Small TBM for Hydro Power

- Challenging the existing drill & blast regime through long term thinking

TBM Applications III, Trondheim, November 4th, 2019 MSc Rune Skjevdal, CEO





Small Hydro

Challenging the Existing

Our TBM: Snow White



10

王朝

Norsk Grønnkraft

A pure developer and constructor of hydro power plants

Are they nuts?

Why on earth does a 6-employee company buy a TBM?



Norwegian SHPP history is >500 years







EFTER OFFENTLIG FORANSTALTNING UTGIT

AV

KR. ENGER ELINGSINGENION I VASDRAGSVÆSENE

THOROLF GREGERSEN

SIGURD HIORTH



KRISTIANIA FORLAGT AV H. ASCHEHOUG & CO. (W. NYGAARD) 1913

UTGATT AV STORTINGSBIBLIOTEKET

Typical Norwegian SHPP today

KVERNÅI SHPP, LESJA:

- 2.8 MW installed capacity
- 7.6 GWh annual production
- Head: 366 m
- Penstock: 2 km
- Flow: 900 I/s
- Cost: 2.8 M€





Blådalselva, Masfjorden, 6,4 GWh, Courtesy of Småkraft AS

A new industry has evolved last 20 years

Following market deregulation in 1991 and increasing power prices

Challenging the existing

How do we get tunnels cheaper and faster?

Different solutions

Norhard technology:

Exceptional technology for precise banana holes on steap gradients with lengths up to 1,5 km and Ø700 - 1500 mm

Drill&blast:

Flexible and known. Not very quick and not very cheap. Huge piles of rock

Raiseboring:

Known and cheap. Strict limitations on precision and length

TBM:

Known. Quick and competence-intensive. High investment cost and rig time

Boring is ideal for hydro power water ways

- Circular cross-section
- Low water flow friction
- Limited need of rock support due to diameter, geometry and lack of explosives
- \bullet Diameter needed is typically less than Ø 2 m
- Less excavated material
- Purely electrical

Courtesy of Sindre Log, TRC

Grytendal project

- 550 m tunnel
- Minimum Ø1500 mm
- Banana both vertical and horisontal

Courtesy of Norhard

Løkkebø project

- 270 m tunnel
- Minimum Ø1000 mm
- Straight hole access to intake

So far so good...

...but what about the longer tunnels?

Problem:

Heavy investment in equipment and people =>

Nobody will buy a TBM and offer cheap tunnels for us

Traditional business model

• Buying a TBM is:

- Customization, not off-the-shelf
- Many details need to be sorted out during engineering and construction
- Complex competence on construction and operation of TBMs as well as the specific project need for the project owner

The business model does not fit

Especially not on multiple projects that you do not know

 New business model needs to cope with numerous risks:

- Market risk?
- Technical risk?
- Employ personell?
- Progress risk?

Our thoughts in 2017

- We want as cheap tunnels as possible and the right risk (not necessary low risk)
- We don't know how to run a TBM
- We have engineering and project management competence
- We are not a contractor
- We are fine with market risk
- We are fine with financial risk
- We need a consortium on this

New business model

Ø 2,8 m main beam open gripper TBM 115 m long 200 tons > 1 000 kN/m² 3 km conveyor 4 shifts / 24 guys

Boring is not boring!

snow White

«Oh my God, what have we done?»

Salvasskardelva project

- 2,8 km tunnel
- Minimum Ø1800 mm
- Banana both horisontal and vertical

7620000

Salvasskardelva kraftverk

| 24.05.2019 | Kirrstr fegnel SLA | SH | Maleslohn | NORSK | |
|---|-----------------------|----|-----------|----------------|---------------|
| EUREPRIV- SONE 33 NN 1954 høyder 1:8100 | | | | GRONNKRAF I | |
| Plan og lengdeprofil Tunnel | | | | Listations for | Lintethet pic |
| | | | | | 201 |

EUR89 33: EUREF89 - SONE 33

7619000

Veiski project

- 1100 m tunnel
- Minimum Ø1600 mm
- Straight

Let's drill and blast through the winter!

Mork project

Are they nuts?

Well, it is always the simplest and least risky solution to say «No, this cannot be done»

The future needs brave project owners to develop underground solutions with less social impact

We will contribute!

Four years of tunneling 10 m from 95 children's day care cente

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