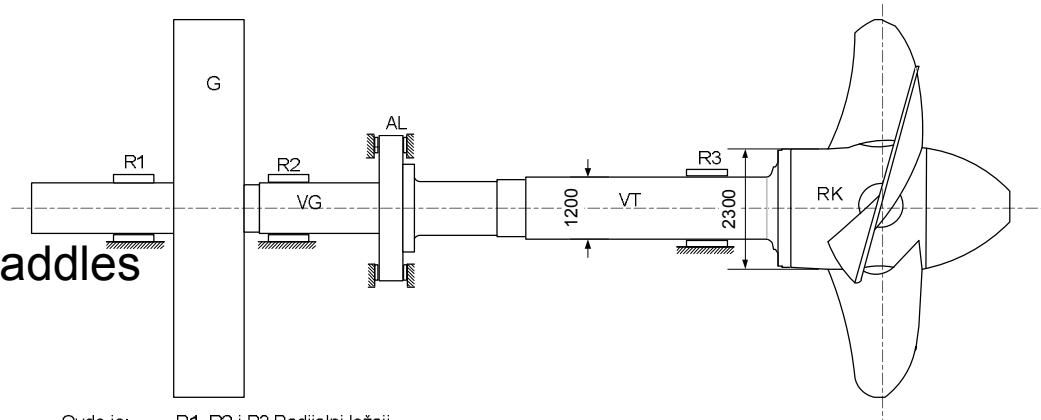


## HPP Djerdap II – Negotin Turbine shafts

- ✓ 1985. - 1987. 8 machines from company LMZ, SSSR
- ✓ 1998.- 2000. 2 machines from Romanian company UCM Resica
- ✓ turbine shaft length 7,55m
- ✓ turbine power 28MW
- ✓ turbine shaft diameter 1400mm
- ✓ paddles diameter 7500mm, 4 paddles
- ✓ rotation 62,5 o/min



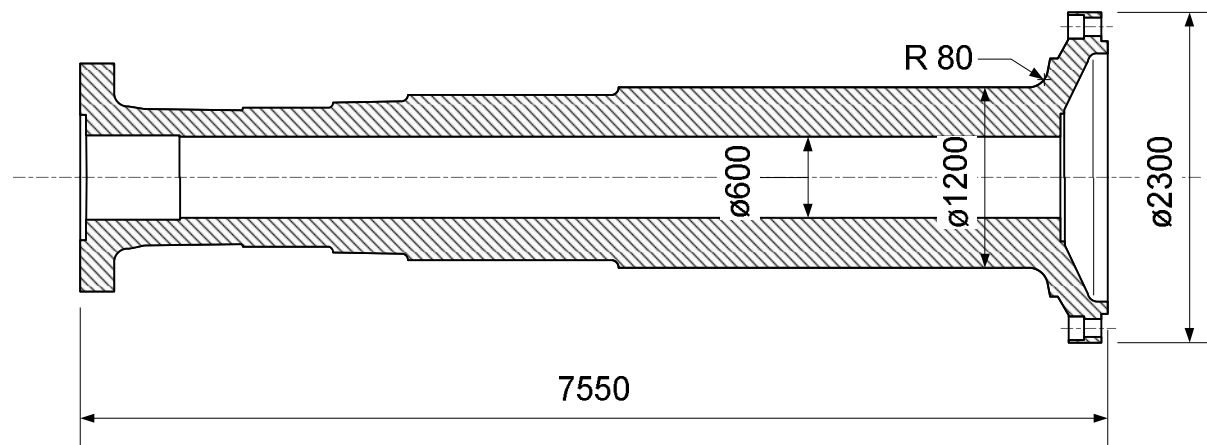
Ovde je:

- R1, R2 i R3 Radijalni ležaji,
- AL Aksijalni ležaj,
- G Rotor generatora,
- VG Vratilo generatora,
- VT Vratilo turbine,
- RK Radno kolo

# Hydro Power Plant



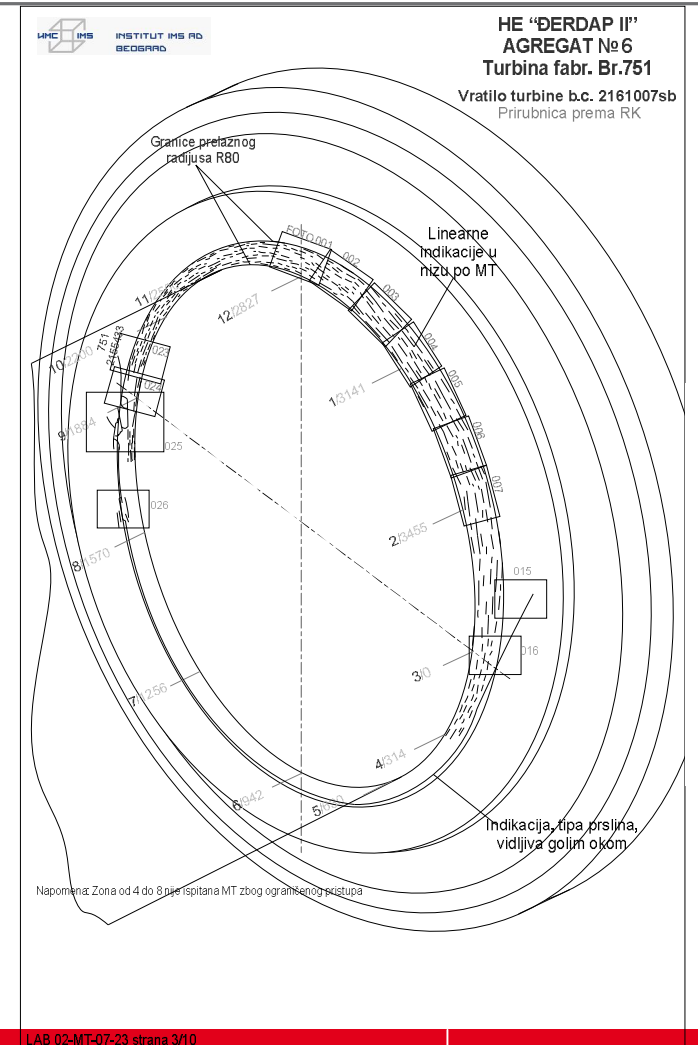
- ✓ turbine base material 20GSL
- ✓ problem at radius R80
- ✓ during working period radius area was not checked



# Hydro Power Plant

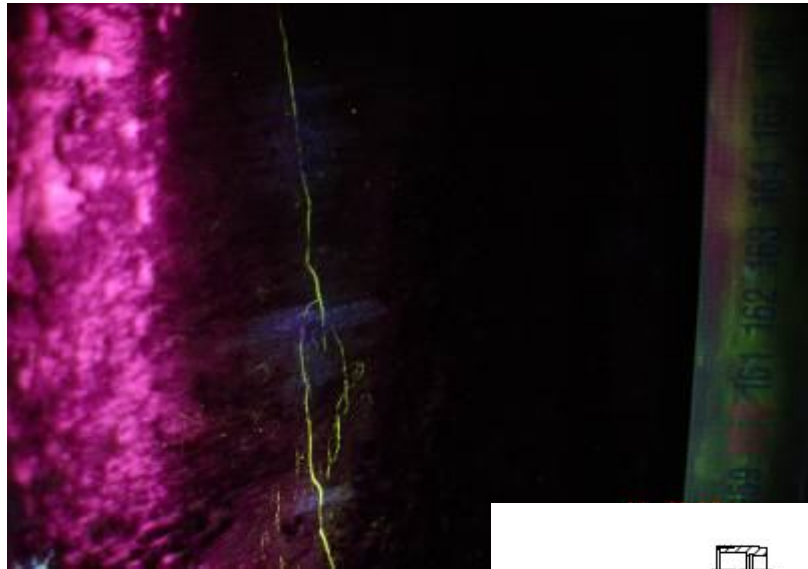
Stronger with...  
Castolin Eutectic

- ✓ after 163411 working hours (ca. 24 years) problem occurs at turbine A6 – January 2007.
- ✓ big oil pressure drop, and then big 2,1m crack reveal at R80 radius
- ✓ detail examination of R80, reveals big numbers of small cracks

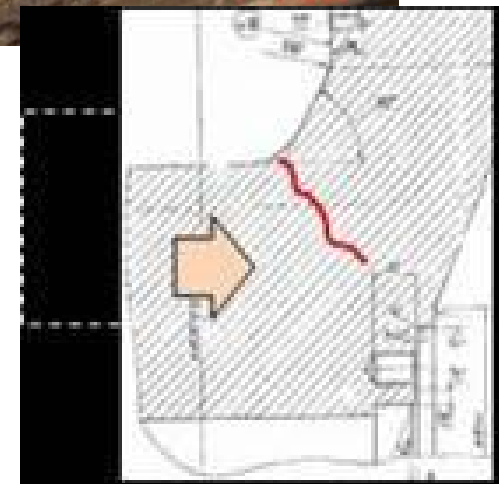
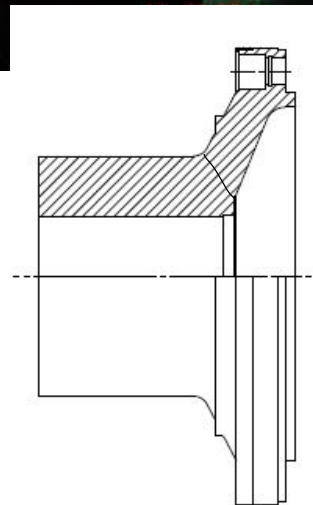


# Hydro Power Plant

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Turbine shaft A6



# Hydro Power Plant

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**Turbine A6**  
**3 months for**  
**disassembling**  
**And 9 months for**  
**assembling**



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# Hydro Power Plant

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shaft



flange



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**A7**



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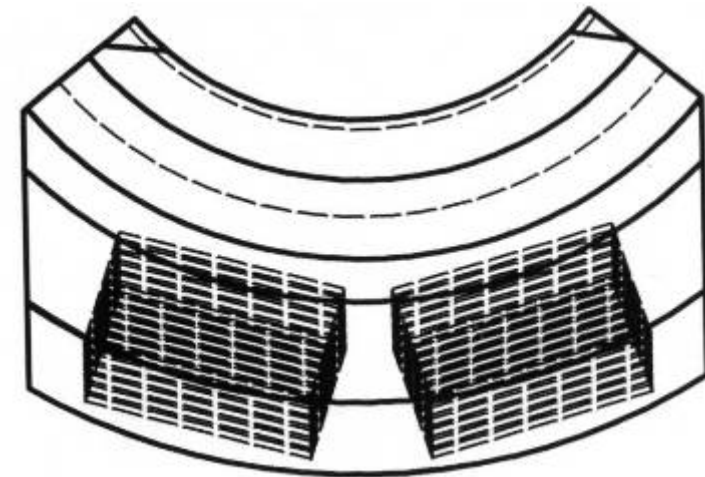
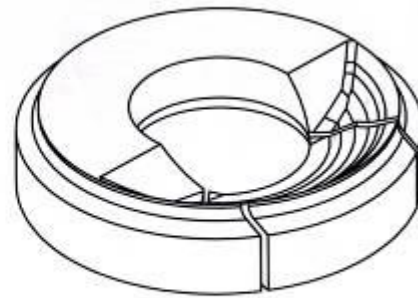
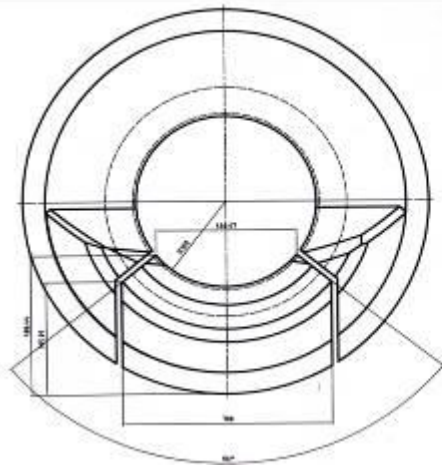


# Hydro Power Plant



Taking the samples (weldability, chemical composition, mechanical properties tests)

**Together with IMS – February 2009**





# Hydro Power Plant



## Chemical composition of base material 20GSL

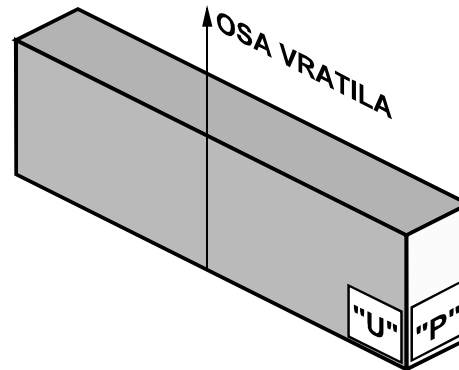
	<b>%C</b>	<b>%Si</b>	<b>%Mn</b>	<b>%S</b>	<b>%P</b>	<b>%Ni</b>	<b>%Cr</b>	<b>%Mo</b>	<b>%V</b>	<b>%Ti</b>	<b>%Al</b>	<b>%W</b>	<b>%Cu</b>
Independent house LJIG	0,191	0,725	0,287	0,019	0,021	0,270	0,273	0,047	0,009	0,008	0,038	0,024	-
IMS	0,12	0,63	1,10	0,002	0,001	0,22	0,23	0,031	-	-	0,038	-	-
<b>Chemical composition according to GOST 977-88</b>	<b>0,16 – 0,22</b>	<b>0,60 – 0,80</b>	<b>1,00 – 1,30</b>	<b>max 0,030</b>	<b>max 0,030</b>	-	-	-	-	-	-	-	-

# Hydro Power Plant

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**Weldability test: 2222 XNT vs. EA 395-9 (Russian electrode)**

## Samples



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**Project starts  
October 2009**



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**Very narrow space for work**



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**Eutectic Castolin**

# Hydro Power Plant

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Thousand of very small cracks



# Hydro Power Plant

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Castolin Eutectic

**Very important to avoid deformation**

- comparators,
- measuring the temperature



# Hydro Power Plant

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TOP quality power source and consumables

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**Grinding**  
**+local low temperature preheating**

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**Eutectic Castolin**

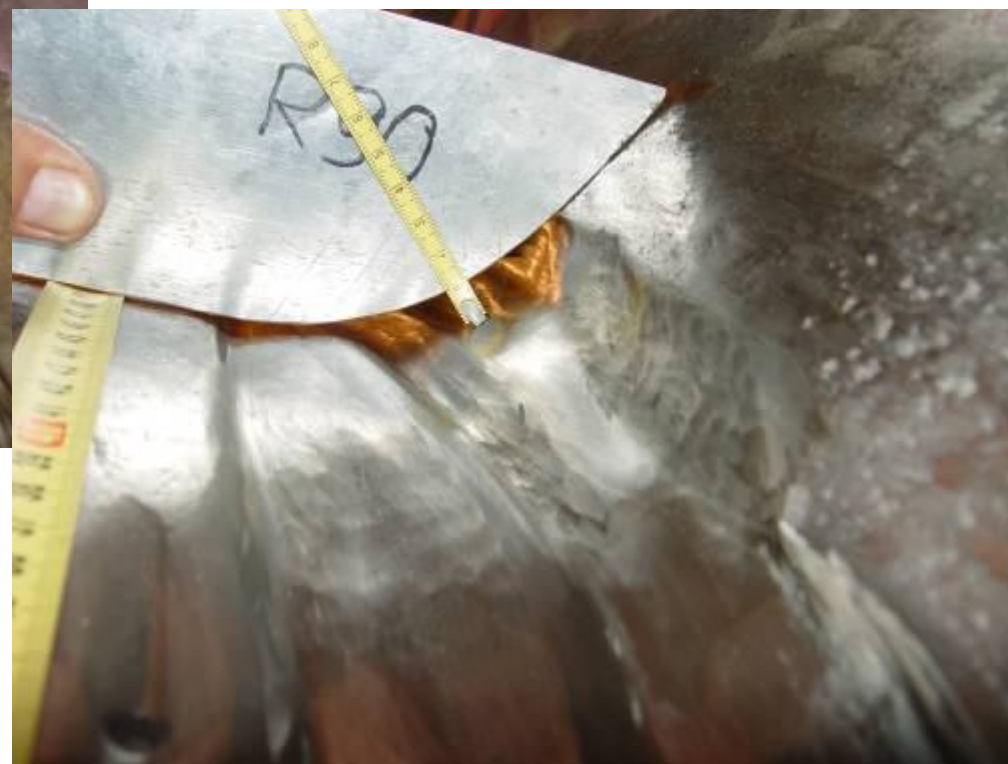


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**Grinding, template estimation**



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## Welding starts 2222 Xuper



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**Before the grinding**



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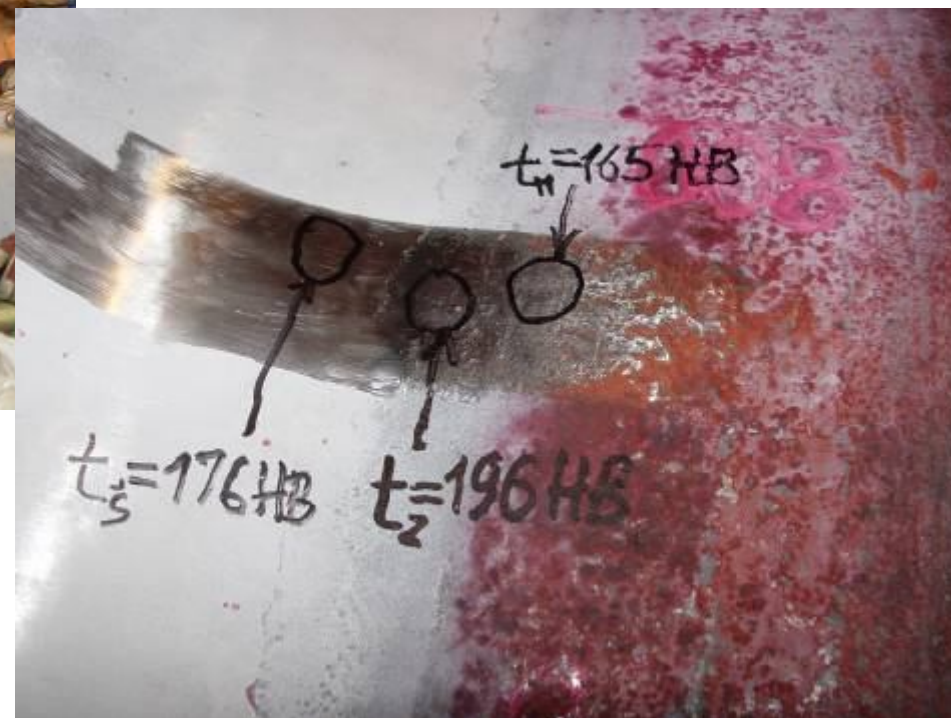


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## Hardness testing

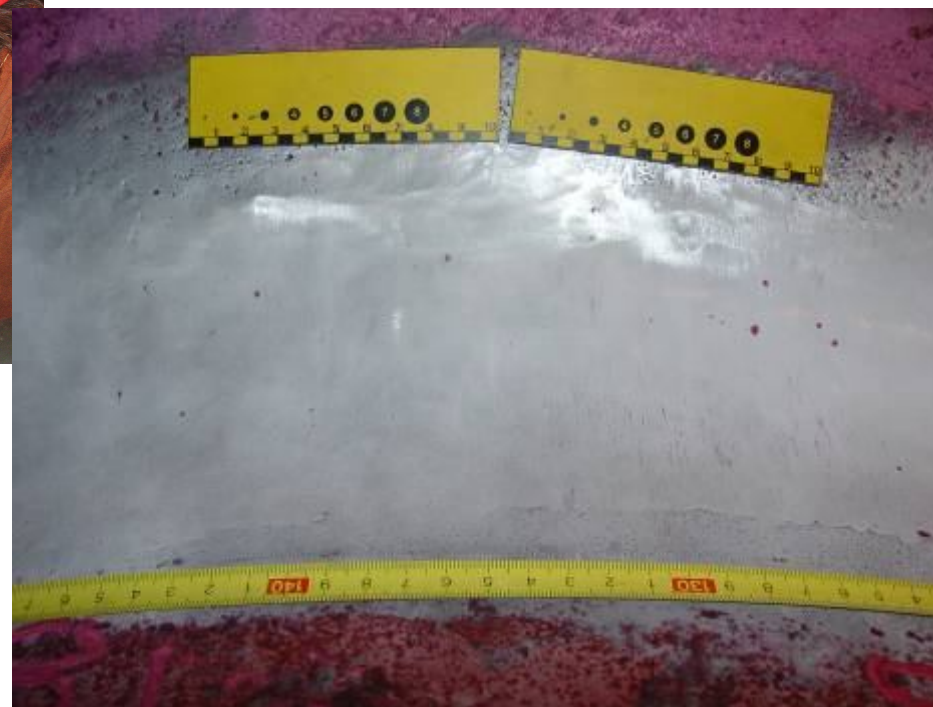


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## Cracks and radius checking

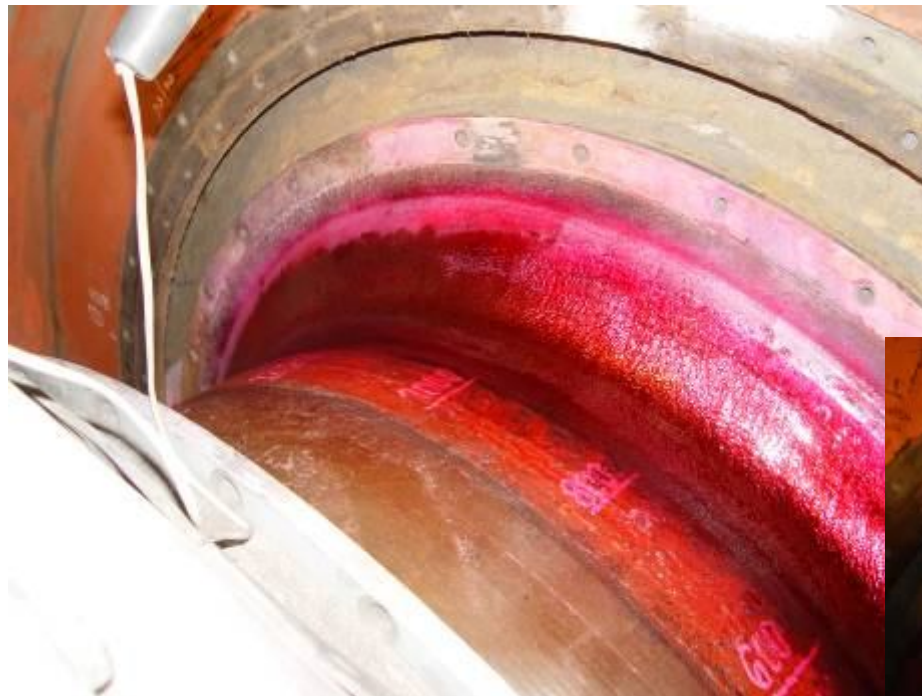


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## Final facts

- the job was done in 24 days,
- **FIRST this kind of job in the world!**
- we worked for ca. 11 ours/day,
- everything was ok
- in two weeks will be first check, then after 3 months, and then after one year
- price of new shaft is between 500.000-1.400.000 eur
- delivery of one shaft + dismantling time = ca. 1 year
- there is 7 other turbine shafts, which have to be repair in next one/two years

# Hydro Power Plant

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**IMS colleagues  
and Castolin  
team**



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# Prezentacija za mašinski fakultet

Stronger with...  
Castolin Eutectic

**Peć za  
sušenje  
elektroda.  
0-400°C**



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# Prezentacija za mašinski fakultet



Stronger with...  
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**Maska za zavarivanje sa  
filterom**



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# Prezentacija za mašinski fakultet

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Čeone brusilice za završnu obradu.



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Eutectic Castolin

# Prezentacija za mašinski fakultet

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## Komperater



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**Castolin Eutectic**  
Eutectic Castolin

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**Plamenici za  
zagrevanje.**



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**Castolin Eutectic**  
**Eutectic Castolin**



# Prezentacija za mašinski fakultet

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Uređaj za  
predgrevanje i  
termičku  
obradu  
Snage 50kW



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Eutectic Castolin

# Prezentacija za mašinski fakultet

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**Komplet za  
penetrantsko  
ispitivanje**



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**Castolin Eutectic**  
**Eutectic Castolin**

# Prezentacija za mašinski fakultet

Stronger with...  
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**Dodatni materijal**  
**Castolin 2222XuperNucleoTec**  
**Prečnici 2,5mm i 3,2mm**



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# Prezentacija za mašinski fakultet

Stronger with...  
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Izvor struje za REL  
zavarivanje  
XuperMax2  
250A



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## Pneumatski čekić za iskivanje



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