Feasibility Study for Construction of SHPP Radova (Korca Prefecture – Leskovik Area)

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1 SUMMARY

MTC Energy shpk Company has win the concession of Radova SHPP and has started the construction in BOT type since 4 months. The company has all intelectual and financial resources for the development of the project. Construction of SHPP of Radova is based on the Concession Low for Infrastructure with the following parameters:

Technical Parameters based on offer from Gugler Supplier:

1. Annual Average Flow — Q_o = 1260 l/sek
2. Design Flow — Q_{ll} = 1700 l/sek
3. Net Head — H_{net} =140
4. Gross Head — H_{brut} = 150 m
5. Installed capacity — N_t = 2025 kW
6. Annual Average Electricity Production — E = 8.26GWh

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4. Gross Head — H_{brut} = 150 m
5. Installed capacity — N_t = 2500 kW
6. Annual Average Electricity Production — E = 9.14GWh

In the following sessions is given the analyzis based on offer from Siemens Supplier, so all technical parameters and Feasibility Study will be refered to these parameters.

1.1 BACKGROUND OF ALBANIAN POWER SECTOR

The new law on concessions provides an important step in the creation of the legal framework which would provide transparency and competition for the investors interested to invest in all sectors of public services and infrastructures, including the sector of electricity generation.

Except the privatization of the distribution which would serve as a good opportunity to attract in our country important investors, a great important is being paid by the Government for the preparation of the suitable legal and institutional framework to attract private investment in the construction of new generation sources, especially in small hydropower plants. Meanwhile a similar PPA for small hydropower plants shall be signed (guaranteed) for all the electricity produced by the power plant for a period that may vary from 10-15 years. Despite this, the PPA for the resources with a big capacity shall be applied taking in consideration even the developments that are expected to occur in the regional electricity market. In the case when there is a big concentration of the local generation in the cascade of Drin River, it is difficult to have a generation competition in the Albanian market in the near future. However, there are possibilities for a limited development related to the low generation of electricity, low co-generation or CHP (plants with combined generation of electricity and thermal energy) and the producers themselves.

Law No. 9072 "On electricity market" (Article 38), which has entered in power in July 2003 has defined the hydropower plants with installed capacity up to 10 MW, CHP generator with installed capacity up to 100 MW and the producers themselves for the additional amount of produced energy when they use renewable energy resources and its installed capacity is not bigger than 10 MW, as privileged energy generators, which have a special treatment by the transmission system operator in the dispatching of the electricity generated by them. The Law provides also that this special treatment is defined in the code of network function.

1.2 TASKS OF DESIGN

The base task of design is the realization of the technical project and of the financial analysis of the construction of the SHPP of Radova. Based on technical and financial analyses (included in this study), initial investments, produced amount of electricity, price of electricity market, cost and operation and maintenance of Radova SHPP, interest rate and loan conditions was possible to realize the Financial Feasibility Analyses.

2. INTRODUCTION AND BACKGROUD OF POWER SECTOR

2.1 Background of the sale and supply of the electricity

Despite the financial barriers of import, the main problem that the Albanian electricity market is facing nowadays is the limited technical ability of the generation, which mainly varies between 14-19Million kWh/day and of the import, which might arrive up to 10–11Million kWh/day providing a total maximum supply of 24-30Million kWh/day. A general overview of the primary energy supply in general and electricity in particular are given in Figures 1-4.

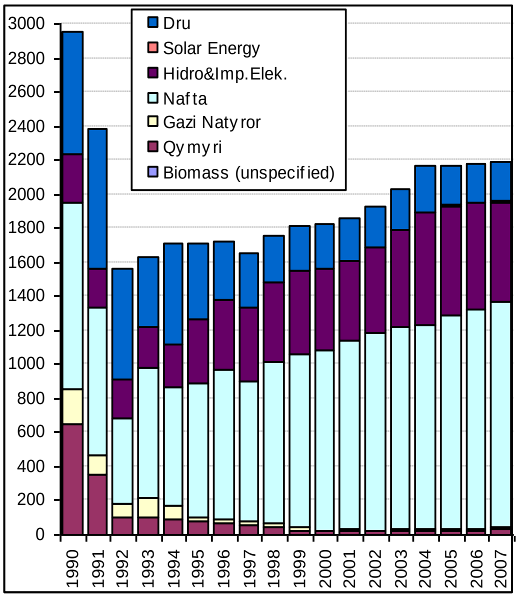


Figura 1.: Supply with primary energy sources in Albania (ktoe)

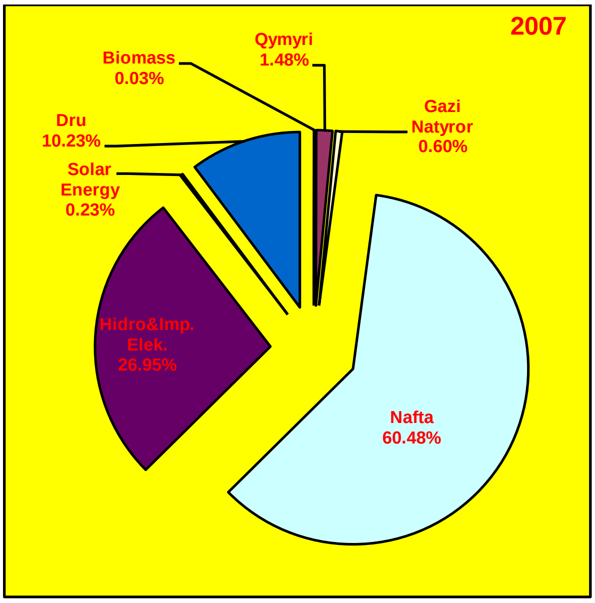


Figura 2.: Contribution of primary energy sources in Albania at the year 2007 (%)

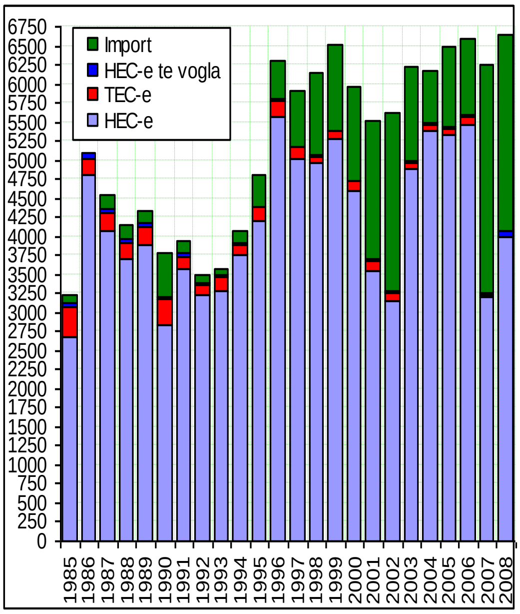


Figura 3.: Supply with electricity for Albania (GWh)

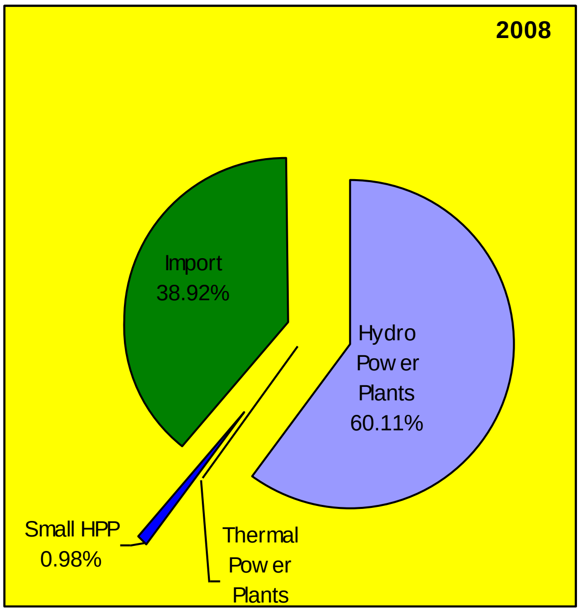


Figura 4.: Contribution of electricity supply for Albania (GWh)

- It must be emphasized also that the consumption needed in a common winter day goes up to 25-27 million kWh. The situation in the country is difficult regarding the coverage of the electricity needs so the energy market for the SHPPs is guaranteed.
- Electric inter-connection with the neighbor countries: The interconnection of the country with the neighbor country is realized through three lines: Elbasan-Kardia (400 kV) with capacity of 1100 MVA, Firza-Prizren (Kosovo) (220 kV-250 MW) and Vau i

Dejes-Podgorica (Monte Negro) (220 kV-250 MW). The main load of import is supported by Kardia-Elbasan.

- Technical loses in the transmission-distribution network: Loses in transmission-distribution network in 1999 were very big, 1406 GWh, (720 GWh loses in transmission and 685 GWh in distribution). Based on the planes implemented for the reduction of level of loses has been reduced to the value of 32 % from 41% that it was in 1999. Even though we have a reduction of this loses in the latest years the values are relatively high, 24 % loses in transmission and distribution.

2.2 Daily curves in the function of the winter and summer seasons of the electricity load

Because of the fact that most of the population use electricity for heating purpose the daily electricity curve during the winter day has a peak up to 1280-1390 MW (maximum value without black out), whereas the peak requirement during the summer season varies between 780-897 MW (even this peak is increasing constantly as electricity is being used more and more for air conditioning). One of the main problems of the Albanian electro-energetic system is the need two times higher in winter period than in summer period. This tendency has been reduced starting from 1999 up to 2008 and this is as a result of higher consumption of electricity for heating purposes. In the figures 5-6 there are given the curves of the third Wednesdays in January and in July in 2007 which displays clearly the respective differences between winter and summer seasons for electricity sector.

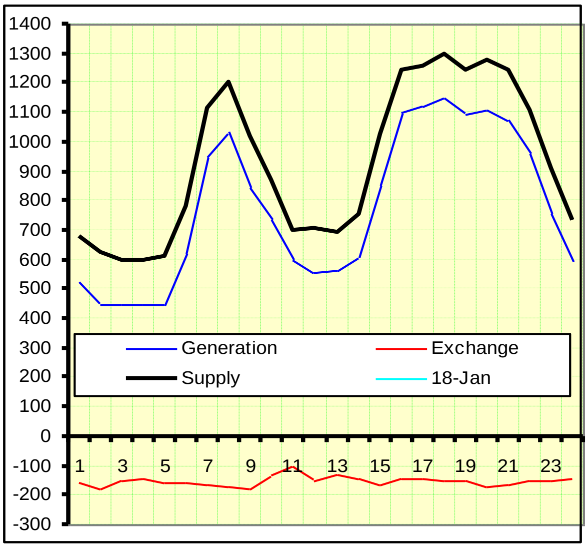


Figure 5.: Daily supply curve with electricity for the third Wednesday of January 2008 (MW)

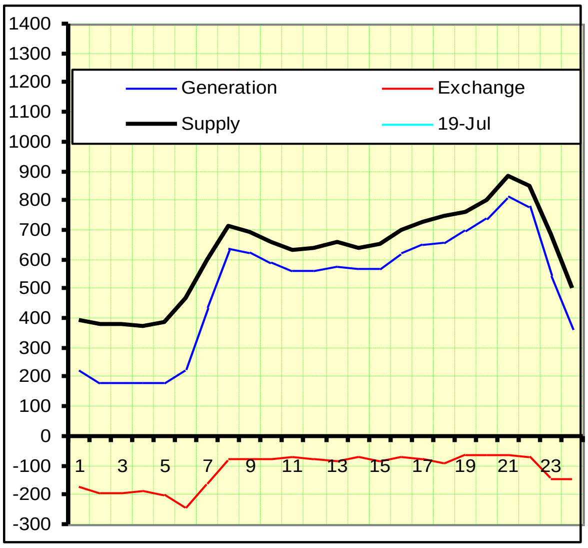


Figure 6.: Daily supply curve with electricity for the third Wednesday of July 2008 (MW)

2.3 Forecast of Electricity Demand

Based on the National Strategy of Energy, in the figures 7 and 8 there are given the needs for electricity and the forecast of loses for the period 1999-2015. As a result, the electro-energetic needs to fulfill the requirements and to reach the level of loses of 10 % are 9535 GWh in 2015.

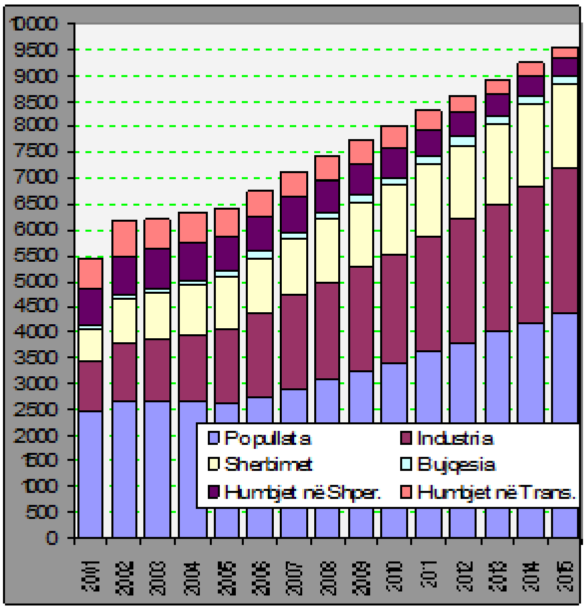


Figure 7.: Forecast of needs for electricity in all sectors (GWh)

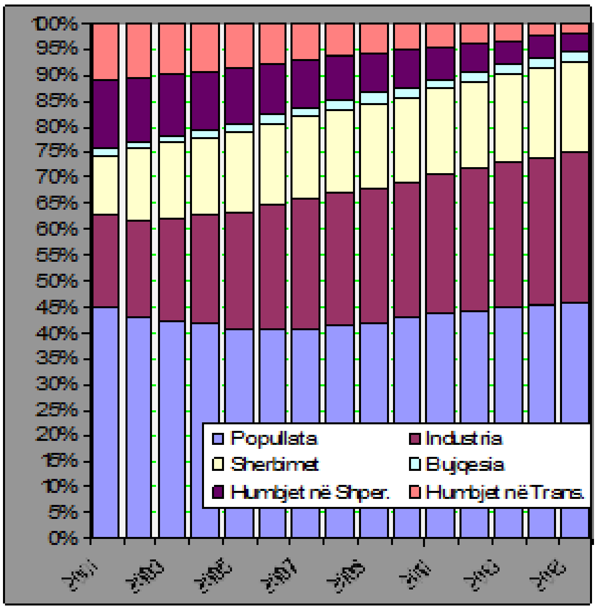


Figure 8.: Forecast of electricity needs and loses in transmission and distribution (GWh)

Privatization of distribution sector which was realized lately (April 2009) and put in efficiency of the local HPPs remains as a possibility to fulfill a part of the needs for electricity of our country.

2.4 Development in electro-energetic sector and technical requirements in generation, transmission and distribution sector

Based on the reconsidered Document of the National Energy Strategy, which is in the approving process, in the following we are giving shortly the generation, transmission and distribution master plan of electricity.

2.4.1 Development of the sector of electricity generation

For the short-term period (up to 2009) and taking also in consideration even the construction of new power plants, new additional needs of Albania will be completed only by increasing the import (as based load) (up to 2.5-3.5 TWh/year). As a result, it is suggested to keep in the plans the import level and it is being worked on the finalization of the installation of CCGT TPP (97 MW), which will start operation at the end of 2009 (figure 9). Based on National Energy Strategy it is calculated that will be installed about 260-300 MW, SHPPs with a mean production about 780 -1200 GWh/year.

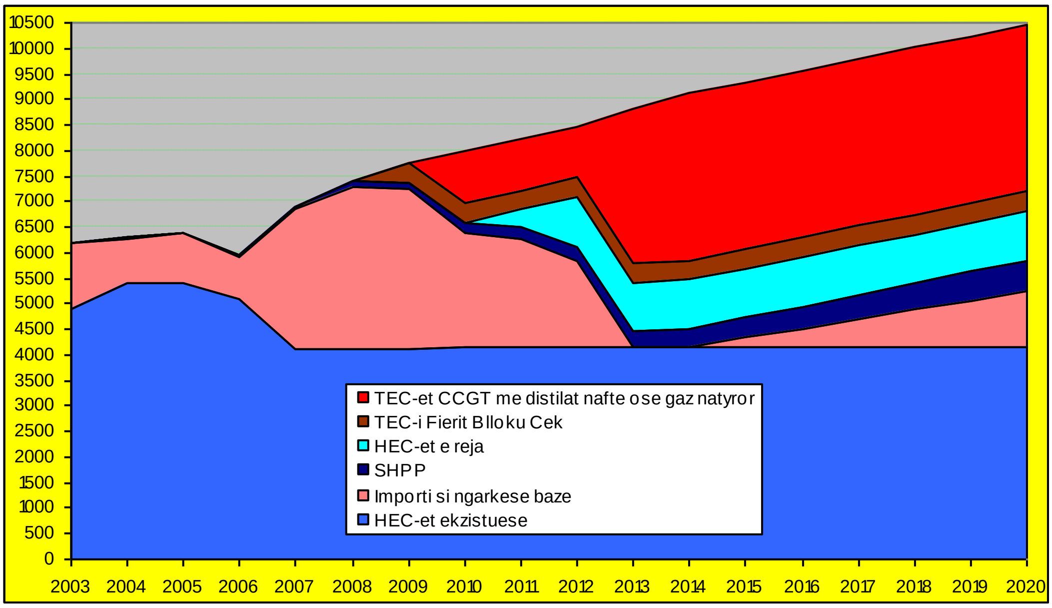


Figure 9.: Masterplan of Development of Generation of Electricity in Albania

2.4.2 Development of transmission sector of electricity

High Voltage Networks of 400 kV and 220 kV together with the respective substations operates near their thermal limits and in the transmission system there are higher loses. The master plan for the development of the transmission network it is prepared in such a way to cover the needs with a minimum cost, with a enough qualitative service and in accordance with the planning criteria. Based on the above level there are taken into consideration all the reinforcement of the network which result in economical benefits and which fulfill the technical requirement, for a safe operation other transmission system integrated in UCTE system. Currently, it is being worked on the realization of the Albanian – Monte Negro interconnection of 400 kV and recently will start the construction of another interconnection project with Albania-Kosovo.

2.4.3 Development in the distribution system of electricity

Based on the strategies for the reduction of the technical loses, the master plan of the distribution system aims at identification and assessment of the best strategies to the enlargement of the network in the way that it will fulfill the increasing demand for all the categories of the consumers. The networks are projected for every region and the distribution master plan in also projected for every region. Rehabilitation and enlargement plan is realized case after case in order to analyze the required intervention to reduce the technical loses and to fulfill the requirements up to 2020. Short-term investment program for the 2009-2011 periods shall realize the expectations as follow:

- Implementation of the project of Rehabilitation of the Distribution, financed by donors group;

- Construction of the distribution lines with a voltage of 20 kV in some of the main cities in the country;
- Installation of the meters within 2009 in all the categories of consumers which aren't installed at the moment;
- Elimination of illegal connection in all areas where this phenomenon is encountered.
- In addition to this, it is emphasized that the reserves factor in the calculation of the investments it is considered to be 15 % as all the assessment are in the pre-feasibility phase. However, it should be mentioned that the detailed action plan must include the maintenance cost, cost of new meters and also the cost of the rehabilitation of the rural network TU with a length of 12156 km with a estimated cost of 111 million Euro, which shall follow the annual plan of OSSH.
- Privatization of the distribution sector is increasing the investments in distributing network which will help considerably the promotion of small hydropower plants in general all over the country and especially of the Radova SHPP. The master plan for the rehabilitation and upgrade of the distribution system consist in reduction of technical loses and future upgrade of the distribution system, which focuses on a list of necessary interventions, in order to fulfill the forecasted increase of the demand for electricity in accordance with the foreseen results of this needs for each sector (apartment blocks, services, industries, etc.).
- Organization of the distribution master plan use the area of a district (region) as main module, which correspond to an area, which is supplied by 1-2 substations of 110/20 kV. In addition to this, for each distribution region it is represented a special master plan, based on the requirements of the district of the distribution regions.

3. SHORT TECHNICAL DESCRIPTION OF RADOVA SHPP

3.1 Hydrology calculation for Radova SHPP

In the hydrological study of the torrent of Carshova, it is considered the runoff regime at the intake of the axis of interest of Radova SHPP associated with the climate features of this catchments area. In this report the multi-annual archive data of Hydro meteorological Institute are used.

The SHPP of Radova is located at the upper part of the Carshova River. The climate conditions are assessed based on the hydrological data of the gauging stations of Çarshova (280 m), Leskoviku (920 m), which are located inside the catchments area of this river, and also in the hydrological data of gauging station of Gërmenji (1200 m).

According to the study the rainfall for the catchments area of Carshova River is assessed to be around 1120 mm. The upper stream of this River is characterized from snow rainfall while the down part is characterized from rain rainfall, according to the study around 1350 mm. The number of snow days is ranging from 7-20 days/year from the downstream to upper stream. As it can be assessed from these figures the snow rainfall is influencing the river runoff mainly in the upper stream.

The Carshova River is a branch of Vjosa River confluencing at the Carshova village, and has a catchment area of Fa = 90,8 km2. The axis of interest is located where the torrent of Postenani confluences with the Carshova River, at the altitude of 606,8 m a.s.l., and has a catchments area of Fx = 69,0 km2, and the average altitude of this catchments area is 900 m a.s.l.

For the runoff data at the axis of intake the study is based on the multi-annual data of the gauging station of Carshova. The series of daily runoff data of this station includes data for 18 years. (1974-1991).

The translocation of the runoff data at the axis of interest is done using the Analogy Method, where two are the main parameters, the sizre of the catchments area and the rainfall at both catchments area.

As concerning the rainfall data of these two catchments areas, where the amount of rainfall for the Analog Station of Carshova is taken Xa = 1150 mm, while the amount of rainfall for the catchments area of interest which is at a higher altitude is taken Xx = 1120 mm, it is not assessed in a proper way.

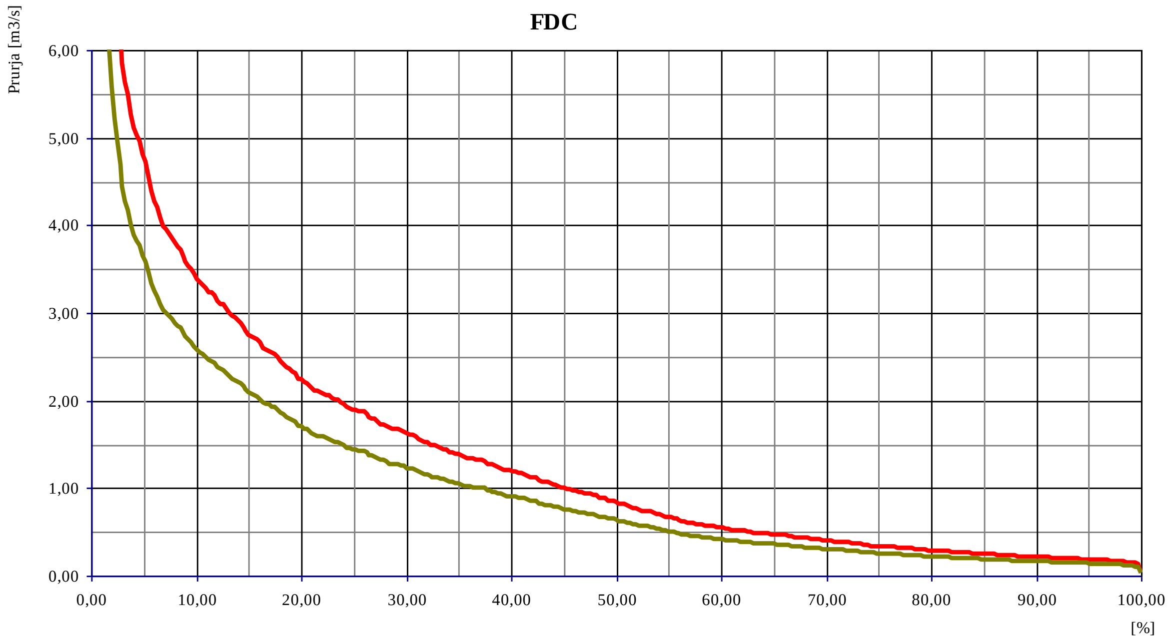
At least these two rainfall data has to be equal, while it is true that the amount of rain rainfall data is decreasing with the increase in altitude, but the amount of snow rainfall, as it is mentioned in the study is increasing.

According to the study the coefficient of translocation is taken Kt = 0,716, but if the rainfall data of both catchments areas are the same, this coefficient will result to Kt = 0,76. In this case the rainfall is not influencing in the calculation of the translocation coefficient. This coefficient is a simple catchments areas ratio.

Later in the study, while the annual runoff distribution is presented, it is made bold the high amount of the flow during April, attributing it to th melting of the snow, which in fact is not taken into consideration while calculating the translocation coefficient.

Later on in the study the Probability of the Flood at the axis of intake is presented, using the distribution Grumbel. According to this assessment the runoff once in 100 years is assessed to be Q = 62,2 m3/s, while the runoff once in 1000 years is assessed to be Q = 86,9 m3/s.

At the end of the study the FDC is presented, taken from the calculations done, where the runoff with 50% probability is assessed to be Q = 0,83 m3/s.



In the given graph the FDC for Carshova gauging station is presented (red color), and the FDC of the axis of intake (green color), considering a translocation coefficient of Kt = 0,76. This is the case where the rainfall data for both catchments areas are taken the same.

Carshova		Radova		In the Study	
$EF_Q(q)$ (%)	Q (m³/s)	$EF_Q(q)$ (%)	Q (m³/s)	$EF_Q(q)$ (%)	Q (m³/s)
100	0,04	100	0,03	100	0,14
90	0,21	90	0,16	90	0,21
80	0,29	80	0,22	80	0,29
70	0,40	70	0,31	70	0,40
60	0,55	60	0,42	60	0,55
50	0,83	50	0,63	50	0,83
40	1,20	40	0,91	40	1,20
30	1,65	30	1,25	30	1,64
20	2,24	20	1,70	20	2,24
10	3,45	10	2,62	10	3,45
1	10,65	1	8,10	1	10,70

As it is shown from the graph or from the given data in the tables above, the curve with a runoff of Q = 0,83 m3/s for the probability of 50% is nearer to the curve of Carshova gauging station rather then to the one of the axis of intake. We come at the same conclusion if the other runoff data for the other probabilities are considered. That is why I think the given FDC in the study is presenting the Carshove gauging station and not the axis of interest. As a conclusion, in the following analyses for the mean annual electricity production, the revised runoff data given above for the Radova SHPP are being used and not the data taken from the study which are overestimated at about 25 %..

3.2 Calculation of Installed Capacity and Electricity Generation from Radova SHPP

Installed capacity of this SHPP is equal to:

N =9.81 x η x Qllog x Hneto =2500 kW

Average yearly electricity generation has been calculated based on average multi year flow duration curve at the intake of this SHPP, based on two most important parameters::

Qo=1.26 m3/s

Qll=2.10 m3/s (for turbines supplied from Simens)

Technical and financiar offer of electromachines frm Simens has been issued to the Bank from the Investor.

Main parameter of turbine is their efficiency. On figure 6.17.7-6.17.8 is shown the efficiency of bigges turbine which is working with 1/2 of the calculated flow..

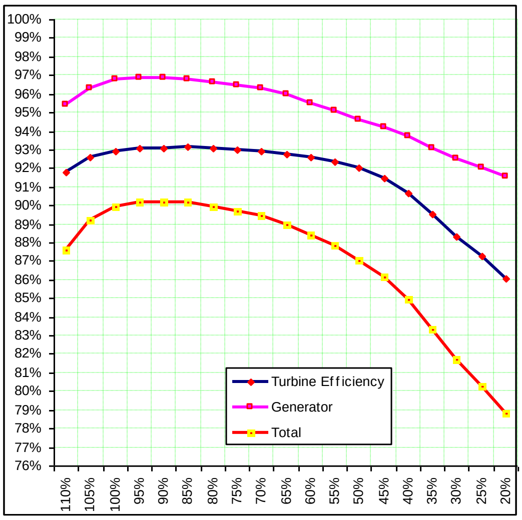


Figure 10.: Efficiencies of turbine, generator and total efficiency for whole group which works with 1/2 of the calculated flow (%)

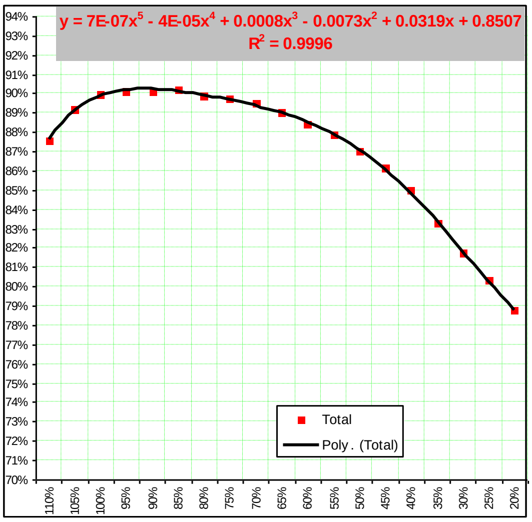


Figure 11.: Efficiencies of turbine, generator and total efficiency for whole group which works with 1/2 of the calculated flow

Flow and water volumes which are entering to the turbine for electricity generation according to the flow duration curve shown in the tables 1-2.

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Table 1.: Calculation of technical and energy parameters for hydro plant

%	Inflow	Ecological flow	Aveilable flow	Turbine flow	Turbine flow 1	Turbine flow 2	Turbine flow 3 3
%	m³/s	m³/s	m³/s	m³/s	m³/s	m³/s	m³/s
8,33%	4.068	0.010	4.06	2.10	1.050	1.050	0
16,67%	2.559	0.010	2.55	2.10	1.050	1.050	0
25,00%	1.649	0.010	1.64	1.64	0.819	0.819	0
33,33%	1.430	0.010	1.42	1.42	0.710	0.710	0
41,67%	0.905	0.010	0.90	0.90	0.448	0.448	0

50,00%	0.630	0.010	0.62	0.62	0.310	0.310	0
58,33%	0.613	0.010	0.60	0.60	0.301	0.301	0
66,67%	0.413	0.010	0.40	0.40	0.201	0.201	0
75,00%	0.306	0.010	0.30	0.30	0.296	0.000	0
83,33%	0.218	0.010	0.21	0.21	0.000	0.208	0
91,67%	0.145	0.010	0.13	0.13	0.000	0.135	0
100,00%	0.030	0.010	0.02	0.02	0.000	0.000	0

Table 2: Calculation of technical and energy parameters for hydro plant

Eff. Tot. 1	Eff. Tot. 2	Eff. Tot. 3	Net had	Capacity 1	Capacity 2	Capacity 3	Capacity	Electricity Generation
			m	kW	kW	kW	kW	GWh
0.866	0.866	0.8664	140.00	1,249	1,249	0	2,499	1.824
0.863	0.8629	0.8629	141.09	1,254	1,254	0	2,508	1.831
0.859	0.8594	0.8594	142.18	982	982	0	1,964	1.434
0.856	0.8559	0.8559	143.27	854	854	0	1,708	1.247
0.852	0.8523	0.8523	144.36	540	540	0	1,081	0.789
0.849	0.8488	0.8488	145.45	375	375	0	751	0.548
0.845	0.8453	0.8453	146.55	366	366	0	732	0.534
0.842	0.8418	0.8418	147.64	245	245	0	491	0.358
0.838	0.8382	0.8382	148.73	361	0	0	361	0.264
0.835	0.8347	0.8347	149.82	0	255	0	255	0.186
0.831	0.8312	0.8312	150.91	0	166	0	166	0.121
0.8277	0.8277	0.8277	152	0	0	0	0	0.000
						Av. Yearly Electricity Generation		**9.14**

In figures 12-13 is shown the optimisation of water flow for both turbines and factic power produced for the respective reaching in thise way maximum utilisation of flow duration curve.

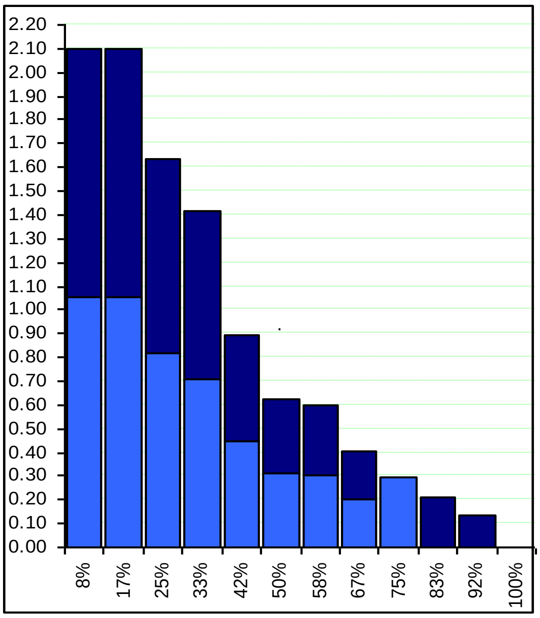


Figure 12.: Inflow used at two turbines (m3/sek) covering the whole yearly water duration curve (m3/sec)

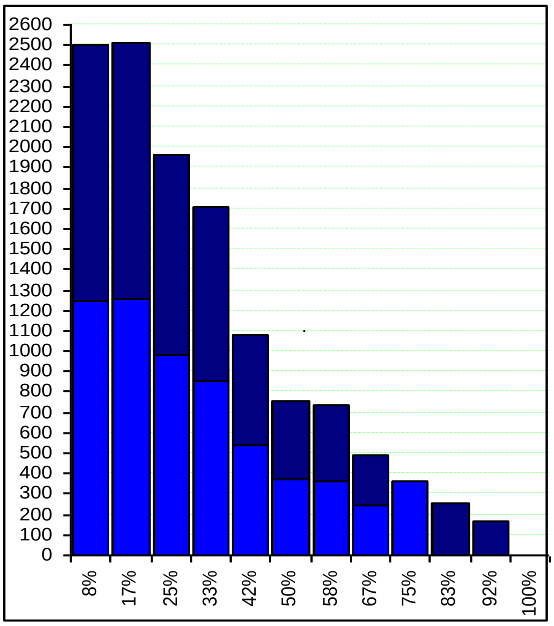


Figure 13.: Capacity at two turbines (m3/sek) covering the whole yearly water duration curve (kW)

Final analysis of calculation checking shows the following values for the firot case when are installed Gugler turbines: installed capacity 2025 kW and electricity generation 8.26 GWh . Meanwhile for Simens electromachines we are gong to have an intalled capacity of 2500 kW and an yearly electricity generation of 9.14 GWh/vit. Both values are higher than respective values presented intpo the detail engineering study: which define total installed capacity of 2000 kW and electricity generation equal to 11.60 GWh/vit.

3.4 Detailed Engineering Design Assessment

3.4.1. Intake

In the first Design it was foreseen that Intake to bo built at joining of the two torrents Carcova and Postenani at the elevation of 606.8 m and also having built in each torrent two small dams (up to 1 m) , in order to reduce slope damages during the flat.

After the topographical survey is finished, the Designer have decided that in the elevation where it was foreseen to built these small dams , to build two Intakes , gravel trap and desander-forebay , one for each torrent . The detailed engineering design is ongoing as the it is chossen the most favourable position.

In the drawings that is been handle to us ,are shown two Tyrrolean Intakes, which based on the charecteristics of the torrent (i=2-3%) are not much favourable as far it is concerned the bed load managment.During the operation of this kind of Intake according to the experience, the gallery of water intake will be blocked ,which would cause the stopage of the functioning of the hydropower plant during the maximum of the discharges , when it is expected to produce the maximum power.The Static calculation of the dam is missing, as it is missing the calculation of the amount of the water, the intake can transport.

The Type of Intake that we have recieved doesn't change much from total cost point of view comparing with Lateral Intake Cost.The cost foreseen in the budget is for a lateral Intake of H=4m .The quantites of invoices are nearly the same as for this type of Intake.The quantites will be more accurate after the Detailed Enginnering Design will be finished **The intake and Desander issue is been discussed with the Investors and they admitted to review the designs considering our recomandations .We strongly reccomend to design a lateral intake for each torrent at the same elevation of the existing drawings**

3.4.2 Desander

The Desander as it is shown in the drawings, will not operate properly ,as it will be blocked as time goes by .This will cause the work stopage of HPP, to do cleaning and flushing of small particles of the Desander coming from Intake and Gravel Trap, each time it is blocked.The calculation of the velocity of the particle in the desander is not shown and the dimensioning of the desander is missing also.(The dimensions of the desander are enough or not, to work properly)

It is recomended that the desander, along its length, at the bottom part, to have a flushing channel in order to flush all the small particles decanted by opening the gate at the end of the desander,without stopping the operation of HPP

The Desander is recomended to be reduced and the Investor accepted this recomendation , after the meeting , that we had.The quantities of the invoices, at the total budget for the desander, are reduced for the proper dimensions .Anyway this will be defined accuratly after the detailed engineering design is finished.

3.4.3 Penstock

At the Desander's Exit the water derivation continues with GRP Pipes of diameter 1200 mm,1100mm , 1000 mm and steel pipes of diameter 1220 mm , 1120 mm.

On the Desander's exit at Carcova torrent, the Penstock is foreseen to overpass the torrent of Postenani, constructing a bridge of H=15 m, which will serve for the village also,joining with the Postenani's Water Intake.

The first Design, with armoured concrete derivation channel, is revised into a Penstock mostly with GRP Pipes, but using steel pipes of diameter 1220 mm , a length 75 m , at Postenani torrent overpass , a length of 320 m at the tunnel and steel pipes of diameter 1120 mm at the bifurcation pipe at the entrance of the PH.

In general this is a good solution, considering the landscape and it needs less maintanance during the operation of the HPP. The solution of the derivation channel is cheaper but during the operation of HPP needs o lot of maintance works, as the slope instability is evident.

Never the less the calculations of the economic diameter of the pipe(GRP or Steel) is required, in order to analyze and optimize the best solution between amount of water transported, unit price, annual production of the power.

Engineering measures like culverts , retaining walls, gabbion walls are missing (where it is needed).
The Anchors of the penstock should have a static calculation for each anchor considering the horizontal forces generated into the curves especially at the befurcation pipe
The quotationsgiven to the investors for the GRP Pipes and Steel Pipes are included in the table of the final budget.

3.4.4 Power House and Turbine, Generator and Transformer

The Construction Drawings of the PH and its alignment are accurate considering the loss because of the curves at the befurcation pipe. Turbines are types Francis and are selected properly.

3.4.6 Connection to the Distribution System

Connection to the grid is made for he folowing parameters:

1. Calculated Power 2 MVA – but it has to be stressed that 10 kV make possible transmittinf of full capacities up to 5 MVA. Since we have an increasing of active power from 2 MW (the value of the project) to 2.5 MW and an increase of full power from 2.1 MVA to 2.63 MVA (with power factor 0.95) ranssmiting of this power.
2. Wind speed for calculation is taken 38 m/sek – bazed on measurements of the wind speed in this zone and calculation are done in the proper way.
3. Gjatesia e linjes eshte 4.5 km bazuar ne nje vleresim topografik te detajuar.

SOUTH EAST EUROPE Transnational Cooperation Programme — ENER SUPPLY — Programme co-funded by the EUROPEAN UNION

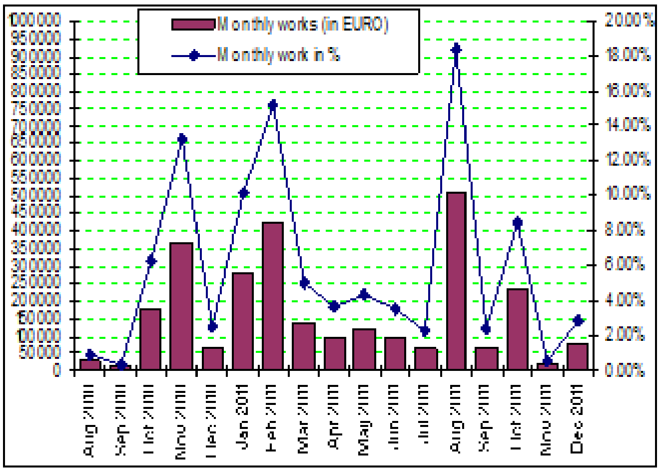
After the Detailed Engineering Design of Intake , Gravel Trap , Desander-Forebay,Penstock, will be finished, we will be able to have an accurate Bill of Quantites . The accurate Total Budget depends on this BoQ , anyway it will be less than Total Budget Foreseen.

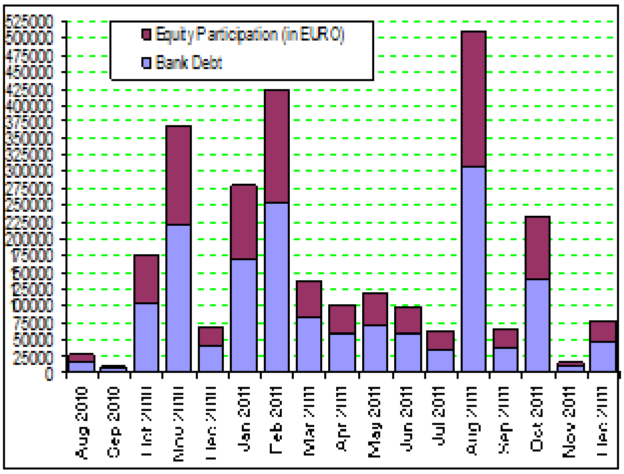
4. EVALUATION OF TOTAL INVESTMENT FOR RADOVA SHPP

4.1 total investment needed for construction of Radova SHPP

In the following table are presented total investment needed for construction of Radova SHPP.

RADOVE SHPP		MONTHS																
ITEM'S DESCRIPTION	EUR	Aug 2010	Sep 2010	Oct 2010	Nov 2010	Dec 2010	Jan 2011	Feb 2011	Mar 2011	Apr 2011	May 2011	Jun 2011	Jul 2011	Aug 2011	Sep 2011	Oct 2011	Nov 2011	Dec 2011
EXCAVATIONS-ROADS OPENING and preparation of construction site																		
(REJ Sh.p.k: 224.14% (MT CONSTRUCTION Sh.p.k: 90.000 €). Total: 118.640 €	98667	26000	10000	10000					12667	20000	20000							
TUNNELS																		
(MT CONSTRUCTION Sh.p.k) Total: 120.000 €	188630			30000	30000	30000	30000	30000	38630									
INTAKE STRUCTURE																		
(MT CONSTRUCTION Sh.p.k) Total: 96.000 €	95472			25000								14472	15000	15000	26000			
Desander Structure																		
(MT CONSTRUCTION Sh.p.k) Total: 90060 €	90060			15000	20000							20000	10000	20000	5060			
SUPPLY-EXCAVATIONS-INSTALLATION OF PENSTOCK																		
(MT CONSTRUCTION Sh.p.k) Total: 401,865 €	424942						200000	52000	52000	60000	38000	22942						
POWER HOUSE BUILDING																		
(MT CONSTRUCTION Sh.p.k) Total: 65.000 €	65000										31000	17000	17000					
TRANSMISSION LINES																		
Licences (ELEKTROMEKANIKA Sh.p.k) Total: 10.200 €	100000								10000	10000	20000	10000	10000	20000	20000			
Construction of the line. (ELEKTROMEKANIKA Sh.p.k) Total: 120,000 €	100000				20000	20000	21000	28800	10200									
ELECTROMECHANICAL WORKS																		
Turbines, Generator, Penstock (turbine pipes), Electrical works (Simens).Supply and installation of all cables from Power Station Bulding until the intakes, for power, CCTV system and controling. Total: 1,330,000 €	1330000				296500			296500						450000		228000		59000
OTHERS																		
Planning and construction supervision (acc. HOAI) 155,000 Euro	155000			95000			5000	5000	5000		5000	10000			10000		10000	10000
Contigency. Total 125,229 Euro (5 %)	125229					20000	25000	10000	10000	10000	5600	5000	10000	5000	5000	5000	5000	9629
Grand Total																		
Grand Total Project Cost	2773000																	
Monthly works (in EURO) from the total amount of: 2773000		26000	10000	175000	366500	70000	281000	422300	138497	100000	119600	99414	62000	510000	66060	233000	15000	78629
Cummulative Investment Amount		26000	36000	211000	577500	647500	928500	1350800	1489297	1589297	1708897	1808311	1870311	2380311	2446371	2679371	2694371	2773000
Sources of Financing																		
Bank Debt		15600	6000	105000	219900	42000	168600	253380	83098	60000	71760	59648	37200	306000	39636	139800	9000	47177
Cumulative Disbursement of the Loan during months (in EURO)		39153	45153	150153	370053	412053	580653	834033	917131	977131	1048891	1108540	1145740	1451740	1491376	1631176	1640176	1687353
Equity Participation (in EURO)		10400	4000	70000	146600	28000	112400	168920	55399	40000	47840	39766	24800	204000	26424	93200	6000	31452
Cumulative Equity during months (in EURO)		26102	30102	100102	246702	274702	387102	556022	611421	651421	699261	739026	763826	967826	994250	1087450	1093450	1124902





Monthly investment to be carry out (Euro)

Monthly investment varry out by loan and by equity to be carry out (Euro)

The preliminary analyses show that the respective investments for the construction of Radova SHPP are 2773000 Euro.

4.2 Exploitation and maintenance cost

During its activity the company foresees some voice of expenses for the operation and maintenance of Radova plant:

The expenses below are for the salaries and social insurances. As it is given in table 4 this voice consists in the main part of the social expenses as far as variable cost is regarded. As the selected staff is 8.5 (as the economist will be employed part-time for the SHPP) persons will operate the SHPP. As it was previously mentioned the staff will consist in 8.5 persons with respective salaries as given in table 3.

Tabela 3.: Shpenzimet per pagat ne tre vitet e para

Nr	STRUKTURA E PERSONELIT	Nr. i pun	VITI I		VITI II		VITI III	
			Paga mujore	Fondi vjetor	Paga mujore	Fondi vjetor	Paga mujore	Fondi vjetor
1	Drejtor	1	70000	840000	73500	882000	77175	926100
	Inxhinjer Mekanik		61000	0	64050	0	67252.5	0
2	Mirembajtje	1	41,000	492000	43050	516600	45202.5	542430
3	Ekonomist	0.5	43000	258000	45150	270900	47407.5	284445
4	Turbinist	4	38,000	1824000	39900	1,915,200	41895	2,010,960
5	Roje	2	30,000	720000	31500	756,000	33075	793,800
	TOTALI	8.5	283,000	4,134,000	297,150	4,340,700	312,008	4,557,735

Maintainace expenses are planned to be 1% of total investment and they remain constant even for the years that will come. The travel expenses/per diem are of such nature to cover all the travel and accommodation cost based on normal standards foreseeing 4 000 lek/day within the country and 12 000 lek/day abroad. The amortization that is considered in the respective table given in the financial calculation is based in some criteria:

- At the same time it should be mentioned that based also on financial accounting Laws it is used the method of linear depreciation of the assets of the future SHPPs.
- The basic criteria are the legislation which has its tolerance for the amortizations (high and low limits of the amortization for the buildings, machineries and various vehicles).

In addition to this, in order to help the environmental programs of the area the company has decided to give every year to the commune a certain amount of grants of 2000 Euro/year for the environmental in general and the forestation of the area specifically. The value of the grant of 3000 Euro/year it is calculated as cost voice in the financial feasibility study and in the business plan accepting in this way the reduction of the income in order to improve the environment for the whole community.

5. INITIAL ANALYSES FOR THE ENVIRONMENTAL IMPACT AS A RESULT OF SELCA 1 SHPP CONSTRUCTION

The components and the environmental factors are:

a. Basement and formations; given in the geological, geomorphologic and pedagogical profile, in the environmental framework, even as non-renewable sources.
b. Atmosphere, the quality of the construction area and the climatic characteristics.
c. Vegetations, flora, fauna; vegetal formation and the animal community, significant emergences, species that shall be protected and natural equilibrium.
d. Hydro environmental, underground and aboveground waters considered as components, as environment and as resource.
e. Public health; the epidemiologic situation of the community.
f. Ecosystem; include the behavior of the physical, chemical and biological factors, their connection and independence among them which form a unitary and identifiable system (so a lake, a forest, a river, sea) for the special structure, for the function and evolution in time.
g. Noises and vibration; consideration in relation with the natural and human environment.
h. Ionizing and non ionizing radiation, consideration in relation with natural and human environment.
i. Landscape; morphological and cultural aspects of the landscape, identity of the interested human community and the cultural goods.

Residual flow is the amount of water which should remain in the river bed, but which is not used for electricity generation and which in the case of Radova SHPP it is accepted to be 2 liter/ (sec*km^2) which is equal to the value given in the European Directive for Water, i.e. in this case in the river bed will be allowed a flow equal to 31 l/sec. This amount of water, which is relatively low) is very important for the protection of the river and of the area surrounding it. If no water is left in the riverbed the communication between the aboveground water and the underground water will be affected considerably

resulting in the lowering of the lever of the underground water. For this reason, the micro-climatic conditions will change toward a drier micro-climate, causing changes in the plants from the intake of the water up to the powerhouse.
For this problem shall be taken in consideration not only the environmental conditions but even those economical, as in this are the land might be used for advanced livestock. The worst scenario would be periodical landslide in this are during heavy rainfall periods in summer due to the lack of plants. The fish economy contributes in a certain rate to increase the income of this region. So, "No water in the river beds" option would affect also the local economy and the social standard. In the pollution problems shall be taken in consideration the distortion of the water quality during the construction and operation period of SHPP. A more detailed analysis is given in the Environmental Impact Assessment Study, but it should be emphasized that in the analyses of the electricity generation this residual flow is taken in consideration.

5.1 Social-economical conditions

The areas where this SHPP will be constructed is located in the villages of Korça region. In these villages lives about 2 000 inhabitants and their main activities are mineral mining, agriculture and livestock. There are considerable incomes from the emigration. Another activity is also the collection of medical herbs. The construction of this SHPP will enable the employment of more than 150 people especially for civil works. This employment period will last 2 years consisting in employment, material goods and in addition to direct employment there will be even indirect employment. As a result of the construction of this power plant will be employed a great number of experts which will consumes considerable amount of fresh products of these villages.

5.2 Cultural sources

In the area where the Radova SHPP will be constructed there are no archeological sources. This area has the same traditions and rituals as the region it is situated in.

5.3 Potential environmental impact and suggested measures for its reduction

Potential environmental impacts of the SHPP occur during both the construction and operation phase. Since the beginning we should emphasize that based on their working principle as electricity generation plant from the renewable energy resources (as is the case of hydro-energy) and the transformation of the electricity from one level of voltage to another causes minimal pollution in the environment.

5.4 Environmental impact during the construction phase

The improvement of the roads that leads to the SHPP construction site is a very short distance as the main road passed just by. As a result, during the improvement of the road there will be small amount of dust emission in the atmosphere as a result of different civil works that will be carried out in it. The Company has already finished all the connecting roads and the dust emission was minimal as the company has transported the soil with covered vehicles. The preparation of the construction sites for the electric plants of

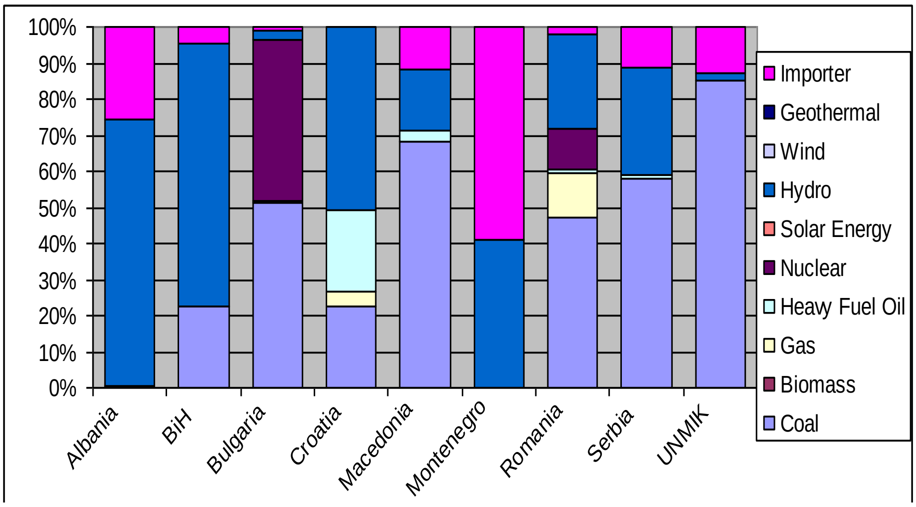
SHPPs has, also, a certain impact in the environment. As a result during the opening of two sites (25X20 m) and during the improvement of this short-distance road there will be a low amount of dust emission in the atmosphere due to different civil works that shall be carried out in the construction site.

6. FINANCIAL ANALYSES OF RADOVA SHPP

The determination of the above parameters provided all the necessary technical parameters, preventives and financial for Radova SHPP and that will be constructed by the Company. In the following section, in all the section of chapter 5 will be described in details the financial analyses of gain-cost of Radova SHPP.

6.1 The trend of the South-East European electro-energetic market

As it is shown in figure 10, the main fuel burned for the generation of electricity in the region is coal providing almost half of the generated electricity in the region. Albania and Monte Negro are totally depended on hydro resources and the import of electricity, whereas nuclear energy contributes only in Bulgaria and Rumania.



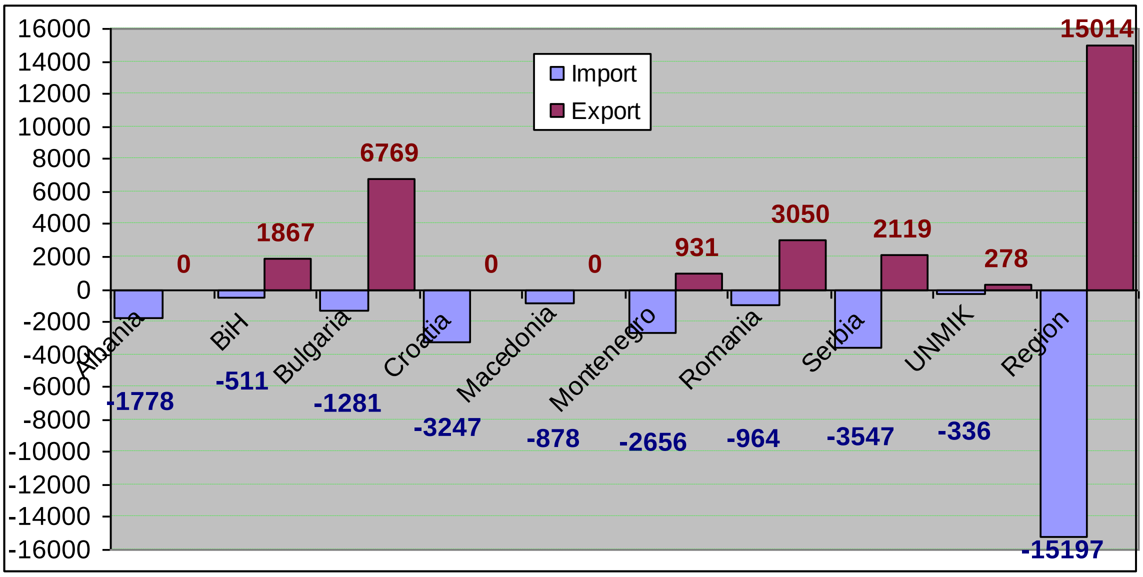


Figura 15.: Importi dhe eksporti i cdo vendi per vitin 2008 (GWh)

The closure of the Nuclear TPP in Kozmodull in Bulgaria, which generated about 7 TWh/year means that the entire region is in total import since 1 January 2007. This is already evident as the supply for 2007 has been reduced and which has been accompanied with an import price of 80-150 EURO/MWh. This tendency (even though it is decreasing for the first three-month period of 2009 due to the very good hydrologic conditions in the region and due to the economic decrease caused by the financial crisis which has been reflected in the decrease of the demand) together with the price increase of the fuels such as oil, natural gas and coil result in a financial environment and high feasibility for the construction of the SHPPs in places where they are designed with high efficiency and minimum environmental impact

6.2 The trend of electro-energetic market in Albania

The Aim of the Electricity Market Model is the first logic step toward a general development of the market. Due to the difficulties to develop national electricity market, this focus is justified for the following reasons:

1. The general electric system is very small. So, the potential for multiple competing native Purchasers (DDC) is limited.
2. The consumption greatly overpasses the supply; the load shading occurs all over the year. "Demand", as this term is used mainly in t the foreseen of the load in enterprises, foresees a energy level that the consumer want to pay.
3. Industrial clients are a decreasing percentage in the total mix of generation. So, the number of potential Qualified Clients is limited.
4. Import capacity of Albania is limited by unsuitable infrastructure of the transmission and interconnection.
5. Hydro occupies 98% of the inland generation of the system or of the mix of the generation installed capacity, almost all of it by three plants located in the same cascade which requires dependant operation of the plants.

The development of these plants requires a more promoting policy from the government, especially for the new plants. The investors ask for the signing of a long-term Power Purchase Agreement (PPA) in order to be safe for the investment that they are going to do. The term of this PPA-s might be limited in years as long as, on one hand it is stimulating (or it is worth) for the construction of new plants, and on the other hand it is acceptable by the purchaser. Different European countries Germany, Greece or Portugal has ratified laws which oblige system operators to all the electricity generated by these plants for 20-year period.

The purchase of the electricity generated by HPPs is another effecting element to invest in these plants. The methodologies for the determination of the electricity price generated by the small hydropower plants shall be in such way that it encourage the development of this plants to bring certain incomes for the consumers. This development is a powerful tool to promote the competition among sellers in the national market and it shall encourage their number and even the increase of their experience in the market.

For small HPP-s it is important even their connection with the system. As these plants due to their low installed capacity are connected with the distribution network, the distribution code shall be amended in such a way that it shall oblige the distribution to connect these plants in the nearest point with the distribution network.

6.3 Analyses of electricity selling price

The Banks won't finance an HPP project if it is not profitable. The profits depend from the volume of the investment, from the cost of financing and the expected profits to be generated by the investment. The profits are a function of the generated electricity (GWh) and to the price with which this electricity is sold. In addition to this, the Banks would give a loan only to the HPPs if the loan taker would take all his/her financial obligations as far as the loan conditions are regarded, i.e. cash flows received from the project shall be coordinated with the time and the requirement of the loan. Electricity selling tariffs in the network from the HPPs has approximately been 34.4 Euro/MWh in 2004 (taken from a long-term purchasing agreement with KESH as a distribution sector). Whereas in 2005, 2006 and 2007 the price was 38.2, 40 Euro/MWh and 52 Euro/MWh applied by ERE. In 2008 the calculated tariff was 9.2 lek/kWh. The electricity tariffs are expected to be calculated based on long-term marginal cost of G/T/SH of electricity.

In the analyses done in the National Strategy of Energy, in the section of the Master plans of Generation, Transmission and Distribution, there are evaluated the necessary investments to implement these master plans. Based on these investments of G/T/D, their respective interests fix costs of operation and maintenance, variable costs of operation and maintenance, cost of the fuels and the cost of imports, it is calculated the long-term unit marginal cost. The analyses give in table 7 the level of long-term marginal cost of G/T/D is 8.63 cent/kWh.

Table 7.: Partial marginal cost and those accumulated according to the divisions of the electric sector

Total [EURO/MWh]	**Marginal cost of Generation**	Development cost of Transmission System	Development cost of Distribution System
Level of Generation (47.2 or 53.53%)	47.2		
Level of Transmission (59.8 or 15.75%)	50.8	9.0	
Level of Distribution (86.3 or 30.70%)	56.8	10.0	19.5

For the financial analyses of the profit-cost selling price of the electricity from Selca 1 SHPP in the Distribution Company was taken in 1 January 2009 to be 9.2 Lek/kWh. In the following section we will give the methods use to determine the tariffs for SHPPs. The commissioning board of ERE has approved with a Decision Nr. 5, dated 26.01.2007 the Methodology use to calculate the selling price of electricity from the SHPPs with capacity up to 10 MW;

The Albanian Government, proposed by METE has prepared the respective formulae to determine the unified selling price of the electricity by the small HPPs on annual base, based on the following formula:

$$P_{feed\text{-}in}(t) = P_{imp}(t-1) * 1.1 * \text{Exchange rate of Euro/Lek}$$

Where:

$P_{feed\text{-}in}(t)$: Electricity selling tariff in year (t)

$P_{imp}(t-1)$: Mean pondered price of import of electricity in the previous years

1.1 Coefficient that takes in consideration the reductions due to the technical loses in transmission and distribution with a value of 10%.

Applying this formula for the unified selling price of electricity is applied for 2008 the selling price would be 9.2 lek/kWh. The above analyses showed that the price of electricity sold from the small HPPs is 9.2 lek/kWh and based on the regional market the import price is expected to be increased with 6-10 % year after year for the following 7-10 years. What is important to emphasize here is that this price is feasible for the construction of small hydropower plants

6.4 Cash flow analyses for Radova SHPP

The initial investment for different plants (including those energetic) include the following voices: the payment done to all the suppliers, transporters (including even the Customs if there are any); the payment done to all the study and project offices; payment done to all industrial offices; a certain amount of expense done to cover the danger during the construction of the plant; all the expenses for the different processes of implementation construction, issuing (up to the time when the HPP will work in full load); of the infrastructure outside the plant (but which are necessary for its normal operation) (roads, water, etc.); other additional expenses for the environmental protection plant etc. During the construction of the projects it is most probably that the value of the initial investment will be increased with a value which varies from one scheme to another and according to the concrete terrain conditions where the HPPs will be constructed. As it has been emphasized in the above section the value of initial investment for Selca 1 SHPP is 2.87 milion Euro. All the evaluation technical of the investments require the basic parameters in order to calculate the exploitation cost, initial investment and profits that will be gained from this investment.

For the evaluation of Radova SHPP cost to divide them in fix costs, independent from the exploitation (the amount of the production) of the plant and in proportional ones (variable)from the exploitation (the amount of the production) of the plant. The exploitation costs independent from the exploitation of the SHPPs evaluated on annual bases are included in the fix cost, independent from the plant load. This include staff cost, primary materials stuff and the cost of the help independent from the exploitation, maintenance and other services cost, loans and payment to third parties. Cash flow is the difference between the profits in a year determined by the sell of electricity with the operation cost and the VAT over the gross profit. So the cash flow for Selca 1 SHPP will be calculated with the following formulae:

$$X_t = B_t - C_t \quad (gross\ profit)$$

$$VAT\ \min = 0.10 \cdot X_t \qquad (1\ \&\ 2)$$

$$X_{t\ (neto)} = (B_t - C_t) - 0.10 \cdot (B_t - C_t) = 0.90 \cdot (B_t - C_t)$$

6.5 Financial Methods for the realization of financial feasibility analyses

Different methods are used and are being used to take the financial decision including that of Net Present Value-NP, Internal Rate of Return-IRR; Wealth-Maximizing Rate-WMR and Pay Back Period- PBP. The most used financial methods are those of NPV and IRR and their respective calculating formulae are given in 3 and 4.

$$NPV = \sum_{t=0}^{30} \frac{B_t}{(1+r_t)^t} - \sum_{t=0}^{30} \frac{C_t}{(1+r_t)^t} \tag{3}$$

$$NPV = \sum_{t=0}^{30} \frac{B_t}{(1+IRR)^t} - \sum_{t=0}^{30} \frac{C_t}{(1+IRR)^t} = 0$$

Where:

$t \rightarrow$ time of cash flow: it varies from 0 (installation year) to n (the last year equal to the lifetime).
$r_t \rightarrow$ minimum rate of discount (in this financial assessment, in the base case it is considered for Selca 1 SHPP: 8% (also it should be emphasized that even the sensitivity analyses has been carried out) based on the bank market analyses. In the sensitivity analyses, when we analyze the variation of NPV toward r_t, it was taken the range (7%-12%).
$B_t \rightarrow$ the profits of the project that come from the multiplication of the generated of electricity in Selca 1 SHPP with the electricity price for every year.
$C_t \rightarrow$ initial investment (only C0) and the cost of project operation that comes from the multiplication of the annual energy generated from Radova SHPP with addition unit cost given in section 3.7.

Another well known method, especially in electricity generation sector (as it is the case of Selca 1 SHPP) is also the long-term Liveliest Discount Cost-LDC of the unit generation of electricity. The long-term Liveliest Discount Cost-LDC of the unit generation of electricity is based on the following formula:

$$LDC = \frac{\sum_{i=0}^{30} \frac{C_i}{(1+r_i)^i}}{\sum_{i=0}^{30} \frac{E_i}{(1+r_i)^i}} \quad \text{[Lek/kWh]} \tag{5}$$

In the above formula there are given these parameters:

C_i - sum of initial investment cost of xxx SHPP, maintenance cost, staff cost, sell/purchase of electricity cost and amortization cost.
E_i - Generated electricity;
r_i - discount rate is considered 8% for the base case (it will be finally determined based on the negotiations with Bank).

Another method used to take the financial decision is based on the concept of the payback period of the investments. Pay Back Period-PBP is determined as the shortest time needed by the Selca 1 SHPP that the profit overpasses the costs for this period. Let's consider Xt every cash flow in year t; Xt is negative if it is cost and it is positive if it is profit (gain). Let's sign with"PBP" the pay back period, than the simplest formulae to calculate the PBP is taken from:

$$\sum_{t=0}^{PBP} X_t \geq 0$$

Where as it was stress $X_t = B_t - C_t$ (6)

By not discounting the cash flow, PBP has considerable errors as it does not take in consideration the value of time in money and for this reason it shouldn't be used any more. As the discontenting is included than the equation for the calculation of the PBP will be:

$$\sum_{t=0}^{PBP} \frac{X_t}{(1+r_t)^t} \geq 0 \qquad (7)$$

In the case, discounted cash flows are added up to the point where their sum is positive. In order to realize a complete financial analysis of the Selca 1 SHPP feasibility will be used all the financial technical described above: NPV, IRR, LDC and PBP.

6.6 Financial Figures for the Best Alternative of Radova SHPP

Up to now there have been calculated the initial investment, operation cost, electricity price and the interest rate of the loan is considered to be 8 % for the base case. As a result we have all the necessary data to calculate the financial figures, based on the above formula and the appropriate Excel program for this purpose, which are respectively:

Financial Figures for the case of installation of Gugler Turbine:

1. Net Present Value NPV) = 4.67 Million Euro
2. Internal Rate of Return (IRR) = 15.03%
3. Pay Back Period =4.67 years
4. Long-term marginal unit cost of generation = 5.51 cent/kWh

Financial Figures for the case of installation of Siemens Turbine:

1. Net Present Value NPV) = 5.98 Million Euro
2. Internal Rate of Return (IRR) = 17.25%
3. Pay Back Period =7 years
4. Long-term marginal unit cost of generation = 4.4 cent/kWh

6.6.1 Sensitivity Analyses versus Main Parameters for Radova SHPP

The most important base parameters that are expected to change in the case of Radova SHPP investment are: interest rate of the loan, the amount of generated electricity in a year, electricity price, initial necessary investment to construct this SHPP and its working life. In order to have a more stable financial feasibility analyses it is necessary to carry out the sensitivity analyses. In the sensitivity analyses will be calculated the variation of NPV, IRR, LDC and PBP versus the above mentioned parameters.

6.6.2 NPV, IRR, LDC and PBP versus the interest rate

On the most important base parameters that are expected to change in the case of Selca 1 SHPP investment is the interest rate of the loan. In order to carry out a complete sensitivity analyze of all the financial figures versus this parameter, the range of the interest rate is considered to be (7-12) %.

In the figure 12-15 it is given the analyses versus the interest rate for Radova SHPP. The most import conclusion of this sensitivity analyses of the financial figures versus the interest rate are:

1. NPV is decreased with the increase of interest rate and it remains positive for all the interest values in the range of 7-12 %;
2. IRR remains constant (17.12%) with the increase of the interest rate because based on its definition it is independent from the interest rate;
3. LDC increases with the increase of the interest rate and for the worst case scenario (when the interest rate is 12%) it reaches the value of 6 cent/kWh, which is lower than the electricity selling price;
4. PBP increases with the increase of the interest rate and for the worst case (when the interest rate is 12%) it reaches a value of 8.00 years;

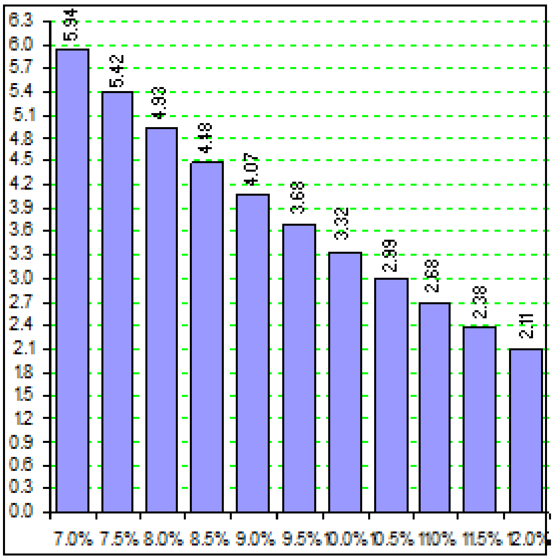


Figure 12.: Sensivity Analysis of NPV versus interest rate for Radova SHPP

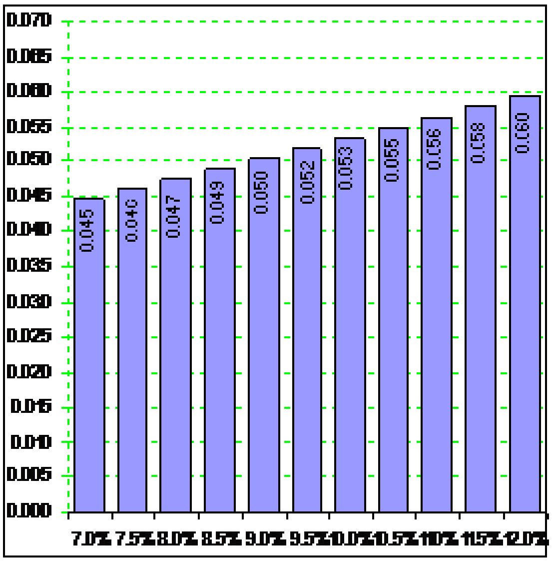


Figure 13.: Sensivity Analysis of LDC versus interest rate for Radova SHPP.

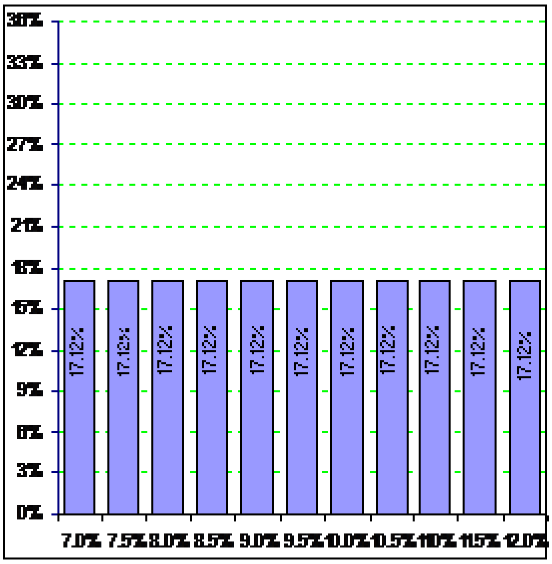


Figure 14.: Sensivity Analysis of IRR versus interest rate for Radova SHPP.

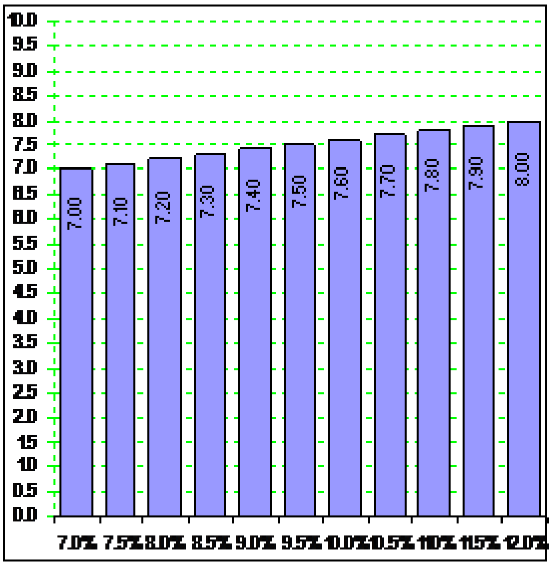


Figure 15.: Sensivity Analysis of PBP versus interest rate for Radova SHPP.

The general conclusion of this analyses shows that all the investment is worth as all the financial figures are very feasible.

6.6.3 NPV, IRR, LDC and PBB versus the value of generated electricity

One of the most important base parameters that are expected to change for the case of Radova SHPP is the amount of generated electricity in a year. In figure 16-19 it is given the analyses versus the amount of generated electricity.

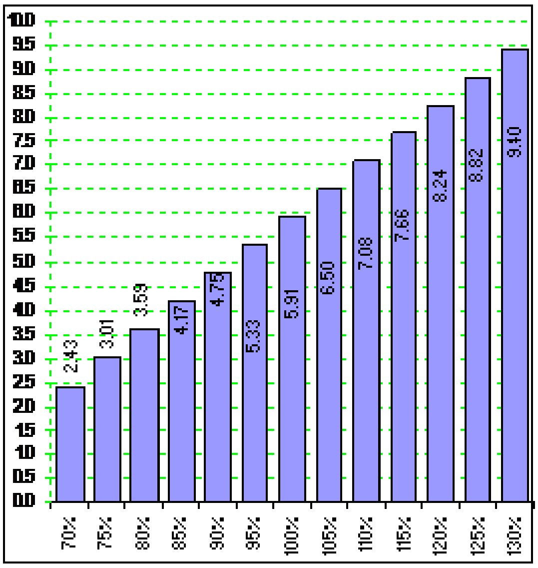


Figure 16.: Sensivity Analysis of NPV versus elec. generation for Radova SHPP.

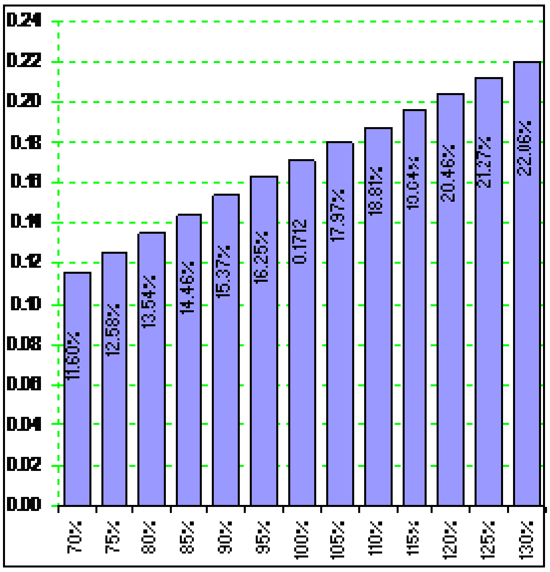


Figure 17.: Sensivity Analysis of IRR versus elec. generation for Radova SHPP.

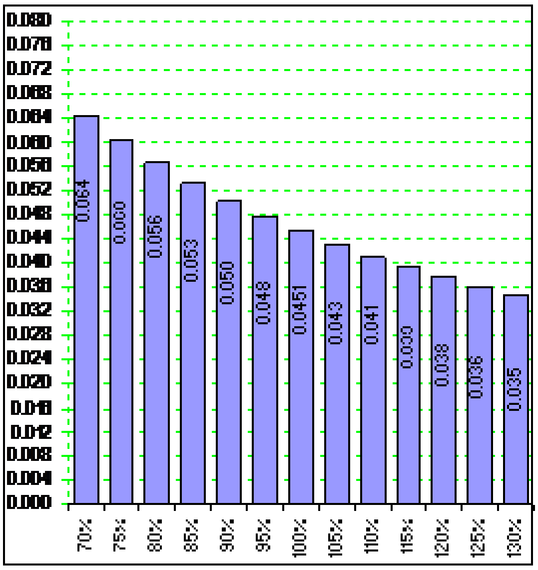


Figure 18.: Sensivity Analysis of LDC versus elec. generation for Radova SHPP.

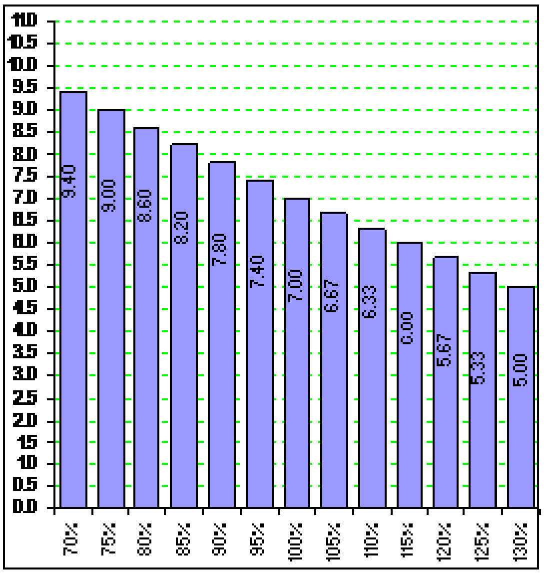


Figure 19.: Sensivity Analysis of PBP versus elec. generation for Radova SHPP.

The most import conclusion of this sensitivity analyses of the financial figures versus the variation of the amount of generated electricity are:

1. NPV is decreased with the decrease of generation of electricity for the 70 % of the normal value (9.14 GWh), NPV remains still positive. Whereas with the increase of electricity generation of NPV increases reaching the value of 9.4 million for the production value of 130 % compared to the normal value.

2. IRR decreases with the decrease of the generation and for 70 % of the normal value, IRR is 11.6 % bigger than the interest rate (8%). Whereas with the increase of the generation of electricity IRR increases reaching the value of 20.66 % for the production value of 130 % compared the normal value
3. LDC increases with the reduction of the generation and for 70 % of the normal value, LDC is 6.4 cent/kWh. Whereas with the increase of the generation of the electricity LDC decreases reaching the value of 3.5 cent/kWh for the production value of 130 % compared to the normal value.
4. PBP increases with the reduction of the production and for the 70 % of the normal value; PBP is 9.4 year (we should not forget that the SHPP working life is 35 years). Whereas with the increase of the generation of the electricity PBP decreases reaching the value of 5 year for the generation value of 130 % compared to the normal value.

Final sensitivity analyses versus to the generation of electricity shows that even in the case when there is 30 % lower generation during all the working life of the plant the investment has very good financial figures and a profit rate of 10%

6.6.4 NPV, IRR, LDC AND PBP versus the electricity price

One of the most important base parameters that are expected to change for the case of Radova SHPP is the electricity selling price. As it has been emphasized in the section of electricity selling price the base value of this price is 9 leke/kWh, but this may be increased considerably in the future especially in the case the special qualified client status is received and the opening of the electricity market. In addition to this, the electricity selling price might be increased considerably as the oil price in the international market is increasing. In order to realize a complete sensitive analysis for all the financial parameters versus this parameter, the variation of the electricity selling price from the Radova SHPP to the Whole Public Supplier is considered to be 8-10.25 leke/kWh.

In the figure 20-23 it is given the analyses versus the electricity price. The most import conclusion of this sensitivity analyses of the financial figures versus the variation of the electricity price are:

- NPV decreases with the decrease of the electricity selling price and for the price 8 leke/kWh, NPV remains still positive with a value of 3.44 Million Euro. Whereas with the increase of electricity selling price NPV increases reaching the value of 6.87 Million Euro for the price 10.25 leke/kWh.
- IRR decreases with the decrease of the electricity selling price and for the price 8 leke/kWh, IRR is 11.82%. Whereas with the increase of electricity selling price IRR increases reaching the value of 17.123% for the price 10.25 leke/kWh.
- LDC remains constant and it does not depend on the electricity selling price, as it depends on the cost not on the profit (which varies directly with the electricity selling price).

- PBP increases with the decrease of with the decrease of the electricity price and for the price of 8 leke/kWh we have a PBP=8 years. Whereas with increase of the selling price, PBP decreases reaching the value of 6.0 year for the price 10.25leke/kWh.

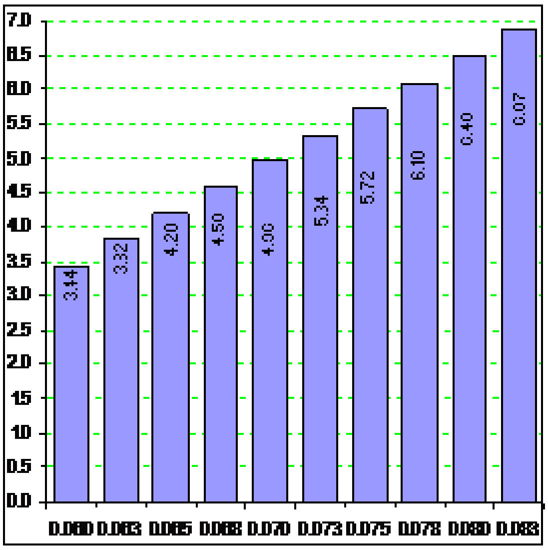


Figure 20.: Sensivity Analysis of NPV versus electricity price for Radova SHPP.

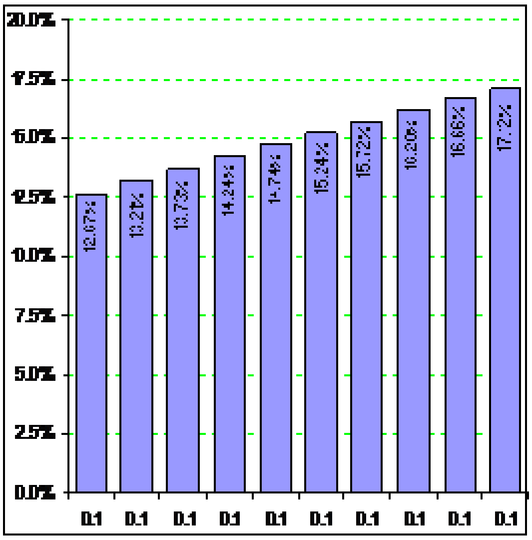
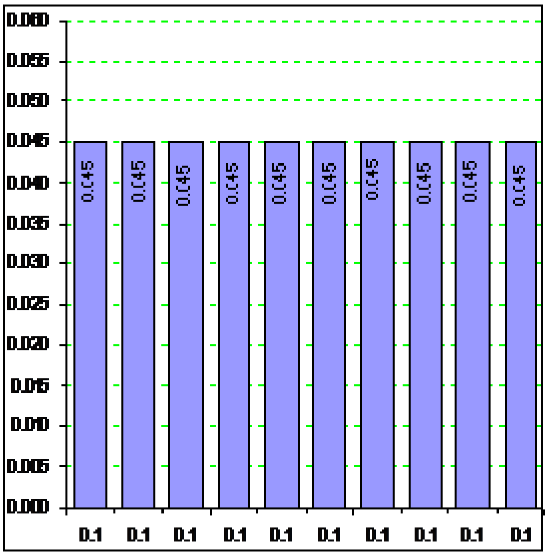


Figure 20.: Sensivity Analysis of IRR versus electricity price for Radova SHPP.



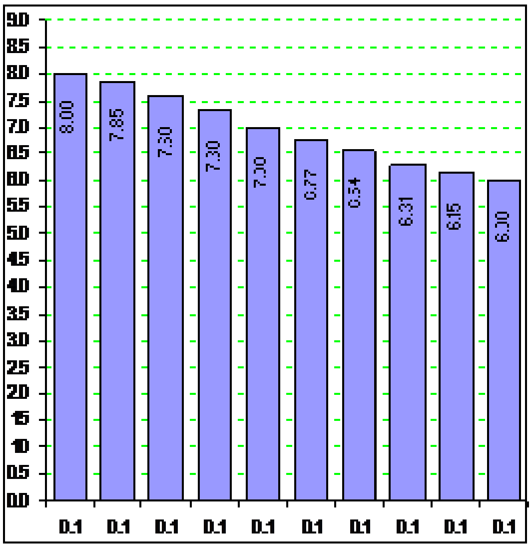


Figure 22.: Sensivity Analysis of LDC versus electricity price for Radova SHPP.

Figure 23.: Sensivity Analysis of NPV versus electricity price for Radova SHPP.

6.6.5 *NPV, IRR, LDC AND PBP versus the initial investment*

One of the most important base parameters that are expected to change for the case of Radova SHPP is the value of the initial investment. Even though, based on the detailed engineering design that is carried out it is accepted a different investment value of +10% compared to the normal value (for Radova SHPP is 2.773 milion Euro, in order to carry out a complete sensitivity analyze of all the financial figures versus this parameter, the variation of the initial investment it is considered in the range of (70-130) %, as we are still in the concept idea phase.

In the figures 24-27 it is given the analyses versus the initial investment. The most import conclusion of this sensitivity analyses of the financial figures versus the variation of the initial investment are:

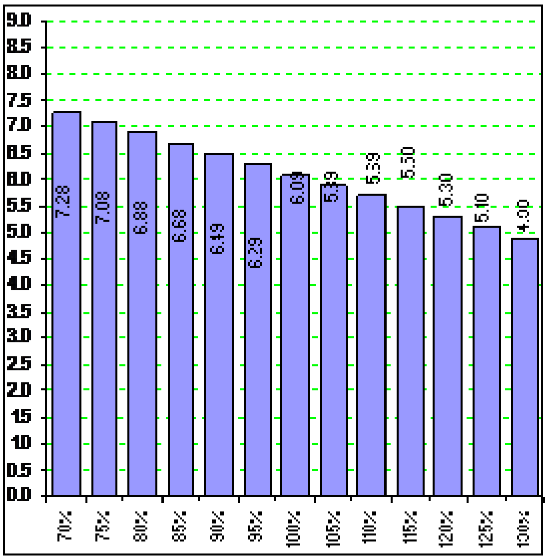


Figure 24.: Sensivity Analysis of NPV versus first investment for Radova SHPP

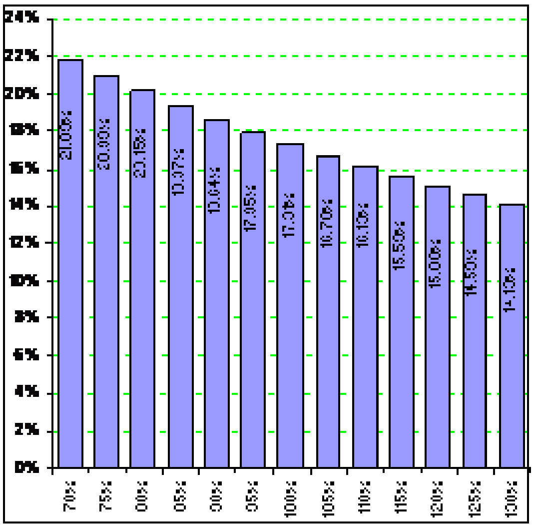


Figure 25.: Sensivity Analysis of IRR versus first investment for Radova SHPP

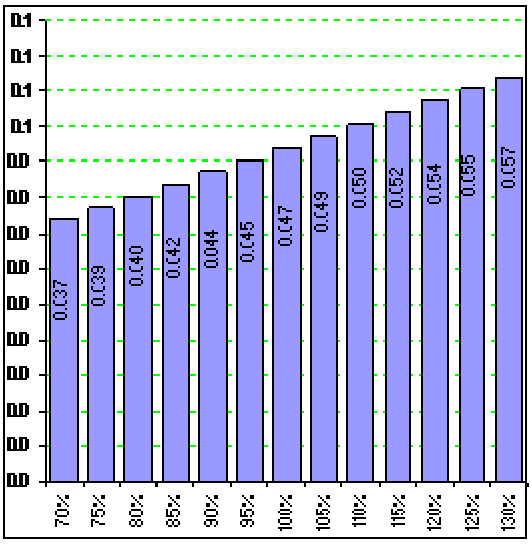


Figure 26.: Sensivity Analysis of LDC versus first investment for Radova SHPP

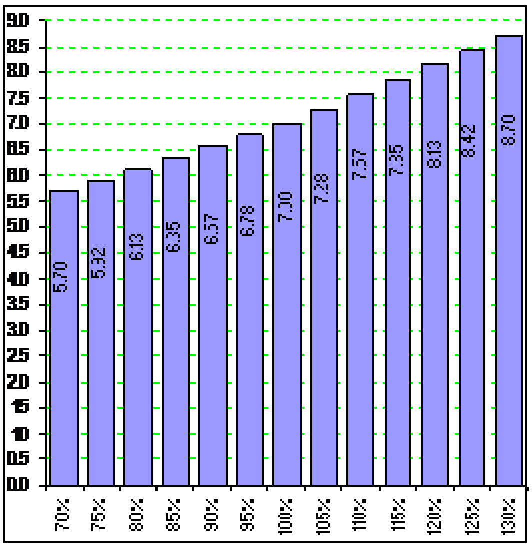


Figure 27.: Sensivity Analysis of NPV versus first investment for Radova SHPP

1. NPV decreases with the increase of the initial investment, but for all the range it remains positive with a very high value even in the worst case scenario;
2. IRR decreases with the increase of the initial investment, but during all the range it remains bigger than the interest rate even for the worst case scenario when the initial investment is 130 % of the normal value IRR is 14.13%;
3. LDC increases with the increase of initial investment and for the worst case (130% of nominal value) it reaches the value of 6.5 cent/kWh, which is still lower than the electricity selling price;
4. PBP increases with the increase of the initial investment and for the worst case scenario (130 % of nominal value) it reaches the value of 8.7 years;

7. CONCLUSIONS OF THE FINANCIAL ANALYSES

The most important conclusions of the financial analyses of Radova SHPP are:

1. **Installed Capacity of RAdova SHPP 2500 kW.**
2. **The amount of electricity generated by Selca 1SHPP is 9.14 GWh/vit.**
3. **Initial investment for the total construction of the Radova SHPP within 12-24 months is 2795 milion Euro.**
4. **Configuration of Radova SHPP is with two Pelton turbines.**
5. **Electric line of Radova SHPP connection will be 5km of 10 kV and it will be connected to the respective substation**
6. **for the base case of the financial figures of Radova SHPP are:**

- **Net Present Value (NPV) = 5.98 Million Euro;**
- **Internal Rate of Return (IRR)= 17.25% ;**
- **Pay Back Period of investments=7 years;**
- **Long-term marginal unit cost of generation = 0.044 Euro/ cent/kWh**