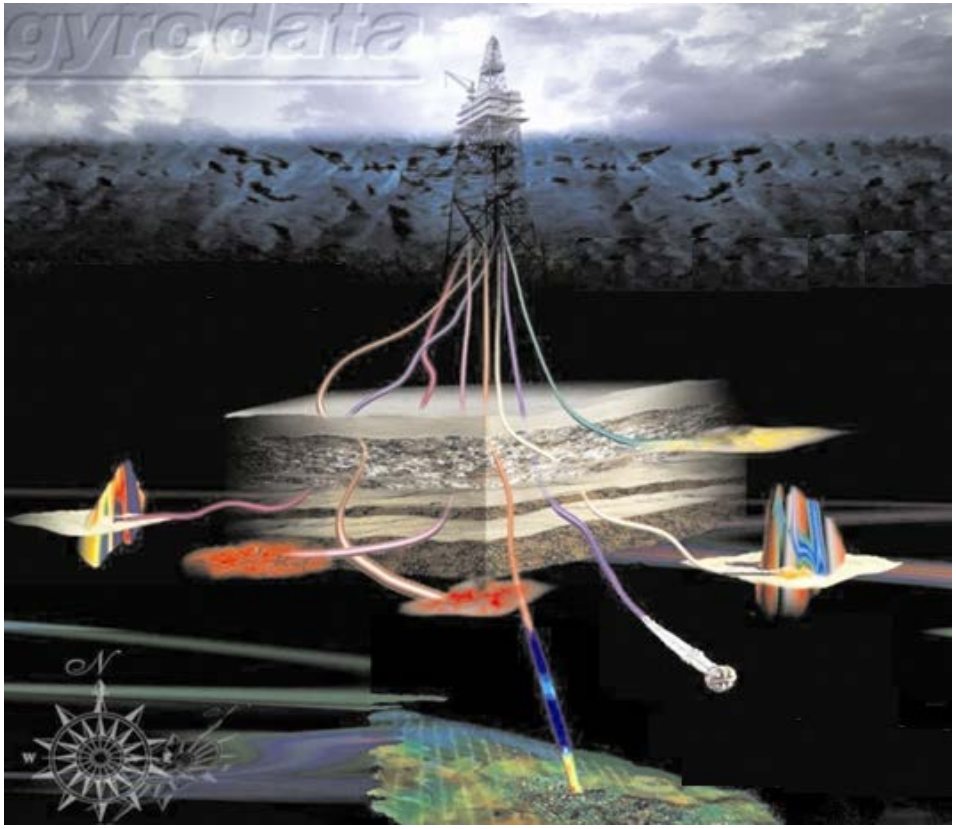
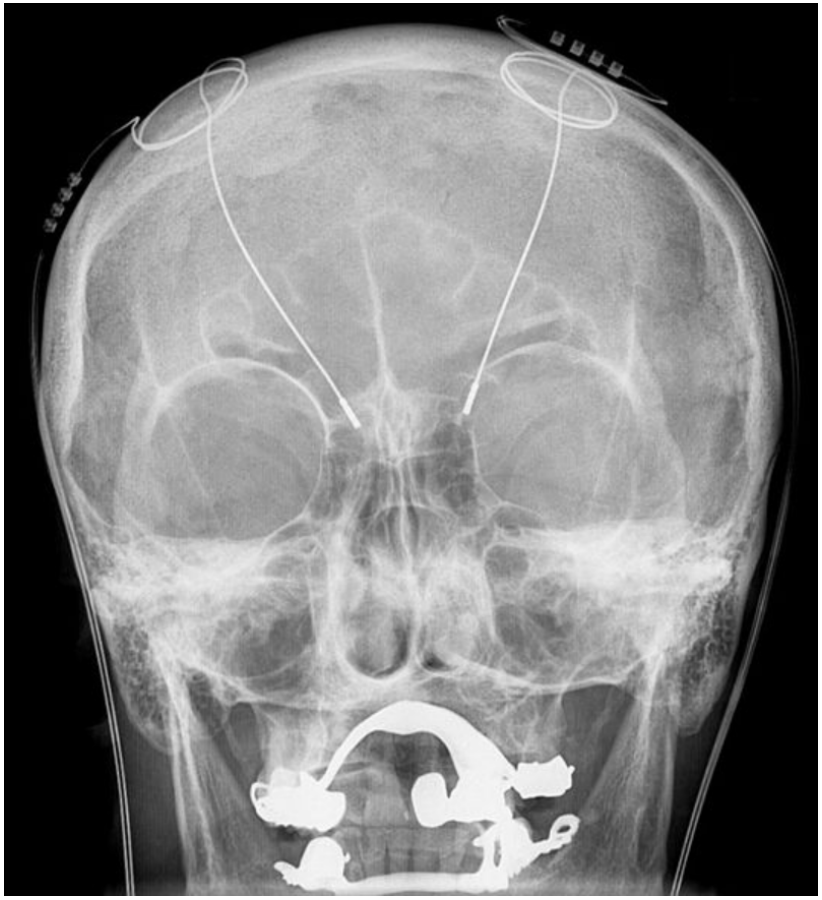
A new world of surveying

ISCWSA 2018 Spring Meeting
Inverness, Scotland

Roger Ekseth 11.04.2018



Similarities between Oil/Gas Technology and Brain Surgery



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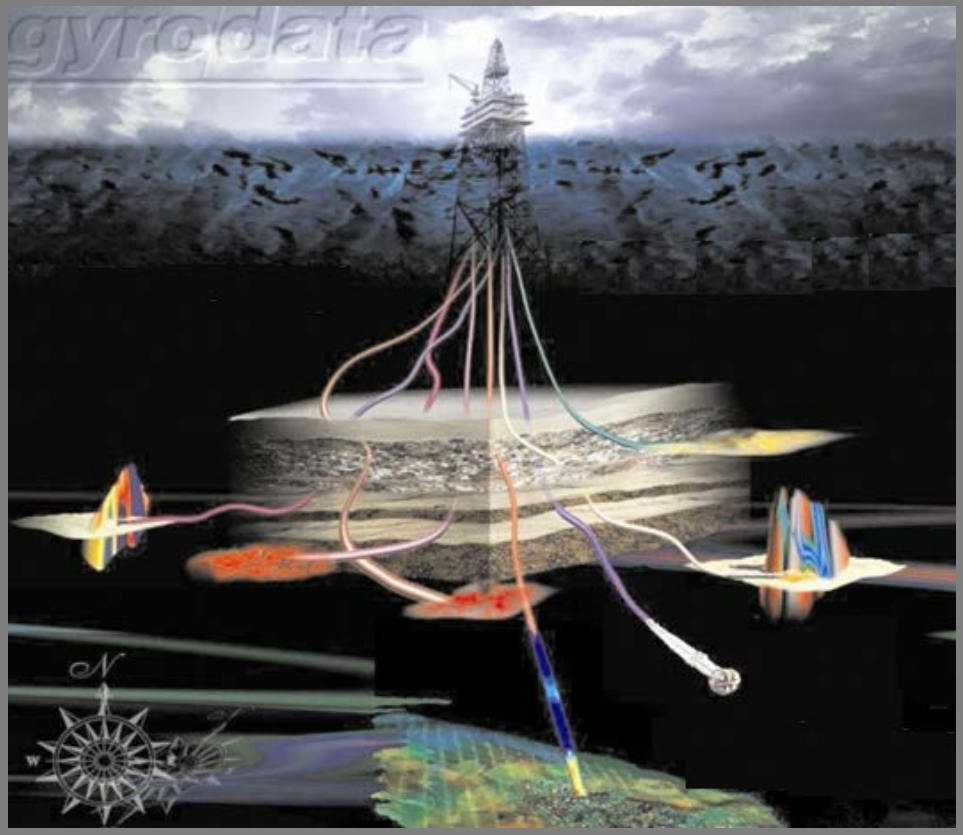
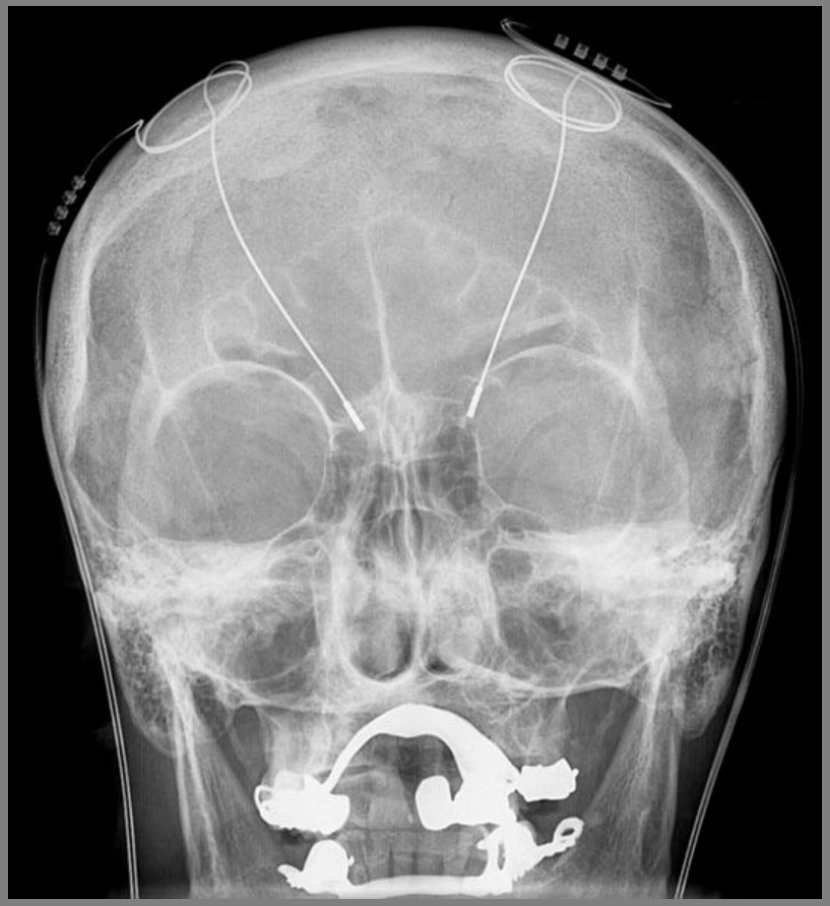




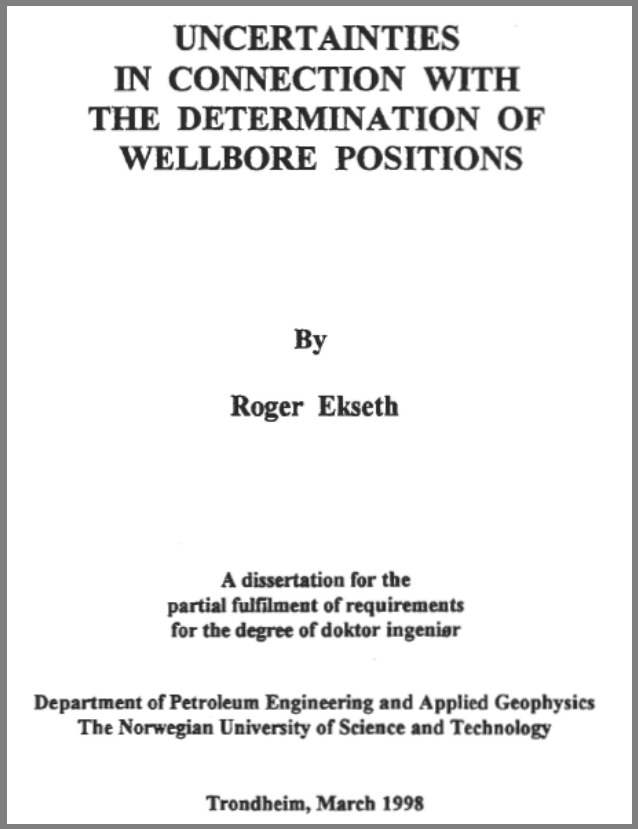
Wellbore Drilling

Versus

Deep Brain Stimuli (DBS)

Personal Background (Slide 2a)

- **Education**
  - **MSc:** Satellite navigation and GPS
  - **PhD:** Wellbore position uncertainty



UNCERTAINTIES
IN CONNECTION WITH
THE DETERMINATION OF
WELLBORE POSITIONS

By

Roger Ekseth

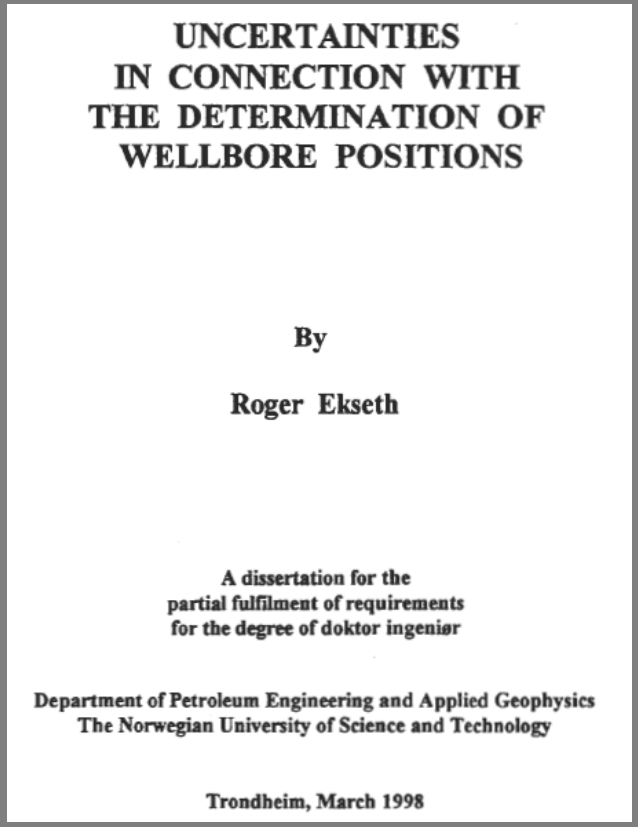
A dissertation for the
partial fulfilment of requirements
for the degree of doktor ingeniør

Department of Petroleum Engineering and Applied Geophysics
The Norwegian University of Science and Technology

Trondheim, March 1998

Personal Background (Slide 2b)

- Education
  - MSc: Satellite navigation and GPS
  - PhD: Wellbore position uncertainty
- **Work experience**
  - **Project manager Norwegian Hydrographic Service**
  - **Development manager Gyrodata Inc.**



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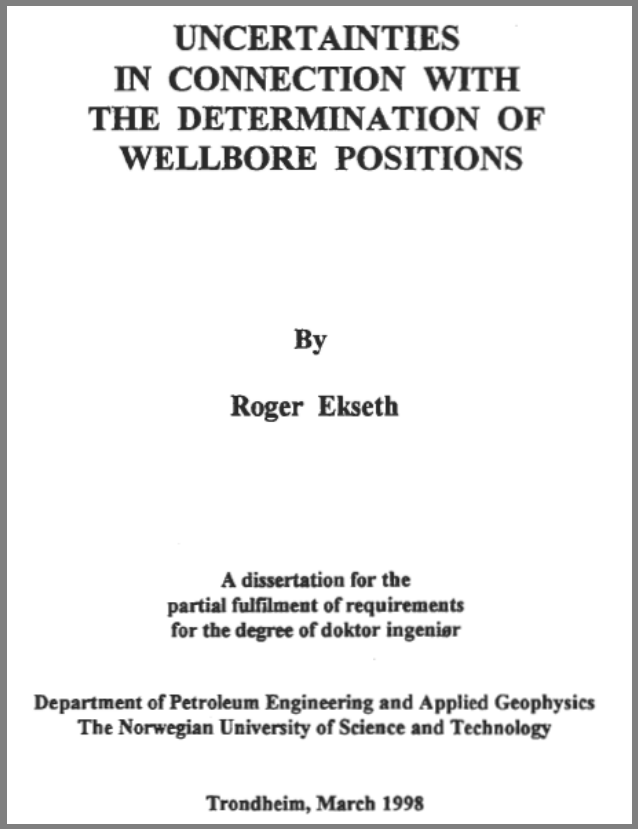
Personal Background (Slide 2c)

- Education
  - MSc: Satellite navigation and GPS
  - PhD: Wellbore position uncertainty
- Work experience
  - Project manager Norwegian Hydrographic Service
  - Development manager Gyrodata Inc.
- Health
  - Diagnosed with Parkinson's Disease 2002
  - DBS operation 2012



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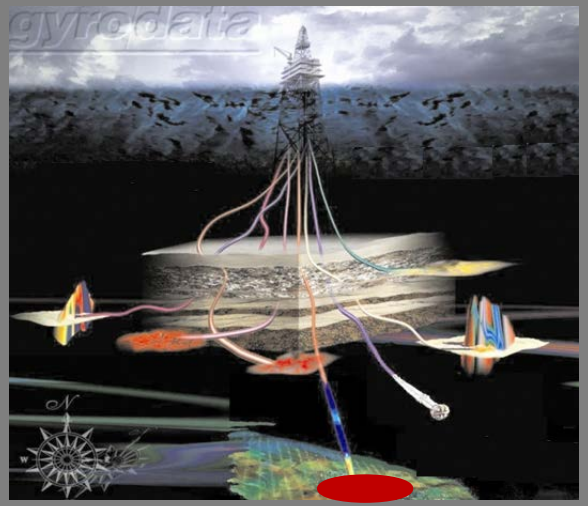
My head after oper.

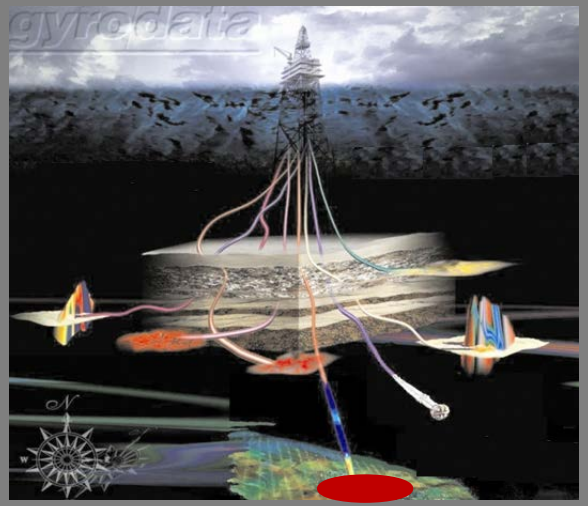
Job objectives – (Slide 3a)

- **Wellbore Drilling**
  - **To safely drill a hole from the surface (or the sea bottom) to a predefined underground target for exploration- or production purposes**

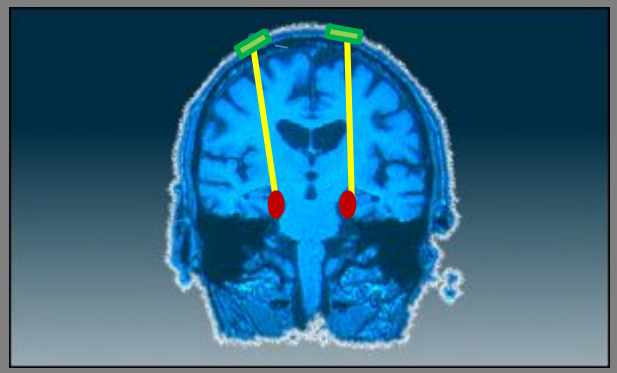


Job objectives – (Slide 3b)

- **Wellbore Drilling**
  - To safely drill a hole from the surface (or the sea bottom) to a predefined underground target for exploration- or production purposes

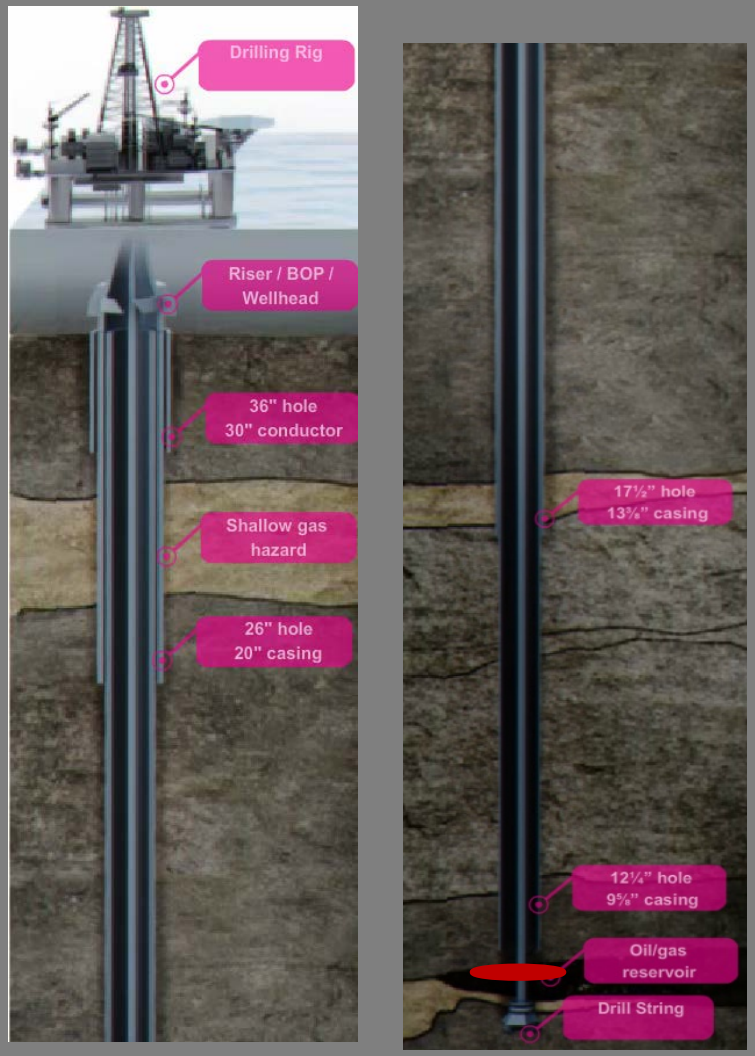


- **DBS-operation (Deep Brain Stimulation)**
  - **To safely drill two holes through the scull and to push electrodes toward targets deep in the core of the brain to improve the life quality of patients with Parkinson's etc.**



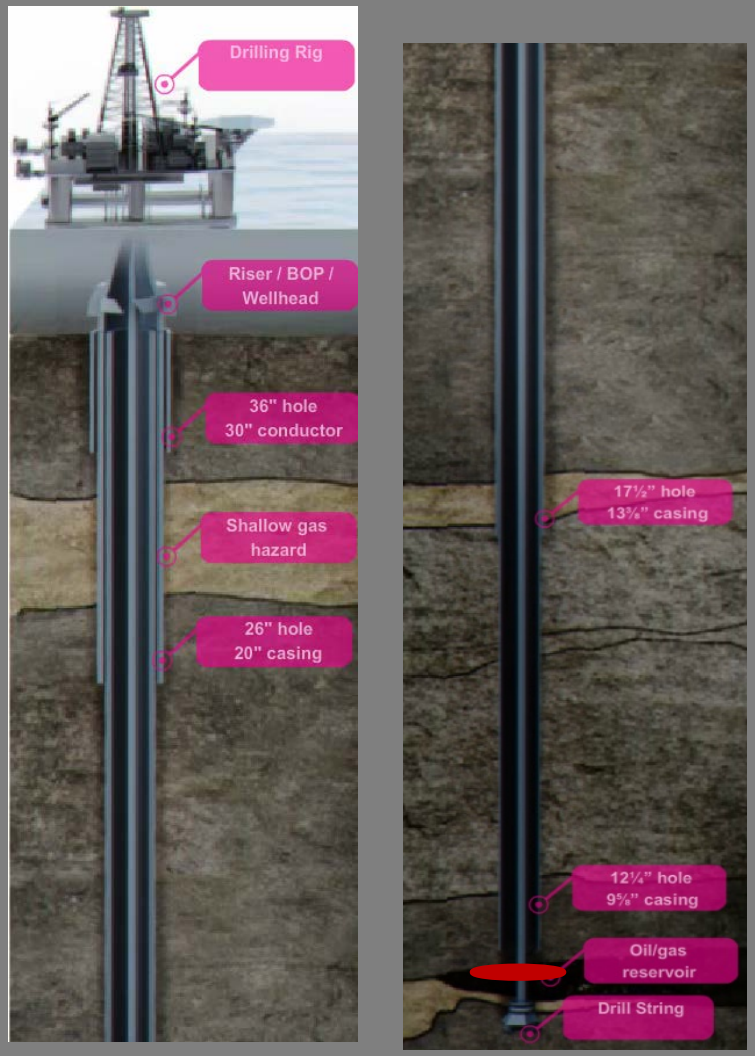
Targets (Slide 4a)

Wellbore drilling

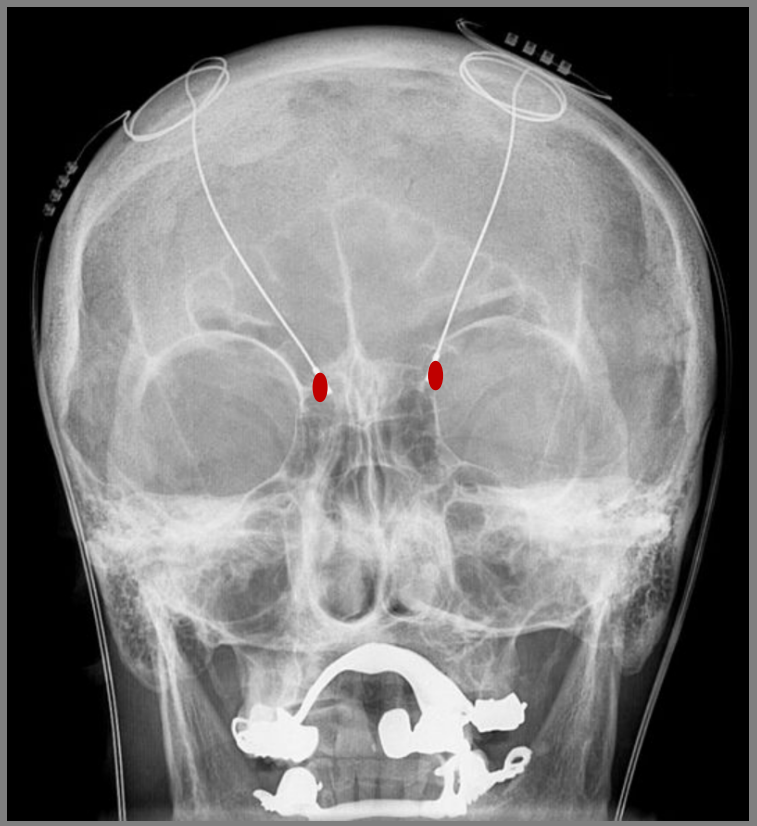


Targets – (Slide 4b)

Wellbore drilling



DBS



Target size
Distance – (Slide 5a)

Wellbore drilling

- **Wellbore length**
  - **1 to 15 km (Typical 2 km)**

DBS

- **Penetration length**
  - **8 to 12 cm (Typical 10 cm)**

Target size
Distance – (Slide 5b)

Wellbore drilling

- Wellbore length
  - 1 to 15 km (Typical 2 km)
- Typical target size
  - Hz: 100m X 100m
  - V: 1m
    (Average 67m)

DBS

- Penetration length
  - 8 to 12 cm (Typical 10 cm)
- Target size
  - About the size of a piece of rice
    6mm X 2mm X 1mm
    (Average 3mm)

Target size
Distance – (Slide 5c)

Wellbore drilling

- Wellbore length
  - 1 to 15 km (Typical 2 km)
- Typical target size
  - Hz: 100m X 100m
  - V: 1m
    (Average 67m)
- **Relative difference**
  - **For 2 km wellbores**
    1D; 67 : 2000

DBS

- Penetration length
  - 8 to 12 cm (Typical 10 cm)
- Target size
  - About the size of a piece of rice
    5mm X 2mm X 1mm
    (Average 3mm)
- **Relative difference**
  - **For 10 cm penetration**
    1D; 0.3 : 10

Target size
Distance – (Slide 5d)

Wellbore drilling

- Wellbore length
  - 1 to 15 km (Typical 2 km)
- Typical target size
  - Hz: 100m X 100m
  - V: 1m
    (Average 67m)
- Relative difference
  - For 2 km wellbores
    1D; 67 : 2000 = 3 : 100

DBS

- Penetration length
  - 8 to 12 cm (Typical 10 cm)
- Target size
  - About the size of a piece of rice
    5mm X 2mm X 1mm
    (Average 3mm)
- Relative difference
  - For 10 cm penetration
    1D; 0.3 : 10 = 3 : 100

→ About the same relative precision demand for both cases

Other Similarities – (Slide 6a)

- **Both tasks can be divided into three closely linked project/job phases**
  - **Initial phase**
    Establishing common references for explorations/underground drilling and for pre investigations/brain operation
  - **Drilling/operation phase**
  - **Production/stimulation phase**

Other Similarities – (Slide 6b)

- **Both tasks can be divided into three closely linked project/job phases**
  - **Initial phase (Establishing common references for explorations/underground drilling and for pre investigations/brain operation)**
  - **Drilling/operation phase**
  - **Production/stimulation phase**

- **The principal project phases may even be divided into closely linked sub groups**

Other Similarities – (Slide 6c)

- Both tasks can be divided into three closely linked project/job phases
  - Initial phase
    Establishing common references for explorations/underground drilling and for pre investigations/brain operation
  - Drilling/operation phase
  - Production/stimulation phase

- The principal project phases may even be divided into closely linked sub groups

- **Most of these tasks are dangerous and may result in fatal accidents**
  - **Especially if safety precautions are not in place or are neglected**

Other Similarities – (Slide 6d)

- Both tasks can be divided into three closely linked project/job phases
  - Initial phase
    Establishing common references for explorations/underground drilling and for pre investigations/brain operation
  - Drilling/operation phase
  - Production/stimulation phase

- The principal project phases may even be divided into closely linked sub groups

- Most of these tasks are dangerous and may result in fatal accidents
  - Especially if safety precautions are not in place or are neglected

Shall now look at each of the three project phases and see that even more similarities are present

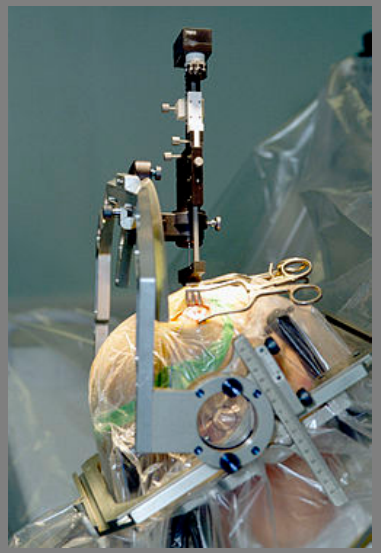
Project Phase 1
Major tasks 1 – (Slide 7a)

Oil and gas industry

- **Exploration/preparation**
  - **3D imaging (Seismic) including ship navigation**

DBS surgery

- **Investigations/preparation**
  - **Mounting of reference frame on the scull**



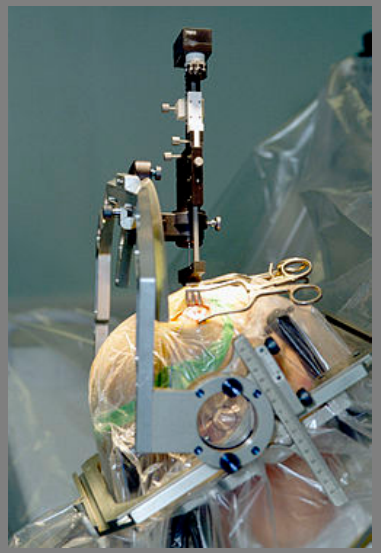
Project Phase 1
Major tasks 1 – (Slide 7b)

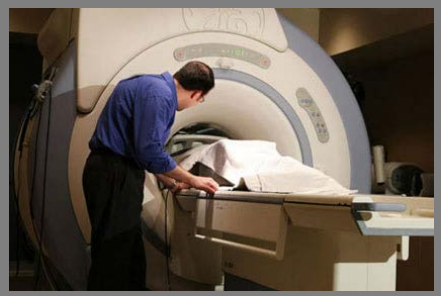
Oil and gas industry

- **Exploration/preparation**
  - **3D imaging (Seismic) including ship navigation**
  - **Orientation of drill rig relative to seismic**

DBS surgery

- **Investigations/preparation**
  - **Mounting of reference frame on the scull**
  - **3D imaging (MRI) of the scull with the reference frame**





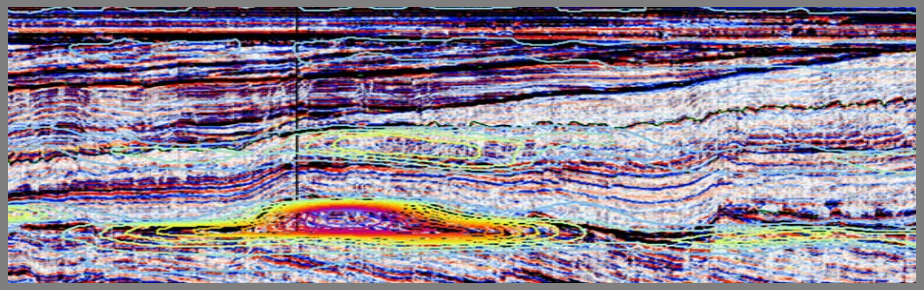
Project Phase 1
Major tasks 1 – (Slide 7c)

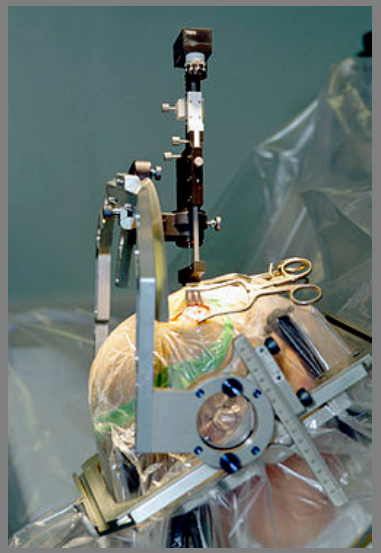
Oil and gas industry

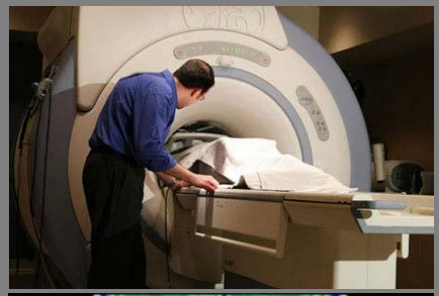
- **Exploration/preparation**
  - 3D imaging (Seismic) including ship navigation
  - Orientation of drill rig relative to seismic

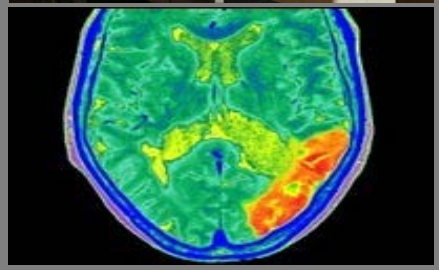
DBS surgery

- **Investigations/preparation**
  - Mounting of reference frame on the scull
  - 3D imaging (MRI) of the scull with the reference frame









Project Phase 1
Major tasks 2 – (Slide 8a)

Oil and gas industry

- **Exploration/preparation**
  - 3D imaging (Seismic) including ship navigation
  - Orientation of drill rig relative to seismic

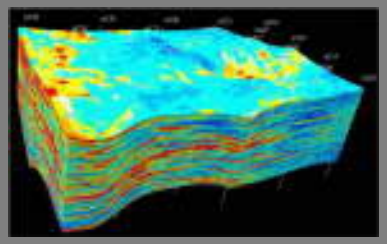
DBS surgery

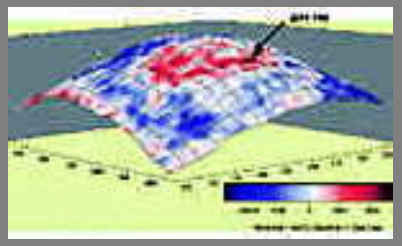
- **Investigations/preparation**
  - 3D imaging (MRI) of the scull with the reference frame
  - Mounting of reference frame on the scull

Project Phase 1
Major tasks 2 – (Slide 8b)

Oil and gas industry

- **Exploration/preparation**
  - 3D imaging (Seismic) including ship navigation
  - Orientation of drill rig relative to seismic
  - “Creation” of a common coordinate system for both seismic and drilling





DBS surgery

- **Investigations/preparation**
  - 3D imaging (MRI) of the scull with the reference frame
  - Mounting of reference frame on the scull
  - “Creation” of a common coordinate system for both MRI pictures and operation

Project Phase 1
Dangers & consequences – (Slide 9a)

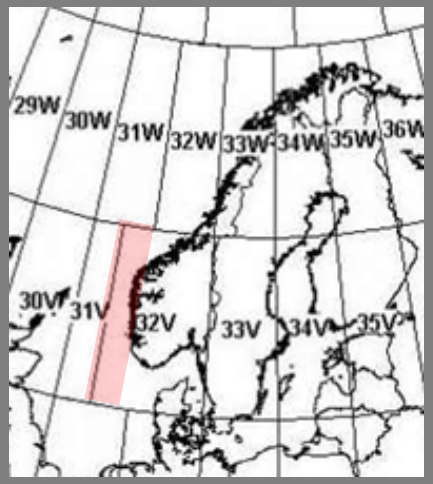
Oil and gas industry

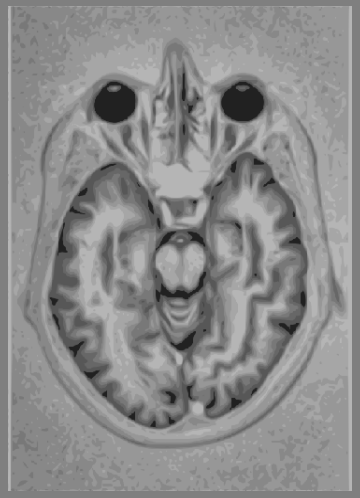
- **Mapping blunders**
  - **Use of wrong UTM zone etc.**

DBS surgery

- **Diagnosing blunders**
  - **Use of upside down MRI pictures**

31V or 32V ?





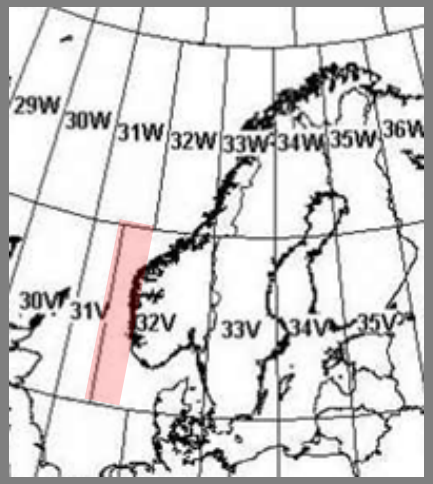
Left or right ?

Project Phase 1
Dangers & consequences – (Slide 9b)

Oil and gas industry

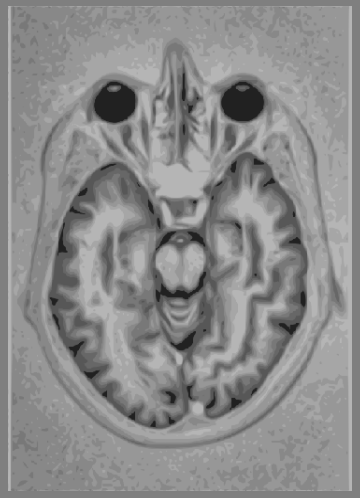
- **Mapping blunders**
  - **Use of wrong UTM zone etc.**
- **May lead to:**
  - **Bad decisions and large economical losses**

31V or 32V ?



DBS surgery

- **Diagnosing blunders**
  - **Use of upside down MRI pictures**
- **May lead to:**
  - **Operation of left/right brain side based on other side's info**



Left or right ?

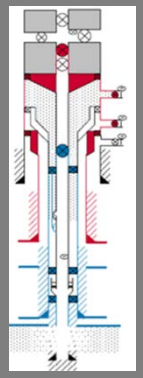
Project Phase 2
Major tasks – (Slide 10a)

Oil and gas industry

- **Drilling process**
  - **Conductor setting/drilling for largest casing diameter**

DBS surgery

- **Operation**
  - **Drilling two 14 mm holes through the scull**



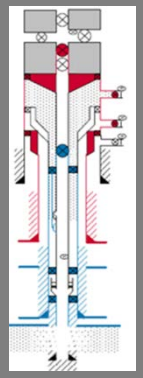
Project Phase 2
Major tasks – (Slide 10b)

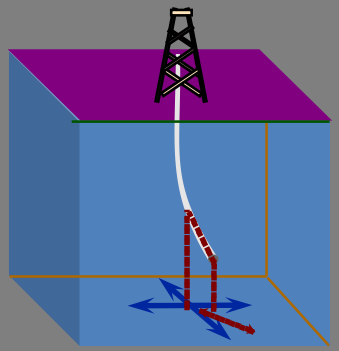
Oil and gas industry

- **Drilling process**
  - **Conductor setting/drilling for largest casing diameter**
  - **Intermediate under-ground wellbore drilling**

DBS surgery

- **Operation**
  - **Drilling two 14 mm holes through the scull**
  - **Running of electrodes into the brain**





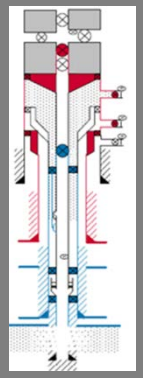
Project Phase 2
Major tasks – (Slide 10c)

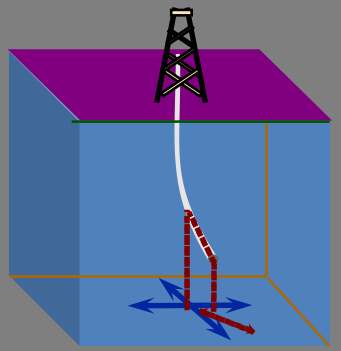
Oil and gas industry

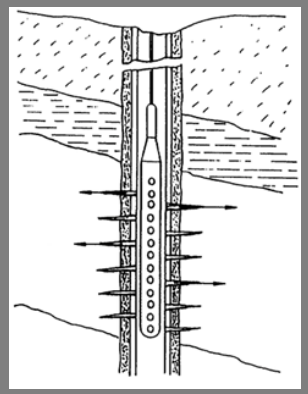
- **Drilling process**
  - Conductor setting/drilling for largest casing diameter
  - Intermediate under-ground wellbore drilling
  - **Running of casing and wellbore completion**

DBS surgery

- **Operation**
  - Drilling two 14 mm holes through the scull
  - Running of electrodes into the brain
  - **Exchanging intermediate electrode with permanent**







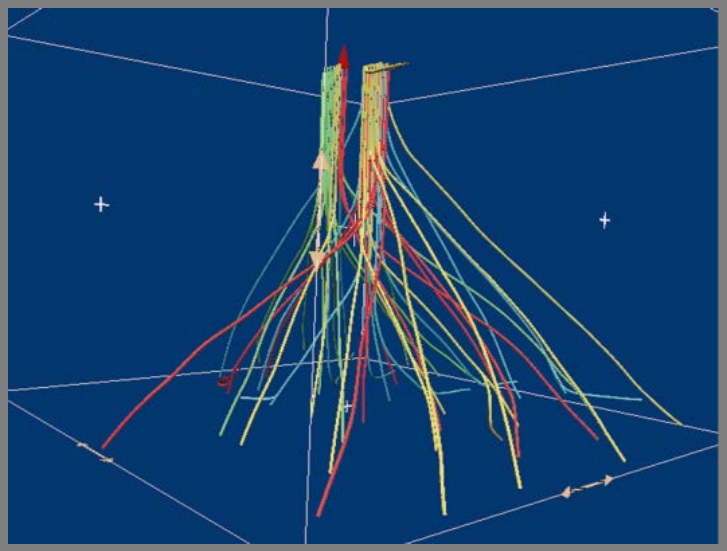
Project Phase 2.1
Dangers & consequences – (Slide 11a)

Oil and gas industry

- **Drilling for the largest casing**
  - **Drilling into adjacent wellbore**

DBS surgery

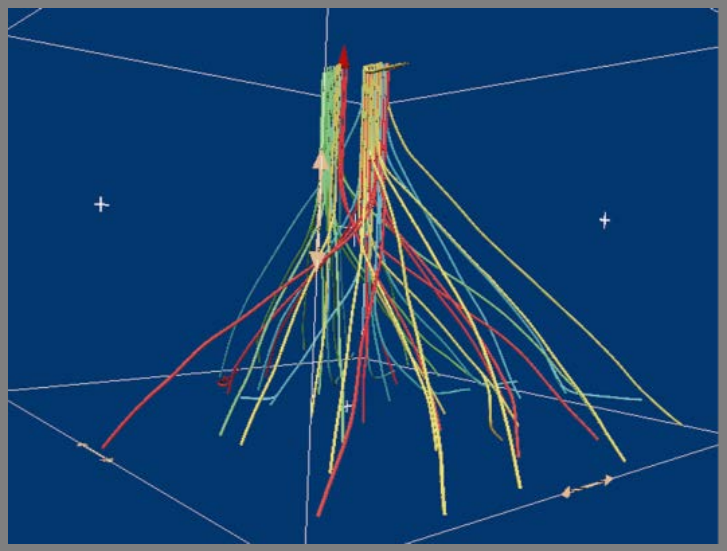
- **Drilling through the scull**
  - **Drilling into the brain tissue**



Project Phase 2.1
Dangers & consequences – (Slide 11b)

Oil and gas industry

- **Drilling for the largest casing**
  - **Drilling into adjacent wellbore**
- **May lead to:**
  - **Blow-out/fatal accident**



DBS surgery

- **Drilling through the scull**
  - **Drilling into the brain tissue**
- **May lead to:**
  - **Severe brain damage -death**

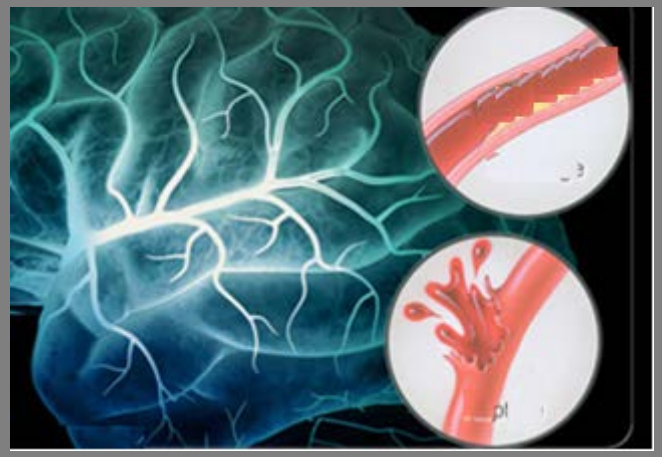
Project Phase 2.2
Dangers & consequences – (Slide 12b)

Oil and gas industry

- **Intermediate under-ground wellbore drilling**
  - **Drilling into shallow gas pockets**
- **May lead to:**
  - **Exploding (or even sinking) platform/fatal accident**

DBS surgery

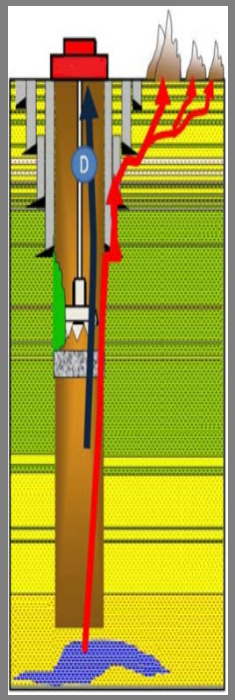
- **Running of electrodes deep into the brain**
  - **Punctuation of large blood vessel**
- **May lead to:**
  - **Brain bleeding/stroke (severe)**



Project Phase 2.3
Dangers & consequences – (Slide 13a)

Oil and gas industry

- **Running of casing and wellbore completion**
  - **Bad cementing/perforations**



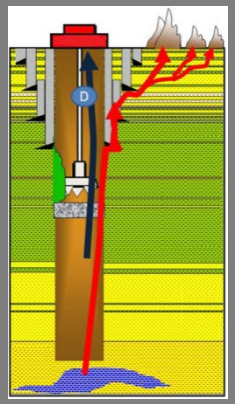
DBS surgery

- **Exchanging intermediate electrode with permanent**
  - **Brain “movement”**

Project Phase 2.3
Dangers & consequences – (Slide 13b)

Oil and gas industry

- Running of casing and wellbore completion
  - Bad cementing/perforations
- May lead to:
  - Interaction with non-reservoir wellbore sections
    - Loss of reservoir



DBS surgery

- Exchanging intermediate electrode with permanent
  - Brain "movement"
- May lead to:
  - Stimulation of other brain parts
    - Upside-down view
    - Depression etc.

Project Phase 3
Major tasks – (Slide 14)

Oil and gas industry

- **Production of oil and gas reserves**
  - **Maintenance of installation and wellbore**

DBS surgery

- **Permanent stimulation of the brain with voltage**
  - **Changing battery and DBS electronics maintenance**

Project Phase 3
Dangers & consequences – (Slide 15a)

Oil and gas industry

- **Maintenance of installation and wellbore**
  - **Failure to follow maintenance plan**

DBS surgery

- **Permanent stimulation of the brain with voltage**
  - **Missing maintenance plan**

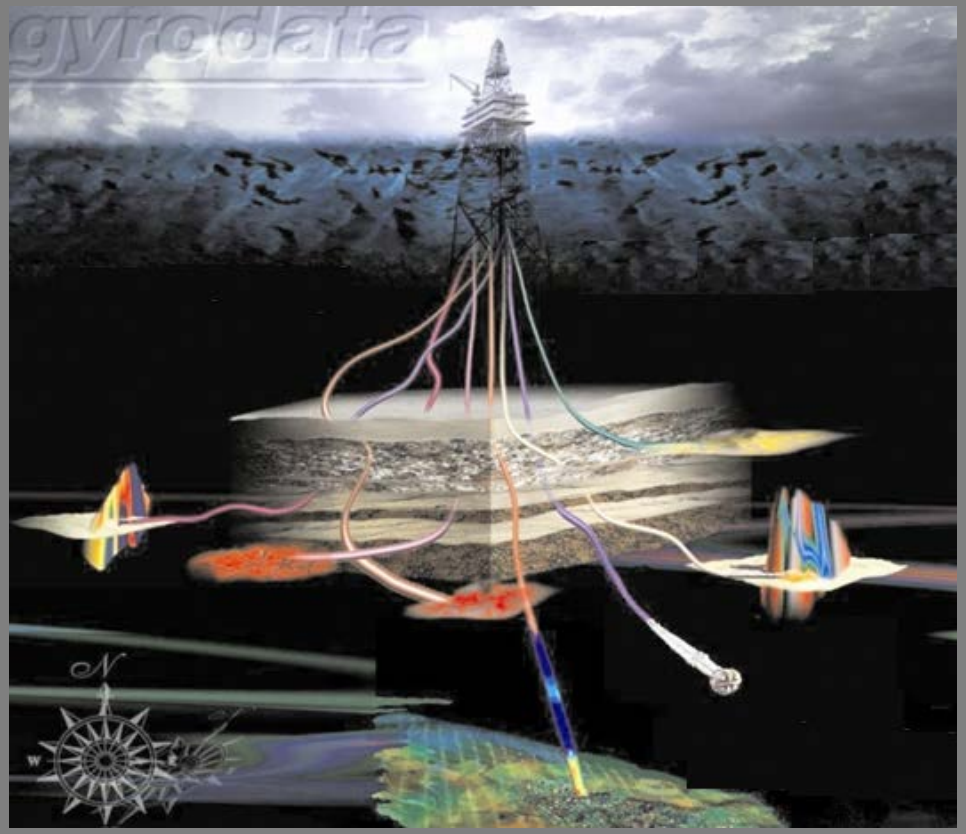
Project Phase 3
Dangers & consequences – (Slide 15b)

Oil and gas industry

- **Maintenance of installation and wellbore**
  - **Failure to follow maintenance plan**
- **May lead to:**
  - **Major accidents**
    - **Exploding platforms**

DBS surgery

- **Permanent stimulation of the brain with voltage**
  - **Missing maintenance plan**
- **May lead to:**
  - **Unscheduled immediate stop in voltage supply**
    - **Parkinson "freezing"**



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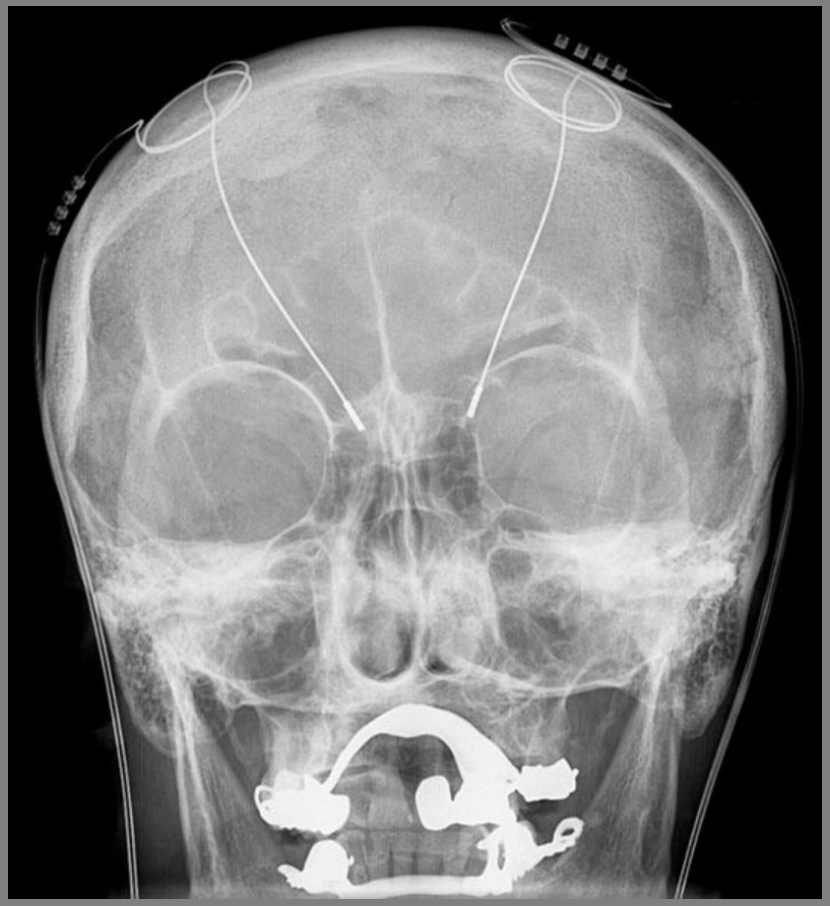

Thank you for listening