= Siah Bishe Pumped Storage Power Plant =

The Siah Bisheh Pumped Storage Power Plant (Persian : ??????? ????? ????? ? ?? ???? ? ????) , also spelled Siy?hbisheh and Siah Bishe , is located in the Alborz Mountain range near the village of Siah Bisheh and 48 km (30 mi) south of Chalus in Mazandaran Province , Iran . The power plant uses the pumped @-@ storage hydroelectric method to generate electricity during periods of high energy demand , making it a peaking power plant , intended to fulfill peak electricity demand in Tehran 60 km (37 mi) to the south . When complete it will have an installed generating capacity of 1 @,@ 040 megawatts (1 @,@ 390 @,@ 000 hp) and a pumping capacity of 940 megawatts (1 @,@ 260 @,@ 000 hp) . Planning for the project began in the 1970s and construction began in 1985 . It was delayed from 1992 until 2001 and the first generator went online in May 2013 . The remaining generators were commissioned by 1 September 2015 . The power plant is the first pumped @-@ storage type in Iran and will also use the country 's first concrete @-@ face rock @-@ fill dam ? two of them .

= = Background = =

A site was first identified for the power plant in the 1970s when a study was carried out on the water resources of the Albors Mountains by the Belgian firm Traksionel . Several sites for dams were identified including Siah Bisheh as a potential place for a pumped @-@ storage power plant . In 1975 , a feasibility report on the Siah Bisheh project was submitted to the Ministry of Energy . The Albors Mountains study concluded in 1977 and geologic studies began in 1978 but were halted in 1979 due to the Iranian Revolution . In 1983 , Lahmeyer International was contracted to create designs for Phase II (underground excavation) which were completed in 1985 , the same year construction on the dam 's diversion tunnels began . Further designs for Phase I (superstructures) were developed and construction continued until 1992 when a lack of funding halted the project once again . Construction would not commence again until 2001 . In 2002 and 2003 , contracts for the dams and power plant were awarded and construction continued . The project was 90 percent complete as of April 2012 . Both the upper and lower reservoir were complete and had finished impounding in January 2013 . The first of four generators was commissioned in May 2013 and the remaining were operational by 1 September 2015 .

= = Design and operation = =

The power plant operates using a lower and upper reservoir along with a power plant connected to both . Water is either pumped from the lower to the upper reservoir to serve as stored energy or released from the upper to the lower reservoir to generate electricity . Pumping occurs during low demand , cheap electricity , periods such as night and generating will occur during peak demand , expensive electricity , hours such as during the day . The pumping / generating process repeats as needed .

Both the upper and lower reservoirs are created by concrete @-@ face rock @-@ fill dams on the Chalus River which has an average inflow of 67 @.@ 1 cubic metres per second (2 @,@ 370 cu ft / s) . The upper dam is 82 @.@ 5 metres (271 ft) tall and 436 m (1 @,@ 430 ft) long . It contains 1 @,@ 550 @,@ 000 cubic metres (2 @,@ 030 @,@ 000 cu yd) of fill (structural volume) and is 12 metres (39 ft) wide at its crest and 280 m (919 ft) wide at its base . Its reservoir has a storage capacity of 4 @,@ 344 @,@ 220 cubic metres (3 @,@ 521 @.@ 92 acre · ft) (of which 3 @,@ 500 @,@ 000 m3 (2 @,@ 837 acre · ft) is active or usable) and a surface area of 141 square kilometres (54 sq mi) . The lower reservoir dam is the bigger of the two and is 102 m (335 ft) tall and 332 metres (1 @,@ 089 ft) long . It contains 2 @,@ 300 @,@ 000 cubic metres (3 @,@ 000 @,@ 000 cu yd) of fill and is 12 m (39 ft) wide at its crest and 360 metres (1 @,@ 180 ft) wide at its base . Its reservoir has a storage capacity of 6 @,@ 874 @,@ 709 m3 (5 @,@ 573 acre · ft) (of which 3 @,@ 600 @,@ 000 cubic metres (2 @,@ 900 acre · ft) is active or usable) and a surface area of 141 km2 (54 sq mi) . Each of the dams are equipped with a chute staircase spillway . The

upper dam 's has a maximum discharge capacity of 203 m3 / s (7 @,@ 169 cu ft / s) and the lower : 198 @.@ 25 cubic metres per second (7 @,@ 001 cu ft / s) . The normal elevation for the upper reservoir is 2 @,@ 406 @.@ 5 m (7 @,@ 895 ft) and the lower 1 @,@ 905 @.@ 4 metres (6 @,@ 251 ft) which affords a gross maximum hydraulic head of 520 m (1 @,@ 706 ft) and normal of 504 metres (1 @,@ 654 ft) .

Connecting the upper reservoir to the power station is an intake which feeds water into two 5 @.@ 7 metres (19 ft) diameter head @-@ race tunnels . Their length from the intake to two surge tanks (used to prevent water hammer) is 2 @,@ 225 metres (7 @,@ 300 ft) (left tunnel) and 2 @,@ 185 metres (7 @,@ 169 ft) (right tunnel) . From the surge tanks the tunnels each turn into a 680 metres (2 @,@ 230 ft) long penstocks which delivers water to the power station which is located underground near the lower reservoir . At the power station , each penstock bifurcates into two penstocks to supply the four Francis turbine pump @-@ generators with water . The pump @-@ generators have a generating capacity of 260 MW and pumping capacity of 235 MW . The generators can each discharge up to 65 cubic metres per second (2 @,@ 300 cu ft / s) of water and the power is converted by transformers to 400 kV . After water is discharged by the generators , it proceeds down one of two tail @-@ race tunnels (197 metres (646 ft) and 159 metres (522 ft) in length) before being discharged into the lower reservoir . When pumping is required , the pump @-@ generators reverse into pumps and send water back to the upper reservoir through the same water conduits . Each generator can pump up to 50 m3 / s (1 @,@ 766 cu ft / s) of water .