Research and Development Programme on Seismic Ground Motion Assessment : SIGMA 2011 - 2015

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INTRODUCTION

Values of $\sigma$ have not been reduced significantly over the years........
Main objectives

Improve and homogenise the **data bases** and **seismic hazard methods**

Better quantify and reduce all **uncertainties** in seismic hazard estimates

We are expecting

*Provide scientific support for updating the regulations and recommendations* (ex **ISSC – IAEA WA1: Seismic Hazard**)

*Foster technical and scientific exchanges between European organizations*
Scope of Works
A research programme in 5 Work Packages:

WP 1 Seismic Source

WP 2 Ground Motion prediction models

WP 3 Site Effects

WP 4 Seismic Hazard Models

WP 5 Representation of design parameters
Study Areas

FRANCE
¼ South-Est

ITALY
Po Plain
WP1: A better knowledge of seismic sources

➢ **Objective**
Produce a catalogue of earthquakes that covers the historical and instrumental periods, and improve knowledge of faults

➢ **Expected results / Deliverables**
- A homogenous seismicity catalogue (Mw, Depth, uncertainties) including all periods: historical and instrumental
- A methodology for better analysing the historical seismicity *(using modern methods with expert historians)*
- A database of faults and identification of capable faults *(methodology and application to the study sites)*

➢ **Organisation & Technical progress**
Development of a method to determine Mw
Characterization of earthquake depths using teleseismic data
Conception of the homogenous catalogue (SiHex Project)
WP2: Ground Motion Prediction Models

➢ **Objective**
To develop a ground motion prediction model adapted to the moderate seismicity context, with a realistic characterisation of uncertainties.

➢ **Expected results / deliverables**

• A homogeneous DATABANK of seismic motion with quantification of uncertainties associated to metaparameters.

• A ground motion prediction models adapted to the French context (and nearby area) with a realistic and quantitative characterization of uncertainties to predictions.
SHARE database data sources

The pan-European dataset of SHARE SMD is extracted to form the SIGMA strong-motion databank.
RESORCE
REference databaSe fOR seismiC ground-motion in Europe

Paola Traversa (EDF), Fabrice Cotton (ISTerre)
METU(Ankara), EMDC-CSEM (Paris), BRGM (Orleans), INGV (Milano), CEA (LDG)
actions:

- Database implementation
- Collection of different databases from different projects and studies
- Improvement of quality and homogeneity of data and metadata
- Quantification of uncertainty in metadata
- Integration of regional weak motion data (French and neighbouring countries acelerometric network data) to calibrate GMPEs in the low magnitude range
W P3: Improve local site representation (Site effects)

➤ Objective

To develop operational methods for predicting the site effects, and to produce appropriate methodologies to include the site effects in the seismic hazard estimates

➤ Expected result

A *Guidelines* to account for site effects
Guidelines to account for site effects

Inventory of methods to account for site effects

Selection, adaptation, optimization...

Testing on test sites

Sensitivity studies

Selection of few real sites, building of « virtual » sites

Simulation tools (non-linear 1D):
*evaluate, optimize, assess uncertainties*

Simulation tools (linear 1D, 2D, 3D):
*evaluate, optimize, assess uncertainties*

Vs characterization methods:
*evaluate, optimize, assess uncertainties*

Definition of reference ground motion

Prenolin
E2VP
InterPacific

From Hollender may 2012 – SIGMA Scientific Committee No 3
WP4: Improve seismic hazard models

Objective
Quantify and reduce uncertainties of probabilistic seismic hazard models estimates

Expected results
• A methodology to optimise the probabilistic prediction:
  - define methods to compare hazard estimates with observations
  - Apply tools to update the seismic hazard models

• A methodology for measuring the quality of probabilistic seismic hazard predictions
  - comparison of two methods of seismic risk assessment: structural fragility functions and macroseismic intensity data

Application to the SIGMA studies sites
WP 5 : Improve characterization and exploitation of seismic ground motion

Objective:
To ensure that results of the overall project fulfil the engineers needs for the design and operations of facilities types

Two technical tasks:

- To identify seismic design parameters and thresholds appropriate for vulnerability assessment

- To develop methods for selecting the Scenario Earthquake Time Histories for SSI Analysis - to develop « conditional spectra » method for the SIGMA study site.
Who work in the SIGMA project?

- **Industrials partners**
  AREVA, CEA, EDF, ENEL are engaged

- **Funding partners**

- **Scientific partners: 8 countries / 30 research organisations**
  - **France**: Grenoble University, Geosciences Azur University, IRSN, EOST, Univ St Quentin, BRGM, CEREGE, Geoter, INSA, LCPC
  - **Germany**: Potsdam university
  - **Italy**: INGV, Politecnico Turin
  - **Turkey**: Middle East Technical University (Ankara)
  - **Belgium**: Observatoire Royal Belge
  - **Switzerland**: ETH
  - **Slovaquie**: Bratislave University
  - **USA**: Virginia university

**Currently involved:**
- 10 PhD students
- 6 post-docs
- 14 research contracts

[www.projet-sigma.com](http://www.projet-sigma.com)