Radioactive waste from nuclear energy, where to put it? and at what cost?

With the new plasma arc propulsion technology PLB - VT

Under the slab of earth, where there is
also come from
or deep in solid rock
with a recovery possibility

Drill deeper than 15000 m without contact with a plasma propulsion head, thereby drilling a faster propulsion (min. 20m/h through hard rock) and a larger jacking diameter (0.06m -1.5m) and to penetrate into rock temperatures of 400 - 600 degrees Celsius.European patent granted on 27.07.2016 Method and apparatus for introducing or sinking cavities in a mountainous

Environment European patent specification: EP 2 825 715 B1.Patent: in Japan, USA, China and Europe

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Plasma propulsion technology

The development project **PLB - VT** (Plasma Light Arc Propulsion Technology) is developing a new type of plasma - based propulsion technology for the development of deep geothermal resources and is to prove its field suitability

Compared to the conventional deep drilling method, this plasma propulsion technique has the advantages that the propulsion process is not mechanical and thus largely independent of parameters such as rock temperature, strength and rheology. Within the framework of the project, important scientific objectives are being pursued in addition to the technical developments necessary for the new advanced drive

These are particularly important in the areas of borehole stability, sensor technology, environmental compatibility and material properties and are indispensable for the further optimization of the process.

The successful completion of the development project is to be seen with a fundamental, exponential advance in drilling technology, as it did last at the beginning of the 20th century. Since the conventional drilling technique is limited (approximately 12 km) due to various problems (essentially no stable flushing at high temperatures and very high costs), this new thermal plasma propulsion technology allows large depths, e.g. For the development of the deep geothermal reservoirs can be achieved quickly, safely, environmentally friendly and effectively.

This contributes to the attainment of the objectives of increasing energy efficiency by increasing its importance.

On the other hand, according to the results of the first laboratory results, the plasma rod on the industrial scale should allow the transmission of electrical energy in the MW range - in addition to the absorption of the relevant forces which still occur during drilling. This would make it possible, according to an initial assessment, to make a more effective drilling process possible in the range of tens of thousands.

Project description: PLB - VT

The development project PLB - VT (plasma arc propulsion technology) is developing a new type of plasma-based drilling technique for the development of deep geothermal resources and is intended to demonstrate their suitability for use in the field. This plasma propulsion technology has the advantage over conventional deep drilling methods that the propulsion process is not mechanical and is therefore largely independent of parameters such as rock temperature, rock strength and rock rheology. In addition to the technical developments necessary for the innovative propulsion technology, the project also pursues important scientific objectives. These are particularly in the areas of borehole stability, sensor technology, environmental compatibility and material properties and are indispensable for the further optimization of the process.Translated with www.DeepL.com/Translator

The successful completion of the final development project can be seen in a fundamental, exponential advance in drilling technology, as it was last achieved at the beginning of the 20th century. As the conventional drilling technique is limited due to various problems (essentially no stable mud at high temperatures and very high costs) (approx. 12 km), this new thermal plasma drifting technique allows great depths, e. g. for the development of deep geothermal reservoirs, to be reached quickly, safely, environmentally friendly and effectively. In this way, a contribution to the achievement of the goals for increasing energy efficiency is made, the significance of which cannot yet be estimated. Translated with www.DeepL.com/Translator

Up to now, energy transfer in conventional drilling methods has only been possible via weight-on-bit (WOB), torque (torque) and volume flow, i. e. density and pressure in the drilling mud. At the same time, in all previous approaches to the development of new (also thermal) drilling techniques, the amount of energy available at the drill head for rock destruction is limited. For example, an R&D project currently underway at the GZB for the development of thermal drilling methods using laser technology intends to transport additional energy in the KW range to the drilling head by means of fiber optic cable and laser technology. According to initial laboratory results, the plasma propulsion rods on an industrial scale should enable the transfer of electrical energy in the MW range - in addition to absorbing the relevant forces that still occur during drilling. According to initial estimates, this would enable a more effective drilling method in the range of ten times the potential. Translated with www.DeepL.com/Translator

Opinion of experts in deep drilling; universities and industrial companies via plasma propulsion technology

6. According to initial estimates, this would enable a more effective drilling method in the range of ten times the potential.

7. Die Stromerzeugung findet dabei kontinuierlich statt (grundlastfähig), kann an jedem Ort installiert werden und hilft bei der Umsetzung der Klimaziele der Bundesregierung.

8. further applications of deep wells with simultaneous large drilling diameters are in the extraction of knowledge in the field of exploration of deposits.

9. If the research project is successfully completed, a fundamental, exponential advance in drilling technology can be expected, as it was last achieved at the beginning of the 20th century. As the conventional drilling technique is limited due to various problems (essentially no stable mud at high temperatures and very high costs) (approx. 12 km), this new thermal plasma drifting technique enables large depths, e. g. for the development of deep geothermal reservoirs, to be reached quickly, safely, environmentally friendly and effectively. In this way, a contribution to the achievement of the goals for increasing energy efficiency is made, the significance of which cannot yet be estimated.

10. Another important aspect is the development, construction and testing of the plasma drill rods. This makes it possible for the first time to transport a large amount of additional energy to the drill head, except through flushing and purely mechanically (WOB and torque). And exactly this fact is the difference to other drilling processes (e. g. EIV drilling in Dresden), because so far this could not and was not realized due to the lack of drill rods.

11. Another accompanying technical aspect is the development and testing of measurement technology for data transmission (MWD and LWD). The installation of geophysical measuring probes on the drill head is an enormous advantage for optimum exploration of the subsoil during drilling. Thus, reaching the desired rock formation would be immediately recognizable and not, as is the case with today's usual technologies, only after the end or after an interruption of the drilling. This would prevent over-drilling, and it would be possible to track the required rock formations by means of steerable drill heads and thus obtain a much greater yield. This should make it possible to transmit physical, hydraulic and chemical data from sensors and measuring instruments during the entire drilling process.

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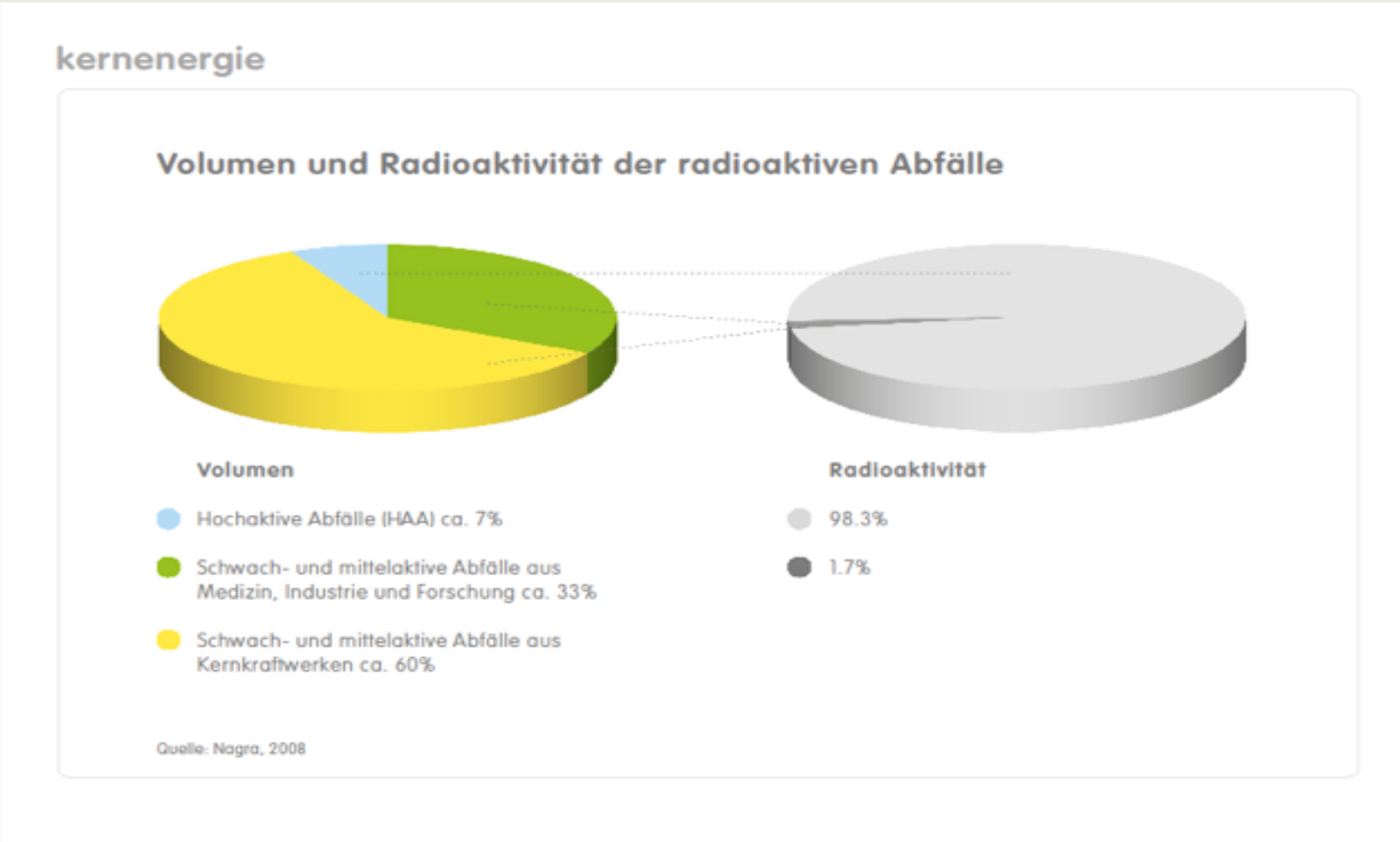


Various types of standardized waste containers for the Konrad repository

Verschiedene Typen der standardisierten Abfallbehälter für das Endlager Konrad

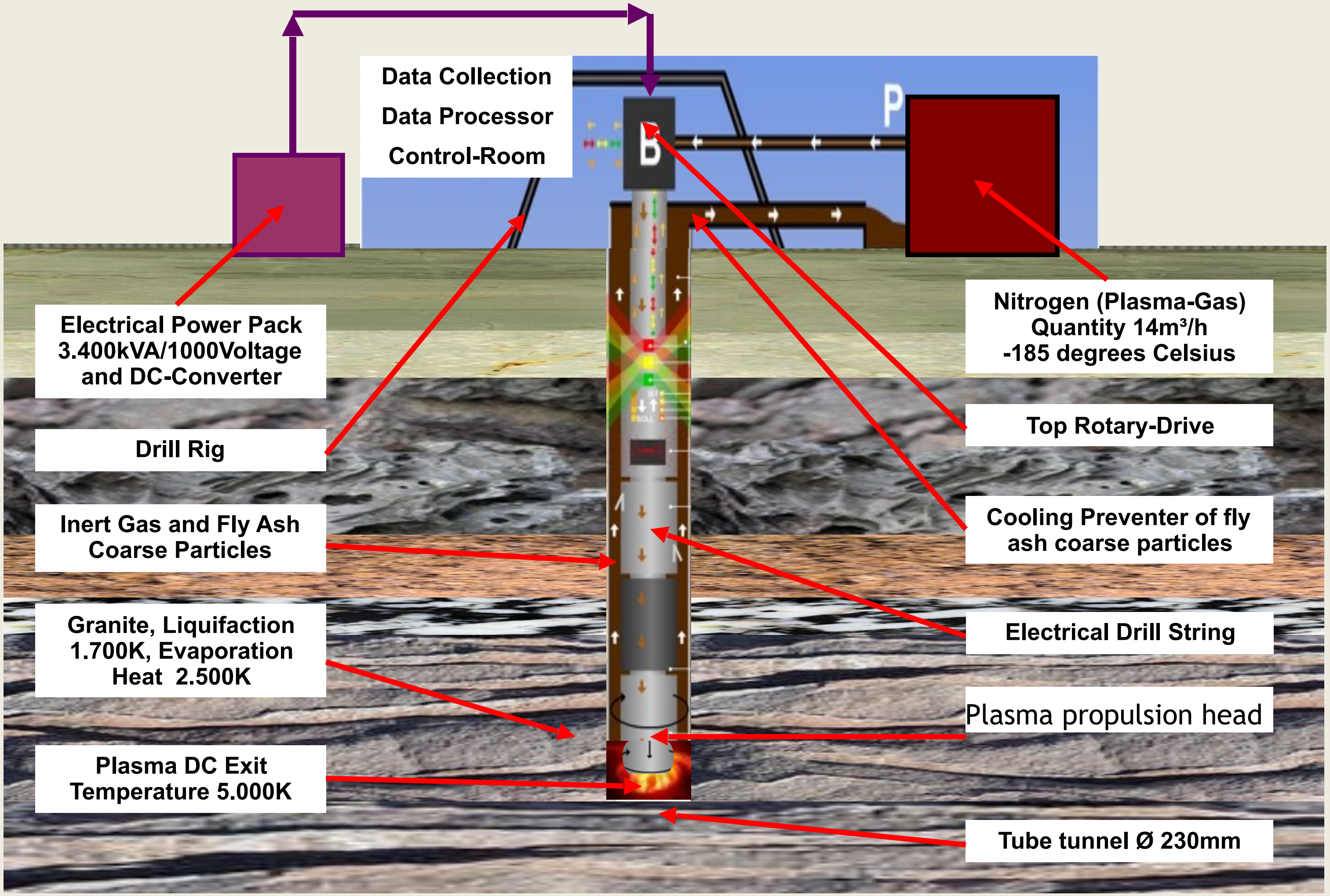
Nr.	Bezeichnung	Außenabmessungen			
		Länge/ Durchmesser mm	Breite mm	Höhe mm	Brutto-volumen m^3
1	Betonbehälter Typ I	1060	-	1370 [1)]	1,2
2	Betonbehäter Typ II	1060	-	1370 [2)]	1,3
3	Gussbehälter Typ I	900	-	1150	0,7
4	Gussbehälter Typ II	1060	-	1500 [3)]	1,3
5	Gussbehälter Typ III	1000	-	1240	1,0
6	Container Typ I	1600	1700	1450 [4)]	3,9
7	Container Typ II	1600	1700	1700	4,6
8	Container Typ III	3000	1700	1700	8,7
9	Container Typ IV	3000	1700	1450 [4)]	7,4
10	Container Typ V	3200	2000	1700	10,9
11	Container Typ VI	1600	2000	1700	5,4

1) Höhe 1370 + Lasche von 90 mm = 1460 mm
2) Höhe 1510 + Lasche von 90 mm = 1600 mm
3) Höhe 1370mm beim Typ KfK
4) Stapelhöhe 1400 mm beim Typ KfK

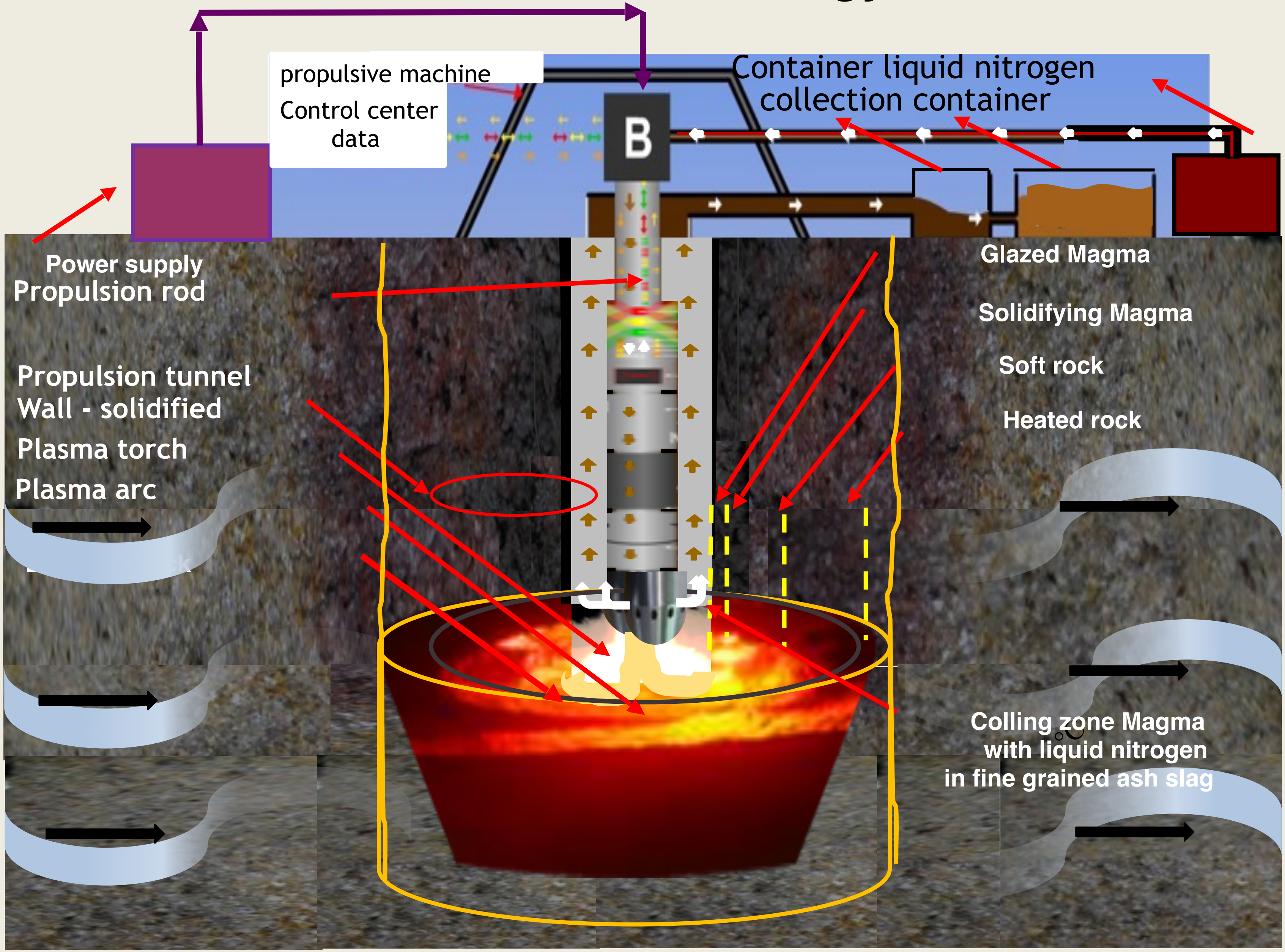
Stand: 01.04.2015

Containerwerkstoffe sind z. B. Stahlblech, armierter Beton oder Gusswerkstoff.

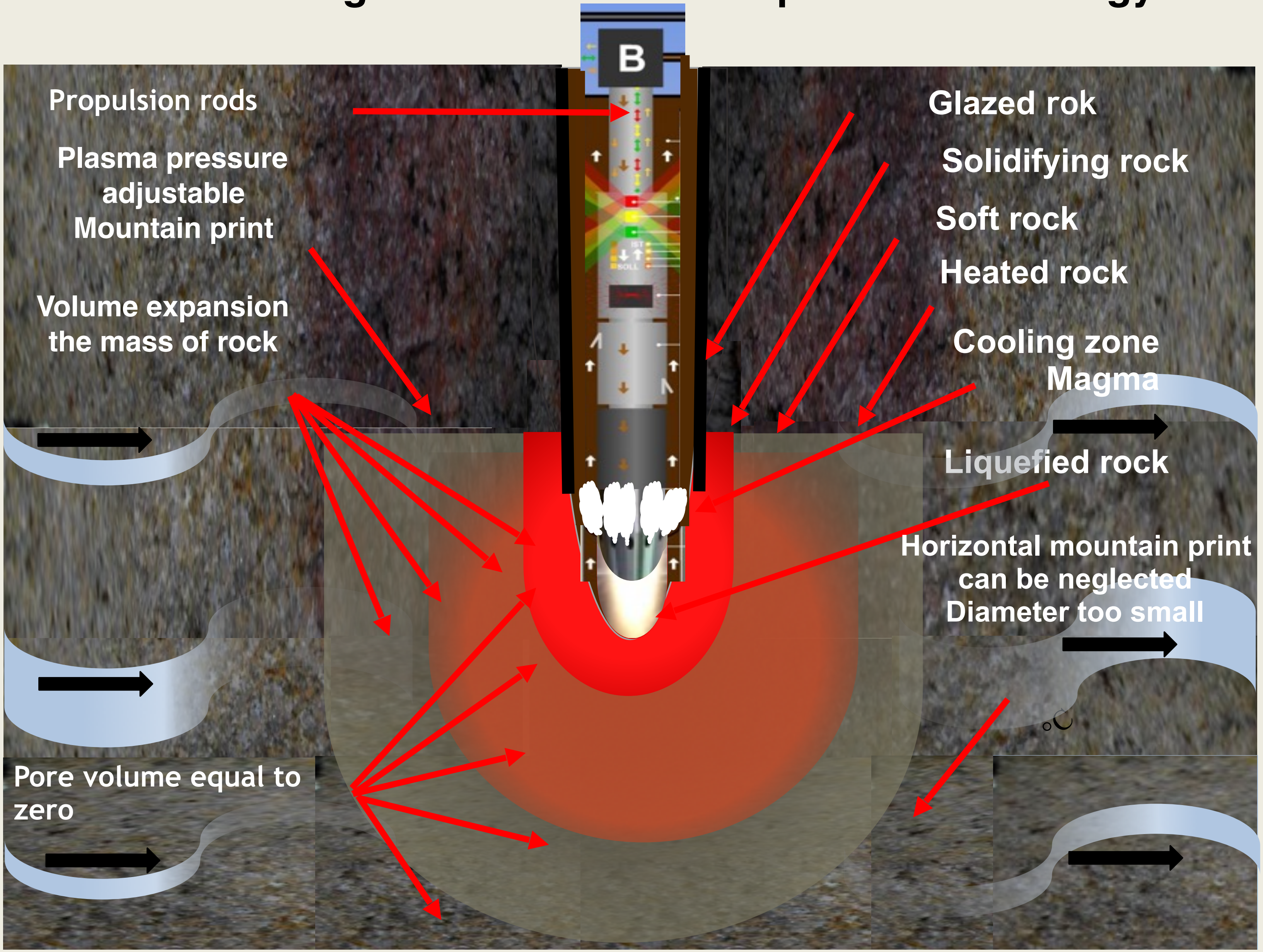
Plasma arc - propulsion for a tube tunnel in the earth's crust



Plasma arc technology



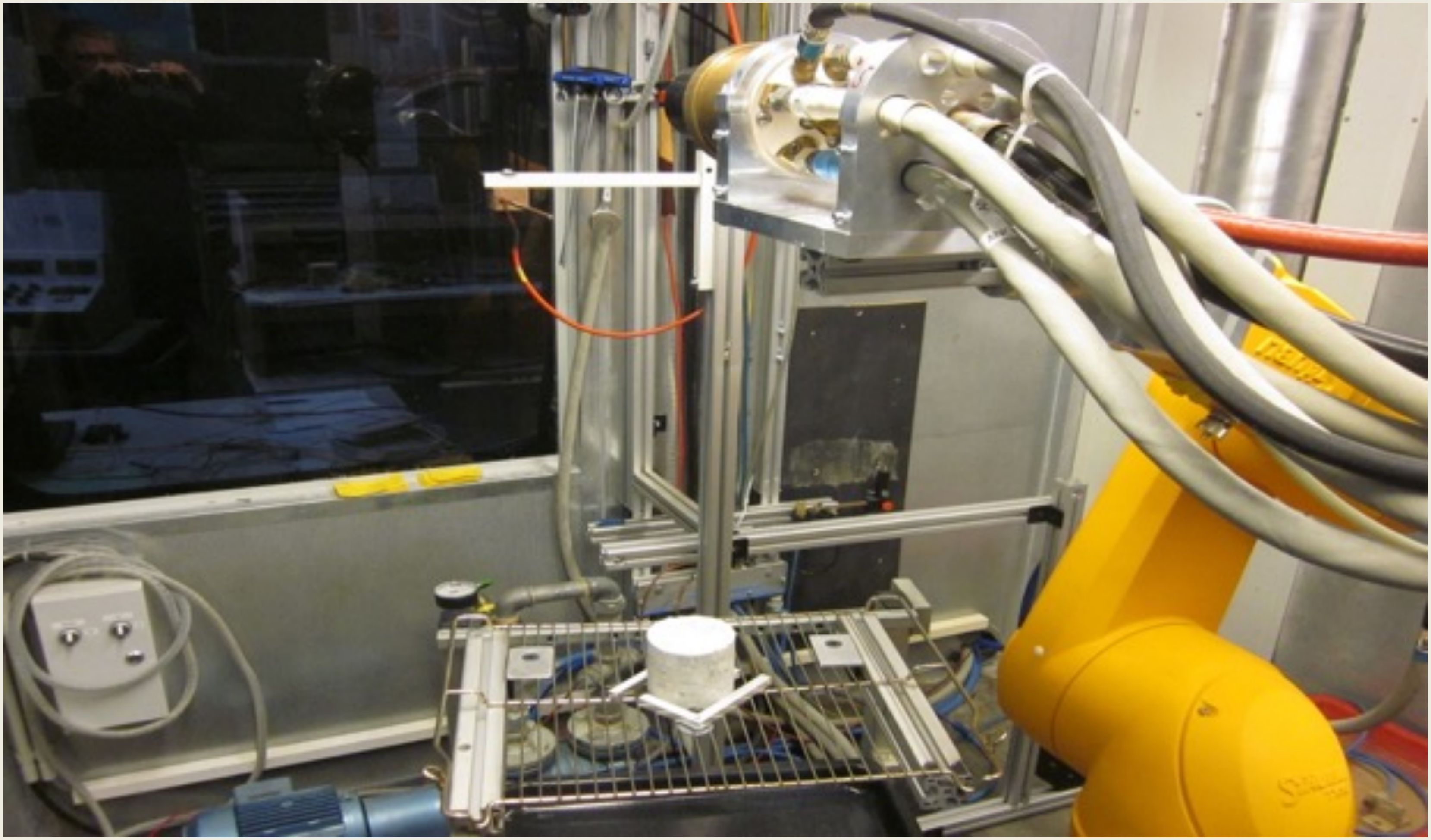
Plasma light arc – PLA - PT Propulsion technology



University of the Bundeswehr in Munich

Plasma test with Plasmatron 150 KW electrical power

Figure 2 Test rig with sample concrete cylinder 120 x 70 mm

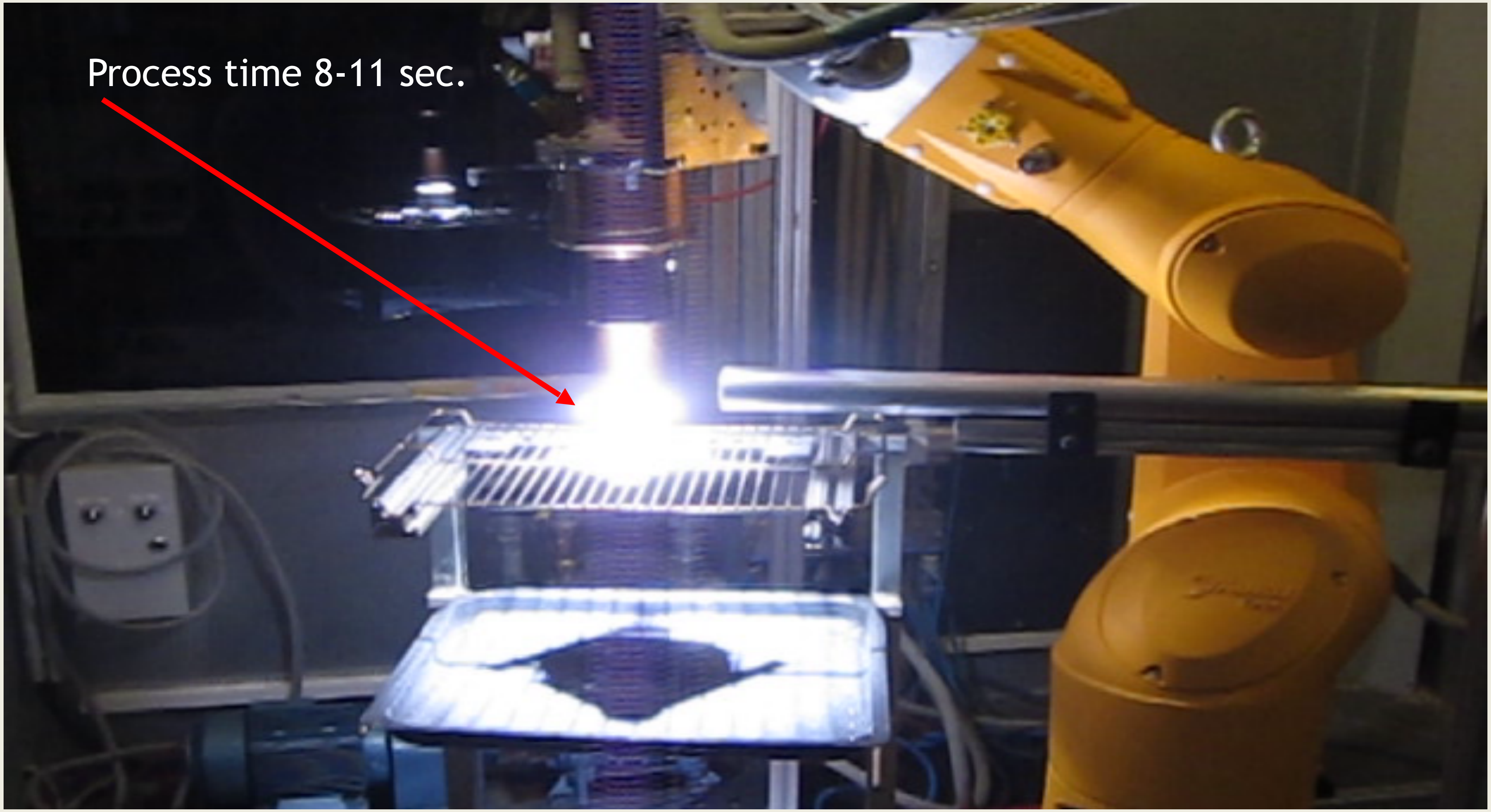


Institute of Plasma Technology and Mathematics

University of the Bundeswehr in Munich

Plasma test with Plasmatron 150 KW electrical power

Figure 3 liquefaction process with plasmatron 150 KW el. Performance



Institute of Plasma Technology and Mathematics

Patents and Milestones

USA Patent: No. US9631433 B2 Method and apparatus for introducing or sinking cavities in rock.

Europe Patent: No. EP 2 825 715 Method and apparatus for introducing
or sinking cavities in the mountains.

EP- Patent Nr. 2 825 715 für Schweiz/Lichtenstein - Belgien - Deutschland – Spanien – Frankreich – Großbritannien - Irland - Italien - Österreich

Japan Patent: No. J 6 066 133 B2 Method and apparatus for introducing or sinking cavities in rock.

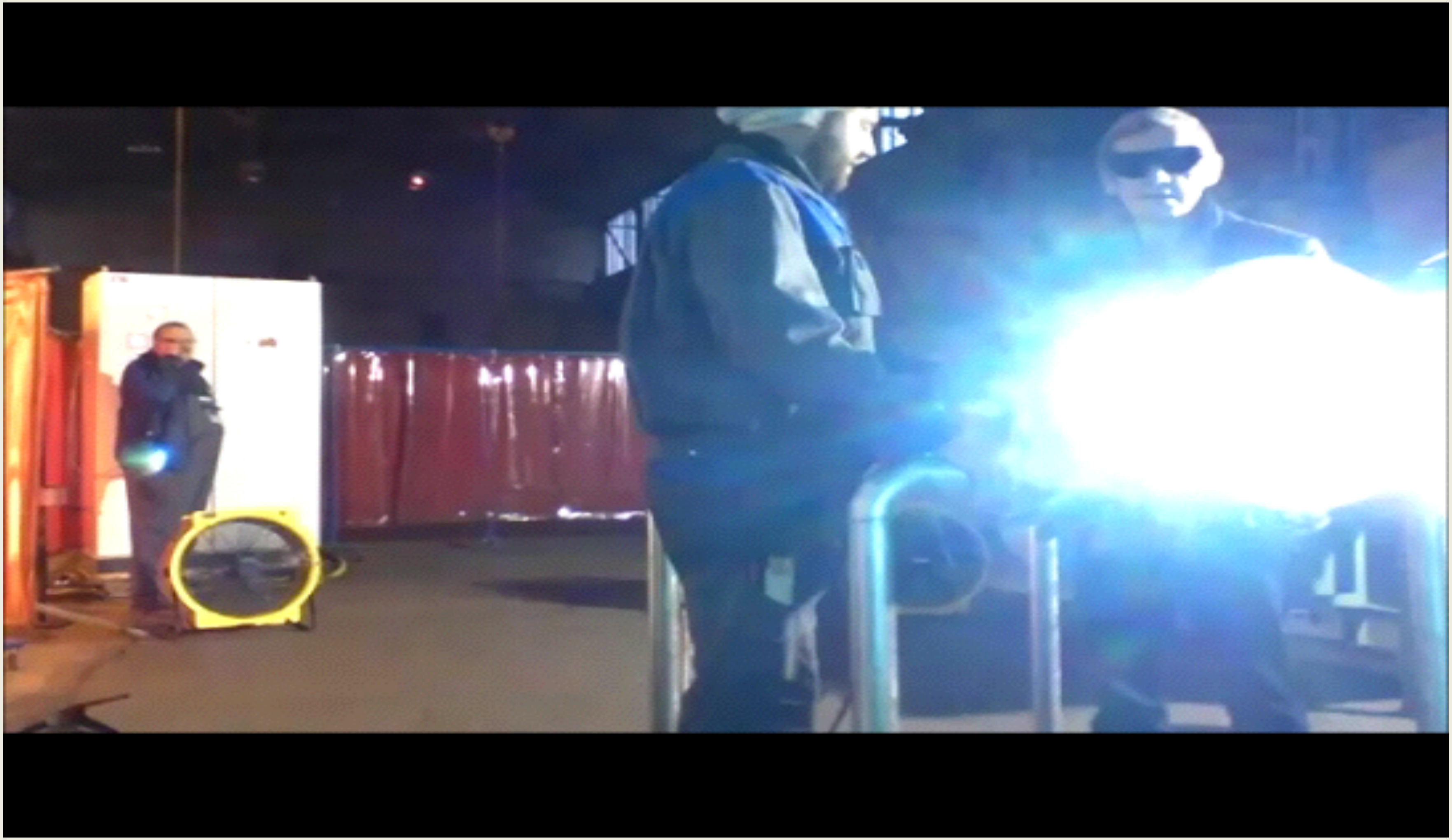
China Patent: No. 201380024380.6 Plasmadrilling

Milestones
The project is monitored and monitored by compliance with the specified milestones. Due to the time and content of the project, it possible to document the progress of the project on an ongoing basis and to recognize changes in time.

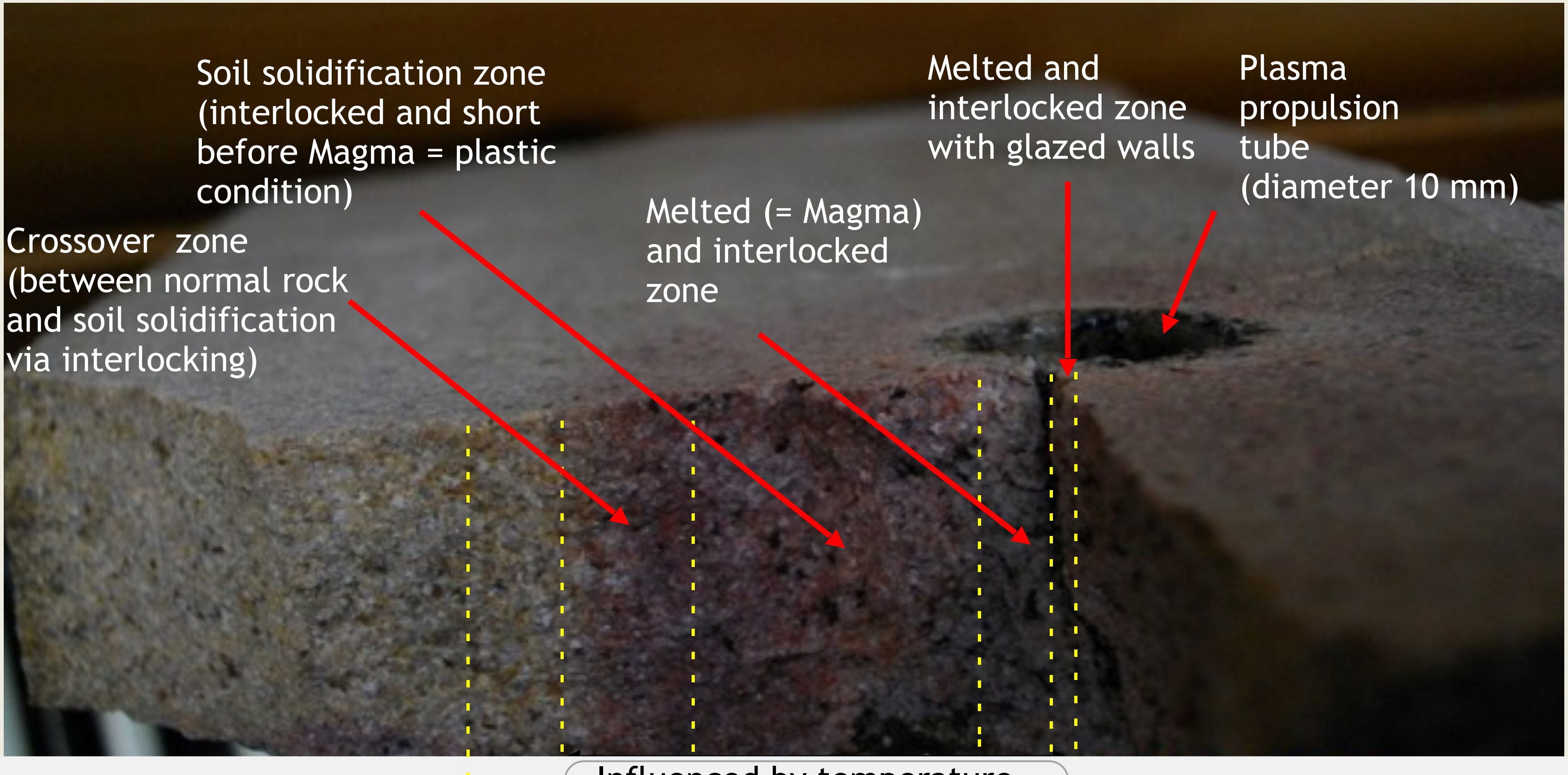
Milestones

Six milestones were conceived:
Milestones 0: within 4 weeks evaporation of 1 piece of egg charcoal - granite - graphite - basalt - clay with plasma arc.
Milestones 1: Modification Plasma Propulsion Rods - Plasmatron 100 mm successful (7 months and 2 m of rock propulsion).
Milestones 2:Successful plasma propulsion through the mountains 10 m in 2 months diameter 250 mm.
Milestones 3: Successful plasma propulsion 100 m 7 months 250 mm diameter.
Milestones 4: with large partners a plasma tube down to 500 m dismantling & take deflection into operation.
Milestones 5: With large partners, two plasma tubes a 1000m, of which two plasma tubes, designed as a deflected plasma plasma propulsion, to produce the mountain heat exchanger with it.

Commissioning
Plasmatron 1.3 MW electric. Power   test 3.

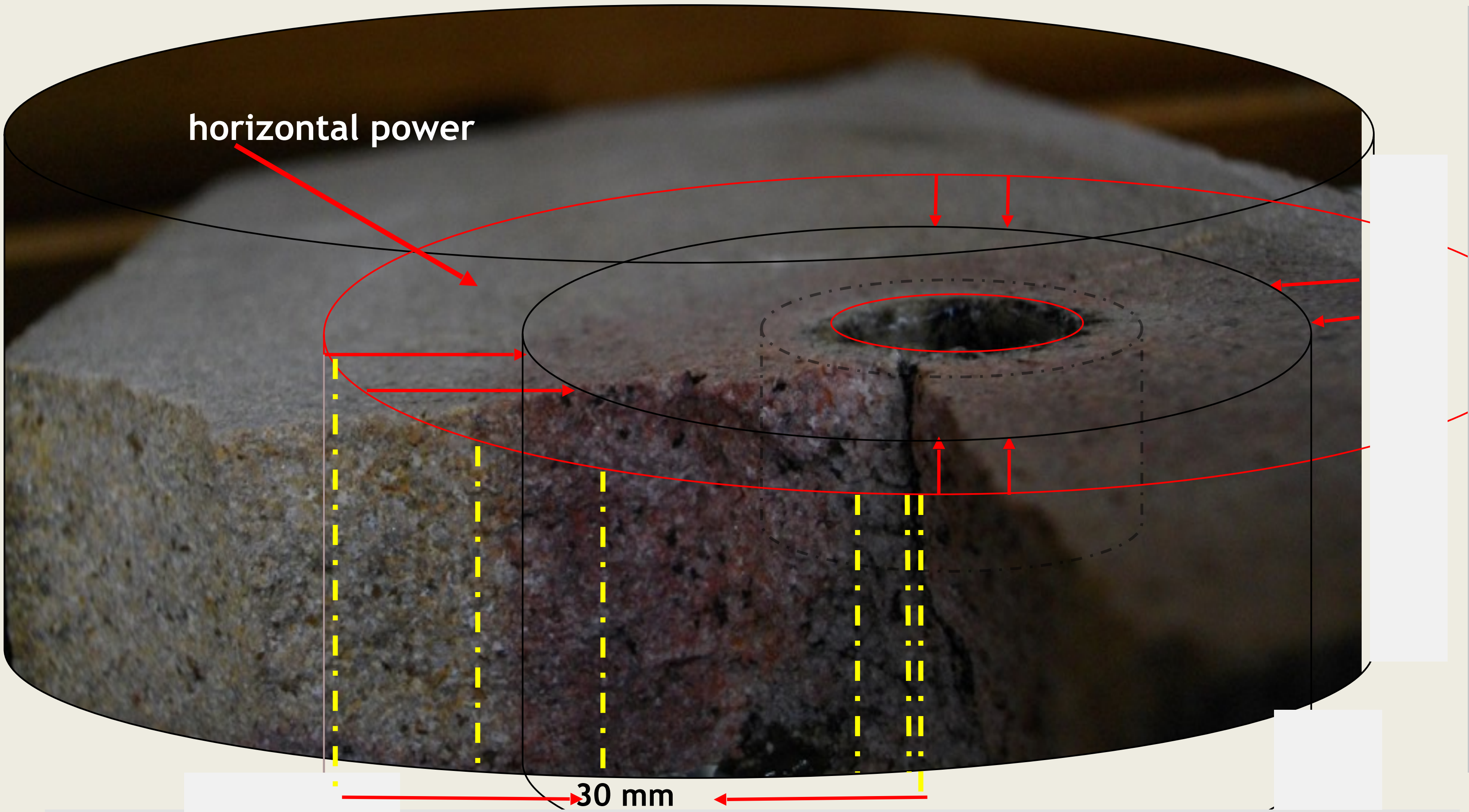


Sample of a hole - influenced by high temperature around the plasma propulsion tube tunnel



Influenced by temperature - approx. 25mm from wall of hole

3 D sectional view of plasma propulsion tube tunnel and the temperature caused by self-locking - supporting glazed assisting toothed formation tube tunnel wall

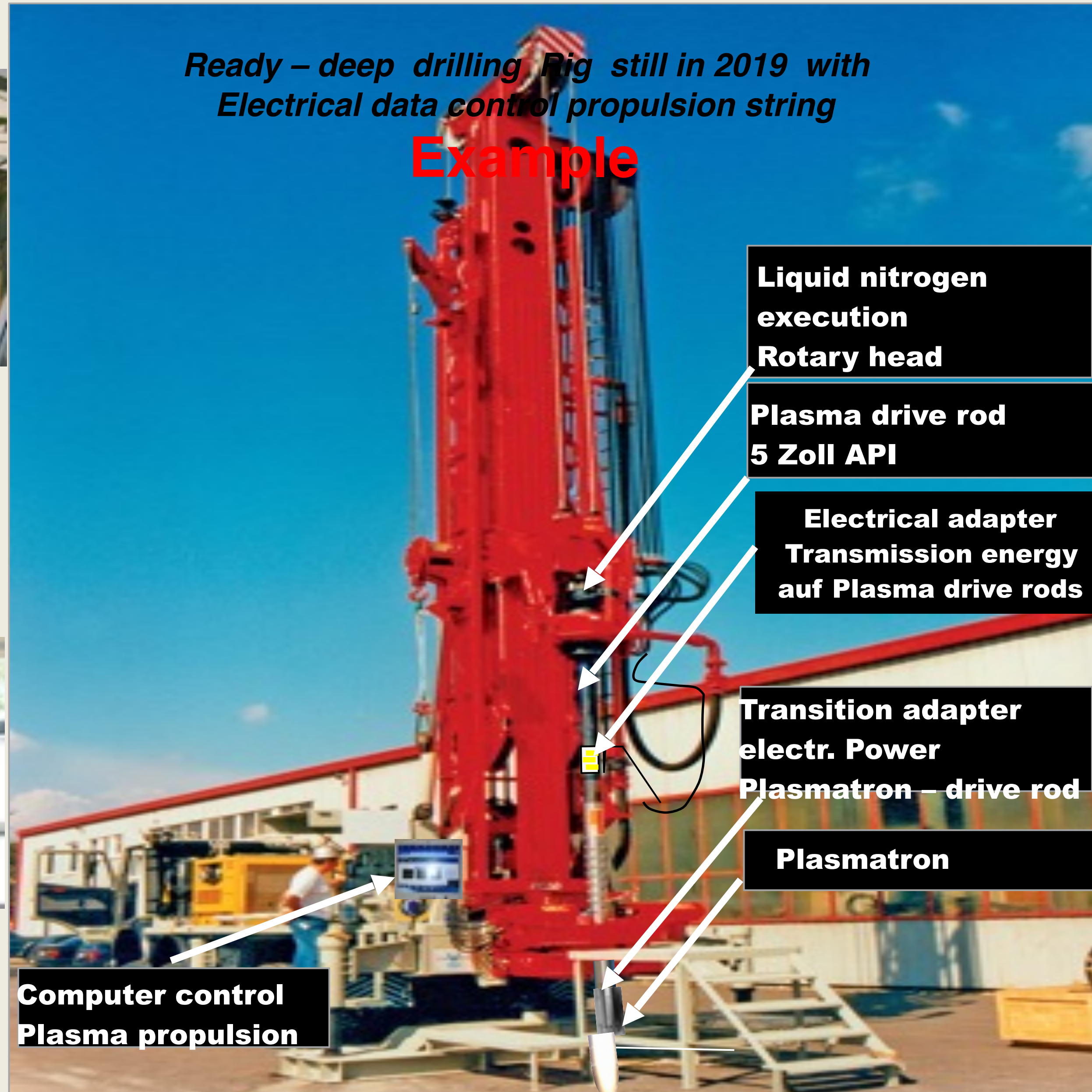


Section through a glazed plasma propulsion tube in 3D in sandstone with high quartzite inlay propulsion tube in 3D

Electrical superconductors

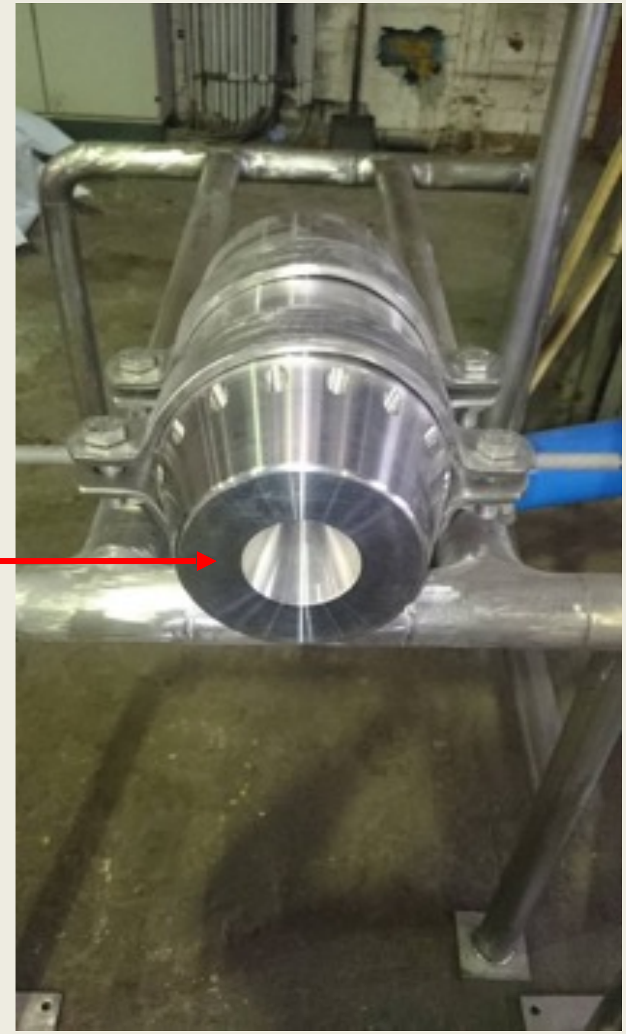
Plasma propulsion rod

5“ API



Plasmatron 1.3 MW built up for field tests 1. Date 22.10.2015
Electric propulsion rods - plasmatron

Superconductors
Plasma propulsion
Linkage API 5 inch



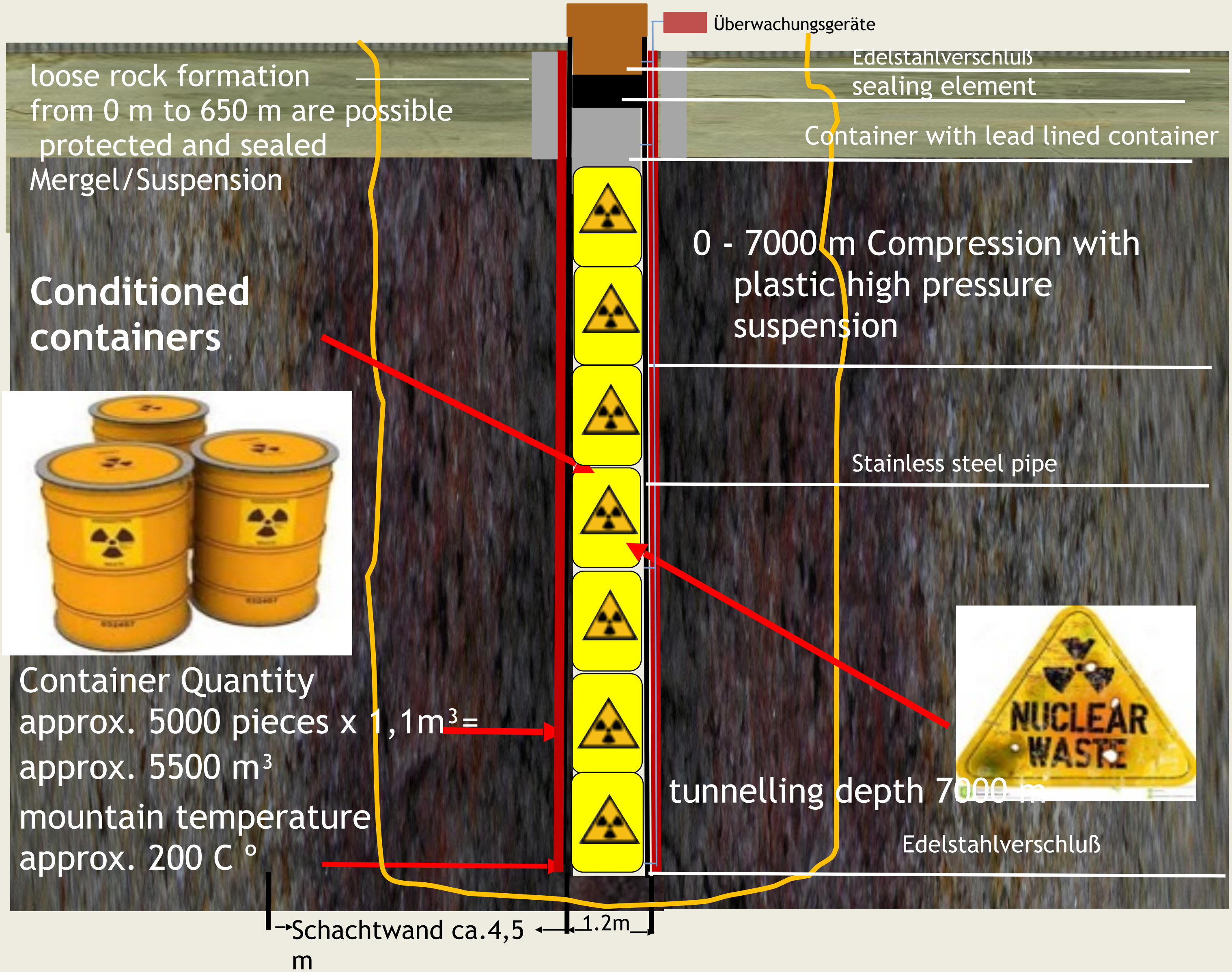
Plasma power head
1300 KW

Technical data - Explanations: PLB - VT
Plasma light arc - propulsion shaft technology

With the plasma propulsion technology, glazed/ceramic wells can be created in any shape and size, vertically 1200 mm and horizontally 300 mm as well as deflected.
During the descent, a 3-dimensional temperature geometry is formed around the plasma flame (approx. 4000 degrees Celsius) around the Plasmatron and the plasma flame, which heats up the liquids in the pore volume of the mountain and converts them into the gaseous state, and also pushes back the existing liquid horizons in the 3-dimensional temperature geometry.
The empty pore conductors in the 3-dimensional temperature geometry are closed by the vertical and horizontal rock pressure and the volume expansion of the mass rock as well as by the pre-pressure of the plasma flame (pressure chamber under the plasmatron). The 3-dimensional temperature geometry precedes the Plasmatron/plasma flame in the mountains.
The 3-dimensional temperature geometry has an expansion of about two and a half times the diameter of the propulsion shaft.
The sunk, glazed shaft has the structure:
Glazed (ceramic) Stone
Solidifying magma stone
Soft rock
Heated rock
Due to the effect of temperature, the shaft wall becomes a glazed ceramic, dense, self-locking, load-bearing, supporting, liquid-tight and interlocked formation shaft wall.
(harder - stronger than basalt rock).

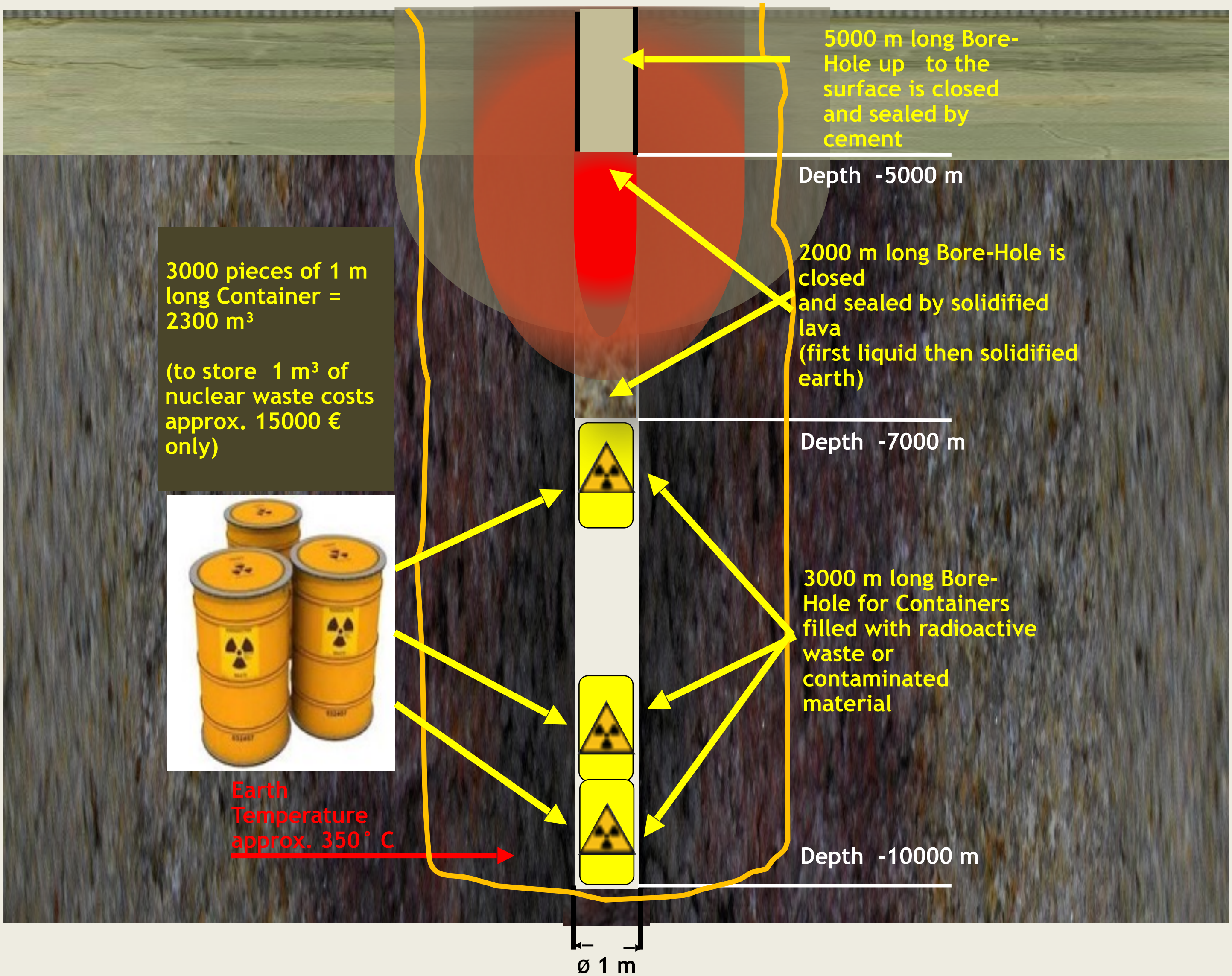
Disposal of radioactive material via a glazed tube tunnel

mit PLB - VT erstellt in der Erdkruste von 1 m - 7000 m **Model 2**



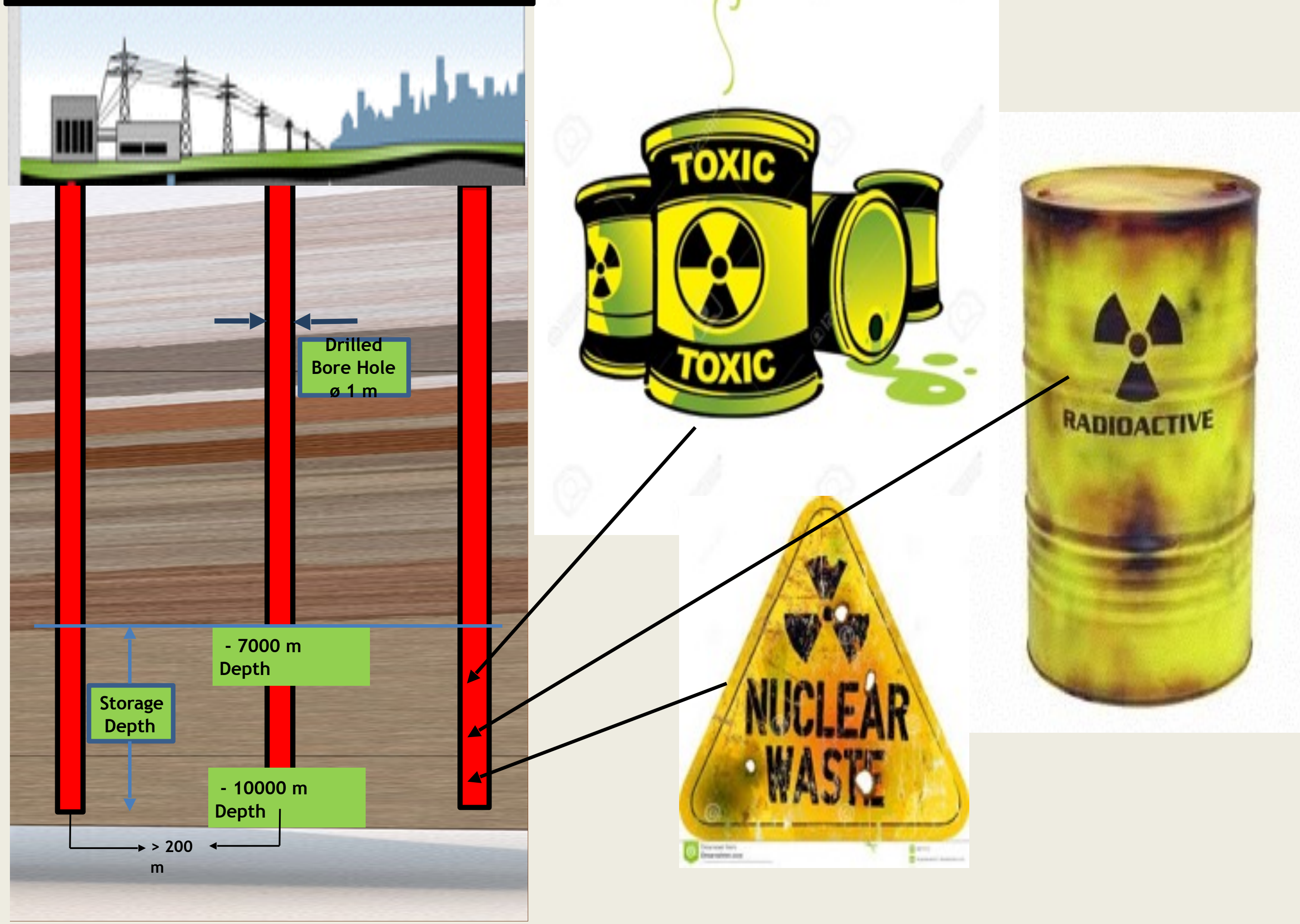
Disposal of radioactive material via a glazed tube tunnel

mit PLB - VT erstellt in der Erdkruste von 1 m - 10.000 m Model 2

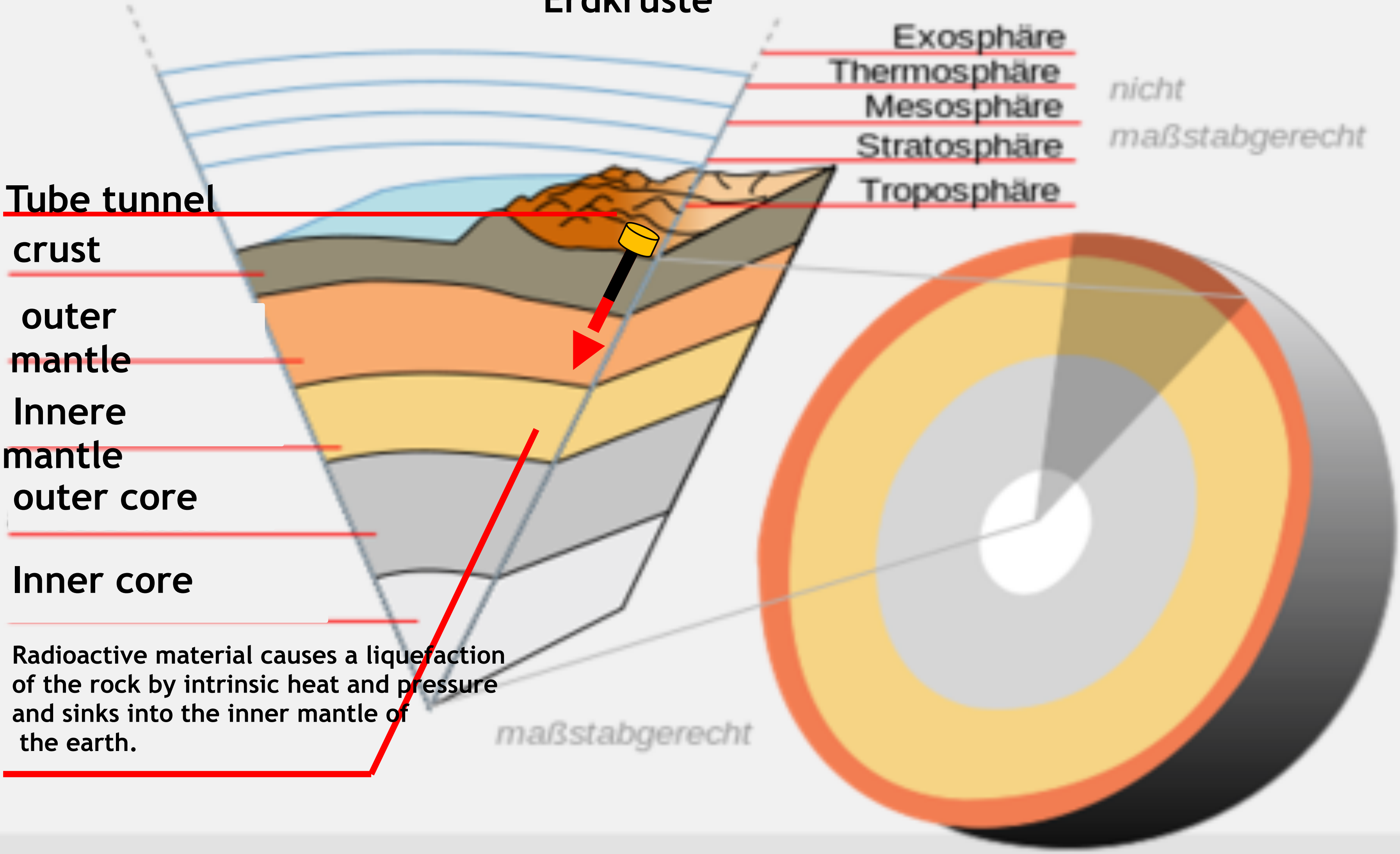


How to store radioactive and contaminated Waste

10000 m deep holes drilled by PlasmaDrilling to store radioactice and toxic waste material



Entsorgung von Radioaktiven Material über einen Röhrenschacht mit Plasma Vortriebstechnologie erstellt in der Erdkruste



Calculation of economic efficiency-1 tube tunnel Ø1200mm Depth 17000 m
Driving speed 15 m/h for exampel

A. Investment costs of plasma tunnelling 1 X 17,000 m pipe shaft

1 1000 to. Driving equipment - rent a. Day 30.000., 00 €	X 80 days	2.400.000 Euro
1 electric plasma propulsion rods 17000 m on 10 projects calculated		1.500.000 Euro
5 engineers a hour 85 € x 10 hours	X 80 days	340,000 Euro
7 skilled workers a hour 65 € x 10 hours	X 80 days	320.000 Euro
2 geologists a hour 150 € X10 hours	X 80 days	240.000 Euro
2 liquid Nitrogen plant. 15 m/h - Rent a day 17.000,00 €	X 80 days	1.360.000 Euro
2 diesel generators 8000 KVA a day 30,000.00 €	X 80 days	4,800,000 Euro
5 Plasma heads 750 mm/6000KW for 100.000 m	X 100.000	500.000 Euro
Diesel 3000 litres/h x 24x 200 days x 1,10 75% load		4.752.000 Euro
Insertion - Laying - Standpipe and other tasks		700.000 Euro
General operating costs: e. g. transport and assembly and dismantling costs		600,000 Euro
Produc. site (concrete foundation) and approach path - lower part of the site. Pers.		800.000 Euro
1 Preventer - Final securing and assembly works - Collecting container – Material		700.000 Euro
Cement - Mergel suspension approx. 5000 m³ - Processing - Production - Unit		400.000 Euro
Total sum total costs of investment in tunnelling of a tube tunnel		**19,412,000 Euro**