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DEPLOYMENT OF DEEP ENHANCED GEOTHERMAL SYSTEMS
FOR SUSTAINABLE ENERGY BUSINESS





European Geothermal Congress

Palais de la Musique et des Congres
Place de Bordeaux, Strasbourg

20. September 2016

Guðmundur Ómar Friðleifsson
DEEPEGS Coordinator

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The DEEPEGS project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 690771



DEEPEGS Project Description

EU SUPPORTED DEMONSTRATION PROJECT

- The goal is to demonstrate the feasibility of Enhanced Geothermal Systems (EGS) for delivering renewable energy for the European citizens
- The project will be testing stimulation technologies for **EGS in deep wells in different geological settings**

DEMONSTRATION LOCATIONS

- The project will demonstrate advanced technologies in three types of geothermal reservoirs,
 - in high enthalpy at Reykjanes with **T** up to 550°C and
 - two deep hydrothermal reservoirs in southern France with **T** up to 220°C.

PROJECT DETAILS

Coordinated by HS Orka, Iceland

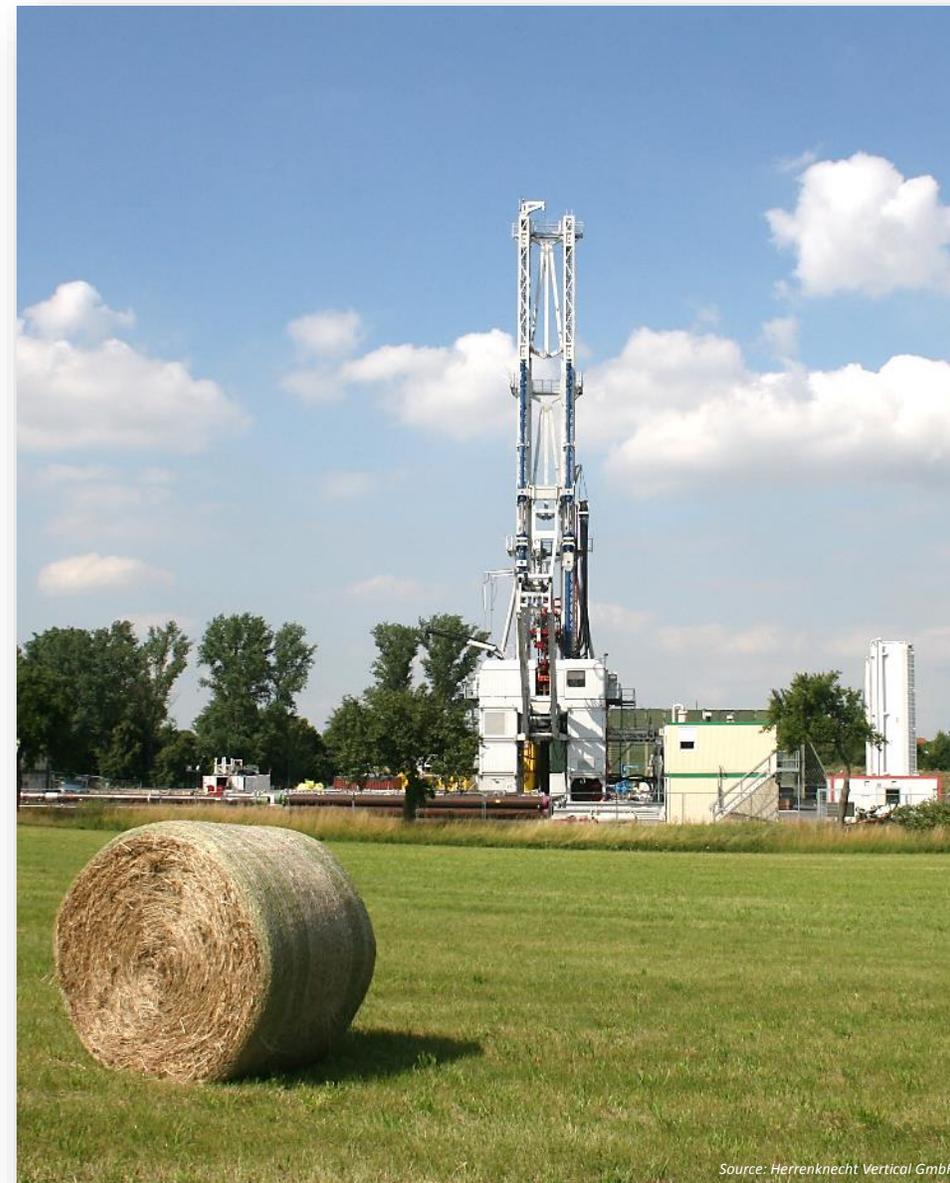
4 year project started **December 1, 2015**

Consortium partners from

Iceland, France, Germany, Italy, and Norway

€44.057.254
Total budget

€19.999.740
EC Grant



Source: Herrenknecht Vertical GmbH

DEEPEGS – Project Consortium

Partners

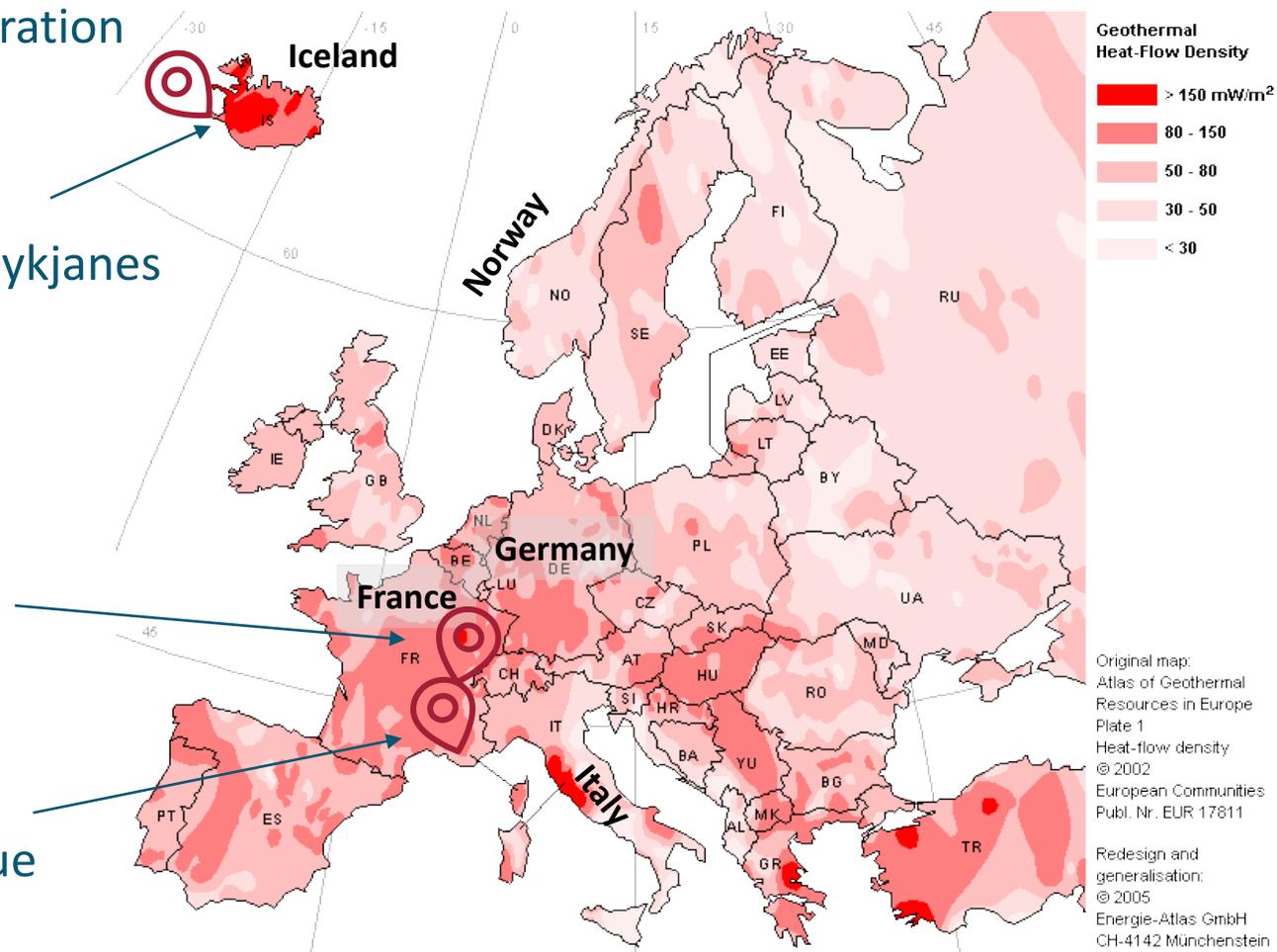
- **Iceland:**
 - HS Orka
 - ISOR
 - GEORG
 - Landsvirkjun
- **France:**
 - BRGM
 - Fonroche Geothermie
- **Germany**
 - Herrenknecht Vertical
 - Karlsruher Institut fuer Technologie
- **Italy**
 - Enel Green Power
- **Norway**
 - Statoil Petroleum

Demonstration sites

Iceland:
RN-15 Reykjanes

France:
Valence

France:
Vistrenque



DEEPEGS – Industry driven consortium

Energy Companies



Supporting Companies &
Research Entities





AMBITION

- Develop a **future approach to geothermal energy** by implementing deep EGS methodologies,
- Laying the **foundation of a novel geothermal engineering** allowing widespread exploitation of deep heat resources for improved energy security.



BUSINESS MODEL TO BE CREATED

- Robust business models for EGS wide spread deployments will be developed
- Showcasing Business Case demonstrators of EGS for deep geothermal energy
- Feasibility frameworks for exploitation in different geological areas/conditions
- Market analysis and cost-benefit assessments for wider deployments of EGS in Europe and world wide

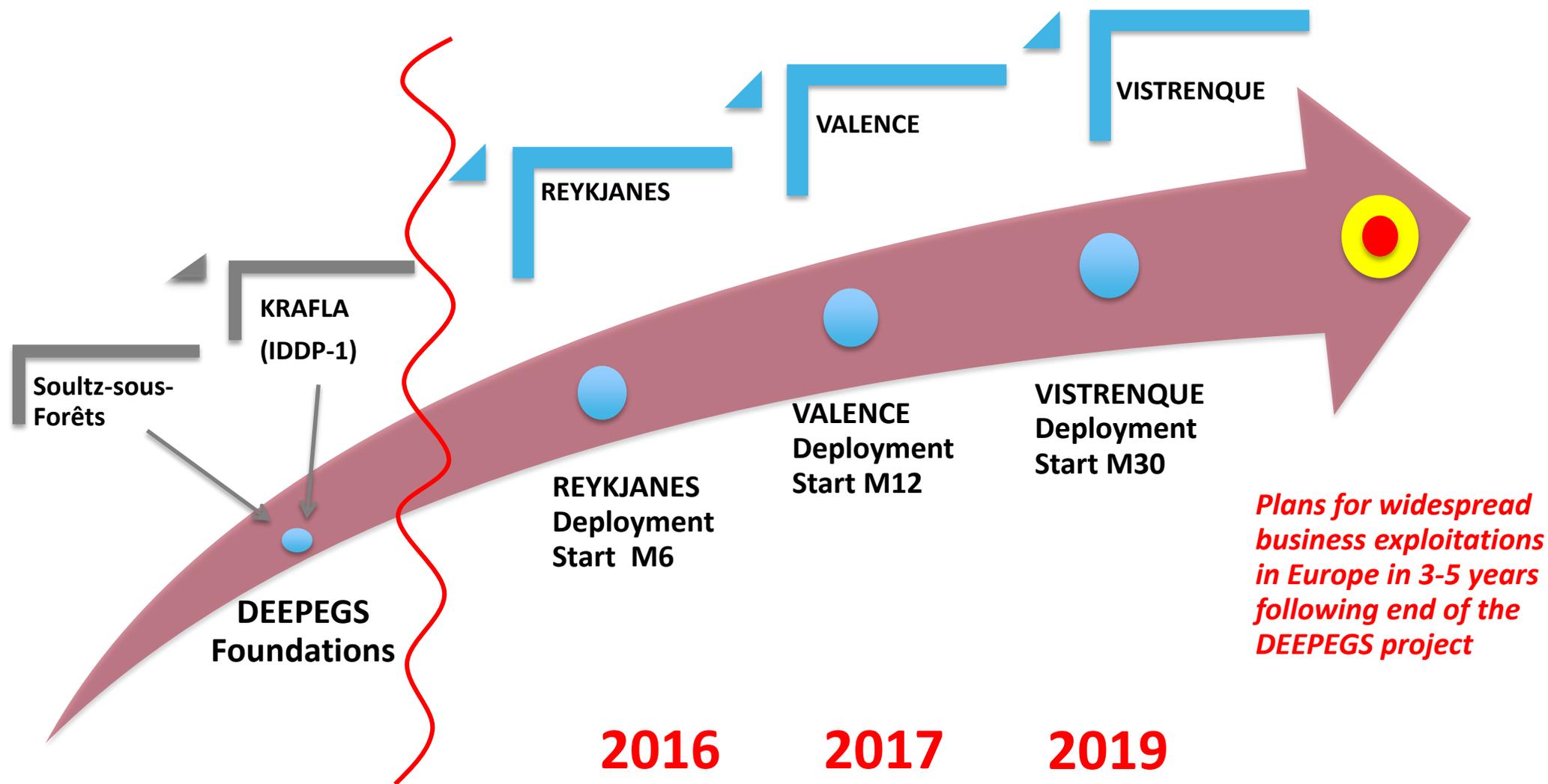


EXPECTED IMPACT

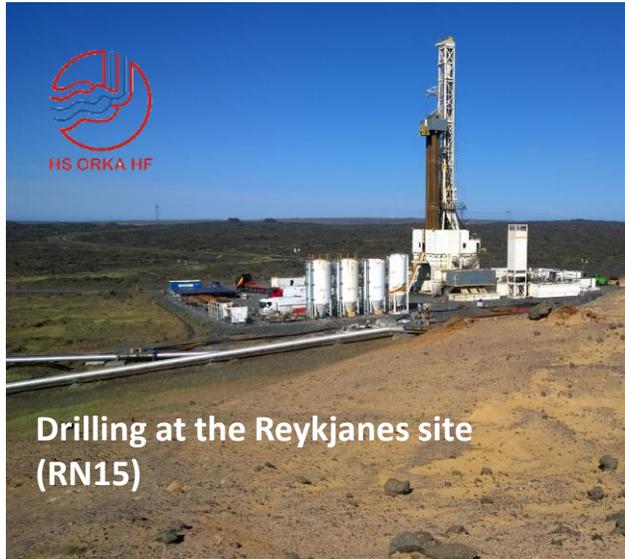
- **Bring down cost** of renewable energy and **increase the attractiveness** of renewable heating and cooling technologies
- Reduce life-cycle environmental impact
- Improve EU **energy security**
- Make renewable electricity generation **more predictable**
- Strengthen the European industrial technology base



DEEPEGS - Timeline



DEEPEGS Scope

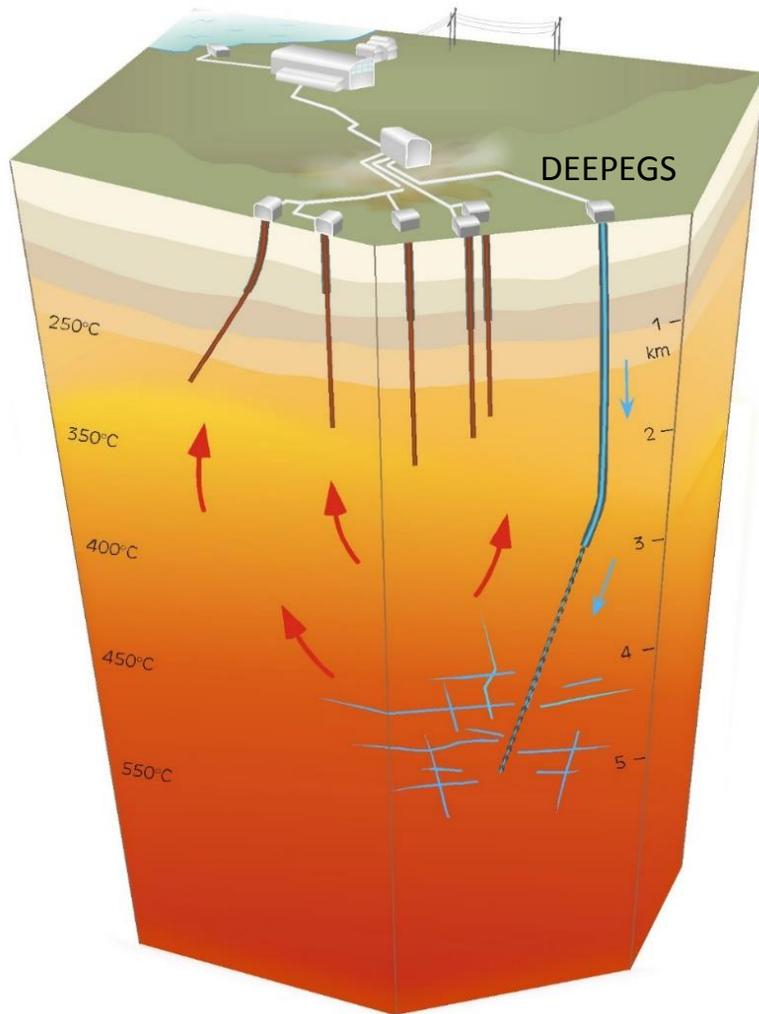


MAIN TARGETS

- DEEP DRILLING IN REYKJANES ICELAND → 5 KM
 - Deep **EGS stimulation** in an existing geothermal field with number of production wells,
 - Power plant on site with existing 100 MW capacity,
 - Through EGS **increase** the available energy output,
 - Demonstrate this business case in a high enthalpy geological environment.

- DEEP DRILLING OF DOUBLETS IN **TWO DIFFERENT GEOLOGICAL ENVIRONMENTS IN FRANCE**
 - **Target depth** at both demonstration sites → 5 KM +
 - **Soft EGS** stimulation to enhance energy recovery,
 - Demonstrate that deep EGS will enable access to deep geothermal energy in France → *business case for wider deployments in Europe.*

RN-15: Production well: offered for deepening as IDDP-2 DEEPEGS demonstration well



Reykjanes power plant: 100 MW_e

RN-15 production well: 2.5 km deep

RN-15 defined as Well of opportunity for IDDP-2 / DEEPEGS

It will be directionally drilled to 5 km depth in 2016

Flow tested in both directions – down and up

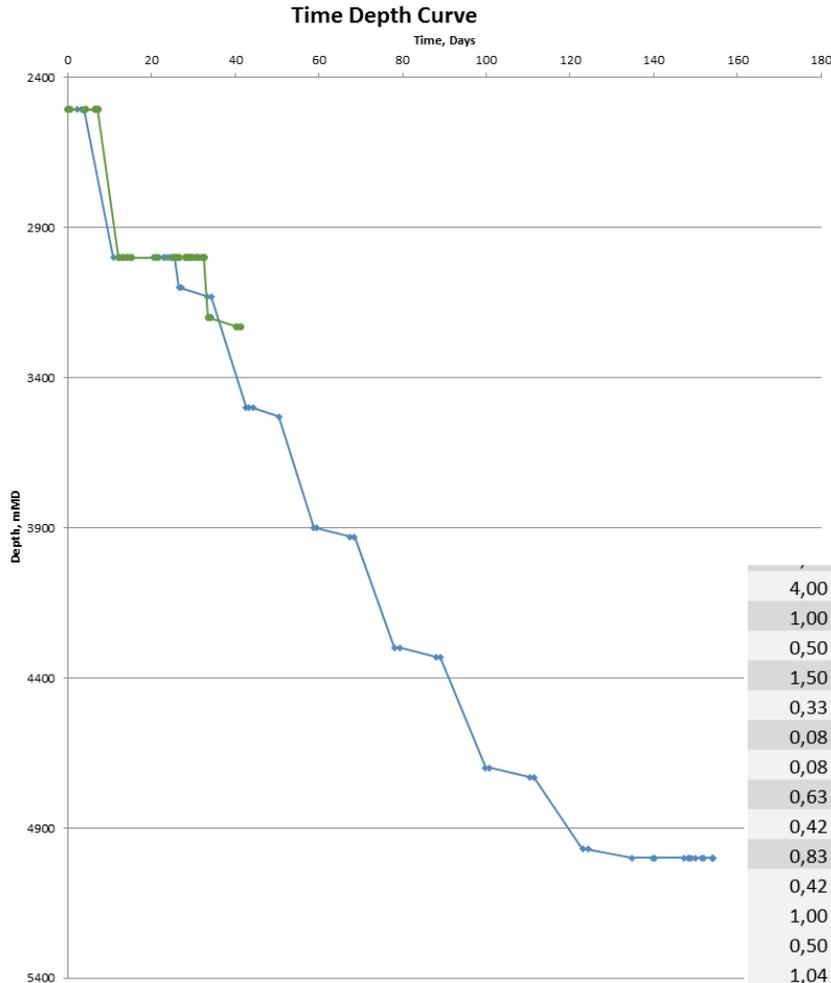
Pilot tested for power production

Scientifically studied as a black smoker analog

Reservoir fluid is of seawater origin

19 September 2016

PROGRESS TO DATE



4,00	25,2	96	RIH 9 7/8" - 9 5/8" casing and cables	3000	3000	0	1.9.2016	5.9.2016
1,00	26,2	24,0	Circulation and cooling well before cementing	3000	3000	0	5.9.2016	6.9.2016
0,50	26,7	12	Cementing casing reverse to surface	3000	3000	0	6.9.2016	6.9.2016
1,50	28,2	36,0	WOC, logging temp and CBL	3000	3000	0	6.9.2016	8.9.2016
0,33	28,5	8	"Cut" Casing and nipple down BOP's	3000	3000	0	8.9.2016	8.9.2016
0,08	28,6	2	Remove 13 5/8" flange	3000	3000	0	8.9.2016	8.9.2016
0,08	28,7	2	Install 9 7/8" flange	3000	3000	0	8.9.2016	8.9.2016
0,63	29,3	15	Nipple up 13 5/8" 5000 psi BOP's, including centralizer flange and test BOP	3000	3000	0	8.9.2016	9.9.2016
0,42	29,7	10	Make up 8 1/2" rotary BHA for drill out cement	3000	3000	0	9.9.2016	9.9.2016
0,83	30,5	20	Drill out cement and POOH	3000	3000	0	9.9.2016	10.9.2016
0,42	31,0	10	RIH cement string for cementing below casing	3000	3000	0	10.9.2016	10.9.2016
1,00	32,0	24	Cement below casing and POOH + brake out DP	3000	3000	0	10.9.2016	11.9.2016
0,50	32,5	12	Make up 8 1/2" DD BHA, RIH	3000	3000	0,00	13.9.2016	14.9.2016
1,04	33,5	25	Drill out cement, DD AB 1,5°/30m, MAB 16°, Azi 210°, @ 16° hold to TD	3000	3200	200	14.9.2016	15.9.2016
0,50	34,0	12	POOH	3200	3200	0	15.9.2016	16.9.2016
6,25	40,3	150	Makeup coring assembly, coring & tripping x 3 runs, about 30 m, POOH	3200	3230	30	16.9.2016	22.9.2016

Reykjanes

- Preparation for drilling
 - ✓ Final design → selection of materials/methods → purchasing materials → receive on site
 - ✓ Cabled thermocouples added on the outside of the casing – Temperature tolerance up to 600°C
 - ✓ Decision made to use IMAGE funded fibre optic cable to 900 m outside casing – GFZ personnel funded by GEOWELL
- Drill rig on site in late July
 - ✓ Drilling operation formally began 11.08.2016
 - ✓ 3 km casing depth reached 23.08.2016
 - ✓ Cementing of casing completed 06.09.2016
 - ✓ Cement being drilled out today - 09.09.2016
 - ✓ Public meeting before drilling held at Reykjanesbaer on 4th August, 2016



- Monitoring
 - ✓ Accelerometer set up in the nearest village (Grindavik) some 12 km from drill site.
 - ✓ Seismic network expanded by ISOR close to the drill site, and network expanded by 3 seismometers and MT monitoring station from KIT
 - ✓ Gas monitoring equipment during drilling supplied by ICDP and set up – we fund transporting of the tools
 - ✓ Conductivity and pH monitoring during drilling added

Valence

- Seismic acquisition in Valence, first geophysical investment in this area since the 80's

- ✓ Done in July 2016
- ✓ 9 - 2D seismic lines for ~95km total length
- ✓ Interpretation ready for T1 2017
- ✓ → good quality acquisition



Thank you!

For more information please contact us via



www.deepegs.eu



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twitter.com/DEEPEGS_demo



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