

## Chapter – 7 Reservoir

### 7.1 General

The Polavaram – Vijayawada link canal takes-off from the right flank of the Polavaram project. Though the Polavaram dam forms an essential component of head works for the Polavaram – Vijayawada link canal, the scope of the present study of NWDA does not include the Polavaram dam and the appurtenant works. As such no detailed description of these works are furnished in the present report. However, in order to have an overall view of the proposed project, various components of the project are briefly discussed in this report in relevant chapters. The present chapter deals with the brief particulars of the Polavaram reservoir as proposed by the State Government in their detailed project report.

### 7.2 Fixation of Storage and Reservoir Levels

As the proposed Polavaram project is going to be the terminal storage project on the river Godavari, it becomes necessary to construct the dam as high as possible to utilise the available waters to the maximum extent. But the creation of reservoir at Polavaram involves submergence of land not only in the State of Andhra Pradesh, but also in Madhya Pradesh and Orissa States. For keeping the area of submergence in Madhya Pradesh and Orissa to the minimum, an agreement has been reached among the States in April, 1980 with respect to the FRL of the reservoir and its operation policies. The agreement has been incorporated in the award of GWDT. As per the award, the FRL of the Polavaram project has been fixed at 45.72 m (150 ft). The MWL has been proposed to be the same as FRL. The live storage of the reservoir at the proposed FRL is only 2130 Mm<sup>3</sup> as compared to the annual utilisation of more than 8000 Mm<sup>3</sup> from the project. As this is a terminal storage reservoir across Godavari, all the balance waters available in the river, after accounting for the upstream and down stream utilisations, are proposed to be utilised under the project. As the storage available is small, in comparison to the quantity of water proposed to be used, run-of-the-river flows will be utilised for ensuring the benefits envisaged. Thus, the project will function on the principle of a barrage project combined with some storage.

Considering the various water demands from the project, there should be sufficient storage between LWL and FRL. Accordingly, LWL has been fixed at 41.15 m (135 ft).

The gross storage capacity of the reservoir at FRL 45.72 m is found to be 5511 Mm<sup>3</sup> and the live storage above 41.15 m is 2130 Mm<sup>3</sup>. The life of the reservoir has been adopted as 100 years. The gross and live storages after 50 years of siltation have been estimated to be 4945 Mm<sup>3</sup> and 2043 Mm<sup>3</sup> respectively. The capacities of the reservoir at FRL and LWL are summarised in Table 7.1.

**Table 7.1**  
**Capacities of Polavaram Reservoir**

Condition	Capacity in Mm <sup>3</sup>	
	At the beginning	After 50 years of sedimentation
FRL (45.72 m)	5511	4945
LWL (41.15 m)	3381	2902
Live Storage Capacity	2130	2043

To safeguard against excessive submergence in the States of Madhya Pradesh and Orissa, the interstate agreement of April, 1980 laid down certain policies regarding the design and operation of the spillway of Polavaram reservoir. The operation policies are detailed in Section 7.8. In accordance with the agreement the spillway has been designed to discharge a maximum flood of 1.02 lakh cumec (corresponding to flood frequency of 500 years) at pond level of 42.67 m (140.0 ft) and not less than 0.57 lakh cumec at pond level of 39.62 m (130 ft).

### 7.3 Sedimentation Studies

The rate of silting is taken as  $595.31 \text{ m}^3 / \text{km}^2 / \text{year}$  from free catchment area and taking 25% of intercepted catchment as contributing silt into free catchment area, as explained in section 6.2 of Chapter on **Structure and Layout**.

For computing sedimentation at Polavaram all the committed and contemplated projects below SRSP are taken into consideration. A period of 25 years is taken as a unit and the sediment trapped at and flowing down from the reservoirs in different periods of time are calculated for this unit period. All the existing projects are assumed to have started at the beginning of the first unit period and the rest of the committed schemes are assumed to come into operation by the end of 25 years, i.e., in the beginning of the second unit period. Similarly, all the contemplated schemes are assumed to come into existence at the beginning of the third unit period.

The silt trapped at many major projects (for which requisite data is available) is computed as per Brune's curves. Sediment flowing down Indravati sub-basin into Inchampalli project is computed in two cases - (1) with Bhopalpatnam project and (2) without Bhopalpatnam project. Similarly sedimentation at Polavaram is considered in three alternatives viz.,

- (1) without Bhopalpatnam and without Inchampalli,
- (2) with Bhopalpatnam and without Inchampalli, and
- (3) with Bhopalpatnam and Inchampalli.

The sediment trapped at Polavaram is calculated for these alternatives and the area capacity table is revised for alternatives (1) and (3), as there is not much difference in the silt quantity in case of alternatives (1) and (2). Further, the area capacity table is revised following the CWC's suggestions to revise the same in small spells of 25 years (instead of the usual way of revision in a single spell of 50 years). The results are given in Table 7.2.

**Table 7.2**  
**Total silt accumulation at Polavaram in TMC**

Alternative	After 50 years	After 100 years
(1)	61.73	130.72
(2)	56.41	120.41
(3)	16.77	34.02

Since the crest level of the spillway is 24.5 m and the gates are to be operated every year, the possibility of silting above this level near the head works is remote.

## 7.4 Reservoir Losses

### a) Evaporation Loss

The monthly reservoir evaporation losses considered are given in Table 7.3. The annual evaporation loss from the reservoir has been estimated to be 989 Mm<sup>3</sup>.

**Table 7.3**  
**Monthly evaporation losses**

Month	Evaporation (mm)
Jan	102
Feb	102
Mar	229
Apr	305
May	305
Jun	229
Jul	152
Aug	152
Sep	152
Oct	152
Nov	102
Dec	102
<b>Total</b>	<b>2084</b>

### b) Seepage Losses

No adverse features like concealed solution channels, karst topography, sub-terrain channels following fault planes or inconformities, which promote leakage of reservoir, have been reported by the Geologist. Seepage losses from the reservoir will, therefore, be negligible.

## 7.5 Effect on Sub-Soil Water Table

Detailed studies to predict the effect of the reservoir on the sub-soil water table have not been done. However, it is presumed that as the reservoir is situated in hilly terrain, the effect on sub-soil water table may not be significant.

## 7.6 Reservoir Rim Stability

The reservoir area narrows down along the river course which passes through a valley in the Papi hills for a distance of 10 km. The hill slopes on either side of this valley are covered by soil and thick jungle along the river banks over rocky strata. There are no reports in the past on any major land slides or rock fall in the area. The geologists who worked in the field previously have also not reported on any potential areas of land slides. It has, therefore, been presumed that there would be no problem of stability of the rim of the reservoir.

## 7.7 Submergence due to Reservoir

The FRL of the Polavaram project is kept as 45.72 m, considering inter alia, the Godavari Water Disputes Tribunal Award. The submergence level considered in Andhra Pradesh including wave height is 48.80 m and that in Orissa and Madhya Pradesh including back water action is 52.82 m. The Polavaram reservoir spreads over an area of 63691 ha between East longitudes 80° 47' and 81° 45' and North latitudes 17° 13' and 17° 58'. The entire area of submergence lies in the Polavaram,

Devipatnam, Vara Ramachandrapuram, Kukunuru, Velairpadu, Kunavaram, Chintoor, Burgampad and Bhadrachalam mandals of Andhra Pradesh, Motu taluk of Koraput district in Orissa and Konta taluk of Bastar district in Madhya Pradesh. The submergence details are given in Table 7.4. Suitable provision is made in the project report for compensation of crops, pucca houses, kutcha houses, etc. A detailed environmental impact analysis and a study on the rehabilitation and resettlement of project affected people are being carried out by the Government of Andhra Pradesh.

**Table 7.4**  
**Submergence details of Polavaram reservoir area**

Sl. No.	Description	Andhra Pradesh	Madhya Pradesh	Orissa	Total
1	Area of submergence (ha)				
	Irrigated wet land	620	--	--	620
	Un-irrigated dry land	27500	1504	1026	30030
	Poramboke outside river bed	16393	--	--	16393
	River bed area	15550	894	204	16648
	Total	60063	2398	1230	63691
2	No. of villages affected	233	10	7	250
3	No. of families affected	15235	680	292	16207
4	Population affected (1991 census)	135449	6620	2743	144812
5	Property affected				
	Permanent houses	1350	42	13	1405
	Semi permanent houses	2300	--	--	2300
	Kutcha houses	18800	300	290	19390

The agreement of April, 1980 entered into between the States of Andhra Pradesh, Madhya Pradesh and Orissa incorporates certain provisions in respect of measures to be taken by the State of Andhra Pradesh including payment of compensation for submerged properties in the States of Madhya Pradesh and Orissa. These provisions are briefly mentioned below:

**(i)** In order to protect the lands and properties above RL 45.72 m (150 ft.) in the territory of the State of Orissa likely to be affected due to construction of Polavaram project, protective embankments with adequate drainage sluices, shall be constructed and maintained at the cost of Polavaram project. However, the State of Orissa may exercise an option at the time of construction of Polavaram project for compensation to land and property likely to be affected above RL 45.72 m.

**(ii)** In respect of the properties in the territory of State of Madhya Pradesh likely to be affected above RL 45.72 m, because of the construction of the Polavaram project, the State of Andhra Pradesh shall:

- (a) pay compensation towards all buildings with their appurtenant lands situated above RL 45.72 m which will be affected due to all effects including backwater effect and rehabilitate the oustees, etc. on the same pattern as below RL 45.72 m at the project cost; or
- (b) construct and maintain at the cost of the State of Andhra Pradesh, the necessary protection embankments with adequate pumping arrangements and/or drainage sluices.

The option for alternatives (a) or (b) may be exercised by the State of Madhya Pradesh at the time of the construction of Polavaram project depending upon the location of each affected site.

- (c) shall pay for damages or injury to lands beyond RL 45.72 m in the territory of the State of Madhya Pradesh. In any event, the State of Andhra Pradesh shall pay full compensation for such damage or injury.

### **7.8 Interstate Agreement on Reservoir Operation**

The following provisions in respect of the operation of Polavaram reservoir have been made in the interstate agreement reached between Andhra Pradesh, Madhya Pradesh and Orissa in April, 1980 with a view to minimise the submergences in the States of Madhya Pradesh and Orissa.

The pond level shall not be kept higher than RL.44.20 m (145 ft) in the month of June if the inflow into the Polavaram reservoir exceeds 8496 cumec (3 lakh cusec).

On receipt of flood warning from the upper sites and/or due to anticipated inflows into the reservoir requiring regulation, the pond levels shall be regulated as follows:

- a) The pond level of RL 44.20 m (145 ft) shall be lowered progressively as the inflows exceed 8496 cumec (3 lakh cusec) so as to restrict the pond level to RL 42.67 m (140 ft) for an inflow of 28320 cumec (10 lakh cusec).
- b) For inflows higher than 28320 cumec (10 lakh cusec), the pond level shall be further lowered so that it does not exceed RL. 39.62 m (130 ft) for an inflow of 56640 cumec (20 lakh cusec).
- c) For inflows higher than 56640 cumec (20 lakh cusec), all the gates shall be opened fully.
- d) The pond level can be built progressively in the receding floods to RL 42.67 m (140 ft) if the inflow drops down to 28320 cumec (10 lakh cusec) and to RL 44.20 m (145 ft) if the inflow drops down to 8496 cumec (3 lakh cusec) or less, but during the months of July and August, the pond level shall not exceed RL 44.20 m (145 ft).
- e) On or after first September, whenever the inflow in the Polavaram reservoir is 2832 cumec (1 lakh cusec) or less, the storage at Polavaram can be built up beyond RL 44.20 m (145 ft), subject to aforementioned depletions at (a) to (c) in the case of higher inflows.

The possibility of the reservoir getting filled up from the level 140 to 145 ft when the discharge is between 8496 cumec (3 lakh cusec) to 28320 cumec (10 lakh cusec) has been examined by the Government of Andhra Pradesh while designing the reservoir. The capacity between 42.67 m (140 ft) and 44.20 m (145 ft) is about 708 Mm<sup>3</sup> (25 TMC). At the rate of 8496 cumec (3 lakh cusec), this capacity can be filled up in one day. If the level is at 39.62 m (130 ft) and the discharge is 28320 cumec (10 lakh cusec), the capacity between 39.62 m (130 ft) and 42.67 m (140 ft) which is 1104 Mm<sup>3</sup> (39 TMC) will be filled up in less than half a day. The capacity between 44.20 m and 45.72 m (145 and 150 ft) is 793 Mm<sup>3</sup> (28 TMC). This will be filled up in a little more than one day when the discharge is little less than 8496 cumec (3 lakh cusec).

It is, thus, seen that the above conditions can be expected to be fulfilled. But on further studies, if it is observed that the conditions cannot be satisfied, then suitable amendment to the agreement clauses has to be examined.