FAST Nuclear Emergency Tools (FASTNET) project

I. Devol-Brown (IRSN, France)

Contents

1. Objectives & context
2. Partnership
3. Final deliverables
4. General structure
5. Current status

1. Objectives & context

Objectives

Call H2020-EE-2014-2-RIA (NFRP-02-2014), Nugenia labelled (T2)
"Tool for the fast and reliable prediction of severe accident progression and anticipation of the source term of a nuclear accident"

The **objectives** are:
- to set-up a severe accident scenarios database

- to qualify a common graduated response methodology that integrates several tools and method to :
  - evaluate the source term,
  - ensure both diagnosis and prognosis of severe accident progression,
  - make the connection between the FASTNET tools and others systems that use source term definition for further assessments

in order to implement in any emergency centres the proposed solution for the management of emergency in all European NPPs or SFP facilities

Context (1)

In Europe:

- The CESAM project (7th EC Framework Programme) which started in April 2013 in order to improve the applicability of the ASTEC integral code to Severe Accident Management in all main types of NPP operating now or in a near future in Europe

- The NERIS European platform which was established in 2011 in order to discuss research needs to further improve radiological and nuclear emergency management and rehabilitation in Europe

- The post-Fukushima WENRA Emergency database working group which has to set up a database, DEEPER, of European reactor designs and SAM features to provide background information on NPP design features within a short timeframe in case of a nuclear accident in Europe

- An initiative from the Heads of the European Radiological protection Competent Authorities (HERCA) which is developed to put in place mechanisms between Member States to enhance such harmonised approaches

Context (2)

Beyond Europe:

- IAEA through a support in the implementation of its Action Plan on Nuclear Safety and specifically in the enhancement of the Response and Assistance Network (RANET) capability for providing international assistance

- OECD through the FASTRUN project dedicated to fast-running source term evaluation and the BSAF project on the understanding of the Fukushima accidents and the benchmarking among several codes (including ASTEC)

- Japanese organisations, such as NRA and JAEA, through a possible collaboration which will strengthen the necessary close link with the Fukushima situations

2. Partnership

Partnership

- This project, coordinated by the Institut de Radioprotection et de Sûreté Nucléaire (IRSN, France) involves 20 partners and 1 third party for 48 months

- A variety of stakeholders:
  - NSA
  - Operators
  - TSO
  - Universities
  - IAEA

  From :
  - EU
  - USA
  - Canada
  - Russian Federation

Participant No	Short name	Participant organisation name	Country
1	IRSN	Institut de Radioprotection et de Sûreté Nucléaire	France
	IAEA	International Atomic Energy Agency	-
2	Abmerit	ABmerit	Slovak Republic
3	Bel V	Bel V	Belgium
4	CIEMAT	Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas	Spain
5	DEMA	Danish Emergency Management Agency	Denmark
6	EDF	Electricité De France	France
7	ENEA	Italian National agency for new technologies, Energy and sustainable economic development	Italy
8	RATEN	Institute for Nuclear Research	Romania
9	IKE	University of Stuttgart, USTUTT (IKE - Institute of Nuclear Technology and Energy Systems)	Germany
10	BOKU	Institute of Safety and Risk Sciences - University of Natural Resources and Life Sciences	Austria
11	JRC	Joint Research Center - European Commission	-
12	KIT	Karlsruhe Institut Technology	Germany
13	LEI	Lithuanian Energy Institute	Lithuania
14	LRC	Lloyd's Register Consulting	Sweden
15	NRPA	Norwegian Radiation Protection Authority	Norway
16	NRI	UJV Rez, a. s.	Czech Republic
17	SSM	Strålsäkerhetsmyndigheten	Sweden
18	STUK	Radiation and Nuclear Safety Authority	Finland
19	CNSC	Canadian Nuclear Safety Commission	Canada
20	US-NRC	US Nuclear Regulatory Commission	USA
21	SEC-NRS	Scientific and Engineering Centre for Nuclear and Radiation Safety	Russian Federation

3. Final deliverables

A severe accident scenarios database

- The database is deployed to a Windows server and is usable on different platforms (Mac, Linux, Windows)

- It is being populated by available data of source term for the most important accident scenarios and by calculations when data is not available for given scenarios

- The type of the input format of the database is:
  - EXCEL file for the grammar description
  (the minimum set of radioelements and their speciation necessary for a consistent calculation of the source term and the received doses…)
  - CSV file for the variable evolution

- The type of the output format of the database is IRIX
(standard format to link with environmental dispersion initiatives and tools)

- The architecture of the database is being completed by an application web integrating different conversion units which manage input and output of the database

- At the end of the project, the database will be managed by IAEA

A common graduated response methodology (1):

The proposed methodology relies on 2 complementary approaches supported by already existing method and tools

- **The deterministic approach:**
  - based on the use of a two-step expertise methodology already in place and operational for French PWR, the **3D3P method (triple diagnosis triple prognosis, IRSN-EDF)**
  - supported by existing fast-running source term evaluation tool **(PERSAN, IRSN)**

- **The probabilistic approach:**
  - based on the use of the existing Bayesian Belief Network (BBN) tool **(RASTEP, SSM)**. The key is to produce a specific ranking of plausible scenarios from the database of European reference accident scenarios and the RASTEP tool
  - complemented by automatic post-processing tools being able to rank scenarios based on external constraints such as the protection of the surrounding population

A common graduated response methodology (2):

Development of these existing method and tools

Deterministic method and tool

3D3P (diagnosis/prognosis method)

PERSAN (fast ST evaluation tool)

Probabilistic tool

RASTEP (BBN diagnosis/prognosis tool based on L2-PSA inversion)

Extension of the BBN capabilities from static to dynamic representation of inferences for complex network

- including deterministic information coming from specific models or severe accident code evaluation

Extension to existing plants in Europe (PWR of Gen II, BWR of Gen II, PWR of Gen III (only EPR), VVER 440 and 1000, CANDU)

Inclusion of functionalities to produce or integrate environmental releases data at a standard format (**IRIX, IAEA**) in order to link them with other initiatives focused on atmospheric transport, radiological consequence assessments and data assimilation

A common graduated response methodology (4):

Improvement/validation of

Developed method and tools
(3D3P, RASTEP, PERSAN)

Realisation of training sessions on each method and tools

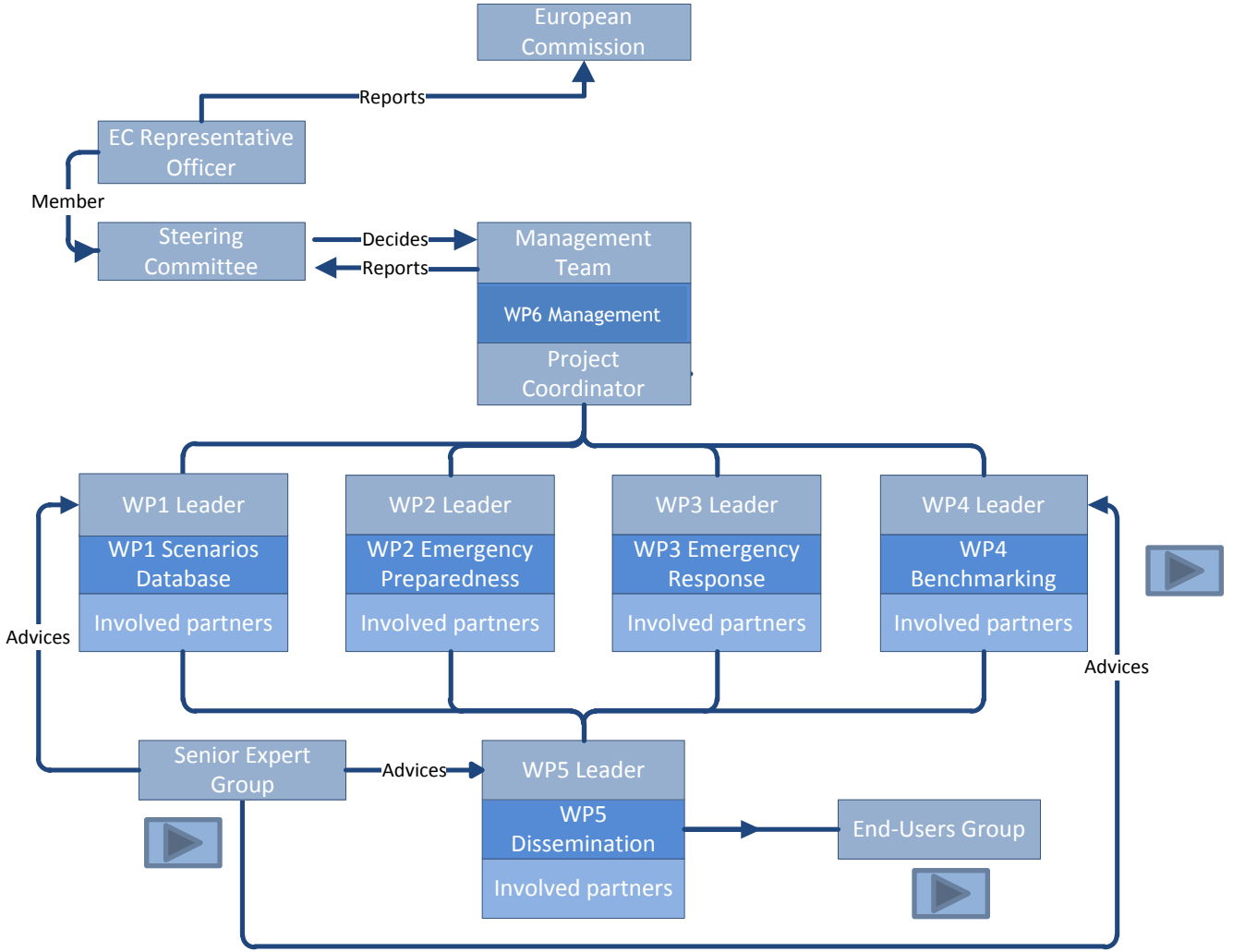
Common response methodology

Realisation of 2 series of emergency exercises:

- the best evaluation of the on-going situation, its evolution and its consequences
- the population protection

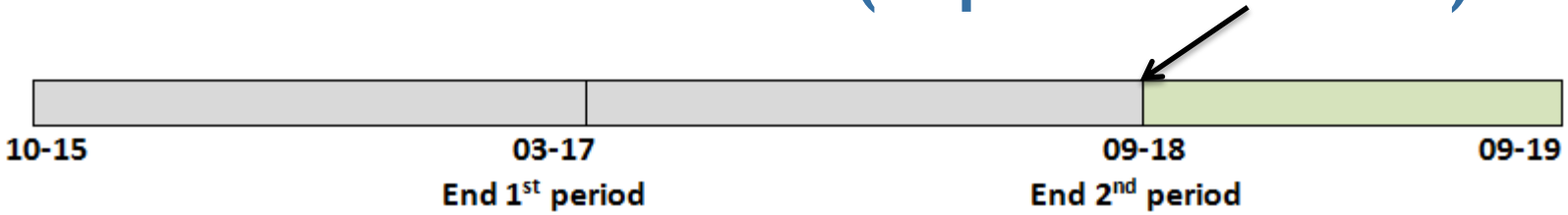
4. General structure

General structure

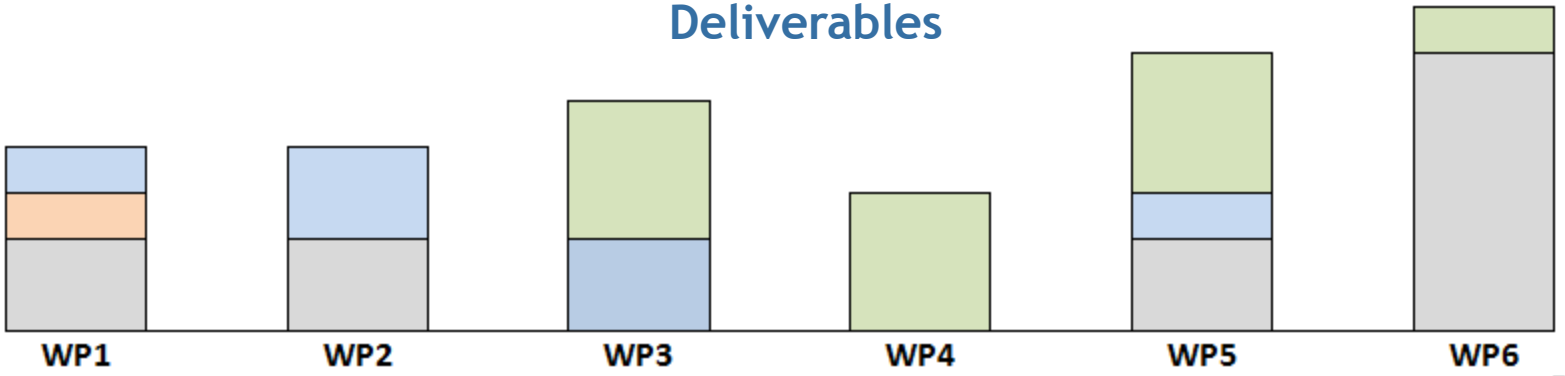


5. Current status

Deliverables & Milestones (September 2018)



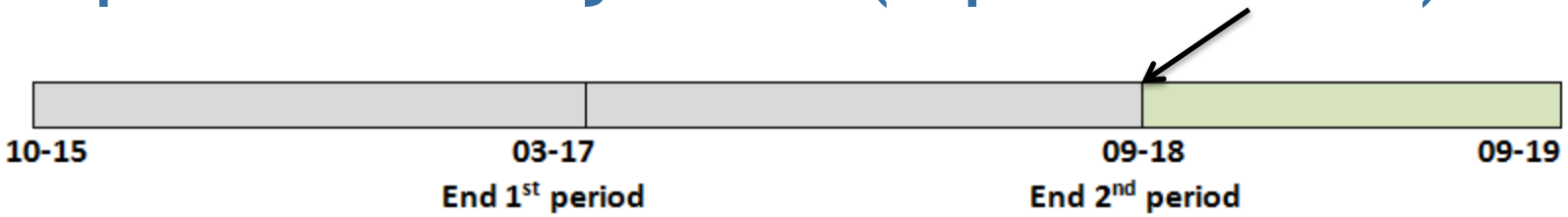
Deliverables



Milestones

	Not started
	In progress but late
	In progress
	Reached/published

Scientific presentations & publications in Conferences or in peer-reviewed journals (September 2018)



- **Presentations**
  - **TopSafe 2017 Conference** in Vienna, Austria, February 2017:" *Trends in severe accident research in Europe: SARNET network from EURATOM to Nugenia*"
  - **8th European Review Meeting on Severe Accident Research (ERMSAR)** in Warsaw, Poland, May 2017: "*FASTNET H2020 project: qualification of a harmonized response methodology for diagnosis and prognosis of severe accident situations*"
  - **ECURIE Competent Authorities' Meeting** in Luxembourg, Luxembourg, October 2017: "*FAST Nuclear Emergency Tools for the reliable prediction of severe accident progression and anticipation of the source term of a nuclear accident*"
  - **10th Meeting of the European MELCOR User Group (EMUG)** in Zagreb, Croatia, April 2018: "*ENEA source term evaluation with MELCOR code in the EU-FASTNET project framework*"
  - **International MACCS Users Group (IMUG) Meeting** in Rockville, USA, June 2018: "*ENEA plans for consequence analyses in Italy*"
  - **Melcor User Group (CSARP/**MCAP**) Meeting** in Rockville, USA, June 2018: "*ENEA activities in the field of severe accidents*"

- **Publications**
  - **Progress in Nuclear Energy** 108 (2018) 351-357: « *Analysis of the releases produced by CANDU type irradiated fuel bundles accidentally remained in the air", M. Constantin, M. Apostol, A. Constantin, 2018*

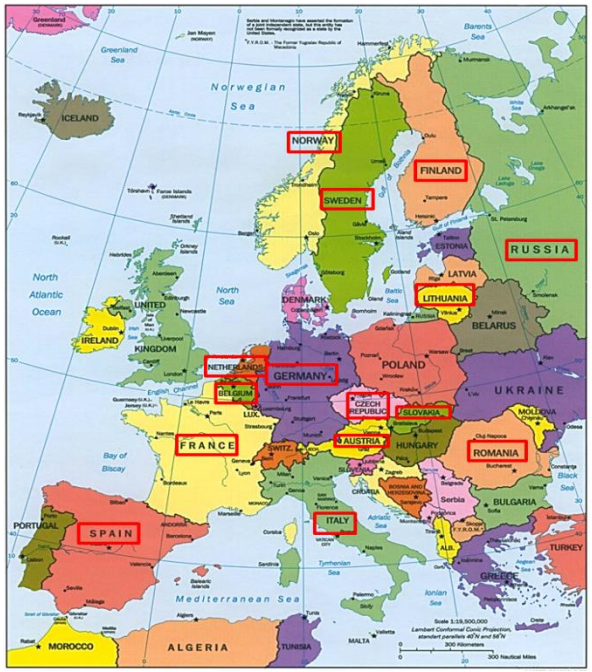
Thank you for your attention

IRSN	Mr ISNARD Olivier, Mr VOLA Didier, Mr COUSIN Frédéric, Mrs CHEVALIER-JABET Karine, Mr DEYRIS Johann, Mrs CREACH Valérie, Mr MESTRALETTI Didier, Mrs DEVOL-BROWN Isabelle
IAEA	Mr CHAPUT Joe, Mr BACIU Florian, Mrs SOLE Erin
Abmerit	Mr CARNY Peter, Mrs SMEJKALOVA Eva, Mr LIPTAK Ludovit
BelV	Mr DEGUELDRE Didier, Mr DELEDICQUE Vincent, Mr VERBOOMEN Bernard, Mrs. DELEU Axelle
CIEMAT	Mr HERRANZ PUEBLA Luis Enrique, Mr FONTANET Joan
DEMA-BRS	Mr HOE Steen Cordt, Mr ISRAELSON Carsten,
EDF	Mr. EYMOND Pierre
ENEA	Mr ROCCHI Federico , Mr MASCARI Fulvio , Mr MELONI Paride
RATEN	Mr RIZOIU Andrei
BOKU	Mr MUELLNER Nikolaus, Mrs AMERI Mandana, Mr ARNOLD Nikolaus, Mr KRAXBERGER Michael
JRC	Mr BRUMM Stephan
KIT	Mr RASKOB Wolfgang , Mr KRETZSCHMAR Frank, Mr MIASSOEDOV Alexei
LEI	Mr URBONAVICIUS Egidijus , Mr PABARCIUS Raimondas
LRC	Mr DI DEDDA Francesco , Mrs TENGBORN Elisabeth, Mr KLUG Joakim, Mr RIBER MARKLUND Anders, Mr KUMAR Manorma
NRPA	Mr DOWDALL Mark , Mr SYED Naeem Ul, Mrs FROVIG Anne Marie, Mrs LILAND Astrid
NRI-UJV	Mr FISER Vladimir , Mr MACHEK Jindrich, Mr KUBICEK Jan, Mr HOLY Jaroslav
SSM	Mr ISAKSSON Patrick, Mrs DANESTIG SJOGREN Catarina
STUK	Mrs LAHTINEN Nina , Mr LEHTOMAKI Thomas, Mrs MANNONEN Jaana
CNSC	Mr MESMOUS Noreddine, Mr SHAWKAT Mohamed
US-NRC	Mr ESMAILI Hossein, Mr ALGAMA Don
SEC-NRS	Mr MISTRYUGOV Denis, Mrs FEDOTOVA Nataliya, Mrs KOZLOVA Nadezhda

A common graduated response methodology (3):

Existing method and tools have to be extended mainly in term of applicability on a larger set of reactors:

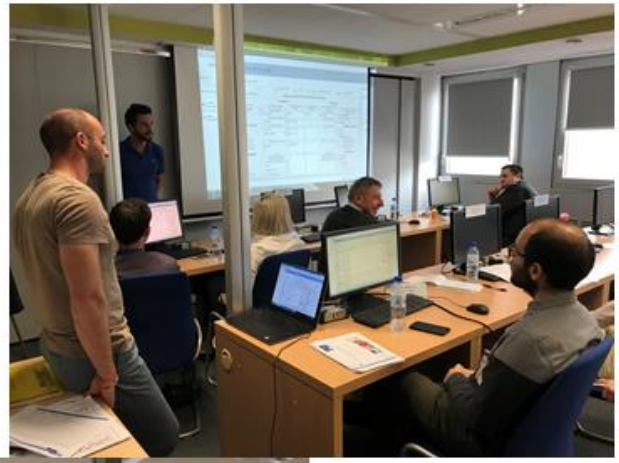
Plant concepts	Partners having recognized skills on each concept							
PWR	BelV	CIEMAT	EDF	IRSN	KIT	LRC	SSM	USNRC
EPR	EDF	IRSN	STUK	USNRC				
BWR	CIEMAT	KIT	LEI	USNRC	STUK	SSM	LRC	
CANDU	CSNC	RATEN						
VVER	ABmerit	NRI	SEC-NRS	STUK				



NPP addresses both to the power plant and its SFP facilities. But, whereas all concept of NPP implemented or foreseen in Europe will be addressed specifically, a generic solution will be proposed for SFP facilities that would be easily adapted if needed.

A common graduated response methodology (5):

Training session organized in France, from May 28th to 30th, 2018, on developed method and tools (38 participants from 22 European or non-European countries)



WP	Name/Lead	Description
WP1	**Scenarios database** (LEI)	Elaboration of a common database of pre-calculated scenarios on all concepts of existing NPPs in Europe including the SFP facilities
WP2	**Emergency preparedness** (LRC)	Evaluation and improvement of 2 types of existing approaches: the deterministic approach (3D/3P) and approaches based on BBN
WP3	**Emergency response** (IRSN)	- Development of specific parameterisations files describing all concepts of existing NPPs in Europe including SFP facilities which will be included with the PERSAN tool to allow the fast calculation of source terms for any situation - Improvement of the BBN approaches to foster their implementation in emergency centres
WP4	**Emergency exercises** (NRPA)	Preparation and the realisation of 2 series of emergency exercises
WP5	**Dissemination** (ENEA)	- Sharing of knowledge, including a scenarios database and reference methods and tools beyond the Consortium - Education and training through workshops
WP6	**Management** (IRSN)	Project overall administrative and financial management

SEG (September 2018)

IRSN, France	M. Didier JACQUEMAIN (didier.jacquemain@irsn.fr)
Abmerit, Slovak Republic	M. Peter CARNY (carny@abmerit.sk)
BelV, Belgium	M. Thibaut VAN ROMPUY (thibaut.vanrompuy@belv.be)
CIEMAT, Spain	M. Luis Enrique HERRANZ PUEBLA (luisen.herranz@ciemat.es)
DEMA-BRS, Denmark	M. Steen Cordt HOE (hoe@brs.dk)
RATEN, Romania	M. Marin CONSTANTIN (marin.constantin@nuclear.ro)
JRC	M. Stephan BRUMM (Stephan.BRUMM@ec.europa.eu) M. Andrija VOLKANOVSKI (andrija.volkanovski@ijs.si)
NRI-UJV, Czech Republic	M. Jan KUBICEK (Jan.Kubicek@ujv.cz)
SSM, Sweden	M. Patrick ISAKSSON (Patrick.Isaksson@ssm.se)

EUG (September 2018)

APA, Portugal	M. Luis PORTUGAL (luis.portugal@apambiente.pt) M. Joao Oliveira MARTINS (joao.martins@apambiente.pt)
EPA, Ireland	M. Robert RYAN (r.ryan@epa.ie), Mrs Veronica SMITH (V.Smith@epa.ie)
GRS, Germany	M. Michael HAGE (Michael.Hage@grs.de)
ISPRA, Italy	Dr Paolo ZEPPA (paolo.zeppa@isprambiente.it) Dr Silvia SCARPATO (silvia.scarpato@isprambiente.it)
JSI, Slovenia	Mr. Ivo KLJENAK (Ivo.Kljenak@ijs.si)
NRI-UJV, Czech Republic	M. Jindrich MACHEK (Jindrich.Machek@ujv.cz)
NRPA, Norway	M. Naeem UL SYED (naeem.ul.syed@nrpa.no)
PAA, Poland	M. Pawel LIPINSKI (pawel.lipinski@paa.gov.pl) M. Mateusz MALICKI (mateusz.malicki@paa.gov.pl) M. Mateusz WLOSTOWSKI (mateusz.wlostowski@paa.gov.pl) M. Adam JAROSZEK (adam.jaroszek@paa.gov.pl)
SSM, Sweden	Mrs. Anna Maria BLIXT BUHR (AnnaMaria.BlixtBuhr@ssm.se) Mrs. Karin FRITIOFF (Karin.FRITIOFF@ssm.se)