THERMAL POWER PLANT "NIKOLA TESLA A": PIPELINES CHANNEL STRUCTURE

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Summary: *Thermal power plant "Nikola Tesla A" (TPPNT-A), located near Obrenovac, will acquire new Flue gas desulfurization (FGD) plant in order to reduce air pollution and improve environment. Part of preparatory construction works is relocation of the existing mechanical pipelines and their protective channel. This paper presents structural design of relocated channel for pipelines. Following TPPNT-A and FGD brief review, the paper shows channel layout in absorber area and then formwork, reinforcement, and details of one typical channel's cross section. After all input data gathering, protective channels structural design is simple engineering task.*

Keywords: *TPPNT-A, layout, pipelines, channel, structure, design*

1. INTRODUCTION

In western Serbia, region of the *Kolubara* River and its the longest tributary the *Tamnava* River was a huge bay of the Pannonian Sea in the past [1]. Today this region is immense basin of *lignite* – brown coal having low heat content. Mining in Kolubara coal basin started at the end of the 19th century. Nowadays *Kolubara Mining Basin* is the largest coal supplier for electric power industry in Serbia. About 50% of the electricity production in Serbia bases on the lignite from Kolubara Mine [2].
Thermal power plant (TPP) using coal produces air pollution that does not know the boundaries. In Serbia, coal-fired TPPs are old, inefficient and function below the environmental standards [3]. Obsolete Serbian TPPs on coal endanger public health with enormous air pollution, affecting people in the region and beyond. Serbia is obliged to align its laws on pollution control with the European Union (EU) legislation.
This paper presents structural design of relocated mechanical pipelines channels designed for new *Flue gas desulfurization* (FGD) plant to reduce pollution of *Thermal power plant "Nikola Tesla A"* (TPPNT-A), located near Obrenovac. The Contractor "*Mitsubishi Hitachi Power Systems*" (MHPS), together with Local Consortium of Contractors and Designers, and with financial support of Japan International Cooperation Agency (JICA), has contracted design and build project worth 167 million euros. "*CPM Consulting*", from Belgrade, designed preparatory works for FGD plant.

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2. THERMAL POWER PLANT "NIKOLA TESLA A" (TPPNT-A)

"Elektroprivreda Srbije" (EPS) [2], state public company, operates *Thermal power plant "Nikola Tesla"* (TPPNT) [4]. The TPPNT is a complex with two plants - A and B, located on the right bank of the Sava River, upstream from Belgrade (*Figure 1*). As fuel, the TPPNT use lignite excavated from the Kolubara Mine and transported by railroad. The TPPNT complex is the largest one in Serbia and covers almost half of annual requirements for electricity of the Republic of Serbia [2, 4].
Thermal power plant "Nikola Tesla A" (TPPNT-A), situated near Obrenovac (*Figure 1*), started in 1970, has 2 chimneys – height 220 m and 150 m, and total capacity 1650 MW [5]. TPPNT-B, started in 1983, has 1 chimney – height 250 m, and capacity 1240 MW.
Existing TPPNT-A (*Figures 2-4*) has 6 *units* (A1,…,A6), 2 *stacks* (ST:A1-A3 for units A1-A3, ST:A4-A6 for units A4-A6), 6 *electrostatic precipitators* (ESP-A1,…,ESP-A6), and 4 *induced draught fans* (IDF-A3,…, IDF-A6).
Unit generates electrical energy. *Stack* (ST) is synonym for a chimney of plant. *Induced draught fan* (IDF) sucks flue gas from unit and vent it out to atmosphere through a stack. *Electrostatic precipitator* (ESP) is a filtration device that removes fine particles from a flue gas using the force of an induced electrostatic charge.

3. FLUE GAS DESULFURIZATION (FGD) PLANT

Flue gas (FG) is a mixture of gases produced by the burning of fossil fuel in power station and exiting to the atmosphere via a flue from a stack. FG composition depends on fuel, but it usually consists of nitrogen, carbon dioxide, and water vapor. Generators in large power plants burn considerable amounts of fossil fuels and therefore emit large amounts of flue gas to the ambient atmosphere [3].
Figure 4 presents TPPNT-A *orthophoto* with new designed *buildings* drawn and colored (blue and red). For FGD process, TPPNT-A has 2 areas (*Figure 4*): *absorbers area* (*Fig. 4: blue*), which is to the East from TPPNT-A internal railroad, and *limestone-gypsum area* (*Fig. 4: red*), which is to the West from TPPNT-A railroad.
In *Absorbers' area* (*Fig. 4: blue*), there are *2 absorbers:* C1 & C2 (*Fig.4: notation*). In *Absorber C1 area* (*Figure 5*), there are *pipelines* & *channels* (*Figure 6: legend*). Relocation of the existing mechanical pipelines and their protective channel is necessary [6, 7] to enable erecting of new absorber C1 structure and new Compressor station.
The process planned for lowering sulfur dioxide (SO_2) amount of in flue gases emitted from the facilities working with lignite coal will base on the *wet scrubbing method* for flue gas desulfurization, where limestone and gypsum are residual materials. After desulfurization, flue gas will release into atmosphere through a wet stack (chimney).
The FGD plant construction will ensure that TPPNT-A units (A3-A6) work in accordance with regulations on maximum allowed level of sulfur dioxide (SO_2) emission [8]. Two absorbers are for FGD. Absorber C1 for units A3-A4, and absorber C2 for units A5-A6 [9]. The FGD plant for four blocks (A3-A6) of TPPNT-A is worth ca. 167 million euros. This new plant will decrease emission of sulfur dioxide nine times, that is from around 74,000. tonnes, to 7,800. tonnes per year.

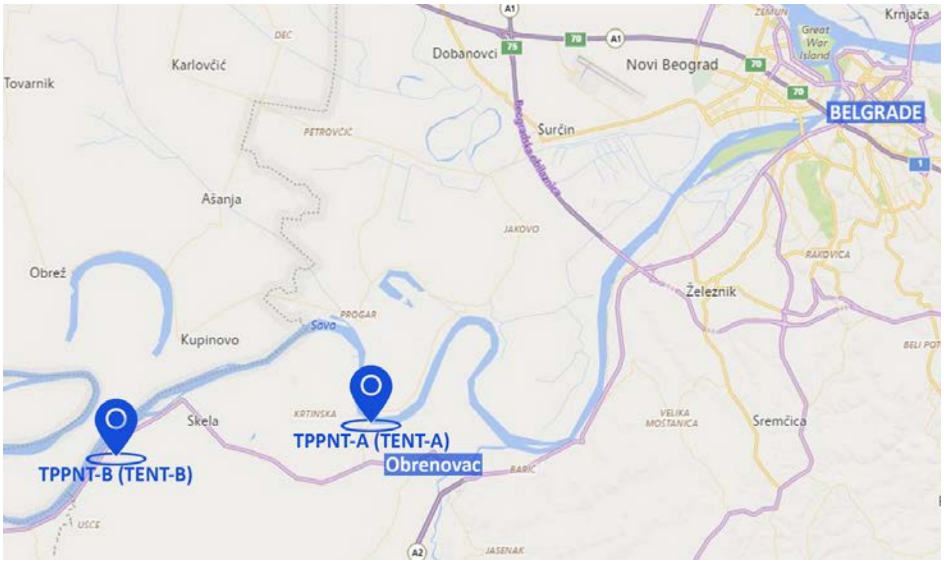

Figure 1. TPPNT-A & TPPNT-B: Location

Figure 2. TPPNT-A: Aerial view [4]

4. PIPELINES CHANNELS STRUCTURE

Figure 5 presents pipelines & channels layout, while *Figure 6* explains types by legend. There are *4 pipe types* (ash pipeline, steam pipeline, heat pipeline, condensate), made of steel, and *3 channel types* (existing, new, removed), made of reinforced concrete (Figures 5-6).

For typical *channel cross section 1-1*, in *Figures 7-12* are shown *formwork* (*Figure 7*), *reinforcement* (*Figure 8*), *supports for pipes* (*Figure 9*), *support anchor detail* (*Figure 10*), and also are shown *cover slab (plate) of channel section 4-4* (*Figure 11*) and *slab lifting anchors details* (*Figure 12*) [9].

The reinforced concrete channel – which layout, shape and cross sections are adopted in accordance with mechanical installations design – protects ash pipelines. This channel depth varies from 90 cm to 230 cm, while its width changes from 80 cm to 195 cm. The bottom slab of the channel is 35 cm thick and the walls are 30 cm thick. The cover slab can be removed when needed intervening on the ash pipeline. The width of cover slab is 100 cm and its thickness is 25cm. Structural steel cold-formed cantilevers inside channel bear pipelines.

Channel structural calculation is carried out for relevant loads (self-weight, soil pressure, vehicle design load V-600, ash pipeline reactions).

Reinforced concrete is made of *concrete* grade C25/30 and *reinforcement* class B500B. All steel elements are made of structural *steel* S235.

Total excavation for new channel route is ca. 1,751. m^3.

5. CONCLUSIONS

It may be underlined, that site visits, investigations, measurements, trial pits, tests and evaluations are core requirements for reliable design of ground installations and, particularly, for their relocations.

Few design iterations may be necessary to achieve final solution easy for implementation in site conditions. Relocation design requires more alternations and amendments than design of a new structure.

All existing underground installations recognition needs due attention with objective to scrutinize assemblage of installations parts.

Synchronous plan of all installations, existing, relocated, and novel one, has to be drawn and scrutinized in order to resolve possible collisions before relocation works begin.

In case of the TPPNT-A, for example, pipelines channel relocation design submitted may need revision before relocation construction works begin. That will happen when all channel's covers are opened and supposed design input data must be updated according to real situation in channel.

Lesson learned in practice is that information continual updating and interchanging among all parties involved in the project helps closing all open issues and fitting design to its purpose.

Figure 3. TPPNT-A: View from the Sava River [4]

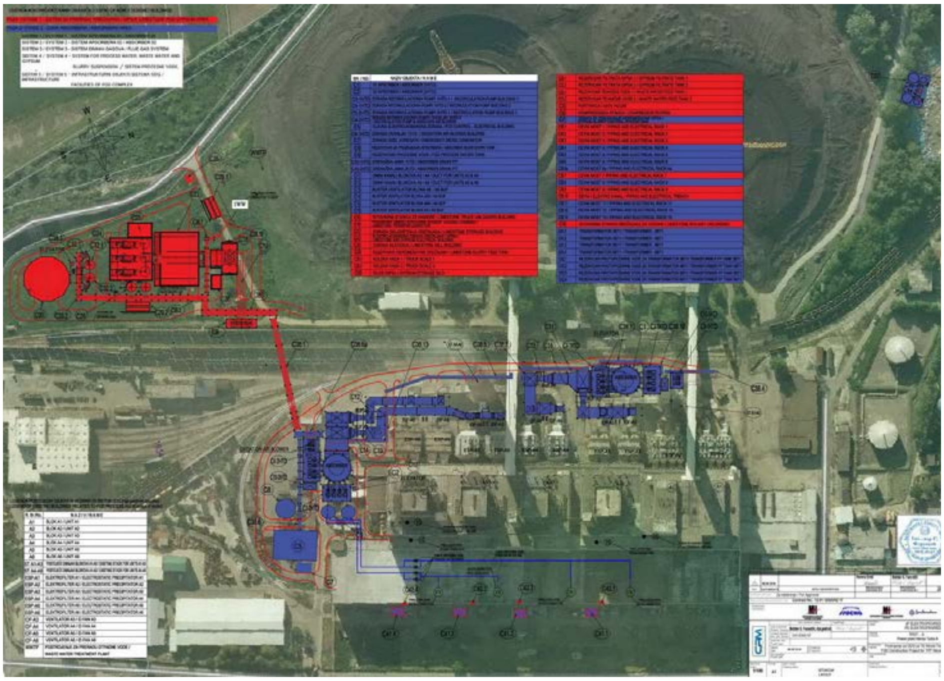

Figure 4. Orthophoto - with absorbers' area (blue) & limestone-gypsum area (red)

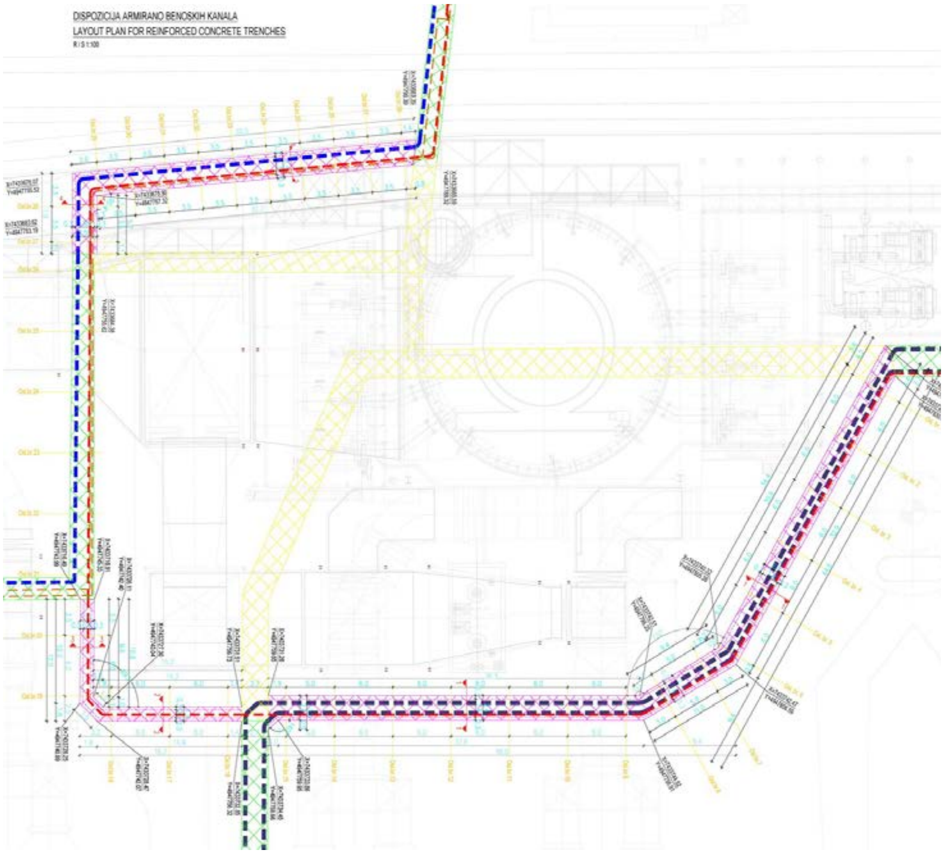

Figure 5. Absorber C1 area: Pipelines channals (existing, demolished, new) layout

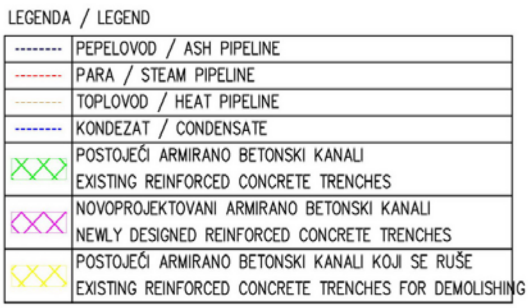

Figure 6. Legend of Figure 5: Pipelines & Channels

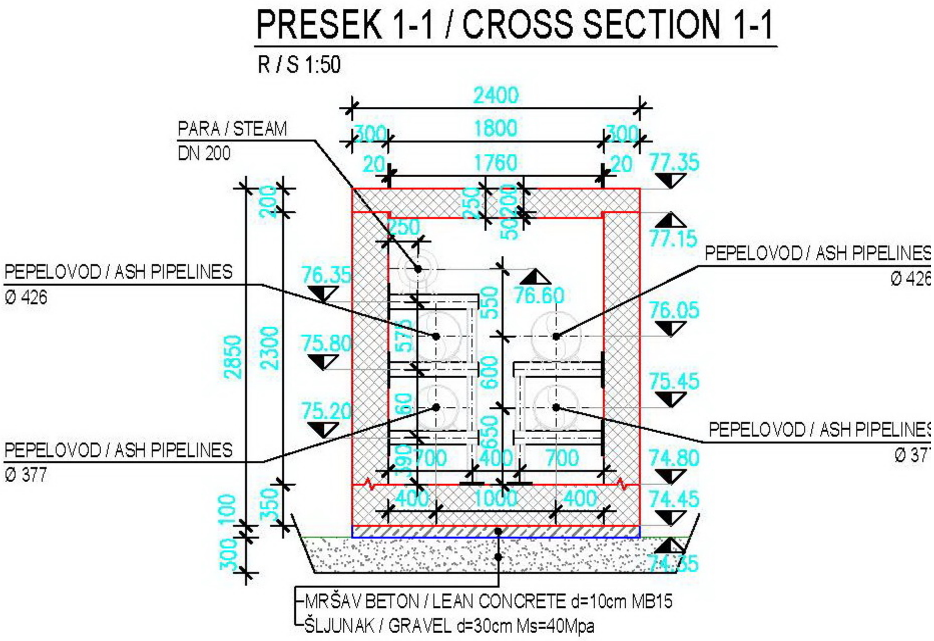

Figure 7. Channel (section 1-1): Formwork

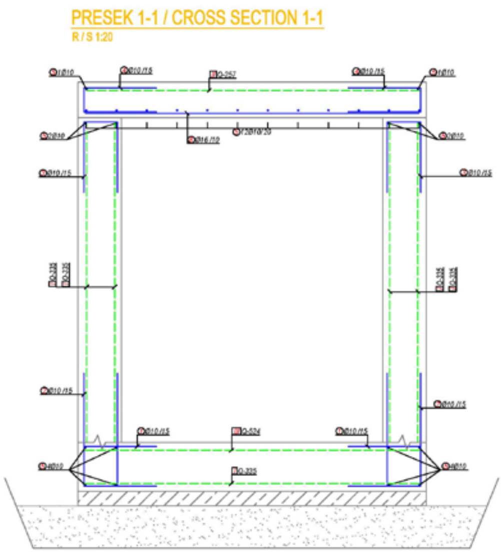

Figure 8. Channel (section 1-1): Reinforcement

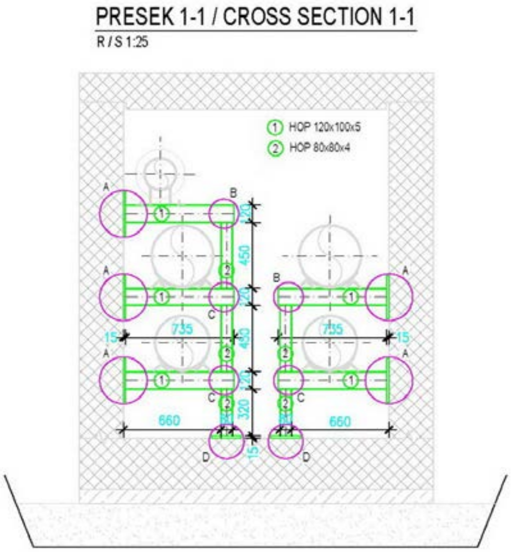

Figure 9. Channel (section 1-1): Supports for pipelines

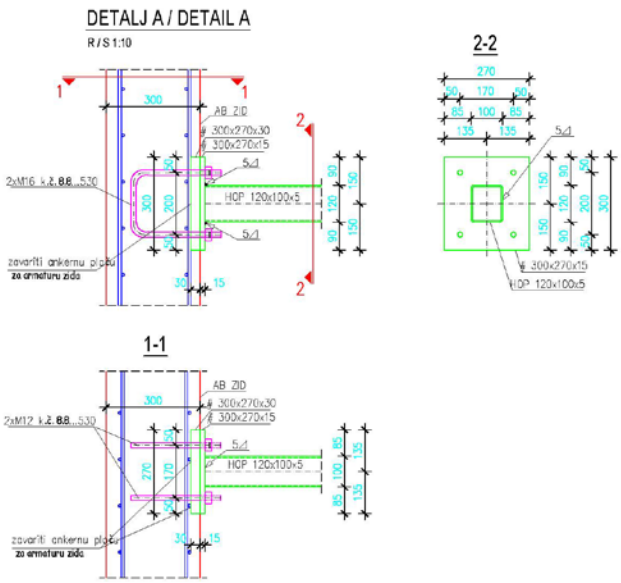

Figure 10. Support anchor: detail A

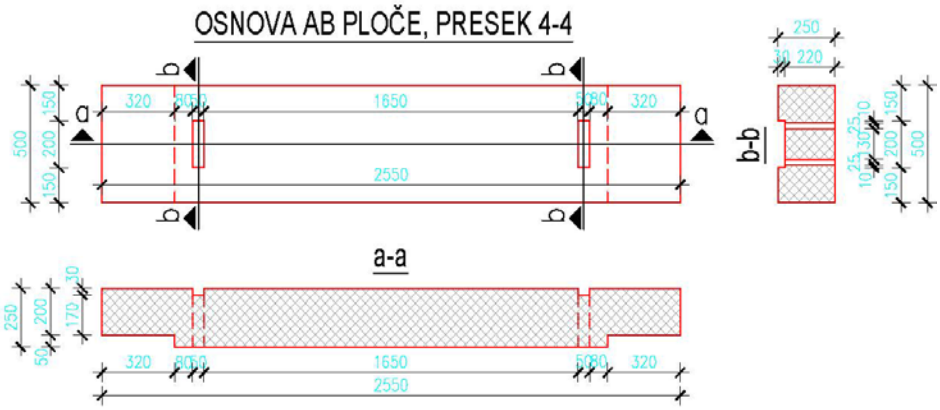

Figure 11. Cover slab of channel: section 4-4

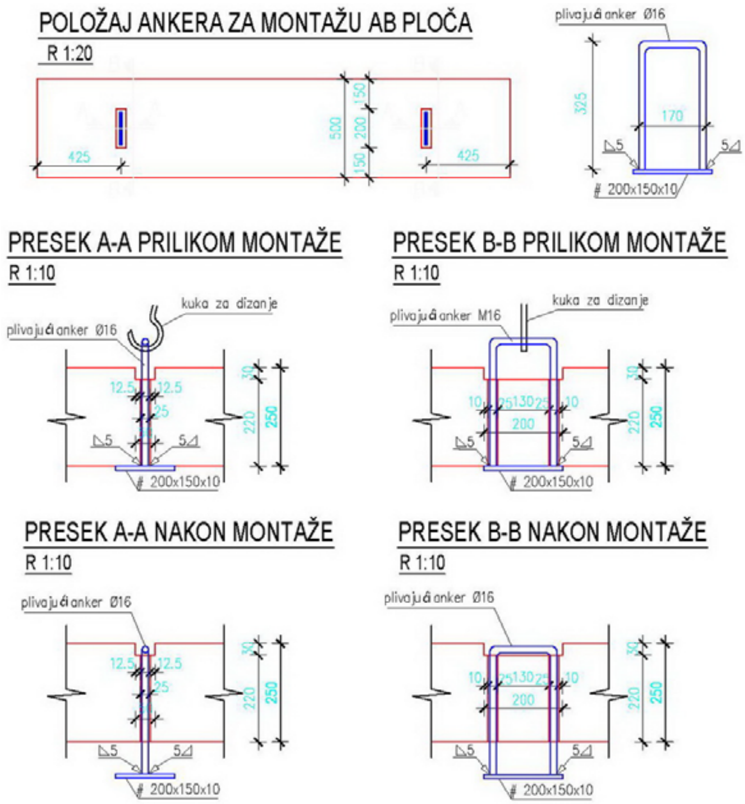

Figure 12. Slab lifting anchor: details

ACKNOWLEDGEMENT

Sources of data used in this paper are given in references [5, 8, 9]. The author of this paper is lead engineer and responsible structural designer for preparatory works, which include 6 basic designs (existing installations relocation; structures of office, storage and preassembly area; preparatory works of phase S1 /limestone & gypsum/ and phase S2 /absorbers/) and 2 detail designs (preparatory works of phases S1 and S2).

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ТЕРМОЕЛЕКТРАНА "НИКОЛА ТЕСЛА А": КОНСТРУКЦИЈА КАНАЛА ЗА ЦЕВОВОДЕ

Божидар С. Фурунџић

Резиме: *Термоелектрана „Никола Тесла А“ (ТЕНТ-А), лоцирана близу Обреновца, добиће ново Постројење за одсумпоравање димних гасова (ОДГ), с циљем да се смањи загађење ваздуха и побољша природно окружење. Део припремних извођачких радова је измештање постојећих машинских цевовода и њиховог заштитног канала. Овај рад приказује пројекат конструкције измештеног канала за цевоводе. После кратког осврта на ТЕНТ-А и ОДГ, рад показује ситуацију канала у зони абсорбера и затим оплату, арматуру и детаље једног типичног попречног пресека канала. Након сакупљања свих улазних података, пројекат конструкције заштитног канала је једноставан инжењерски задатак.*

Кључне речи: *ТЕНТ-А, ситуација, цевоводи, канал, конструкција, пројекат*