: Workshop program

Thursday 1 October	
10:00-10:30	Registration and coffee
10:30-11:00	Opening
	Nordic session *Chair: Eldri N. Holo* Use of Descision Support Systems in the Nordic Countries.
11:00-11:30	Emergency management is a collaborative effort *Michael Ammann*
11:30-12:00	ARGOS overview *Steen Hoe*
12:00-13:00	Lunch
	Nordic session continues
13:00-13:30	Use of DSS in Sweden *Jonas Lindgren*
13:30-14:00	Use of DSS in Norway *Jan Erik Dyve*
14:00-15:00	Session Summary *Eldri N. Holo* Plenary discussion – is there need for a strong nordic cooperation on the use of DSS?
15:00-15:30	Coffee break
	International session *Chair: Stig Husin*
15:30-16:00	Use of RODOS in Germany. *Florian Gering.*
16:00-16:30	ARGOS use in Australian Radiation Emergency Preparedness. *Dr Stephen Solomon*
16:30-17:00	ARGOS implementation in Brazil. *Pedro P. Lima-e-Silva*
17:00-17:30	Use of RODOS and ARGOS in Poland. *Ernest Staron*
17:30-18:00	Use of ARGOS in Canada. *Dominique Nsengiyumva*

Friday 2 October	
08:45-09:00	Coffee
	Friday session *Chair: Morten Sickel*
09:00-09:30	Data Visualization using Web GIS Software. *Tuomas Peltonen*
09:30-10:00	Implementation of FDM in Ireland. *Catherine Organo*
10:00-11:20	What can we expect from DSSs in the future

	ARGOS: *Jan Persson* RODOS: *Florian Gering* *IRIX: Jonas Lindgren* Discussion
11:20-12:00	Consensus session. End of workshop.
12:00-13:00	Lunch

Appendix: List of participants

Name	Organisation
Catherine Organo	Radiological Protection Institute of Ireland
Dominique Nsengiyumva	Health Canada
Eldri N Holo	Norwegian Radiation Protection Authority
Ernest Staron	Polish Atomic Energy Agency
Florian Gering	Federal Office for Radiation Protection, Germany
Jan Erik Dyve	Norwegian Radiation Protection Authority
Jan Pehrsson	Prolog Development Centre A/S, Denmark
Jonas Lindgren	Swedish Radiation Protection Authority
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Abstract	Nuclear preparedness and response authorities in the Nordic countries are using decision support systems (DSS) as part of their operational capability. A DSS compile, display and analyse data that makes up the current and future radiological state of an emergency. ARGOS and RODOS are the two most common systems in use in the Nordic region. The aim of of the NordDSS workshop was to gather Nordic and international experts on DSS, and share knowledge and experience. The workshop brought together 22 experts for two days in Copenhagen.
Key words	Nuclear preparedness, Decision support system, ARGOS, RODOS, emergency management systems, GIS

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