Generation of hydro-accumulated energy while filling up the Dead Sea

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Summary

The authors propose to build a water conduit to the Dead Sea and to combine it with a 3 GW pumped-storage hydroelectric plant (PSP). This will allow to "save" the Dead Sea and to give water to the desert also to improve efficiency and reliability of electric power supply in Israel by balancing the load of thermal power stations.

Proposal

In this proposal, a water conduit will bring about 1000-1200 million m^3 of desalinated water to the Northern Basin of the Dead Sea. The conduit will feed water into PSP in order to improve efficiency of the project. To reduce the time and cost of construction, the conduit and PSP must be built in common project. The PSP can also operate independently from the conduit, with water supplied by a small desalination unit

Special features of the proposal

Unique features of the landscape near the Dead Sea can be utilized to build a PSP with 660 m difference in the levels of the upper and the lower reservoirs. The lower reservoir will be built on the shore of the Dead Sea. The length of the high pressure penstock will not exceed 2 km.

In order to supply water to the reservoirs and to fill up the Dead Sea, the conduit will be built from the Mediterranean Sea going around the Palestinian Authority through the most arid areas of Negev. This will provide fresh water and enable development of this region. To reduce the time and cost of construction, the conduit can be built by laying 4m pipes into the trenches. Figs 1 and 2 show the plan of the PSP and the route of the aqueduct.

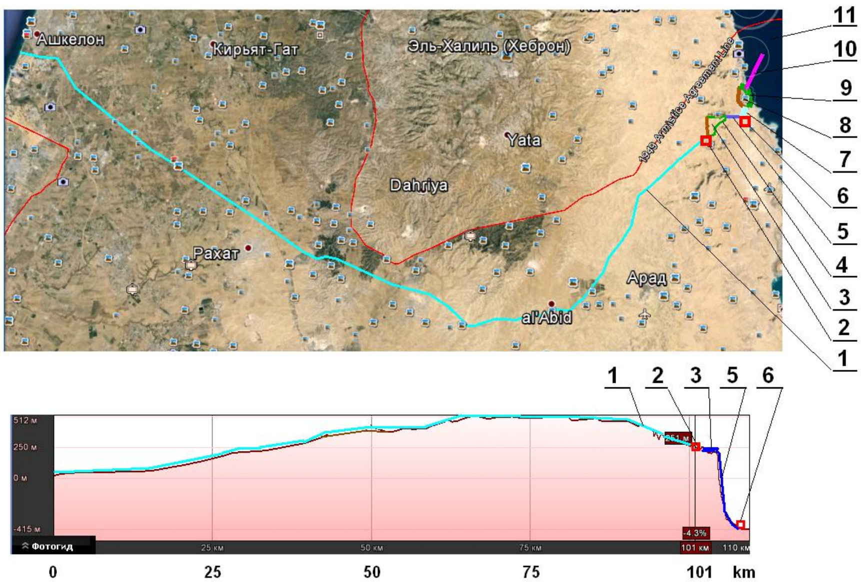

Fig 1. Plan of the PSP and the route of the water conduit from the Mediterranean Sea to the Dead Sea: 1 – the route of the conduit; 2 – dam-less hydroelectric plant; 3 – the upper reservoir; 4 – the dam of the upper reservoir; 5 – penstock; 6 – PSP; 7 – open channel; 8 – lower reservoir; 9 – dam of the lower reservoir; 10 – aqueduct to the sea; 11 – northern basin of the Dead Sea

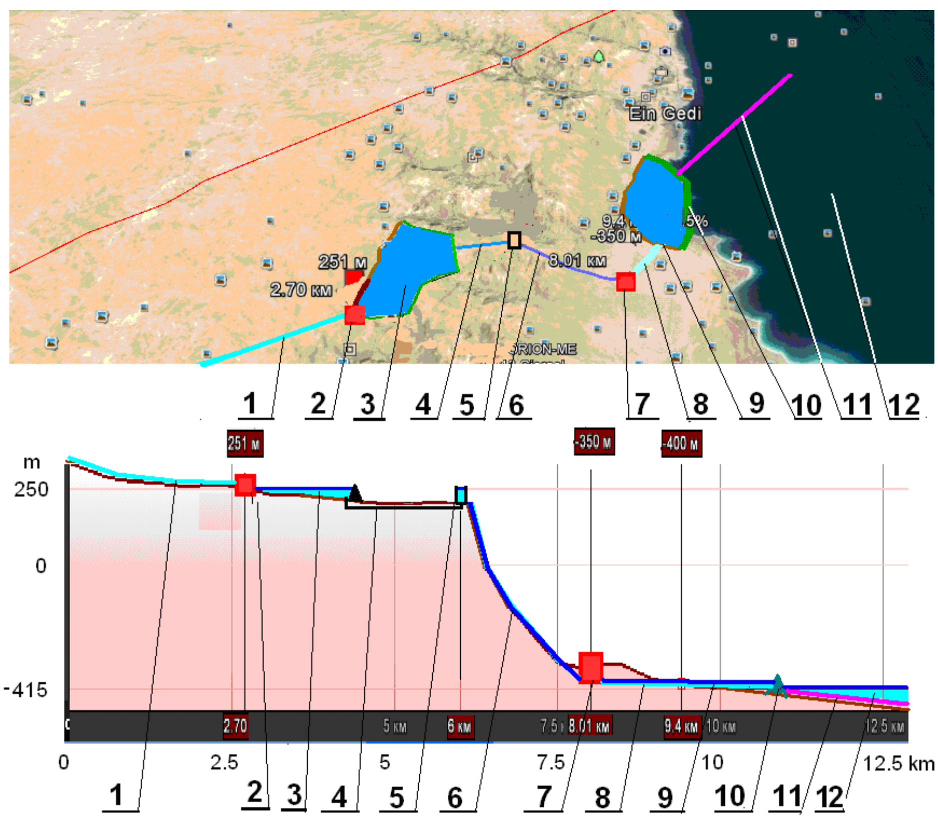

Fig 2. Plan of the PSP: 1 – route of the conduit; 2 – dam-less hydroelectric plant; 3 – upper reservoir; 4 –siphon; 5 – collector; 6 – penstock; 7 – pumped-storage hydroelectric plant; 8 – open

channel; 9 – lower reservoir; 10 – dam of the lower reservoir; 11 – aqueduct to the sea; 12 – northern basin of the Dead Sea

Fig 3: The aerial view of the pumped-storage hydroelectric plant

Operation of the pumped-storage hydroelectric plant

Water is continuously pumped from the Mediterranean Sea via the conduit (1) (Fig 2) to the dam-less hydroelectric plant (2), and then to the upper reservoir. PSP (7) pumps water from the lower reservoir (3) into the upper reservoir (9) during the night. The pumps are using spare off-peak capacity of Israel's thermal power plants. Additionally, water accumulates in the upper reservoir through continuous pumping from the Mediterranean Sea. During peak load times, water released from the upper reservoir generates peak or emergency electric power, which is fed into the electric grid. Water accumulated daily in the lower reservoir is released into the Dead Sea.

The total volume of the reservoirs and the difference between the levels of 660 m allow generating peak or emergency electric power up to 3 GW up to 10 hours. This power generating and storage capacity is sufficient to balance the demands on Israel's thermal power stations and therefore maintain their constant load (without daily changes of power of thermal power plants) [1]. See Figs 4 and 5.

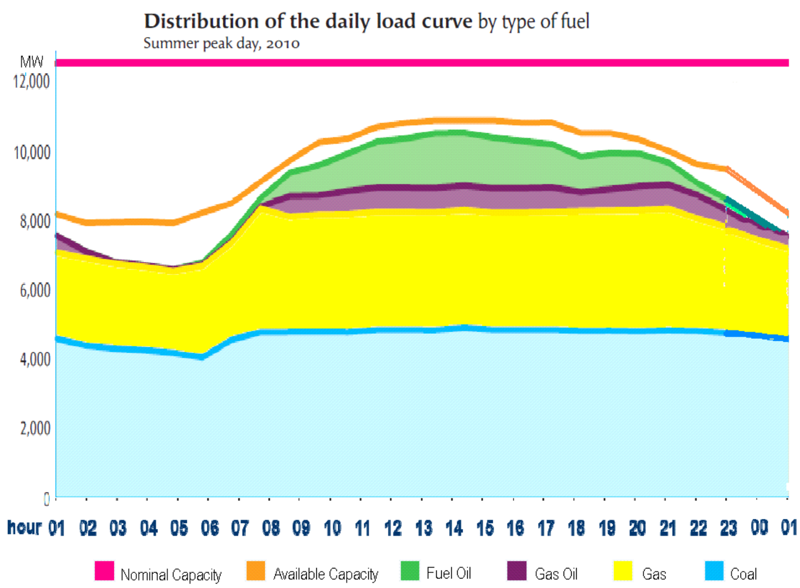

Fig 4. Daily variation of all available electric power in Israel (summer of 2010) [1]

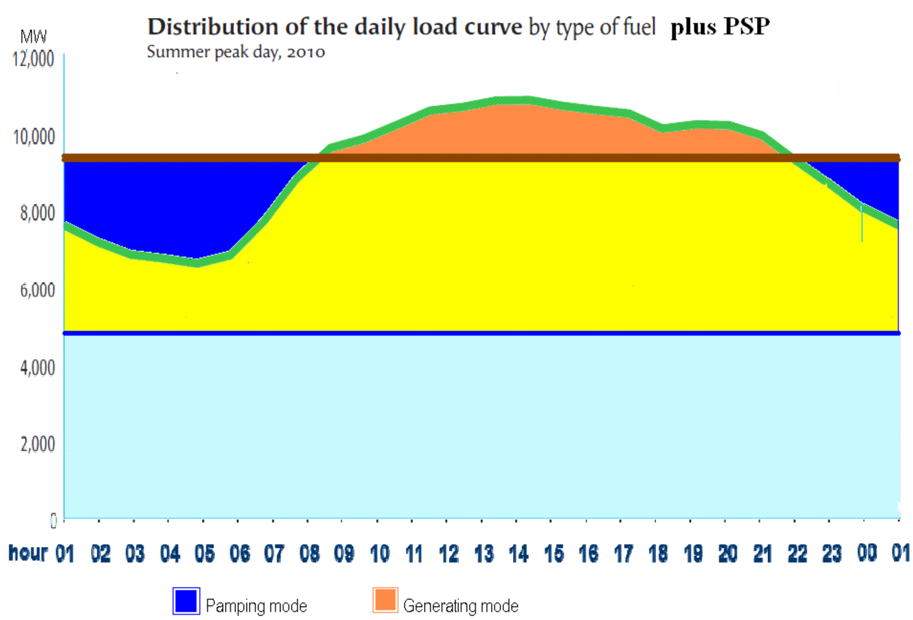

Fig 5. Smoothed out daily power load when thermal electric powers are used in conjunction with PSP.

Stages of construction

The price of construction of a PSP with generating capacity of 3 GW is about $3-4 Billion [2; 3; 4; 5; 6; 7; 8]. Typically, operations of large PSP are phased in with gradually increasing power. At the first stage, we propose building the PSP with 2 reservoirs each having the area of 2 km^2 and the volume of 20 million m^3, a one km–long open channel

from the lower reservoir to the Dead Sea and a water conduit from the Mediterranean Sea to the Dead Sea with pumping stations to fill not desalinated water to the Dead Sea.

At the second stage, we suggest involving sponsors from ecologically-oriented non-profit organizations and the UN in order to solve regional ecological problem of the Dead Sea and to give water to the desert. There are dozens of such organizations in different countries. For example: the World Bank (http://data.worldbank.org/), United Nations Foundation, UNF (www.unfoundation.org), Global Environment Facility, GEF(www.undp.org/gef/), David and Lucille Packard Foundation (http://www.packard.org/), United Nations Environment Programme, UNEP (http://www.unep.org/) and others (http://www.unep.org/maweb/es/Donors.aspx).

At the third stage, the dam-less hydroelectric plant will be built using the 250 m difference between the levels and to increase productivity of desalination installations, in particular for replenishment of the Dead Sea.

This short note discusses only transportation and energy issues, without considering chemical interaction of the sea water with water of the Dead Sea or desalination of sea water. Detailed calculations of the required power, size of the pipes and so on are not shown.

References:

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