SIXTH FRAMEWORK PROGRAMME

PRIORITY 1.6

**En**hanced **G**eothermal **I**nnovative **N**etwork for **E**urope

Project no 019760

# ENGINE

## **En**hanced **G**eothermal **I**nnovative **N**etwork for **E**urope

**Instrument**: Coordination Action

**Thematic Priority**: 1.6 Sustainable energy systems

# 3rd Periodic activity report

**Deliverable 2: six month and one year activity report**

**Period covered**: from 1st November 2007 to 30thApril 2008 **Date of preparation**: 15/06/08

**Start date of project**: 1st November 2005 **Duration**: 30 months

**Project coordinator name**: Patrick Ledru

**Project coordinator organisation name**: BRGM

Version 1: 30th July 2008

# Table of contents

# 1. Periodic activity report

## 1.1. PUBLISHABLE EXECUTIVE SUMMARY

### 1.1.1. Summary description of project objectives

The work programme of the FP6 priority thematic area 1.6, "Sustainable energy systems", defines a need for co-ordinating ongoing research and promoting the development and uptake of innovative methods and technologies to expand the exploitation of Unconventional Geothermal Resources, in particular Enhanced Geothermal Systems.

To summarise, by exploring Unconventional Geothermal Resources, research and development institutes face:

- a scientific challenge to understand the distribution of heat and permeability at depth in the uppermost crust. High amplitude and small wavelength anomalies, related to local high conductivity layers or highly radioactive sources, may develop on the large wavelength thermal anomalies and present a great interest for assessment of reservoirs for Hot Dry Rock energy systems.
- a technological and economic challenge to improve and render cost-efficient investigation and development technology in order to make these geothermal systems viable.
- communication challenges to rally the support of policy makers and investors and, in certain cases, increase the social acceptance of a broader community.
- a challenge to integrate the different, yet parallel, research paths that currently exist, namely one for investigation and resource assessment and another for sustainable exploitation schemes, one for Hot Dry Rocks and another for High Energy Systems.

The Co-ordination Action, called “Enhanced Geothermal Innovative Network for Europe” (ENGINE) has been proposed in this framework. Its main objectives are to motivate the scientific community to face up to the above-mentioned challenges, to capitalise the know-how acquired in the framework of the Hot Dry Rocks Soultz experiment but also from the exploration and exploitation of Italy, Bouillante and Iceland geothermal fields, to define new integrated projects that will federate the scientific community working in the "geothermal field", in partnership with industry, in order to achieve the strategic objectives of the European Community. It will provide (1) an updated framework of activities concerning geothermal energy in Europe, including the integration of scientific and technical know-how and practices, the evaluation of socio-economic and environmental impacts; (2) the definition of innovative concepts for investigation and use of Unconventional Geothermal Resources and Enhanced Geothermal Systems; groups of experts will present a ”Best Practice Handbook”; (3) a scientific and technical ”European Reference Manual” including the information and dissemination systems developed during the Co-ordination Action. The links established between research and development teams, national development programmes, industrial partners and international agencies will be used to promote the geothermal energy as a major renewable and sustainable source of energy and to propose innovative high-level medium- to longer-term research projects

The structure of the project is based on 9 workpackages (Figure 1). The *Project management* activities are gathered in the Workpackage 1. A special attention is paid to the *Information and dissemination system of the Co-ordination Action* (WP2) as the potential impact of the project will be related to the mobilisation of a large scientific and industrial community and to the establishment of a sustainable institutional and political support. It will provide (i) a working platform for exchanging general or specialised information, (ii) on-line exchange and dissemination of scientific and technical know-how and practices, (iii) access to a metadata base, specified database, open-source software and models, (iv) an interface with non-member institutes and the international geothermal community, (v) development and maintenance of a regular contact with the media's.

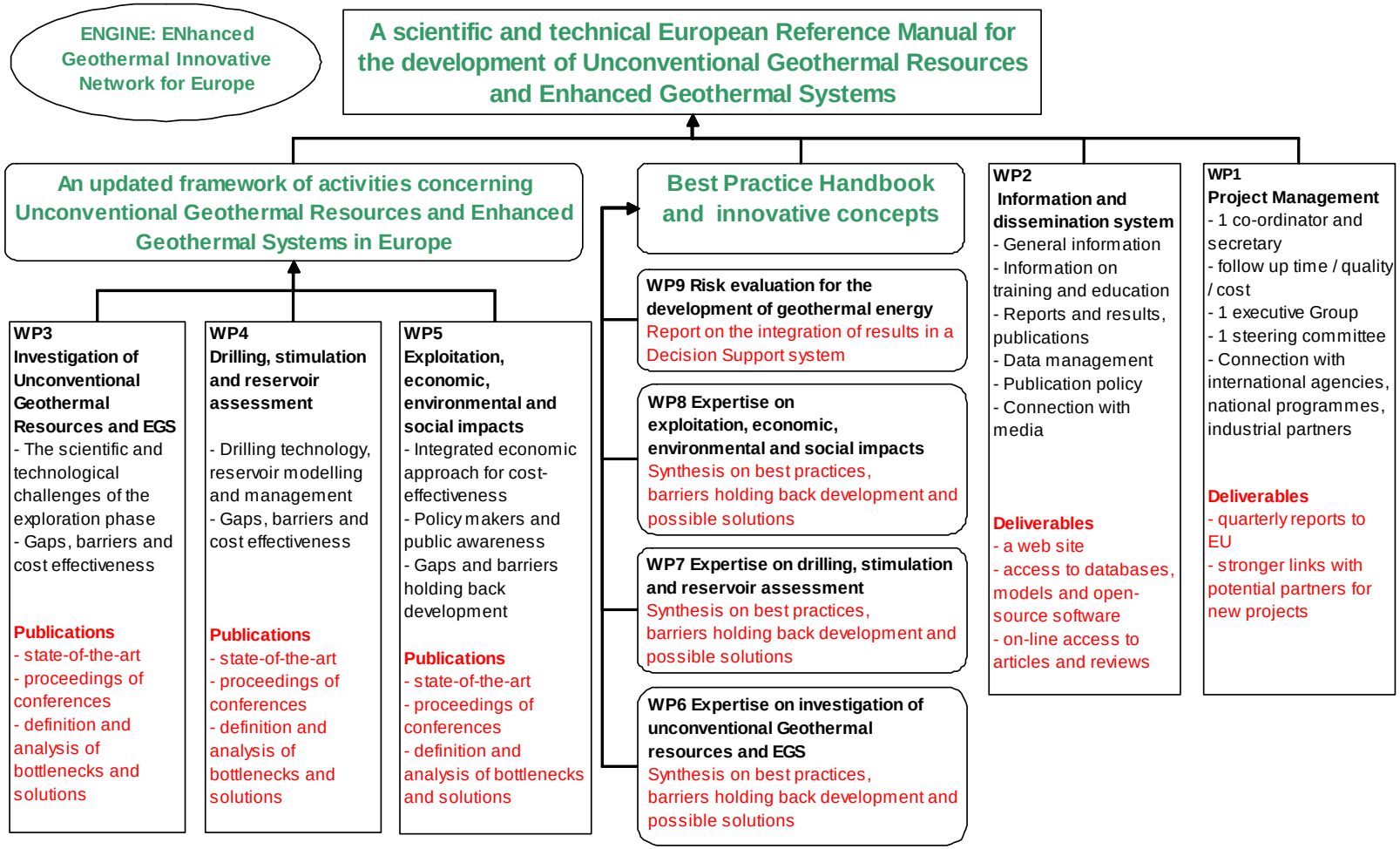



**Figure 1. Breakdown structure of the ENGINE Coordination action**

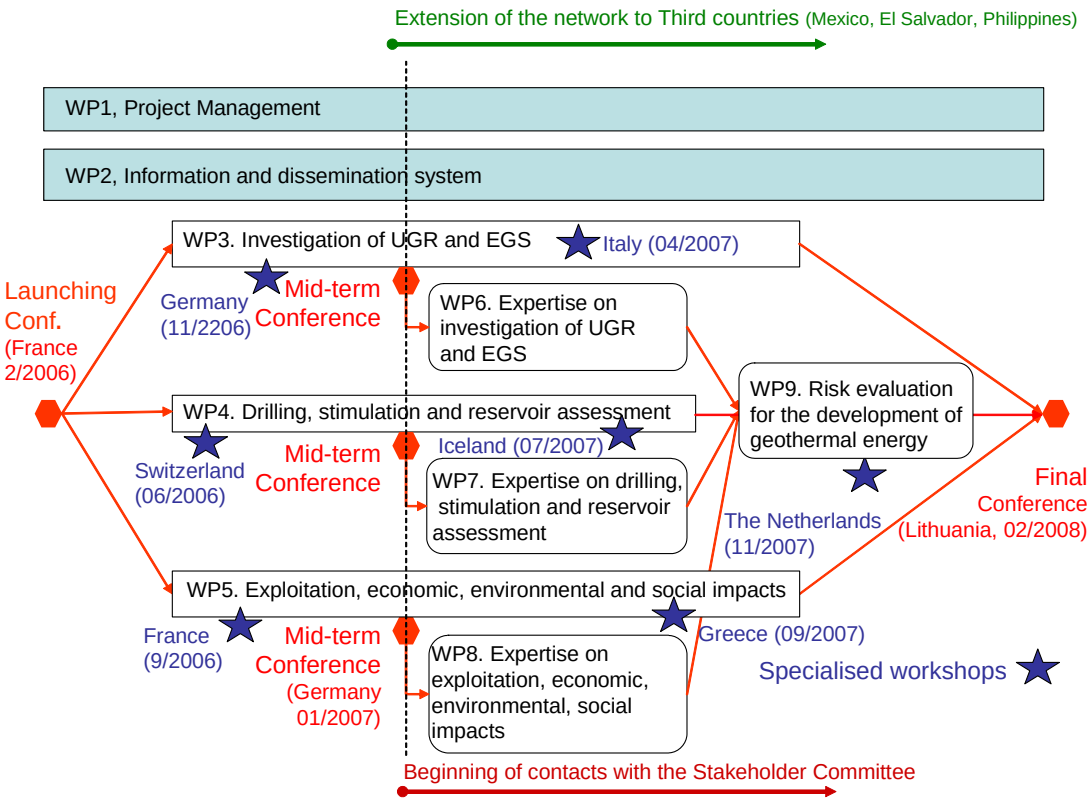



**Figure 2: Project network of activity**

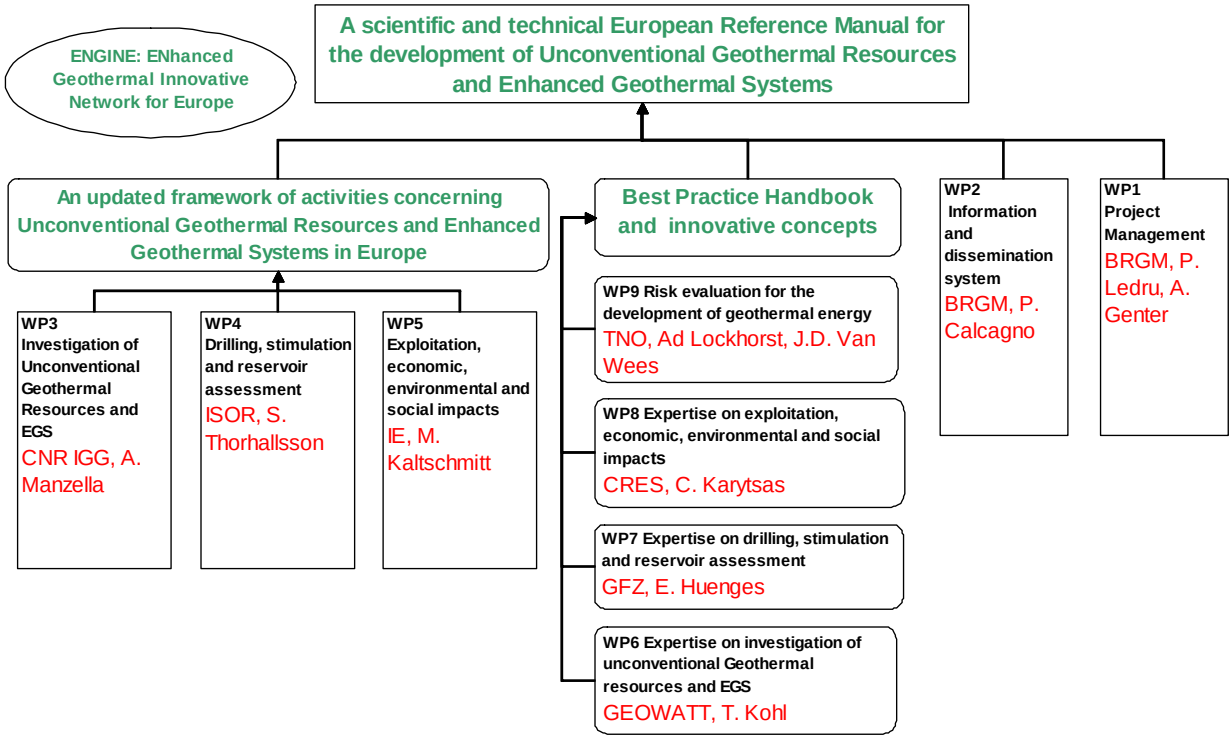



**Figure 3: Breakdown of the ENGINE resources and Workpackage leaders**

To promote an efficient network of geothermal activities, the Co-ordination Action defines and manages joint and common initiatives through (Figure 2):

- an Integration Phase, i.e. a bottom-up and federative strategy to motivate the scientific community to face up to the scientific and technical challenges. Workshops and conferences are regularly organised to ensure a smooth and streamlined flow of exchanges and co-ordination. *This integration of scientific and technical know-how and practices provides* an updated framework of activities concerning geothermal energy in Europe. It *covers all initiatives and bottlenecks* encountered during the *Investigation of EGS and unconventional Geothermal resources* (WP3), *Drilling, stimulation and reservoir assessment* (WP4) and *Exploitation, economic, environmental and social impacts* (WP5). For each of these Workpackages, the co-ordination workis aimed at (i) presenting the state-of-the-art, (ii) defining the most appropriate scientific and technological approaches, (iii) identifying the main gaps, barriers and unsolved questions; (iv) analysing how such know-how and procedures can be transferred and bottlenecks overcome. The economic factor and the cost-effectiveness of each scientific and technological approach are systematically considered. The deliverables mainly consist of publications providing access to the conclusions of these integration actions and, in particular, to the state-of-the-art.
- a Synthesis Phase; i.e. the creation of Expert Groups/panels in charge of defining priorities in the field of research investment and strengthening the links with the financial and political institutions. Four groups of experts, acting within WP 6-7-8, perform an evaluation of the best practices and innovative concepts to be adopted on the different types of activities covered by the WP 3-4-5. WP9 on *Risk evaluation for the development of geothermal energy* is aimed at synthesising the main scientific and technical aspects, as well as economic and environmental constraints, resulting from the different expert groups. Deliverables include a Best Practice Handbook and the definition of innovative concepts for geothermal investigation, reservoir stimulation and assessment and exploitation.

A scientific and technical European Reference Manual for the development of *Unconventional Geothermal Resources* will finally present this Best Practice Handbook and will include all publications, information, metadata base, database and models collected and compiled during the integration phase of the Co-ordination Action.

### 1.1.2. Contractors involved

The project involves 31 contractors. The workpackage leaders are presented on figure 3. The first group of partner has a broad knowledge covering large aspects of the geothermal energy. It comprises **BRGM** (France), co-ordinator of the ENGINE project, **CFG SERVICES** (France), **GeoForschungsZentrum Potsdam** (GFZ, Germany), **ISlenskar ORkurannsoknir** (ISOR, Iceland GeoSurvey), **Centre for Renewable Energy Source** (CRES, Greece), **the Geological Survey of Denmark and Greenland** (GEUS, Denmark), **Shell International Exploration and Production B.V.** (SIEP B.V., Netherlands).

The second group of partner has a knowledge covering mainly the exploration and drilling and reservoir assessment: the **Instituto di Geoscienze e Georisorse** (IGG, Italy), the **Department of Geophysics of the Eotvos University** (ELTE, Hungary), the Institute of Earth Sciences, Dept. of Tectonics, of the **Vrije Universiteit Amsterdam** (VUA, Netherlands), the **Groupement Européen d'Intérêt Economique "Exploitation Minière de**

**la Chaleur"** (GEIE “EMC”, an international consortium operating on the site of Soultz-sous-Forêts, France), the **Panstwowy Instytut Geologiczny** (PGI, Polish Geological Institute, Poland), **Tsentr geoelektromagnitnykh issledovanii Instituta fisiki zemli Rossiskoi akademii nauk (**GEMRC IPE RAS, GEoelectromagnetic Research Center of the Institute of the Physics of the Earth, Russian Academy of Sciences , Russian Federation), the **Geologijos Ir Geografijos Institutas** (IGGL, Institute of Geology and Geography, Lithuania).

A large group of partners have a large experience in drilling and reservoir assessment, exploitation and impact of the geothermal energy. It is composed of the **Netherlands Organisation For Applied Scientific Research** (TNO, Netherlands), ten laboratories of the French **CNRS** (France) involved in the HDR Soultz experiment, **Geoproduction Consultants** (GPC, France), the Chemical Process Engineering Research Institute (CPERI) of the **Center for Research and Technology-Hellas (CERTH)**, the Environmental Research Laboratory of the **National Centre for Scientific Research "Demokritos"** (NCSRD, Greece), the **Institutt for Energiteknikk** (IFE, Institute for Energy Technology, Norway), the **Deep Heat Mining Association** (DHMA, International Consortium), The company **Geowatt AG**, the **Instituto Geológico y Minero de España** (IGME Geological and Mining Institute of Spain, Spain), the **Leibniz Institute for Applied Geosciences** (GGA-Institute, Germany)

Another group of partners are mainly involved in the development and management of exploitation and in impact studies of the geothermal energy: the **Institut für Energetik und Umwelt** gGmbH (IE, Institute for Energy and Environment, Germany), the **Institut vysokikh temperatur Rossyiskoi academii nauk** (IVTRAN, Institute for high temperatures, Russian academy of sciences, Russian Federation), **the Institute for Geothermal Research of the Daghestan Scientific Centre of Russian Academy of Sciences** (IGR DSC RAS, Russian Federation) and 3 private firms, **ORME JEOTERMAL A.S.**, operating in Turkey, **Joint Stock Company “Intergeotherm”** (JSC “Intergeotherm”, Russian Federation), involved in the construction of geothermal plants worldwide and **MeSy GeoMessSysteme GmbH** (MeSy, Germany) partner of the European HDR Soultz-sous-Forêts project, the **University of Oradea** (UOR, University of Oradea, Romania).

The European Community has offered possibilities to associate new partners from third countries with ongoing projects through INCO (International cooperation). This opportunity has been successfully taken up by inviting research institutes and private firms that have experience in stimulation of natural or provoked reservoirs in geothermal fields to join the consortium. **Filtech Energy Drilling Corporation** (Philippines), **Instituto de Investigaciones Eléctrica** (IIE, Mexico), **Centro de Investigación Científica y Educación Superior de Ensenada** (CICESE, Mexico), and **LaGeo S.A. de C.V.** (El Salvador)I are thus nvolved since the 1st November 2007 into the network.

**BRGM** (France) is the co-ordinator of the ENGINE project. The Co-ordination is performed by Patrick Ledru, Project coordinator at the Research Division of the BRGM, with the support of Albert Genter, Project manager (until September 2007) and Philippe Calcagno, Project manager (since September 2007). Christian Fouillac, Research Director of the BRGM, is chairing the Executive group of this Coordination Action (see contact details in Table 1). The management structure is presented on figure 4.

| | | Tel | Fax | e-mail |
|---|---|---|---|---|
| Patrick Ledru | Co-ordinator | +33 2 38 64 48 19 | +33 2 38 64 39 87 | p.ledru@brgm.fr now at patrick.ledru@areva.com |
| Albert Genter until September 2007 | Co-ordinator Assistant | +33 2 38 64 39 38 | +33 2 38 64 33 34 | a.genter@brgm.fr now at genter@soultz.net |
| Christian Fouillac | Chairman of the Executive Group | +33 2 38 64 36 90 | +33 2 38 64 39 87 | c.fouillac@brgm.fr |
| Philippe Calcagno since September 2007 | Co-ordinator Assistant Project leader | +33 2 38 64 30 54 | +33 2 38 64 33 34 | p.calcagno@brm.fr |
| Annick Darcheville | Accounting manager | +33 2 38 64 | +33 2 38 64 | a.darcheville@brgm.fr |

**Table 1. Coordinator Contact details**

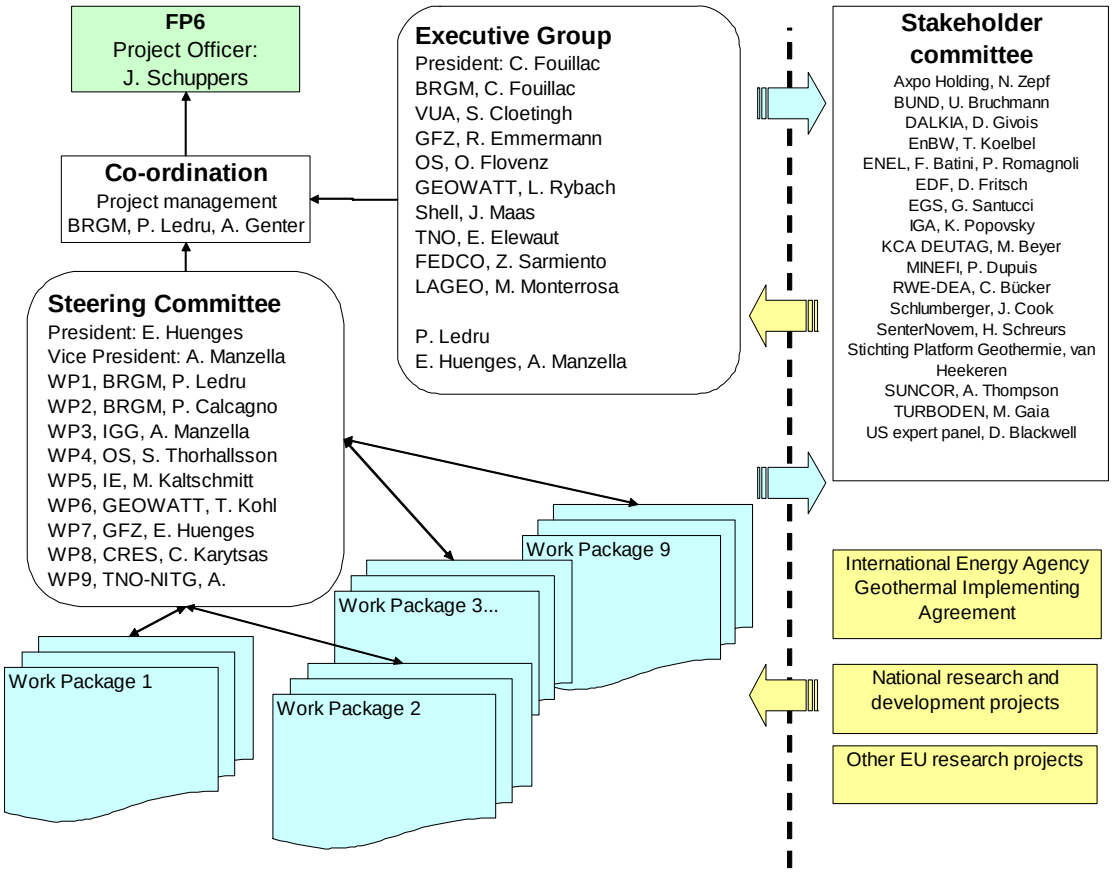



**Figure 4. Management structure of the project**

### 1.1.3. Work performed and results achieved so far

The planning of the "Descrption of the work" document has been followed during the 3rd period. Information resulting from this period is available on the Web site http://engine.brgm.fr.

The Final Conference marked the end of the expert phase synthesised by the Best Practice Handbook. An overview of the results has been presented by the work package leaders at the Final Conference (http://conferences-engine.brgm.fr/conferenceDisplay.py?confId=9). Based on the state of the art defined during the 1st year of the project and on the recommendation of the experts, a strategy has been set up to define priorities in the field of medium- to long-term research investment.

During the project, several points about the impact of the Coordination Action have been emphasized, such as the interest of partners to share their knowledge and practices, the progressive broadening of the community participating to these meetings and the definition of R&D's stakes for developing unconventional geothermal resources. The close and frequent relationship and exchanges between partners belonging to the conventional geothermal community and partner representing European EGS pioneers was also a major element of success for the meetings hold during the 30 months of ENGINE. It has been emphasised by the extension of the network to the 4 partners from Targeted Third Countries, i.e. Mexico, Salvador and Philippines. The settlement of a stakeholder committee has also permitted to enhance links between R&D teams and stakeholders by providing strategic guidance to the Executive Group and to Contractors in general.

### 1.1.4. Intention for use and impact

The main potential impact expected from the Co-ordination Action is to re-establish the institutional and political support that is currently lacking to ensure that geothermal energy reaches its full efficiency and profitability thresholds at European scale. It is first of all necessary to structure the geothermal-energy community towards the definition of innovative research projects. The emergence of such projects requires a capitalisation of the knowledge of the different actors currently playing in the "geothermal field", which implies sharing experiences, exchanging best practices and clearly identifying the gaps and barriers. The expected impact of this Co-ordination Action is that a large scientific research community will be mobilised that is able to promote such spin-off projects with industrial partners. The Co-ordination Action also intends to play a "transmission role" and constitute an exchange platform. It will provide an opportunity to integrate and synthesise all information about know how, practices, innovations and barriers at the level of the Steering Committee and Expert Groups. This will be particularly helpful during discussions with Executive Directors of international funding agencies or National Policy makers.

### 1.1.5. Plan for using and disseminating knowledge

The knowledge acquired during through this Co-ordination Action is already well disseminated and available through the information and publication systems, and should arise the interest of other potential scientific and industrial partners. This dissemination also contributes to the transfer of knowledge towards those requiring more information about the technical and socio-economic know-how for building up the geothermal industry, especially in Central and Eastern Europe. This could speed up the exploitation of both conventional and unconventional geothermal resources in these countries and thus contribute considerably to the short- and long-term goals of the EU to reduce carbon dioxide emissions by increasing the share of renewable energy.

## 1.2. SECTION 1 – PROJECT OBJECTIVES AND MAJOR ACHIEVEMENTS DURING THE REPORTING PERIOD

During the 3rd period of activity, the main objective was to complete the expert phase. On one hand, it consisted in defining the best practises for EGS conception, exploration, site development and production in correlation with risk analyses and public acceptance. On the other hand, a strategy has been set up to define priorities in the field of medium- to long-term research investment. Each Workpackage is supervised by one leader that is member of the Steering Committee.

The work has been performed according to the following guidelines:

- The setting up of a common information system including an original collaborative platform Web site and an electronic newsletter in order to exchange and share information. All presentations, abstracts and articles can be downloaded from the web site through an appropriate software (INDICO) developed for management of conferences and workshops.
- Definition of a policy to encourage the publication of the state-of-the-art, compilations and the results of studies and analyses performed during the Co-ordination Action. The conferences and workshop are dedicated to this aim. Since the very beginning, the focus has been on the quality of the organisation of the meetings.
- Organisation of 1 specialised workshop and the Final Conference on Unconventional Geothermal Resource common for all work packages. Corresponding abstract books, CD-Roms and Newsletters have disseminated information resulting from each meeting and the web site http://engine.brgm.fr has had a constant growth of visits.
- Applications for additional funding have been successfully supported by the Co-ordination Action to support the coming of an US international expert, J. Faulds (Bureau of Mines Nevada) in BRGM Orléans on a project enabling exchange of best practices applied to geothermal resources in Turkey and education.
- Work of past and present IEA-GIA international groups has been integrated within the tasks of the Workpackages, by direct representation of the ENGINE experts in these groups and meetings (T. Megel, L. Rybach, P. Ledru, R. Baria…). Of particular interest are the GIA Annexes I on “Environmental impacts of geothermal energy development” and III on “Enhanced Geothermal Systems”. A new step has been done as the BRGM; coordinator of the project now represents France within the IEA-GIA group since March 2007.
- Exchange of personnel has been favoured as this is a highly efficient way of sharing experience, disseminating best practices and integrating information from different sources. Thus, the stay of a researcher from BRGM in GFZ Potsdam during 3 months has been set up for connecting different approaches of geophysical modelling.
- Informal meetings and contacts spontaneously organised between a limited number of partners and participants on specific issues of the project.
- Integration in the meetings of participants that are not officially members of the network (on their own funds or being associated as sub-contractors if necessary). Each ENGINE meeting attracts some of them from non European countries who wanted to benefit from the audience provided by the co-ordination action to present their results and projects. Such meetings constitute exceptional opportunities to develop new contacts with industry and stakeholders that are concerned by the scope of the project.

Several facts revealed the positive impact of the Coordination Action. As mentioned above, the interest of partners to share their knowledge and practices, the progressive broadening of the community participating to these meetings and the definition of R&D’s stakes for developing unconventional geothermal resources has shown the strong motivation to face up the scientific and technical challenges. The close and frequent relationship and exchanges between partners belonging to the conventional geothermal community and partner

representing European EGS pioneers was also a major element of success for the meetings hold during the 3rd period of ENGINE.

The expert phase of the project which started at the mid-term conference (January 2007) has been completed along the 3rd period. Groups of experts took the opportunity of informal meetings, the specialised workshop and the Final Conference to prepare a preliminary compilation has been presented at the final conference in Vilnius (February 2008) and has been reviewed by independent experts before being finalised in the Best Practice Handbook. During the 3rd period, the expert groups also defined a strategy for EGS development. By analysing the gaps in knowledge, it defines priorities in the field of medium- to long-term research investment.

The settlement of a stakeholder committee has also enhanced links between R&D teams and stakeholders by providing strategic guidance to the Executive Group and to Contractors in general. The composition of this group is given in Table 2.

| Name | Address | e-mail |
|---|---|---|
| **ASMUSSEN Jörg** | Vattenfall, Group R&D Programme Manager, Jamtlandsgatan 99, SE-162 87, Stockholm, Sweden | joerg.asmussen@vattenfall.com |
| **BATINI Fausto** | Enel S.p.A. - International Department, Renewable Energy Development Viale Regina Margherita 125 00198 Roma ITALY | fausto.batini@enel.it |
| **BEYER, Silke WERUM** | Drilling Company KCA DEUTAG Drilling GmbH Deilmannstrasse 1 48445 Bad Bentheim GERMANY | silke.werum@de.kcadeutag.com |
| **BLACKWELL David** | Department of Geological Sciences, Southern Methodist University, Dallas, Texas | blackwel@mail.smu.edu |
| **BRUCHMANN Ullrich** | Bundesministerium für Umwelt Naturschutz und Reaktorsicherheit Alexanderplatz 6 10178 Berlin GERMANY | ullrich.bruchmann@bmu.bund.de |
| **BÜCKER Christian (Dr)** | RWE-DEA AG Überseering 40 22297 Hamburg GERMANY | christian.buecker@rwedea.com |
| **CHIACCHELLA Sergio (Dr)** | Cos.Vi.G Via Caduti di Cefalonia 44 Florence ITALY | chiacchella.cosvig@momax.it |
| **CLAUSER Christoph** | E.ON Energy research center, RWTH Aachen University, Lochnerstr. 4-20, 52056 Aachen Germany | c.clauser@geophysik.rwth-aachen.de |
| **COOK John (Dr)** | Schlumberger Research Cambridge High Cross Madingley Road CB3 OEL Cambridge UK | cook@cambridge.scr.slb.com |
| **DELHOMME Jean Pierre** | Schlumberger Water Services, Schlumberger Water Services, Le Palatin 1, 1 cours du Triangle, 92936 La Défense Cedex, France | delhomme1@slb.com |
| **DUNN C.** | Sierra, Geothermal Power Corporation Suite 550-666 Burrard Street Vancouvert, BC V6CP6 CANADA | craig@welldunn.ca |
| **DUPUIS Pascal** | MINEFI - Chef du bureau des Energies renouvelables et des techniques nouvelles 61 boulevard Vincent Auriol 75003 Paris | christophe.jurczak@industrie.gouv.fr |
| **FRITSCH Daniel** | GEIE Exploitation Minière de la Chaleur BP 38 67250 Kutzenhause | daniel.fritsch@edf.fr |
| **GAIA Mario** | Turboden s.r.l. Viale Stazione 23 25122 BRESCIA ITALY | mario.gaia@turboden.it |
| **GIVOIS Denis** | Dalkia D10, espace 21 33 place ronde 92981 La Défense CEDEX | dgivois@dalkia.com |
| **KREUTER Horst** | Herrenknecht AG, Tunnelvortriebstechnik, Schlehenweg 2, 77963 Schwanau-Allmannswerder, GERMANY | |
| **RUDER Martin** | Herrenknecht Vertical GmbH, Im Heidewinkel 5, 77963 Schwanau | Ruder.Martin@vertical-herrenknecht.de |
| **KOELBEL Thomas** | EnBW (Electricité de Bade-Wurttemberg Allemagne) Durlacher Allee 93 76131 Karlsruhe GERMANY | t.koelbel@enbw.com |
| **PEARSON Pamela** | Chevron Headwuarters 6001 Bollinger Canyon Rd San Ramon CA 94583 USA | PamPearson@chevron.com |
| **POPOVSKI Kiril** | ul. Dame Gruev br.1-3/16 1000 Skopje MK, MACEDONIA | isskiril@sonet.com.mk |
| **ROMAGNOLI Paolo** | Enel S.p.A. - Enel Produzione Via A. Pisano 120 56100 Pisa ITALY | paolo.romagnoli@enel.it |
| **SANNER Burkhard** | EGEC Asternweg 2 35633 LAHNAU GERMANY | sanner@sanner-geo.de |
| **SANTUCCI Giorgio** | EGS Association, C.so di Porta Nuova n. 15, 20121 Milan ITALY | giorgio.santucci@egs-a.com |
| **SCHREURS Harry** | SenterNovem Postbus 17 6130 AA Sittard NETHERLANDS | h.schreurs@senternovem.nl |
| **THOMPSON Alison** | Manager, Technology Transfer Nexen Inc. CANADA | alison_thompson@nexeninc.com |
| **WEIMANN Thorsten** | | thorsten.weimann@gec-co.de |
| **VAN HEEKEREN Victor** | Stichting Platform Geothermie, van Heekeren & Frima Consultants, Jan van Nassaustraat 81 2596 BR Den Haag NETHERLANDS | heekeren@heekeren.nl |
| **ZEPF Niklaus** | Leiter Corporate Development Axpo Holding Parkstrasse 23 Postfach CH-5401 Baden SUISSE | Niklaus.Zepf@axpo.ch |

**Table 2. Composition of the stakeholder committee**

The development of links with international funding agencies and associations as been strengthen during the 3rd period. That objective of ENGINE has been reached through several initiatives:

- The partners from Targeted Third Countries Filtech Energy Drilling Corporation (Philippines), Centro de Investigación Científica y Educación Superior de Ensenada (CICESE, Mexico), and LaGeo S.A. de C.V. (El Salvador).strengthen their implication in the network. Moreover, they have been represented to the the Executive Group. However, Instituto de Investigaciones Eléctrica (IIE, Mexico) decline participation to the project as the staff was not allowed to engage resources before the money was transferred on their bank account. IIE resigned in November 2007after BRGM made the pre-payment but it was too late for the partner. BRGM asked IIE for transferring back to pre-payment. Money was back in April 2008.
- ENGINE was invited to make several presentations during special occasions, like at the International Geological Congress 2008 or at the Geothermal Research Council 2008 Annual Meeting. International representatives from US and Australia have been invited to participate to workshops and conferences to provide their input taking into account the new development in geothermal projects in these countries.

These initiatives, along with the information system of the project and the actions of the Executive Group and Steering Committee, made the ENGINE project visible and sparked the interest of the international community.

No important problems have been recorded during the period.

## 1.3. SECTION 2 - WORKPACKAGE PROGRESS OF THE PERIOD

For each active workpackage, an overview of the actions carried out in the reporting period is provided.

| **Workpackage number** | **2** | | **Start date or starting event:** | | t1 | | |
|---|---|---|---|---|---|---|---|---|
| **Activity type** | Co-ordination activity | | | | | | | |
| **Participant ID** | **1** | 3 | 8 | 15 | 23 | 24 | 29 | 35 |
| **Person-months per participant:** | **6** | 4 | 1 | 2 | 2 | 6 | 2 | 1 |

**Objectives**, **Information and dissemination System**

The setting up of the information system of the Co-ordination Action is a very important objective as it will play a major role in the exchange and dissemination of data, good practices and standards. As publications will be the main deliverable, the publication system is also indicated as a main item of the Co-ordination Action.

The breakdown of Workpackage 2 is as follow:

*2.1. The information system*
- *2.1.1.* General information
- *2.1.2.* Training and education
- *2.1.3.* On-line reports and results, publications
- *2.1.4.* Data and metadata base, models, open-source software

*2.2. The publication system*
- *2.2.1.* Scientific publications (peer-review journals, proceedings of conferences and meetings, on-line on the Web site)
- *2.2.2.* Reports (open file or with access restricted to Co-ordination Action members)

*2.3. The dissemination system*
- *2.3.1.* The Web site and the electronic monthly newsletter of the Co-ordination Action
- *2.3.2.* Connection to scientific Web site for dissemination of international scientific news
- *2.3.3.* Participation to the national and international debates about sustainable development and renewable energy
- *2.3.4.* General scientific dissemination (multimedia programmes, articles and information brochures)
- *2.3.5.* Public relation through press releases and media contacts

**Progress towards objectives – tasks worked on and achievements made with reference to planned objectives, identify contractors involved**

The Information and Dissemination System led by P. Calcagno (p.calcagno@brgm.fr, BRGM) plays a major role in the exchange and dissemination of information, data, good practices and standards within the Co-ordination Action. The WP2 work package is the vector to share and to promote the action of the ENGINE community towards institutions, funding agencies and citizens. This work is conducted in close relationship with the other work packages with the help of the WP2 delegates: Chiara Giolito (giolito@igg.cnr.it, IGG) for WP3, Brynja Jonsdottir (brj@isor.is, ISOR) for WP4, Stephanie Frick (Stephanie.Frick@ie-leipzig.de, IE) for WP5, Clément Baujard (baujard@geowatt.ch, GEOWATT AG) for WP6, Angela Spalek (spalek@gfz-potsdam.de, GFZ) for WP7, Evgenia Kontoleontos (ekont@cres.gr,

CRES) for WP8, Erik Simmelink (Erik.Simmelink@tno.nl, TNO) for WP9.

The following presents the progress of WP2 and the deliverables produced over the 3rd period.

## 1. Scientific and technical activity

The organization of the WP2 activity follows the WP2 goals and deliverables (see ENGINE Annex 1 - "Description of the Work" document).

The scientific and technical activity was presented during the Final Conference (Vilnius, Lithuania, 12-15/02/2008) in:

- Information and dissemination system (14/02/2008).
  - P. Calcagno, "The ENGINE information system: a reference base of knowledge for EGS in Europe"
  - M. Rosca, "Future Project Proposal on Geothermal Education and Training"
- Two special WP2 sessions (12 and 14/0/2008).

WP2 scientific and technical activity was also discussed during the Steering Committee meeting organized at Vilnius, Lithuania (13/02/2008). See minutes here.

## 2. Organisation and maintenance of the Web site (http://engine.brgm.fr)

The ENGINE Web site (***Deliverable n°7***) is designed to be the place where the ENGINE production is shared among the partner, related and public audience. It presents the ENGINE Co-ordination Action, partners activities, conferences and workshops material, press releases, newsletters (***Deliverable n°3***), EGS lighthouse project in Europe, reference documents and links. A section of the Web site aims at sharing restricted access to the partners for implementing and exchanging documents by using eProjet. The Web site also uses RefShare from Refworks for displaying and exporting ENGINE bibliography (***Deliverable n°8***) including partners' EGS related references and ENGINE references.

The final version of the Web site is a reference knowledge base for EGS on the Internet. It maintain the material produced during the ENGINE coordination action available after the end of the project to (i) keep disseminating the works of ENGINE, (ii) facilitate ENGINE network continuation and (iii) help new projects proposals.

The main contents of the finalised Web site are :
1/ A home page with a few words about what was ENGINE and with a direct link to the Best Practise Handbook
2/ A menu with the following items

- The Best Practise Handbook
- Material of the meetings (Conferences & Workshops)
- Bibliography of ENGINE (via RefShare)
- Partners' releases including the Lighthouse projects compilation, the Education and training map, etc.
- "The ENGINE story", mainly to display minutes of the committees, newsletter and partners' presentation
- Search tool
- Links

## 3. Meetings management

One of the goals of the ENGINE Co-ordination Action is to organize conferences and workshops. BRGM provides tools and methodologies to the work packages for managing the 3 conferences and 7 workshops of the project. Meetings management was achieved via the Internet using Indico (Integrated Digital COnference) for finding out past and future meetings, registering to a meeting, submitting abstract, reviewing proposed abstracts by organizers, uploading material (slides, papers, posters, etc.) by contributors, downloading material of past meetings by visitors. At the end of ENGINE, the Indico tool that is no more needed for organizing meetings was removed from the Information System. However all the material collected during the meetings (abstracts, presentations slides, posters, papers, photos, etc.) was transferred to the final Web site to keep it still available.

Apart from the Internet organizing tool, WP2 helps the other work packages to manage documentations

and CD containing information and material of their meeting by defining the ENGINE publication policy.

The following meetings have been organized during the reporting period:

- Risk analysis for development of geothermal energy - Leiden, The Netherlands, Workshop7, 07-09/11/2007
- Special meeting (Steering Committee) - Soultz, France, 18/12/2007
- Final Conference - Vilnius, Lithuania, 12-15/02/2008. Such as for the other Conferences and Workshops, the proceedings of the Final Conference are available on the Web site (***Deliverable n°6***). See also the appended Book of abstracts and CD.
- Special meeting (Steering Committee) - Budapest, Hungary, 19/03/2008

## 4. Follow-up of the publications

As publications will be one of the main deliverable of the project, the publication system is indicated as an important item of the Co-ordination Action. Contents of the publications are managed by the work packages but WP2 defines a publication policy in order to ensure a coherent look of the ENGINE production. For the reporting period, the publication policy focussed on:

- Bibliography of the partners' papers related to EGS (***Deliverable n°8***). BRGM provides RefShare to manage the bibliography. This task will be achieved by the end of the project.

- Newsletters to report about project activities to partners and related. BRGM provides a template and manage the edition of newsletters (***Deliverable n°3***). The 4 issues that came out during the reporting period (January and June 2008) are appended to this report.

- Minutes report about the project management meetings (Executive Group, the Steering Committee, WP, etc.) WP2 provides templates and manage the edition of the minutes. The minutes include a BRGM ID number to easily retrieve them.

- Conferences and workshops electronic and paper material. WP2 provides Indico to manage the contents of the meetings. WP2 also prepares templates for the book of abstracts, programme, list of participants and CD of a meeting. The proceedings CD is an off-line version of the meeting Web pages generated by Indico including the material (slides, papers, posters, etc.). ISSN and ISBN numbers provided by the Bibliothèque Nationale de France (French National Library) reference the CDs in order to easily retrieve them. A selection of Books of abstracts and CDs edited for the conference and workshops of the reporting period are appended to this report.

## 5. Dissemination and Education

A special attention is given to dissemination in order to strengthen the position of the geothermal energy among the other renewable energies. The main vector is the Web site that is dedicated to ENGINE partners, related and public audience. Newsletters play as well an important role in disseminating information. Every issue is sent to ENGINE partners and related and can be displayed by public on the Web site.

During the Information and dissemination system session at the Final Conference (Vilnius, Lithuania, 12-15/02/2008), the state of the art of education and dissemination was presented in the following contributions:

- The ENGINE information system: a reference base of knowledge for EGS in Europe
- Future Project Proposal on Geothermal Education and Training

A compilation of the lighthouse geothermal projects in Europe has been presented at the Final Conference: ENGINE Geothermal lighthouse projects in Europe. This work was lead by ENGINE partner GEUS (Anders Mathiesen). Details are available on the Web site in the Lighthouse projects section.

Training and Education is an important objective of the Co-ordination Action. At the Final Conference, ENGINE partner UOR (Marcel Rosca) proposed some Geothermal Education and Training Recommendations and proposed a Future Project Proposal on Geothermal Education and Training during the Final Conference.

**Deviations from the project workprogramme, and corrective actions taken/suggested: identify the nature and the reason for the problem, identify contractors involved**

No deviation from the project work programme has to be mentioned. However, the following adaptations are reported:

- Newsletter issuing was originally scheduled every month. The project progress shown that the newsletter is more efficient if issued between the ENGINE meetings. The periodicity of the newsletters depends on the dates of the meetings but the average is about an issue every second month.
- The ENGINE steering Committee has decided to maintain the material collected during the coordination action available after the end of the project to (i) keep disseminating the works of ENGINE, (ii) facilitate ENGINE network continuation and (iii) help new projects proposals. A final version of the Web site adapted to this goal is under preparation and will be proposed during summer 2008. By that time the "classic" ENGINE Web site is still available and up to date.

Table 4a: Deliverables List

| Del n° | Deliverable name | WP n° | Date due | Actual/Forecast delivery date | Lead contractor |
|---|---|---|---|---|---|
| 3 | A provisional Web site and an electronic monthly newsletter | 2 | t3 | 10/11/2005 | 1 |
| 4 | Presentation and documentation of the provisional Web site and of the perspective of the information system at the Launching conference, Session 2 | 2 | t3 | 15/02/2006 | 1 |
| 5 | Proceedings of the Mid term conference, Session 2. Information and Dissemination System | 2 | t14 | February 2007 | 1 |
| 6 | Proceedings of the Final conference, Session 2. Information and Dissemination System | 2 | t25 | April 2008 | 1 |
| 7 | A finalised Web site and an Information System (including an electronic monthly newsletter) | 2 | t14 | Summer 2008 | 1 |
| 8 | The bibliography of the Co-ordination Action | 2 | t14 | April 2008 | 1 |

Documents appended to this report:

- Book of abstracts of the Workshop 7 Risk analysis for development of geothermal energy - Leiden, The Netherlands, Workshop7, 07-09/11/2007 online available at http://conferences-engine.brgm.fr/conferenceDisplay.py?confId=8
- Book of abstracts of the Final Conference - Vilnius, Lithuania, 12-15/02/2008 online available at http://conferences-engine.brgm.fr/conferenceDisplay.py?confId=9
- CD of the Final Conference (Vilnius, Lithuania, 12-15/02/2008) ISBN 978-2-7159-2993-7. Orleans, BRGM Editions. Collection Actes/Proceedings. ISSN 1773-6161. Avril 2008.
- CD of the Workshop 7 (Leiden, The Netherlands, Workshop7, 07-09/11/2007) ISBN 978-2-7159-2992-0. Orleans, BRGM Editions. Collection Actes/Proceedings. ISSN 1773-6161. Octobre 2007.
- Newsletter #10 January 2008 online available at http://engine.brgm.fr/bulletins/ENGINE_Newsletter10_012008.pdf
- Newsletter #11 June 2008 online available at http://engine.brgm.fr/bulletins/ENGINE_Newsletter11_062008.pdf

| **Workpackage number** | **3** | **Start date or starting event:** | t1 |
|---|---|---|---|
| **Activity type** | Co-ordination activity | | |

| **Participant ID** | 1 | 3 | 5 | **8** | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 22 | 25 | 34 | 35 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Person-months per participant:** | 4 | 4 | 1 | **6** | 3 | 3 | 1 | 1 | 4 | 2 | 3 | 3 | 3 | 6 | 2 | 3 |

**Objectives, Investigation of Unconventional Geothermal Resources and EGS**

The objective of Workpackage 3 is to integrate scientific and technical know-how and practices related to the investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems.

The breakdown of Workpackage 3 is following the main scientific issues:

*3.1 Integration of recent progress in knowledge concerning the European lithosphere*

*3.2 Mechanical behaviour of the upper crust and its response to stress, fluid circulation and heat-flow gradients*

3.3 *Exploring different types of geothermal reservoir*

- 3.3.1 High-energy geothermal fields (active/recent volcanism and peripheral zones)
- 3.3.2 High-temperature / low-permeability reservoirs (hot dry rocks)
- *3.3.3* New deep, and possibly supercritical, geothermal reservoirs
- 3.3.4 Multipurpose geothermal reservoirs

3.4 *Technological challenge of the investigation phase*

- 3.4.1 Improved exploration methods for deep geothermal resources
- 3.4.2 Combined geological and geophysical imaging methods for defining and assessing reservoirs for potential heat exchange
- 3.4.3 3D modelling and imaging of permeable systems

For each of the above, the state-of-the-art must be established in order to identify and analyse the best practices to be adopted, the innovative concepts to be applied or developed, as well as the main gaps in knowledge and/or technology.

**Progress towards objectives – tasks worked on and achievements made with reference to planned objectives, identify contractors involved**

In this last period of activity the final documents have been prepared. The coordination was maintained through e-mail exchange and the final WP3 meeting, organized in the occasion of the Final Conference in Vilnius. Participating WP3 Partners: BRGM, GFZ, TNO, IGG, ELTE, CNRS, GGA, GEIE, IGGL, VUA, CRES, PGI, GEMRC, GEOWATT, LaGEO. The Minutes of this last meeting were provide shortly after the meeting itself and contained the last information and instructions discussed during the meeting.

The Deliverables have been provided, in the form of documents and material, and has been the backbone of the workshop organized by the ENGINE coordinator and WP3 responsible for the next EAGE conference: from the program and the proceedings it is visible that these four ENGINE Deliverables will be presented at the workshop by the partners in charge of the Deliverables and the material they prepared have been used as extended abstract of the workshop. The partners actively participating to this activity were BRGM, GFZ, TNO, IGG, ELTE, CNRS, GEIE, VUA, CRES, GEMRC, GEOWATT. The content of these documents formed part of the Chapter 1 of the Best Practice Handbook prepared under the coordination of WP6. As a matter of fact the whole WP3 activity in this period was strictly interconnected to that of WP6 and the experience gained throughout the state-of-the-art definition has been the base for the definition of bottlenecks, main missing matters and roadmap described in the BPH.

Another Deliverable, the database of the exploration tools of ENGINE, has been organized on-line and the link http://servergis.igg.cnr.it/engine/ has been provided to the WP2 coordinator in order to link this page under the ENGINE website. The link was also provided to the WP3 partners during the WP3 meeting and its Minutes, and its content has been explained both as a poster and during the WP2 presentation in the Final Conference. This Deliverable substitute the foreseen Deliverable 18 “inventory of database, maps”, as explained in the previous report. The collected material will form a part of the final ENGINE DVD. The database was not completed due to lack of material from some of the partners, although requests have been made both at the meetings and through Minutes and e-mails. Deliverable 19 was joined to Deliverable 18, as a list of projects and experience gained by WP3 partners in the field of geothermal. It represent part of the prepared database. Moreover, a list of all available papers from partners has been requested by WP3 leader and organized by WP2 leader.

The EAGE workshop as well as the next GRC Conference have been considered the best place for disseminating the main results collected during Engine Project, and fulfill the Deliverable 20. Some posters from WP3 partners have been already proposed during the EAGE workshop and many partners already registered to the workshop. The Proceedings has been prepared on March 2008 and will be circulated at the Workshop. An overall conclusion has been prepared for the GRC conference, including the results achieved during WP3. Moreover, the main results of WP3 and joined WP6 activities have been used for the preparation of the document **Propositions for the definition of Research areas on Enhanced Geothermal Systems** presented by the ENGINE coordinator in Bruxelles at the end of the ENGINE Project and included in the BPH.

**Deviations from the project workprogramme, and corrective actions taken/suggested: identify the nature and the reason for the problem, identify contractors involved**

In agreement with the ENGINE Steering Committee, deliverable 18 was replaced by an inventory of exploration tools within the Engine partners, available on the ENGINE Web site.

Table 4b: Deliverables List

| Del n° | Deliverable name | WP n° | Date due | Actual/Forecast delivery date | Lead contractor |
|---|---|---|---|---|---|
| 9 | Proceedings of the Launching conference, Session 3. Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems. | 3 | t3 | 13-15 February 2006 | 8 |
| 10 | Proceedings of the Mid term conference, Session 3. Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems. | 3 | t14 | February 2007 | 8 |
| 11 | Proceedings of the Final conference, Session 3. Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems. | 3 | t25 | February 2008 | 8 |
| 12 | Guide to the Workshop 1 "Defining, exploring, imaging and assessing reservoirs for potential heat exchange" | 3 | t6 | 8-10 November 2006 | 8 |
| 13 | Guide to the Workshop 2 "Exploring Supercritical fluid reservoir: a new challenge for geothermal energy" | 3 | t18 | April 2007 | 8 |
| 14 | A Review article about recent progress in knowledge concerning the European lithosphere and the exploration of EGS | 3 | t25 | April 2008 joined to D15 | 8 |
| 15 | A review article about Mechanical behaviour of the upper crust and its response to stress, fluid circulation and heat-flow gradients | 3 | t25 | April 2008 joined to D14 | 8 |
| 16 | A review article about Exploring different types of geothermal reservoir | 3 | t25 | April 2008 | 8 |
| 17 | A review article about Technological challenge of the investigation phase | 3 | t25 | April 2008 | 8 |
| 18 | An inventory of database, maps and models concerning the distribution of heat within the upper crust | 3 | t25 | February 2008 | 8 |
| 19 | Reports of study and analysis | 3 | t25 | December 2007 | 8 |

| | | | | | |
|---|---|---|---|---|---|
| 20 | General scientific dissemination (multimedia programmes, articles and information brochures, to be decided according to the results of the integration) about Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems | 3 | t25 | April 2008 | 8 |

Table 5a: Milestones List

| **M. no** | **Milestone name** | **WP no.** | **Date due** | **Actual/Forecast delivery date** | **Lead contractor** |
|---|---|---|---|---|---|
| 4 | Workshop 1 | 3 | t6 | 8-10 November 2006 | 4 |
| 8 | Workshop 2 | 3 | t18 | April 2007 | 8 |

| **Workpackage number** | | | **4** | | | | **Start date or starting event:** | | | t1 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Activity type** | | | | | | | Co-ordination activity | | | | | | | | | | | | | |
| **Participant ID** | 1 | 3 | **4** | 5 | 8 | 9 | 12 | 13 | 14 | 16 | 19 | 20 | 21 | 23 | 28 | 31 | 32 | 33 | 34 | 36 |
| **Person-months** | 3 | 3 | **6** | 1 | 2 | 1 | 2 | 3 | 1 | 4 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 2 | 3 | 3 |

**Objectives, Drilling, stimulation and reservoir assessment**

The objective of Workpackage 4 is to integrate scientific and technical know-how and practices related to the drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems.

The breakdown of Workpackage 4 is following the main scientific issues:

4.1 *Dynamics of the geothermal field, stimulation and reservoir assessment*
- 4.1.1 Stress pattern
- 4.1.2 Stimulation and improvement of the permeability of a geothermal field
- 4.1.3 Dynamics of the fissured horizons and induced microseismicity
- 4.1.4 Reservoir physics and physical properties of rocks and hydro fracturing group
- 4.1.5 Fluids, rock-fluid interaction, tracer and geochemistry, scaling factor

4.2 *Drilling*
- 4.2.1 Drilling cost effectiveness and feasibility of high-temperature drilling
- 4.2.2 Micro-drilling and laser drilling

For each of the above, the state-of-the-art must be established in order to identify and analyse the best practices to be adopted, the innovative concepts to be applied or developed, as well as the main gaps in knowledge and/or technology.

**Progress towards objectives – tasks worked on and achievements made with reference to planned objectives, identify contractors involved**

Two WP meetings were held in collaboration with WP7 on 12. and 14.02.2008 during the Final Conference at Vilnius. A summary paper was presented at the Final Conference by SCHULTE Thomas, HUENGES Ernst, THORHALLSSON Sverrir, titled: Drilling Stimulation and Reservoir Assessment - State of the art and challenges ahead. The CD of the Reykjavik workshop were prepared and distributed during the Final Conference. The pappers and presentations were available on the Internet immediately following the workshop. Work on the ENGINE Best Practices Handbook was ongoing (WP7) and information was provided to that task by WP4, as requested. 2 posters were presented during the Final Conference: JONSDOTTIR Brynja, THORHALLSSON, Sverrir: Geothermal Welcome Centres in Iceland. A poster showing points of interest and JONSDOTTIR Brynja: Dissemination of geothermal knowledge by Iceland GeoSurvey.

**Deviations from the project work programme, and corrective actions taken/suggested: identify the nature and the reason for the problem, identify contractors involved**

No deviation from the project work programme has to be mentioned for the reporting period.

Table 4c: Deliverables List

| Del n° | Deliverable name | WP n° | Date due | Actual/Forecast delivery date | Lead contractor |
|---|---|---|---|---|---|
| 21 | Proceedings of the Launching conference, Session 4. The drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems | 4 | t3 | 13-15 February 2006 | 4 |
| 22 | Proceedings of the Mid term conference, Session 4. The drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems | 4 | t14 | 9-12 January 2007 | 4 |
| 23 | Proceedings of the Final conference, Session 4. The drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems | 4 | t25 | February 2008 | 4 |
| 24 | Guide to the Workshop 3 "Stimulation of reservoir and induced microseismicity" | 4 | t17 | 29 June–1 July 2006 | 4 |
| 25 | Guide to the Workshop 4 "Drilling cost effectiveness and feasibility of high-temperature drilling " | 4 | t19 | 2-5 July 2007 | 4 |
| 26 | A review article about recent progress in knowledge concerning the Dynamics of the geothermal field | 4 | t25 | April 2008 | 4 |
| 27 | A review article about Drilling | 4 | t25 | July 2007 | 4 |
| 28 | Reports of study and analysis | 4 | t25 | May 2007 | 4 |
| 29 | General scientific dissemination (multimedia programmes, articles and information brochures, to be decided according to the results of the integration) about drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems | 4 | t25 | February 2008 | 4 |

Table 5b: Milestones List

| M. no | Milestone name | WP no. | Date due | Actual/Forecast delivery date | Lead contractor |
|---|---|---|---|---|---|
| 5 | Workshop 3 | 4 | t17 | 29 June–1 July 2006 | 4 |
| 9 | Workshop 4 | 4 | t19 | 2-5 July 2007 | 4 |

| Workpackage number | 5 | Start date or starting event: | t1 |
|---|---|---|---|
| Activity type | Co-ordination activity | | |

| Participant ID | 1 | 3 | 6 | 7 | 8 | 9 | 10 | 18 | 22 | 23 | 26 | 27 | 30 | 31 | 33 | 36 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Person-months per participant: | 2 | 3 | 1 | 3 | 1 | 5 | 6 | 4 | 3 | 2 | 3 | 3 | 5 | 1 | 3 | 2 |

**Objectives, Exploitation, economic, environmental and social impacts**

The objective of Workpackage 5 is to integrate scientific and technical know-how and practices related to the development and management of exploitation. It will also identify and analyse the environmental and socio-economic barriers that hamper the development of the geothermal industry.

The breakdown of Workpackage 5 is following the main scientific issues:

*5.1. Exploitation*
- 5.1.1. Unconventional exploitation systems
- 5.1.2. Development of innovative tools for exploitation
- 5.1.3. State-of-the-art of down-hole fluid treatments
- 5.1.4. Plant and reservoir monitoring
- *5.1.5.* Re-injection

*5.2. A global economic approach of geothermal energy*
- 5.2.1. Sustainability of geothermal energy
- 5.2.2. Multiple integrated uses group
- *5.2.3.* Socio-economic benefits of geothermal exploitations
- *5.2.4.* Energy-economic placements

*5.3. Environmental impacts*
- 5.3.1. Barriers to development
- 5.3.2. Microseismicity and risk assessment related to stimulation and exploitation
- 5.3.3. Conditions for a 100% clean exploitation of geothermal energy

*5.4. Increasing policy makers awareness and public acceptance*
- 5.4.1. Building a network for political support
- 5.4.2. Societal needs and public requirement
- 5.4.3. Communication policy

For each of the above, the state-of-the-art must be established in order to identify and analyse the best practices to be adopted, the innovative concepts to be applied or developed, as well as the main gaps in knowledge and/or technology.

**Progress towards objectives – tasks worked on and achievements made with reference to planned objectives, identify contractors involved**

**Article about environmental impacts.** With the widely spread resources, geothermal energy is a resource which can noteworthy contribute to the future energy provision in Europe. However, a contribution to a sustainable heat and electricity provision is only reasonable if its use does not result in disadvantages for the environment compared to given alternatives. This has to be true for the environmental impacts connected with the whole life cycle (i. e. life cycle assessment (LCA) regarding construction, operation and deconstruction and including the respective pre-chains) but also for the effects on the natural environment, which are primarily site specific and regional. This paper will provide an insight how to approach the environmental impacts through geothermal energy provision. As the environmental impacts through the use of high-enthalpy resources has already comprehensively addressed in existing publications (such as Hunt 2000 or Kagel et al. 2005) this paper focuses on hydro-geothermal and Enhanced geothermal systems. Based on theses results, advices regarding a wider use

of geothermal energy provision will be derived. The article is available on the ENGINE shared space.

**Article about policy makers` awareness and public acceptance.** Based on the results of Workshop 6, the paper analyses the reasons for weak social acceptance of geothermal development, identifies possible solutions for changing the situation, highlights the need of a strategy and examines the policy that should be followed in order to overcome this problem. In detail, the paper examines why this is the case, what mistakes have been made in geothermal energy promotion up to now, how can the present situation change and enable better conditions for further and faster geothermal development, and try to identify the positive and negative case histories. The article is available on the ENGINE shared space.

**Reports of study and analysis.** General reports of study and analysis have been provided by the WP5 partner IGR. These reports have been put on the shared space on the ENGINE site and are accessible for all WP5 partners.

**Deviations from the project work programme, and corrective actions taken/suggested: identify the nature and the reason for the problem, identify contractors involved**

There were no deviations from the project work programme

Table 4d: Deliverables List

| Del n° | Deliverable name | WP n° | Date due | Actual/Forecast delivery date | Lead contractor |
|---|---|---|---|---|---|
| 30 | Proceedings of the Launching conference, Session 5. Exploitation, economic, environmental and social impacts | 5 | t3 | 13-15 February 2006 | 10 |
| 31 | Proceedings of the Mid term conference, Session 5. Exploitation, economic, environmental and social impacts | 5 | t14 | 9-12 January 2007 | 10 |
| 32 | Proceedings of the Final conference, Session 5. Exploitation, economic, environmental and social impacts | 5 | t25 | 12-15 February 2008 | 10 |
| 33 | Guide to the Workshop 5 "Electricity generation, combined heat and power" | 5 | t21 | 14-16 September 2006 | 10 |
| 34 | Guide to the Workshop 6 "Increasing policy makers awareness and the public acceptance" | 5 | t10 | 13-14 September 2007 | 10 |
| 35 | An article about Economic approach of geothermal energy | 5 | t25 | 29 October 2007 | 10 |
| 36 | An article about Socio-economic benefits of geothermal exploitations | 5 | t25 | 29 October 2007 | 10 |
| 37 | An article about Environmental impacts | 5 | t25 | December 2007 | 10 |
| 38 | An article about Increasing policy makers awareness and public acceptance | 5 | t25 | December 2007 | 10 |
| 39 | Reports of study and analysis | 5 | t25 | October 2007 | 10 |
| 40 | General scientific dissemination (multimedia programmes, articles and information brochures, to be decided according to the results of the integration) about the development and management of exploitation | 5 | t25 | December 2007 | 10 |
| 41 | General scientific dissemination (multimedia programmes, articles and information brochures, to be decided according to the results of the integration) about economic, environmental and social impacts | 5 | t25 | December 2007 | 10 |

Table 5c: Milestones List

| Ml n° | Milestone name | WP no. | Date due | Actual/Forecast delivery date | Lead contractor |
|---|---|---|---|---|---|
| 6 | Workshop 5 | 5 | t21 | 14-16 September 2006 | 10 |
| 10 | Workshop 6 | 5 | t10 | 13-14 September 2007 | 10 |

| Workpackage number | 6 | | | Start date or starting event: | | | | t14 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Activity type | Co-ordination activity | | | | | | | | | | |
| Participant ID | 1 | 3 | 4 | 6 | 8 | 11 | 14 | 17 | 22 | 25 | 29 | 35 |
| Person-months per participant: | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 2 | 4 | 6 | 2 |

**Objectives**, **Expertise on investigation of Unconventional Geothermal Resources and EGS**

The objective of this expertise is, using information collected during the integration phase of the Co-ordination Action, an evaluation of the most pertinent methods for resource investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems. Generic studies for such resources will be realised in contrasting geo-environments in Europe. Two chapters 1a and 1b of the Best Practice Handbook concerning the definition of innovative concepts for investigating geothermal energy and Highlights of Generic studies for Unconventional Geothermal Resources and Enhanced Geothermal Systems in contrasting geo-environments in Europe will be the deliverables of this work.

**Progress towards objectives – tasks worked on and achievements made with reference to planned objectives, identify contractors involved**

The main objective of the Work Package 6 is to provide chapter 1a and 1b of the Best Practice Handbook and chapter 1 of the European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems.

In order to do so, the following steps were achieved during the reporting period:

- The contributions of the authors were reformulated in order to enhance the clarity of the Best Practice Handbook chapter 1. Results were discussed with the steering committee in Leiden on November the 7th, during the Workshop 7.
- The next version of the chapter was proposed to the authors in the final conference in Vilnius.
- The conclusion was then strongly reformulated, by IGG and GEOWATT AG
- The chapter was sent to reviewer (Mr. Christoph Clauser – Angewandte Geophysik RWTH Aachen) and corrections wished were made to the chapter before being sent to BRGM.

**Deviations from the project work programme, and corrective actions taken/suggested: identify the nature and the reason for the problem, identify contractors involved**

The opportunity to check the homogeneity of the Best Practice Handbook during the Final Conference in Vilnius on Feb. 2008 could not be achieved as no full preliminary version of the Handbook was available at that time. As a result, each WP was isolated from the others and results of the investigations lead in the different Workgroups could not be cross-checked.

Concerning deliverable 44, the information gathered during the ENGINE meetings represents the contents of the European Reference Manual. All that information is compiled on the ENGINE Web site in the Conferences & Workshops section. It includes all the slides, posters and papers presented arranged following the workshops and conferences sessions topics. A summary describes the results of each workshop. It as been decided by the Steering Committee to make that Conferences & Workshops section the European Reference Manual.

Table 4e: Deliverables List

| Del n° | Deliverable name | WP n° | Date due | Actual/Forecast delivery date | Lead contractor |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| 42 | A chapter 1a of the Best Practice Handbook on the definition of innovative concepts for investigating geothermal energy | 6 | t30 | April 2008 | 29 |
| 43 | A chapter 1b of the Best Practice Handbook on generic studies for Unconventional Geothermal Resources and Enhanced Geothermal Systems in contrasting geo-environments in Europe | 6 | t30 | April 2008 | 29 |
| 44 | A chapter 1 of the European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems | 6 | t30 | April 2008 | 29 |

| Workpackage number | | | | 7 | | | Start date or starting event: | | | | | | | t14 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Activity type | | | | Co-ordination activity | | | | | | | | | | | | |
| Participant ID | 1 | 3 | 4 | 6 | 13 | 14 | 16 | 19 | 20 | 21 | 28 | 31 | 32 | 33 | 34 | 36 |
| Person-months per participant: | 1 | 6 | 1 | 1 | 2 | 1 | 3 | 1 | 1 | 1 | 3 | 2 | 2 | 1 | 1 | 1 |

**Objectives**, **Expertise on drilling, stimulation and reservoir assessment**

The objective of this expertise is, using information collected during the integration phase of the Co-ordination Action, an evaluation of the most pertinent methods for drilling and reservoir assessment. A chapter 2 of the Best Practice Handbook and the definition of innovative concepts will be the deliverables of this work.

**Progress towards objectives – tasks worked on and achievements made with reference to planned objectives, identify contractors involved**

Following the decisions taken at the joint WP4/WP7 working group meeting during ENGINE workshop 4, articles and key publications were gathered representing the state of the art in the field of drilling, stimulation and reservoir assessment. Publications were provided by: BRGM (1), GFZ (3), ISOR (4), TNO (6), IGG (8), CNRS (12), GGA (13), MESY (16), NCSR (19) IFE (21), DHMA (28), IGME (31), FEDCO (33) and LAGEO (36). These key publications were compiled in a database, which forms one building block of the entire ENGINE bibliography.

Following the decisions taken during the ENGINE mid term conference in Potsdam, and special ENGINE workshop in Reykjavik, text contributions were gathered building the base for deliverable 45 and 46, the chapter 2 of a Best Practice Handbook, and chapter 2 of a European Reference Manual. Contributions were provided by BRGM (1), GFZ (3), ISOR (4), IGG (8), CNRS (12), GGA (13), MESY (16), NCSR (19) IFE (21), DHMA (28), FEDCO (33) and LAGEO (36).

After compilation and editing, the text was circulated amongst all working group members, asking for comments and suggestions. Remarks were incorporated into the document which was then sent out for a re-evaluation by external reviewers. Finally the document was presented and discussed comprehensively and in detail at the joint WP4/WP7 Working group meeting taking place during the ENGINE Final Conference in Vilnius, February 12th, 2008, at which BRGM (1), GFZ (3), ISOR (4), GGA (13), NCSR (19), GPC(20), IFE (21), DHMA (28), IGME(31) and LAGEO (36) paricipated. Here it was decided to extend chapter 2.2.1.3, Hydraulic Stimulation - Granites - Soultz, with a particular focus on specific stimulation parameters and procedures which were successfully applied in Soultz and to replace table 1 in section 2.2.3 chemical stimulation, by a more comprehensive table, giving also explicit values of injectivity indices before and after stimulation.

**Deviations from the project work programme, and corrective actions taken/suggested: identify the nature and the reason for the problem, identify contractors involved**

No deviation from the project work programme has to be mentioned for the reporting period. Nevertheless, three adaptations can be reported:

- With regard to the initial budget, GFZ travel costs have been higher than estimated, due to extensive contributions to the final conference and the ENGINE Leiden workshop. These contributions came to a major degree from GFZ staff, bringing their expertise into the project,

without being actually paid by ENGINE. At the same time, the GFZ costs spent on personnel were lower than in the initial budget.

- For the purpose of general scientific dissemination and promotion of geothermal, a film titled: "Technological challenges in exploiting geothermal reservoirs" has been commissioned (about 15 min length; cutting and editing existing film material and adding sound). The film is licensed for worldwide utilization and to be made accessible via the internet, and as such, it is an additional deliverable of the ENGINE project. The additional costs, with regard to the initial budget, for editing and cutting are balance by the costs for project workshop organization, which have been lower than anticipated in the initial budget.

- Concerning deliverable 46, the information gathered during the ENGINE meetings represents the contents of the European Reference Manual. All that information is compiled on the ENGINE Web site in the Conferences & Workshops section. It includes all the slides, posters and papers presented arranged following the workshops and conferences sessions topics. A summary describes the results of each workshop. It as been decided by the Steering Committee to make that Conferences & Workshops section the European Reference Manual.

Table 4f: Deliverables List

| Del n° | Deliverable name | WP n° | Date due | Actual/Forecast delivery date | Lead contractor |
|---|---|---|---|---|---|
| 45 | A chapter 2 of the Best Practice Handbook and the definition of innovative concepts for drilling, stimulation and reservoir assessment | 7 | t30 | April 2008 | 3 |
| 46 | A chapter 2 of the European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems | 7 | t30 | April 2008 | 3 |

| Workpackage number | 8 | | | Start date or starting event: | | | t14 | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Activity type | Co-ordination activity | | | | | | | | | | | |
| Participant ID | 1 | 3 | 7 | 9 | 10 | 18 | 22 | 26 | 27 | 33 | 34 | 36 |
| Person-months per participant: | 1 | 1 | 2 | 2 | 2 | 5 | 2 | 3 | 2 | 1 | 1 | 1 |

**Objectives, Expertise on exploitation, economic, environmental and social impacts**

The objective of this expertise is, using information collected during the integration phase of the Co-ordination Action, an evaluation of the most pertinent methods for exploitation of the geothermal resource. The economic, environmental and social impacts will be illustrated and proposals for promotion of the positive impacts will be made. A chapter 3 of the Best Practice Handbook and the definition of innovative concepts will be the deliverables of this work.

**Progress towards objectives – tasks worked on and achievements made with reference to planned objectives, identify contractors involved**

During the last period of the project (1 November 2007 to 30 April 2008) the expert group which was approved by the project executive group during its meeting of Potsdam was appended in order to include Mr. M. Monterrosa from LAGEO, as an industry expert. The WP8 experts group consists of the following experts:

| | | | |
|---|---|---|---|
| Dr. C. Karytsas | CRES | chairman | WP8 participant |
| Mr. D. Mendrinos | CRES | member | WP8 participant |
| Mr. Z. Sarmiento | FEDCO | member | industry network partner |
| Dr. K. Povarov | JSC | member | WP8 participant |
| Dr. A. Alkhasov | IGR DSC RAS | member | WP8 participant |
| Prof. O. Mertoglu | ORME | member | WP5 participant |
| Dr. L. Le Bel | BRGM | member | WP8 participant |
| Dr. D. Tournaye | CFG | member | WP8 participant |
| Dr. P. Ungemach | GPC | member | industry |
| Dr. O. Flovenz | ISOR | member | research agency |
| Prof. J. Goldbrunner | GEOTEAM | external | industry |
| Dr. P. Seibt | GTN | external | industry |
| Dr. J. Van Wees | TNO | observer | WP5 participant |
| Mr. M. Monterrosa | LAGEO | external | industry network partner |

The above group of experts continued its work towards the preparation of chapter 3 of the best practice handbook and the definition of innovative concepts of exploitation (deliverable 47), towards the preparation of chapter 4 of the best practice handbook analysing the economic, environmental and social impacts (deliverable 48), as well as towards the preparation of chapter 3 of the European reference manual for the development of unconventional geothermal resources and enhanced geothermal systems (deliverable 49).

The experts group evaluated all different aspects of geothermal energy exploitation and economic, environmental and social impacts. The results are included in the chapters which were completed as follows:

Best practice handbook chapter 3 “Exploitation: best practices and innovation needs”: Plant configurations (condensing, binary, hybrid, combined geothermal and gas), thermodynamic cycle, turbine type, plant cooling means, technology, cogeneration of heat and power, brine cycle, fluid supply and disposal (wells,

casing, piping, production pumps, reinjection pumps, heat exchangers, inhibition systems), heat plant, environmental protection, field management, monitoring and control, further R&D needs.

Best practice handbook chapter 4 “Economic, Environmental and socioeconomic impact”: Economic considerations including further R&D needed towards improving the economics of EGS plants in terms of delivered unit energy costs. Emissions reduction, benefits to local environment and community, environmental concerns in low enthalpy hydrothermal fields, high enthalpy hydrothermal fields and enhanced geothermal systems, social aspects.

European reference manual chapter 3 “EGS exploitation”: An integration of all documents and work performed for the work packages 5 and 8 of the ENGINE project.

For this purpose the experts group took into consideration the work, the reports and the results of the workshops and conferences produced for the purposes of this project and especially for work package 5. In general the work was organised as follows:

Expert group members from CRES (WP8 leader) prepared the draft deliverables 47-48-49. These were mailed out several times to the other members of the Expert Group as well as to the WP 5 and 8 partners and industry experts, who replied with their comments. The chapters were then discussed during the project meetings, workshops and conferences. In addition, based on the above work, furtehr research needs for EGS were drafted which were integrated within chapters 3 and 4 of the best practice handbook.

**Deviations from the project work programme, and corrective actions taken/suggested: identify the nature and the reason for the problem, identify contractors involved**

Concerning deliverable 49, the information gathered during the ENGINE meetings represents the contents of the European Reference Manual. All that information is compiled on the ENGINE Web site in the Conferences & Workshops section. It includes all the slides, posters and papers presented arranged following the workshops and conferences sessions topics. A summary describes the results of each workshop. It as been decided by the Steering Committee to make that Conferences & Workshops section the European Reference Manual.

Table 4g: Deliverables List

| Del n° | Deliverable name | WP n° | Date due | Actual/Forecast delivery date | Lead contractor |
|---|---|---|---|---|---|
| 47 | A chapter 3 of the Best Practice Handbook and the definition of innovative concepts for exploitation | 8 | t30 | April 2008 | 18 |
| 48 | A chapter 4 of the Best Practice Handbook analyzing the economic, environmental and social impacts | 8 | t30 | April 2008 | 18 |
| 49 | A chapter 3 of the European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems | 8 | t30 | April 2008 | 18 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Workpackage number** | **9** | | | | **Start date or starting event:** | | | | | | t25 | | | |
| **Activity type** | Co-ordination activity | | | | | | | | | | | | | |
| **Participant ID** | 1 | 3 | 4 | **6** | 7 | 10 | 11 | 16 | 18 | 20 | 26 | 27 | 29 | 30 |
| **Person-months per participant:** | 1 | 1 | 1 | **5** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**Objectives, Risk evaluation for the development of geothermal energy**

The objective of this expertise is a technical and socio-economic risk evaluation for the development of geothermal energy taking into account the information collected during the bottom up and expertise phases of the Co-ordination Action. It will also aggregate the main conclusions of each expertise. A European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems will result of this work.

**Progress towards objectives – tasks worked on and achievements made with reference to planned objectives, identify contractors involved**

The work of the work package consisted of attending all the workshops and meetings of ENGINE and to prepare the workshop 7" Risk analysis for development of geothermal energy". The workshop has been organised as planned november 2007, involving WP leaders from WP6, WP7 and WP8, providing an excellent starting point for an integrated presentation of risk evaluation for the development of geothermal energy.

The location of this workshop was in Leiden. Over 10 presentations and 25 participants led to a successful meeting including one full day of discussion. The presentations as well as a summary of the workshop's presentations and discussion have been put on the Engine-website.

The presentations of the workshop showed lessons learned and best practice risk analysis techniques and presented the future outlook for uptake of EGS. Within the presentations a three-partite division could be made in different aspects of risk assessment:

- Optimum decision and risk techniques for assets and prospects performance assesment
- Compliance to regulatory (HSE) constraints, including operational hazards
- Public relations issues

The workshop's discussion focussed on rationales for future research needed to fill in gaps. quick scan of EGS prospectivity in Europe for the next 5-10 years, identifying technical, economic and legal/HSE barriers to be overcome by future research and EU incentives.

The results of workshop discussion have been presented in the workshops report and the final meeting of the conference, covering:
General concept of risk evaluation

- Techno-economic assessment for exploration and exploitation
- Different types of EGS resources in Europe, what we learned in ENGINE
- Resource potential Portfolio
- Key (research) challenges in exploration and production workflow and
- Exploitation improvements which can make sub-economic prospects profitable
- Legislation and PR issues

**Deviations from the project work programme, and corrective actions taken/suggested: identify the nature and the reason for the problem, identify contractors involved**

For deliverable 51 and 52 it has been decided, in close feedback to comments of stakeholders of the

stakeholder meeting in Brussels 20th September that Engine should focus on delivering advices for future research facilitating uptake of EGS fitting in the EU agenda of renewable energy for 2020.

For this reason, it has been decided by the SSC of Engine that WP9 should focus on delivering techno-economic methods and tools for a quick scan of EGS prospectivity in Europe for the next 5-10 years, identifying technical, economic and legal/HSE barriers to be overcome by future research and EU incentives. This has been prime focus of the workshop 7, combined with techno-economic tool development.

A dedicated WP9 meeting at the final conference allowed feedback from ENGINE stakeholders and partners to the methods and tools developed. After this meeting, it has been decided to replace Deliverable 51 by a Performance Assessment Tool (xls spreadsheet) for computing simulations depending on the parameters of geothermal resources and production. This DSS tool is available on the ENGINE Web site. A draft report on techno-economic methods and tools have been presented at the final meeting, serving as starting point to be filled in by country coordinators to allow to build a portfolio of prospectivity and techno-economic barriers therein. Deliverable 51 will also be presented as an EGS book chapter, to be published early 2009.

Testing and further development of methods and tools has been performed in close feedback with engine partners and stakeholders. A special meeting in PISA 15th of april has been organised to test and evaluate the methods, involving IGG and stakeholders including ENEL.

Concerning deliverable 52, the information gathered during the ENGINE meetings represents the contents of the European Reference Manual. All that information is compiled on the ENGINE Web site in the Conferences & Workshops section. It includes all the slides, posters and papers presented arranged following the workshops and conferences sessions topics. A summary describes the results of each workshop. It as been decided by the Steering Committee to make that Conferences & Workshops section the European Reference Manual.

GEIE EMC contributed to this workpackage during the reporting period even if this was not scheduled in the initial plan (see the management report for more information).

Table 4h: Deliverables List

| Del n° | Deliverable name | WP n° | Date due | Actual/Forecast delivery date | Lead contractor |
|---|---|---|---|---|---|
| 50 | Guide to the Workshop 7 "Risk analysis for development of geothermal energy" | 9 | t27 | 7-9 november 2007 | 6 |
| 51 | An article presenting the risk evaluation for the development of geothermal energy | 9 | t30 | April 2008 | 6 |
| 52 | European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems | 9 | t31 | Spring 2008 | 6 |

Table 5d: Milestones List

| Ml n° | Milestone name | WP no. | Date due | Actual/Forecast delivery date | Lead contractor |
|---|---|---|---|---|---|
| 6 | Workshop 7 | 50 | t27 | 7-9 November 2007 | 6 |

## 1.4. SECTION 3 – CONSORTIUM MANAGEMENT

This section presents the status of the project, its management and follow-up activities, including information on :

- consortium management tasks and their achievement; problems which have occurred and how they were solved
- contractors: Comments regarding contributions, changes in responsibilities and changes to consortium itself[1], if any. The schedule of the ENGINE coordination activity is presented ion figure 5.

Other information about the ENGINE consortium management activities are presented within the periodic management report.

| | | | |
|---|---|---|---|
| **Workpackage number** | 1 | **Start date or starting event:** | t1 |
| **Activity type** | Management activity | | |
| **Participant ID** | **1** | | |
| **Person-months per participant:** | **10** | | |

**Objectives, the project management**

The objectives of the project management are (i) the preparation, start up and closure of the project administration and organisation, (ii) the reporting with the Authorities of the 6th Framework, (iii) the smooth and streamlined information flow within the consortium, (iv) the controlling duties of the project.

**Progress towards objectives – tasks worked on and achievements made with reference to planned objectives, identify contractors involved**

The management activities have been focused on the preparation of the Final Conference - Vilnius, Lithuania, 12-15/02/2008. Official letters have been prepared at the attention of the Commissioner for Energy, A. Piebalgs and to R. Liberali (DG Research) and S. Tostmann (DG TREN). Because of busy agenda, these official representatives have not been able to attend to the meeting. A. Piontek has represented the European Commission. The French Embassy of Lithuania has also been contacted and has been very active during the preparation through its economic department. The French ambassador, Guy YELDA, has honoured the conference of his presence as well as Vytas NAVICKAS (Minister of Economy of Lithuania)

Several talks, dedicated to the general achievements of ENGINE and to global perspectives, have been presented during the opening and closing sessions:

- Christian Fouillac, “ENGINE Project …In a rapidly changing situation”
- Ladsi Rybach, “Ongoing cooperative EGS activities within the IEA GIA framework”
- Patrick Ledru, “The final conference of the ENGINE Coordination Action: a milestone towards EGS demonstration projects”
- Andreas Piontek, “Geothermal energy R&D in the 7th Framework Programme”

[1] Changes to the consortium membership must be addressed in a specific request for an amendment to the contract

- Albert Genter, Thomas Kohl, Patrick ledru, Jan-Diederik van Wees, " Strategy for a reassessment of the geothermal potential of Europe"
- Ladsi Rybach, “Post ENGINE tasks – What remains to be done”

In parallel, the management activity of the coordination action has mainly consisted in:

**1. Following up the project administration and organisation**

- Following up administrative and organisation procedures in BRGM
- Debriefing from the Vilnius conference during the EHDRA meeting, Soultz, 6 March 2008
- Support to work package leader for settlement of work package activities
- Organisation of the meetings of the Executive Group (13 February 2008) and Steering Committee (13 February 2008, 18 March 2008)

**Reporting with the Authorities of the 6th Framework**

- Communication of the reports of the meetings of the Executive Group and Steering Committee and of the Newsletters
- Discussion of the propositions for the definition of Research areas on Enhanced Geothermal Systems with A. Piontek, J. Schuppers, E. Boelman (DG TREN), 21 December 2007, Brussels, European Commission
- presentation of a document “Propositions for the definition of Research areas on Enhanced Geothermal Systems” to A. Piontek and J. Schuppers, 5 May 2008, Brussels, European Commission
- Preparation and acceptance of the second intermediate report
- Preparation of the final report

**Smooth and streamlined information flow within the consortium**

- Preparation of reports of the meetings of the Executive Group and Steering Committee
- Conception of the Newsletters (n°10 in January 2008, n°11 in June 2008)
- Preparation of an insert in 2 issues of the Parliament Magazine for Dissemination (Issue 259, 14 January 2008; Issue 264, 31 March 2008)

**2. Promotion of the ENGINE coordination action at an international level**

**Scientific communication:**

P. Ledru et al. Towards a thermal tomography of the Rhine Graben. EUCOR-URGENT TOPO-WECEP, 25-28 March 2008, Mt St Odile.

Preparation of 1 paper for the 33 International Geological Congress, Oslo, 6-14 August 2008:

- P. Ledru and P. Calcagno. A European Coordination Action as a major step forward to move Enhanced Geothermal Systems ahead

Preparation of 2 papers for the next GRC meeting, Reno, USA 2008:

- A. Robertson-Tait, P. Ledru, B. Goldstein, J. Nathwani. Current EGS Funding Initiatives in Europe, Australia and the United States.
- P. Calcagno et al. Results from ENGINE (ENhanced Geothermal Innovative Network for Europe)

**Working groups:**

Presentation of the achievements of the ENGINE project and definition of new actions at the Workshop organized in Moscow: « Utilization Of Geothermal Resources In Russian Federation» organized with the support of ADEME and French Embassy of Federation of Russia, 12-14th December 2007 Moscow.

Presentation of the ENGINE project to a workshop “Energy – Challenges of European Research Collaboration” in Prague (Czech Republic), 5 December 2007, organised by Ing. Jana Bobosikova, Czech Member of the European Parliament

Participation to the Executive Committee International Energy Agency, Geothermal Implementing agreement, Paris, France, 16-18 April 2008.

Presentation of the ENGINE project to the Australian Geothermal Energy Group (AGEG) workshop, Adelaide, Australia, 5-6 November 2008.

**Preparation of spin-off projects**

Participation to the preparation of the FP7 GEOPOT Project to the 2008 call for proposal of DG TREN.

Participation to the preparation of proposals for the FP7 DGTREN ENERGY.2008.2.4.1 call.

Participation to the preparation of a proposal for the FP7 DGTREN ENERGY.ENERGY .2008.8.1.1 call.

Meeting in Budapest, 19 March 2008 with the company MOL for an EGS projects in Zala county, Fabiansebestyen (Hungary) to be proposed to the next DG TREN 2008 call.

**Spin-off projects**

Launching of a project "Structural controls on geothermal activity in western Turkey: analogues to the western great basin, USA" for a 1 year sabbatical year for J. Faulds (Bureau of Mine Nevada) in BRGM Orléans (project supported by a grant from Région Centre).

Organisation of an expert mission of CFG in the Republic of Adygea, organized with the support of ADEME and French Embassy of Federation of Russia, 17-20 February 2008.

**Deviations from the project work programme, and corrective actions taken/suggested: identify the nature and the reason for the problem, identify contractors involved**

Concerning deliverable 14, the information gathered during the ENGINE meetings represents the contents of the European Reference Manual. All that information is compiled on the ENGINE Web site in the Conferences & Workshops section. It includes all the slides, posters and papers presented arranged following the workshops and conferences sessions topics. A summary describes the results of each workshop. It as been decided by the Steering Committee to make that Conferences & Workshops section the European Reference Manual.

Table 4i: Deliverables List

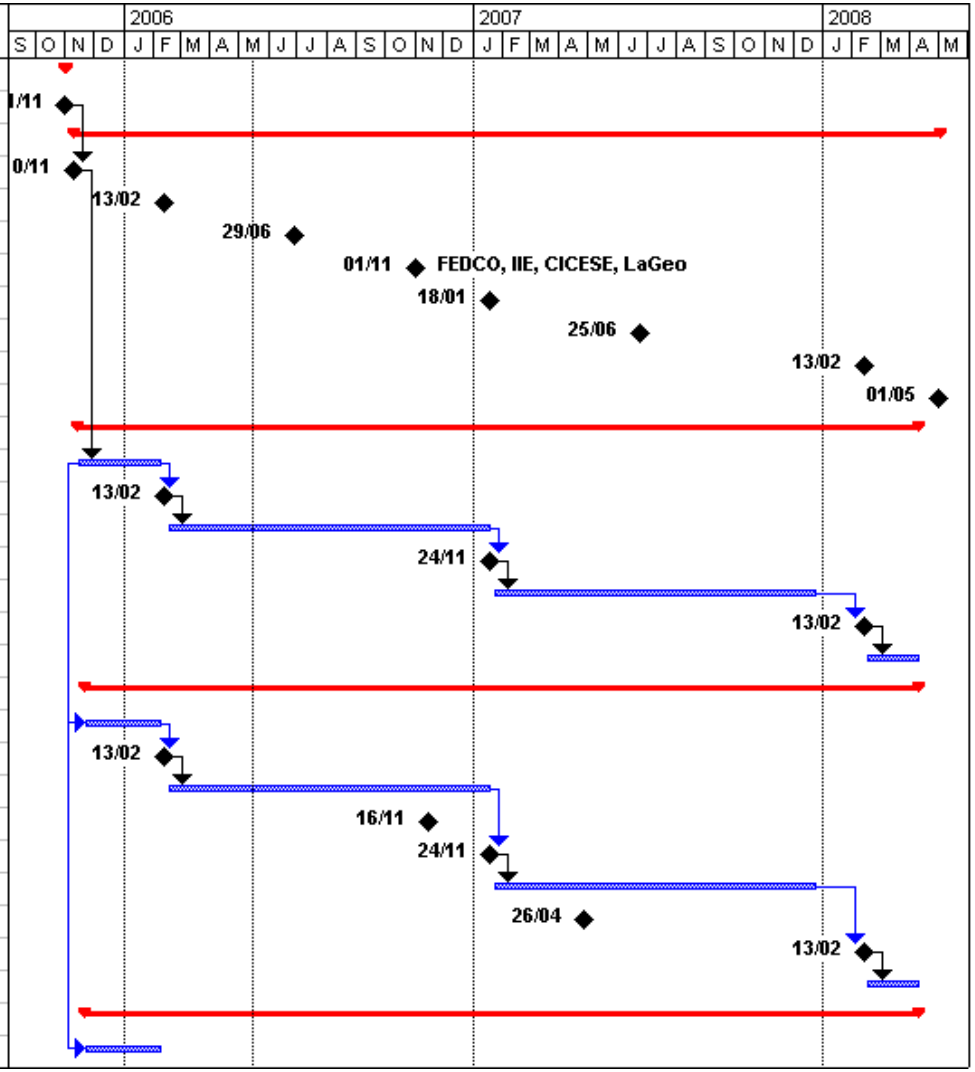
| Del n° | Deliverable name | WP n° | Date due | Actual/Forecast delivery date | Lead contractor |
|---|---|---|---|---|---|
| 1 | A project Manual, defining the guidelines of the Co-ordination Action, submitted for approval to the Executive Group, presentation at the Launching conference, Session 1 | 1 | t3 | 29 November 2005 | 1 |
| 2 | Six-months reports to the EU Commission | 1 | t3 | 15 December 2006 | 1 |

Table 5e: Milestones List

| M. no | Milestone name | WP no. | Date due | Actual/Forecast delivery date | Lead contractor |
|---|---|---|---|---|---|
| 1 | Kick off meeting | 1 | t1 | 10-11 November 2005 | 1 |
| 2 | Six-months reports to the EU Commission | 1 | t6, 12, 18, 24, 30 | 15 December 2006 | 1 |
| 3 | Launching conference | 1 | t3 | 12-15 February 2006 | 1 |
| 7 | Mid Term conference | 1 | t14 | 10-12 January 2007 | |

| | | | | | |
|---|---|---|---|---|---|
| 11 | Final conference | 1 | t25 | 12-15 February 2008 | |
| 13 | Achievement of the Best Practices Handbook | 1 | t30 | April 2008 | |
| 14 | Achievement of the European Reference Manual | 1 | t30 | April 2008 | |
| 15 | Final meeting | 1 | t30 | 19 March 2008 | |

| N° | Nom de la tâche |
|---|---|
| 1 | **Contract preparation** |
| 2 | Official starting date |
| 3 | **WP1. Organisation of the Project** |
| 4 | Steering committee and Executive Group, Kick-off Meeting 1 |
| 5 | Steering committee and Executive Group, Meeting 2 |
| 6 | Steering committee, Meeting 3 |
| 7 | Introduction of new partners fromThird Party Countries |
| 8 | Steering committee and Executive Group, Meeting 4 |
| 9 | Steering committee, Meeting 5 |
| 10 | Steering committee and Executive Group, Meeting 6 |
| 11 | Steering committee, Final meeting 7 |
| 12 | **WP2. The Information system of the CA** |
| 13 | Preparation of the scient./techn. Activity |
| 14 | Launching conference of the CA |
| 15 | Organisation and maintenance 1 |
| 16 | Mid term conference and review |
| 17 | Organisation and maintenance 2 |
| 18 | Final conference of the CA |
| 19 | Achievement of information system |
| 20 | **WP3. Investigation of the UGR and EGS** |
| 21 | Preparation of the scient./techn. Activity |
| 22 | Launching conference of the CA |
| 23 | Integration 1 |
| 24 | Workshop1, Germany (Potsdam) |
| 25 | Mid term conference and review |
| 26 | Integration 2 |
| 27 | Workshop 2, Italy |
| 28 | Final conference of the CA |
| 29 | Preparation of the Reference Manual |
| 30 | **WP4. Drilling, stimulation, reservoir assessment** |
| 31 | Preparation of the scient./techn. Activity |



| N° | Nom de la tâche |
|---|---|
| 32 | Launching conference of the CA |
| 33 | Integration 1 |
| 34 | Workshop 3, Switzerland (Zurich) |
| 35 | Mid term conference and review |
| 36 | Integration 2 |
| 37 | Workshop 4, Iceland |
| 38 | Final conference of the CA |
| 39 | Preparation of the Reference Manual |
| 40 | **WP5. Exploitation and impacts** |
| 41 | Preparation of the scient./techn. Activity |
| 42 | Launching conference of the CA |
| 43 | Integration 1 |
| 44 | Workshop 5, France (Strasbourg) |
| 45 | Mid term conference and review |
| 46 | Integration 2 |
| 47 | Workshop 6, Greece |
| 48 | Final conference of the CA |
| 49 | Preparation of the Reference Manual |
| 50 | **WP6. Expertise on investigation of UGR and EGS** |
| 51 | Preparation of the Best Practice Handbook |
| 52 | Presentation of the 1st conclusion to the final conference |
| 53 | Preparation of the European Reference Manual |
| 54 | **WP7. Expertise on drilling, stimulation, reservoir assessment** |
| 55 | Preparation of the Best Practice Handbook |
| 56 | Presentation of the 1st conclusion to the final conference |
| 57 | Preparation of the European Reference Manual |
| 58 | **WP8. Expertise on Exploitation and impacts** |
| 59 | Preparation of the Best Practice Handbook |
| 60 | Presentation of the 1st conclusion to the final conference |
| 61 | Preparation of the European Reference Manual |
| 62 | **WP9. Risk evaluation for the development of geothermal energy** |
| 63 | Integration of the results of the different synthesis |
| 64 | Review of existing risk analysis approaches |
| 65 | Workshop 7, Nederlands |
| 66 | Evaluation of the risk |
| 67 | Reviewing and discussion with the Executive Group |
| 68 | Reception of the European Reference Manual |

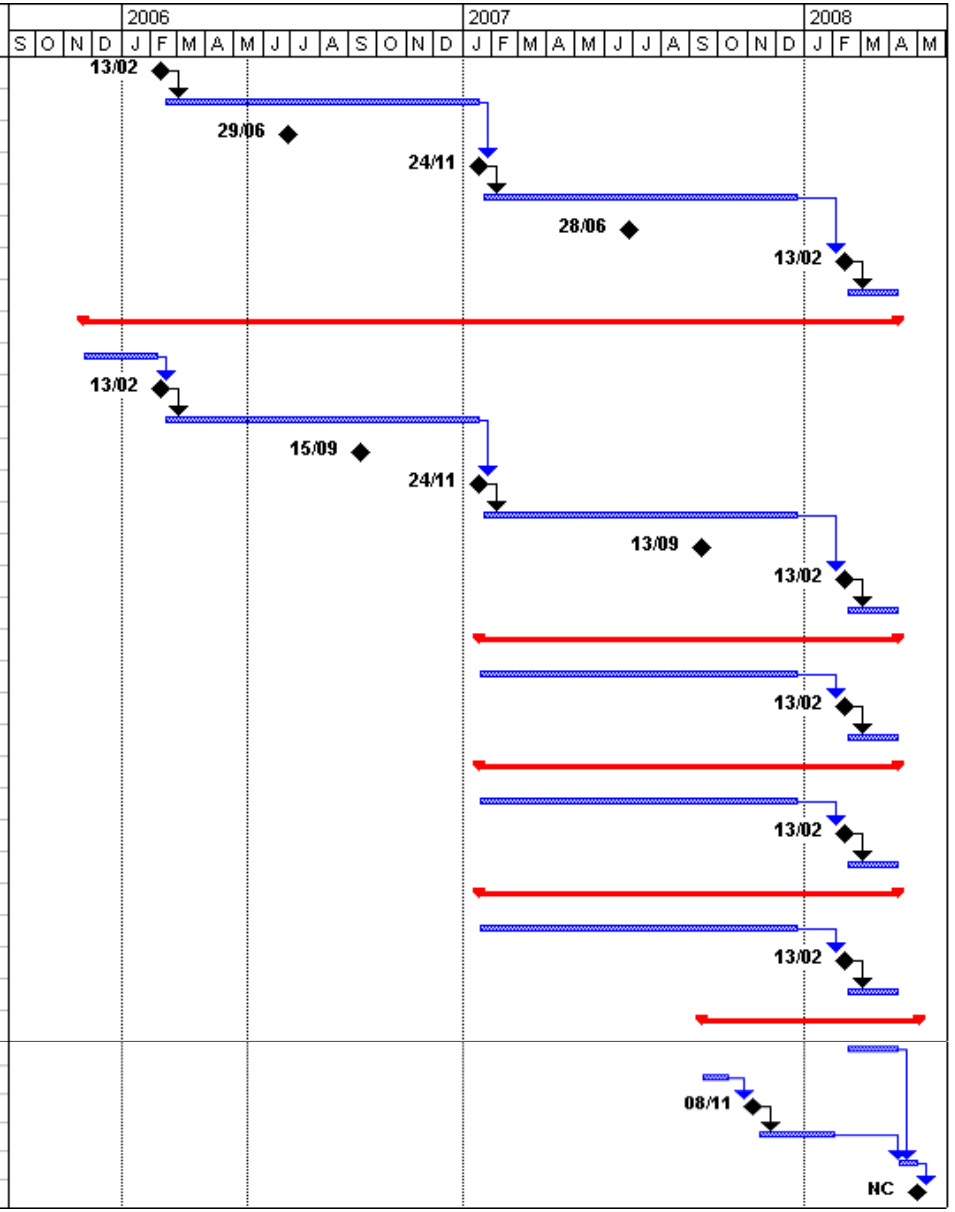



**Figure 5. The Gantt chart of the ENGINE Co-ordination Action**

## 1.5. SECTION 4 – OTHER ISSUES

The ENGINE project was not subjected to requirements and/or recommendations concerning ethical issues.

# APPENDICE : List of deliverables

| Del n° | Deliverable name | Delivery date | Location |
|---|---|---|---|
| 6 | Proceedings of the Final conference, Session 2. Information and Dissemination System | t25 | - ENGINE_D6_D11_D23_D32_BOA_FC_Vilnius_12-15022008.pdf<br>- CD of the Final Conference |
| 7 | A finalised Web site and an Information System (including an electronic monthly newsletter) | t14 | http://engine.brgm.fr |
| 8 | The bibliography of the Co-ordination Action | t14 | Part of the Web site |
| 11 | Proceedings of the Final conference, Session 3. Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems. | t25 | - ENGINE_D6_D11_D23_D32_BOA_FC_Vilnius_12-15022008.pdf<br>- CD of the Final Conference |
| 14 | A Review article about recent progress in knowledge concerning the European lithosphere and the exploration of EGS | t25 | Joined to D15<br>ENGINE_D14_D15_WP3_EuropeanLithosphereAndMechanicalBehaviour_Collective_052008.pdf |
| 15 | A review article about Mechanical behaviour of the upper crust and its response to stress, fluid circulation and heat-flow gradients | t25 | Joined to D14<br>ENGINE_D14_D15_WP3_EuropeanLithosphereAndMechanicalBehaviour_Collective_052008.pdf |
| 16 | A review article about Exploring different types of geothermal reservoir | t25 | ENGINE_D16_WP3_GeophysicalExplorationMethodsAtEuropeanSites_GFZ_052008.pdf |

| | | | |
|---|---|---|---|
| 17 | A review article about Technological challenge of the investigation phase | t25 | ENGINE_D17_WP3_TechnologicalChallengeOfTheInvestigationPhase_IGG_052008.pdf |
| 18 | An inventory of database, maps and models concerning the distribution of heat with the upper crust | t25 | Part of Web site |
| 19 | Reports of study and analysis | t25 | ENGINE_D19_WP3_GeothermalExplorationGreecePaper_CRES_05122007.pdf |
| 20 | General scientific dissemination (multimedia programmes, articles and information brochures, to be decided according to the results of the integration) about Investigation of Unconventional Geothermal Resources and Enhanced Geothermal Systems | t25 | - ENGINE_D20_WP3_EAGEWS9_IGG_062008.pdf<br>- ENGINE_D20_WP3_GeothermalExplorationGreecePresentation_CRES_05122007.pdf<br>- ENGINE_D20_WP3_PosterMilos_CRES_05122007.pdf |
| 23 | Proceedings of the Final conference, Session 4. The drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems | t25 | - ENGINE_D6_D11_D23_D32_BOA_FC_Vilnius_12-15022008.pdf<br>- CD of the Final Conference |
| 26 | A review article about recent progress in knowledge concerning the Dynamics of the geothermal field | t25 | - ENGINE_D26_WP4_HengillTomography_ForGeothermics_Collective_042008.pdf<br>- ENGINE_D26_WP4_HengillTomography_BRGMReport_BRGM_042008.pdf<br>- Geothermics I-GET special issue 2009 |
| 27 | A review article about Drilling | t25 | ENGINE_D27_WP4_SnapshotDrillingCompletionPracticesPhilippines_FEDCO_072007.pdf |
| 29 | General scientific dissemination (multimedia programmes, articles and information brochures, to be decided according to the results of the integration) about drilling, stimulation and reservoir assessment of Unconventional Geothermal Resources and Enhanced Geothermal Systems | t25 | - ENGINE_D29_WP4_GeothermalWelcomeCentres_ISOR_022008.pdf<br>- ENGINE_D29_WP4_Dissemination_ISOR_022008.pdf |

| | | | |
|---|---|---|---|
| 32 | Proceedings of the Final conference, Session 5. Exploitation, economic, environmental and social impacts | t25 | - ENGINE_D6_D11_D23_D32_BOA_FC_Vilnius_12-15022008.pdf<br>- CD of the Final Conference |
| 37 | An article about Environmental impacts | t25 | ENGINE_D37_WP5_EnvironmentalImpacts_Collective_122007.pdf |
| 38 | An article about Increasing policy makers awareness and public acceptance | t25 | ENGINE_D38_WP5_IncreasingPolicyMakersAwarenessAndPublicAcceptance_Collective_05072008.pdf |
| 40 | General scientific dissemination (multimedia programmes, articles and information brochures, to be decided according to the results of the integration) about the development and management of exploitation | t25 | ENGINE_D40_WP5_OptimizedGeothermalBinaryPowerCyclesPresentation_CRES_05122007.pdf |
| 41 | General scientific dissemination (multimedia programmes, articles and information brochures, to be decided according to the results of the integration) about economic, environmental and social impacts | t25 | ENGINE_D41_WP5_IdentificationOfDissolvedOrganicSubstance_IGR_DSC_RAS_122007.pdf |
| 42 | A chapter 1a of the Best Practice Handbook on the definition of innovative concepts for investigating geothermal energy | t30 | ENGINE_D42_D43_D45_D46_D47_D48_BestPracticeHandbook.pdf |
| 43 | A chapter 1b of the Best Practice Handbook on generic studies for Unconventional Geothermal Resources and Enhanced Geothermal Systems in contrasting geo-environments in Europe | t30 | ENGINE_D42_D43_D45_D46_D47_D48_BestPracticeHandbook.pdf |
| 44 | A chapter 1 of the European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems | t30 | Part of the Web site |
| 45 | A chapter 2 of the Best Practice Handbook and the definition of innovative concepts for drilling, stimulation and reservoir assessment | t30 | ENGINE_D42_D43_D45_D46_D47_D48_BestPracticeHandbook.pdf |
| 46 | A chapter 2 of the European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems | t30 | ENGINE_D42_D43_D45_D46_D47_D48_BestPracticeHandbook.pdf |

| | | | |
|---|---|---|---|
| 47 | A chapter 3 of the Best Practice Handbook and the definition of innovative concepts for exploitation | t30 | ENGINE_D42_D43_D45_D46_D47_D48_BestPracticeHandbook.pdf |
| 48 | A chapter 4 of the Best Practice Handbook analyzing the economic, environmental and social impacts | t30 | ENGINE_D42_D43_D45_D46_D47_D48_BestPracticeHandbook.pdf |
| 49 | A chapter 3 of the European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems | t30 | Part of the Web site |
| 50 | Guide to the Workshop 7 "Risk analysis for development of geothermal energy" | t27 | - ENGINE_D50_BOA_WS7_Leiden_07-09112007.pdf<br>- CD of the Workshop 7 |
| 51 | An article presenting the risk evaluation for the development of geothermal energy | t30 | DSS spreadsheet tool on the Web site, notice: ENGINE_D51_WP9_PreformanceAssessmentTool_10092008.pdf |
| 52 | European Reference Manual for the development of Unconventional Geothermal Resources and Enhanced Geothermal Systems | t31 | Part of the Web site |


**Centre scientifique et technique**
3, avenue Claude-Guillemin
BP 36009
45060 – Orléans Cedex 2 – France
Tél. : 02 38 64 34 34

**Research Division**
3, avenue Claude-Guillemin
BP 36009
45060 – Orléans Cedex 2 – France
Tél. : 02 38 64 34 34