



ANNUAL REPORT

2014-15 to 2016-17

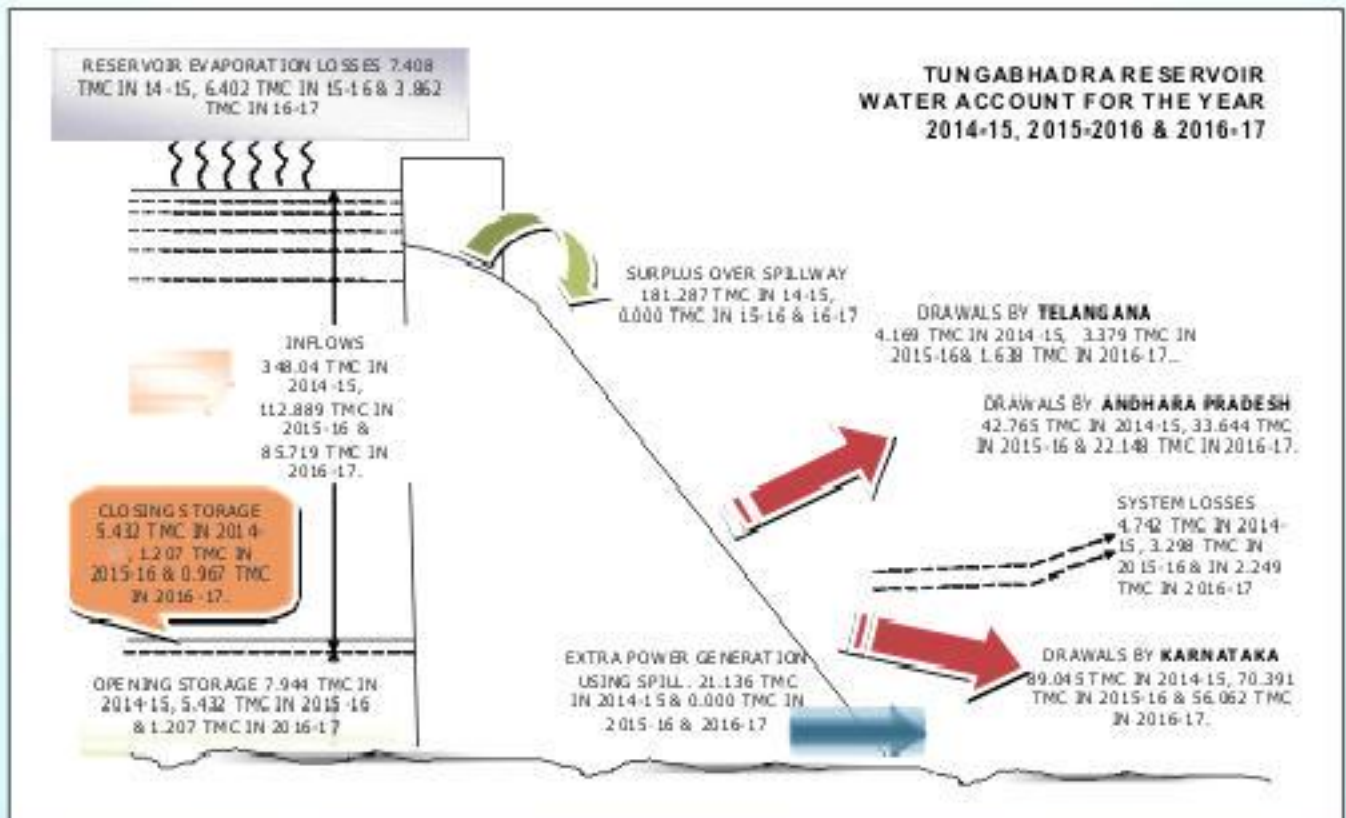


TUNGABHADRA BOARD, T.B.DAM, HOSPET, KARNATAKA

TUNGABHADRA BOARD

HIGHLIGHTS OF THE YEAR 2014-15, 2015-16 & 2016-17

- ✓ The Tungabhadra Project completed 64 years of operation since the first release of water into canals on 1st July 1953.
- ✓ The inflow realized in the Tungabhadra reservoir has been estimated as 9855.10Mm³ (348.040 TMC) for 2014-15, 3196.56 Mm³ (112.889 TMC) for 2015-16 & 2427.21 Mm³ (85.719 TMC) for 2016-17
- ✓ The utilization including evaporation losses and system losses was 4194.42 Mm³ (148.129 TMC) for 2014-15, 3316.20 Mm³ (117.114TMC) for 2015-16 & 2434.01 Mm³ (85.959 TMC) for 2016-17.
- ✓ The total withdrawals net of evaporation and system losses by Karnataka and Andhra Pradesh were 3850.35 Mm³ (135.978 TMC) for 2014-15, 3041.53 Mm³ (107.414TMC) for 2015-16 & 2260.97 Mm³ (79.848TMC) for 2016-17
- ✓ The total withdrawal by Karnataka was 2521.39 Mm³ (89.045 TMC) against their share of 2524.34 Mm³ (89.149 TMC) for 2014-2015, 1993.19 Mm³ (70.391 TMC) against their share of 2042.06 Mm³ (72.117 TMC) for 2015-2016 & 1587.45 Mm³ (56.062 TMC) against their share of 1582.80 Mm³ (55.898 TMC) for 2016-2017.
- ✓ The total withdrawal by Andhra Pradesh was 1210.93 Mm³ (42.765 TMC) against their share 1207.79 Mm³ (42.654 TMC) for 2014-15, 952.66 Mm³ (33.644 TMC) against their share 977.043 Mm³ (34.505 TMC) for 2015-2016 & 627.142 Mm³ (22.148 TMC) against their share 627.142 Mm³ (22.148 TMC) for 2016-2017.
- ✓ The total withdrawal by Telangana was 118.049 Mm³ (4.169 TMC) against their share 118.247 Mm³ (4.176 TMC) for 2014-15, 95.679 Mm³ (3.379 TMC) against their share 95.651 Mm³ (3.378 TMC) for 2015-2016 & 46.381 Mm³ (1.638 TMC) against their share 46.381 Mm³ (1.638 TMC) for 2016-2017.
- ✓ Hydro-electric power generated was 164.2784 million units in 2014-15, 116.6759 million units in 2015-16 and 80.365 million units in 2016-17. The same was shared between Karnataka and Andhra Pradesh in the ratio of 20:80.





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TUNGABHADRA BOARD

Tungabhadra Board, Hospet, Karnataka

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TUNGABHADRA PROJECT HISTORY

RIVER TUNGABHADRA

Tungabhadra River is one of the major tributaries of Krishna River in south India. The river finds a mention in the epic Ramayana as Pampathirtha. Hampi, the seat of power of the Vijayanagar Empire founded in 1336 AD, is located on the southern bank of the Tungabhadra River.

Tungabhadra River derives its name from the confluence of two streams, the Tunga and the Bhadra, both of which rise in the wooded eastern slopes of the Western Ghats in the State of Karnataka and flow eastward. After confluence of these two streams at Kudali near Shimoga, the Tungabhadra runs for about 531 km and joins the river Krishna at Sangamaheswaram near Kurnool in the State of Andhra Pradesh. The river runs for 382 km in Karnataka, thereafter forms the boundary between Karnataka and Andhra Pradesh for 58 km and flows for the remaining 91 km in Andhra Pradesh. Tungabhadra sub-basin is part of the Krishna basin with a drainage area of 69,552 km². The river basin is influenced by the South-West monsoon, with copious inflows during monsoon which dwindles to few cumecs in summer months.

The drainage area of the Tungabhadra River in the Western Ghats receives about 4500 mm of rainfall, while in the Rayalaseema area in the Peninsula receives less than 500 mm of rainfall. As most part of the Tungabhadra catchment is located in the center of the Peninsula, the basin receives an average of 560 mm of rainfall in a year.

The high spatial and temporal variation of the rainfall exposed the valley in the Peninsula to the vagaries of intermittent famine and drought.

HARNESSING OF TUNGABHADRA WATERS

For harnessing the Tungabhadra waters the great Rayas of the Vijayanagar Empire built 17 anicuts across the Tungabhadra. With the fall of Vijayanagar Empire later in 1565, these irrigation systems lapsed into despair. During pre-independence days, the Tungabhadra was the border between the Princely State of Hyderabad on the north bank and then British State of Madras on the south bank. These States were keen to harness waters of the Tungabhadra, but no agreement on sharing

the water could be reached. The sharing of waters of Tungabhadra between Hyderabad and Madras began with the construction of Sunkesula Anicut in the year 1861 for diverting water to Kurnool-Cuddapah Canal.

GENESIS OF TUNGABHADRA PROJECT

Sir Arthur Cotton originally conceived the Tungabhadra Project in the year 1860 to alleviate the sufferings of the people of the districts of Bellary, Kurnool and Cuddapah in the then State of Madras on the south bank and Raichur district of the then Hyderabad on the north bank. However, the project was not taken up due to economic considerations. It was in 1902, Col. Smart, Chief Engineer of Madras Irrigation submitted a project report on Tungabhadra Dam to the First Indian Irrigation Commission. The report envisaged construction of a storage reservoir, on Tungabhadra river a high level canal through Bellary and Kurnool districts to cut through the Pennar Valley for inter-basin transfer of Tungabhadra waters. A preliminary survey based on which a report was made in 1903. After detailed investigation Mr. Mackenzie, Chief Engineer of Madras Irrigation submitted a detailed project report in 1906. This report envisaged a reservoir at Mallapuram, at the present site, to provide irrigation for 3.23 lakh hectares of wet and garden crop, 0.61 lakh hectares of second crop and for protection of 3.34 lakh hectares of dry crops in the districts of Bellary, Kurnool, Anantapur, Cuddapah and Nellore.

In 1930, Government of Madras proposed a joint project with Hyderabad at the present dam site. After protracted negotiations and discussions followed by arbitration of the Government of India, two agreements were reached, between Madras and Hyderabad during June 1944 and between Madras and Mysore during July 1944 finally clearing the ground for execution of the Tungabhadra Project.

The June 1944 agreement between Madras and Hyderabad provided that each side may draw 1841 Mm³ (65 TMC) of water for irrigation, construction of a large dam jointly at Mallapuram (present dam site) and an unspecified quantity of water to be used for hydropower generation and let down the river. The July 1944 agreement between Madras and Mysore provided that Mysore would not claim any share of water from the reservoir at Mallapuram after upstream abstraction of the agreed quantity.

PROJECT CONSTRUCTION

The two agreements executed between Madras & Hyderabad during June 1944 and between Madras & Mysore in July 1944 finally cleared the ground for execution of Tungabhadra Project. So, Sri C.C. Dalal, a Hyderabad Engineer proceeded to design the Dam. The Government of Madras entrusted a team of engineers under Sri M.S. Thirumale Iyyengar to design the dam and canal system. Thus two independent project reports were prepared.

The project report prepared by Sri M.S. Thirumale Iyyengar in 1942 consisted of dam at Mallapuram and two canals with alternative schemes for the right bank. The Government of Madras accepted this project report with certain modifications. The project was finally accepted as a joint project consisting a dam at Mallapuram to impound 3,766 Mm³ (133 TMC) of water in the reservoir. The irrigation system comprised a left bank main canal for irrigating areas in Raichur district, a right bank low level canal for irrigating areas in Bellary and Kurnool districts, distribution system from these canals. Development of hydroelectric power through powerhouses at left and right banks at dam and at Hampi was also envisaged. By the end of 1944 Government of India sanctioned the joint scheme. The index map of the project is at Annex 1.1 .

The project was formally taken up for construction with laying of foundation stone on 28 February, 1945 by His Highness the Prince of Berar on the left bank and His Excellency Sir Arthur Hope, Governor of Madras on the right side as a joint venture of the Governments of Hyderabad and Madras.

Two independent builders, two governments, two Chief Engineers and two corps of workmen built the dam from opposite banks of the river. There were differences of opinion on many issues including designs, specifications and method of execution. A Committee of Chief Engineers was setup to sort these issues.

The committee often met to settle the issues. The eminent Engineer and Statesman Sir M. Visvesvaraya was unanimously selected as Chairman of the Board of Chief Engineers in 1947. It was the decision of the Chairman that prevailed on many of the contentious issues of designs, use of surkhi mortar, single design for the dam and sharing the cost etc. The Government of India was always available as a court of last resort. The field engineers were given complete set of drawings and printed specifications for each item of works.

The use of surkhi in mortar made a big saving in cost of construction. A tram line was constructed to transport earth for surkhi. Use of machinery was kept minimum, due to adoption of stone masonry. A workshop was established on the Right Bank for manufacturing the sluice gates and spillway gates. This workshop later became a pioneer fabricating company of India known as M/s Tungabhadra Steel Products Ltd.

As the Reservoir submerged the Valvapur and Hosakota anicuts constructed by the Rayas, a sluice was provided in the right side of the dam with a lead channel to connect the old Raya and Basavanna channel to provide irrigation for 11 months. Similarly, the old Koregal Anicut (left flank of Valvapur Anicut) and its channel got submerged in the Reservoir. So a channel has been connected to the first distributory of the left bank main canal to serve the old ayacuts.

The 1.6 km long dam, with its two saddles on the left side was ready to impound the monsoon flow up to 491.642 m (1613 ft) level in the year 1953. Water was let into the canals on both banks on 1st July 1953. The full reservoir capacity was, however, not available as erection of 33 spillway gates was not completed by then. The erection of gates, Spillway Bridge, road on top of dam, utility tower, etc. was completed by June 1958. The salient features of Tungabhadra Project is at Annexure 1.2.

The Tungabhadra Dam comprises a 1040 m long masonry Dam with 33 Nos. of spillway gates, a 547 m long composite dam and 152.40 m long earth dam. The reservoir of the project is spread over 378.10 Sq.km at FRL. Irrigation is provided through canal systems taking of from Left Bank and Right Bank. The project generates hydro power through three powerhouses located at left and right toe of dam and at Hampi.

The break up of the project cost is given in the adjacent table. The project has very high cost benefit ratio. The cost benefit ratio for irrigation alone was 11.8 and the cost benefit ratio considering irrigation and power was 9.6

BREAKUP OF PROJECT COST

Sl. No.	Scheme	Cost (Rs crores)
1.	Irrigation Scheme: x Head Works x RB LLC x RB HLC x LBMC Sub-total	17.98 16.27 33.22 50.00 117.47
2.	Hydro Electric Scheme	13.29
	Total	130.76

TUNGABHADRA BOARD

CONSTITUTION OF THE BOARD

The Tungabhadra project was taken up by then States of Madras and Hyderabad during February 1945. With the formation of Andhra State, as per the Andhra State Act 1953, certain areas of the project on the right side of the river belonging to the then Madras State were transferred to the then Mysore State and the project became a venture of the then States of Mysore, Andhra and Hyderabad. This resulted in more than 55 percent of irrigated area on the right bank of the river falling in Andhra and the Reservoir with the head reaches of the canal system lying in the State of Mysore. The center line of the Tungabhadra River which was the boundary earlier no longer remained so and the canal on the right bank meandered through the State of Andhra Pradesh and Karnataka. This situation warranted constitution of an independent body to look after the timely completion of the approved project, its maintenance and oversee distribution of benefits to the States. Subsequently, as per the Andhra State Act, 1953, President of India was authorized to give directions for the completion of the project and its operation and maintenance thereafter. Accordingly, under a Presidential order, Tungabhadra Board was constituted with effect from 1st October, 1953 vide notification No. DW II-22 (129)

dated 29th September, 1953 of the then Ministry of Irrigation and Power.

The Board consisted of Chairman appointed by Government of India and six Members. The Members were Chief Engineers of both Irrigation and Power Departments of the Government of Andhra, Mysore and Hyderabad. Chairman of the Central Water and Power Commission was appointed the Chairman of the Board in addition to his normal duties. The Board was entrusted with the task of completion of the Project and to deal with all matters relating to works, which were common to both the States of Andhra and Mysore.

The Board was reconstituted with effect from 15th March, 1955 vide Notification No DW VI (4) (9) dated 10-3-1955 of the then Ministry of Irrigation and Power (Annexure 2.1). The reconstituted Board consisted of a Chairman appointed by the Government of India and four Members representing Governments of India, Andhra, Mysore and Hyderabad. After the reorganization of the States in 1956, the Hyderabad Government representative was deleted from Board vide Notification No. 39(25)/56 DW.VI dated 1.11.1956 of then Ministry of Irrigation and Power.

PRESENT COMPOSITION OF BOARD

The present composition of the Tungabhadra Board is as follows:

Chairman (Nominated by GoI)	Chief Engineer, Krishna & Godavari Basin , Central Water Commission, Hyderabad
Member (Representing GoI)	Financial Adviser and Joint Secretary, Ministry of water Resources, New Delhi
Member (Representing GoAP)	Engineer-in-Chief (Irrigation) Water Resources Dept., Vijayawada.
Member (Representing Govt. of Telangana)	Engineer-in-Chief (Irrigation), Irrigation & CAD Department Hyderabad.
Member (Representing GoK)	Secretary to Government, Water Resources Department, Government of Karnataka, Bangalore.

The following were the Chairman and Members during the year 2014-2015, 2015-16 & 2016-17:

Chairman:

Shri K.S.Jacob (From 25-04-2014)
Shri S.K.Srivastava (From 29-10-2014)
Shri R.K.Gupta (From 09-04-2015)

Member, Government of India:

Shri Jagan Mohan Gupta (From 22-6-2015)

Member, Government of Andhra Pradesh:

Shri M.Venkateshwara Rao (28-05-2014)

Member, Government of Telangana:

Shri C. Muralidhar (From 28-05-2014)

Member, Government of Karnataka:

Shri.B.G.Gurupadaswamy (From 17-03-2011)

Secretary, Tungabhadra Board

Shri. D. Rangareddy (From 07-10-2013)

FUNCTIONS OF THE BOARD

The important functions of the Board, initially laid down were:

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The important functions of the Board, initially laid down were:

- 9 Completion of the construction of the sanctioned project;
- 9 Regulation of supplies of water and power in accordance with such rules as may be made in this behalf by the Board (From 1976-77 onwards, in compliance of the KWDT Award, as notified by GOI);
- 9 Maintenance of canals and other works common to both the States of Karnataka and Andhra Pradesh;
- 9 Maintenance of the dam and reservoir of the project;

9 Granting of lease of fisheries in the reservoir and in the canals;

In the discharge of its assigned functions, the Board exercises powers of a State Government. Board makes its own rules for the conduct of its own business. The Board appoints a whole time Secretary.

STAFFING PATTERN

All the posts in the Board are sanctioned on year to year basis by the Board. The posts of Secretary and Assistant Secretary are filled by deputation from the Government of India. All other regular posts of the Board are cadre posts of the participating States of GoK and GoAP in an agreed ratio. Work charged and Contingent staff of the Board are treated as Board employees. Officers and staff drawn on deputation from the GoI and posted by GoAP and GoK to the Board are governed by the respective service rules of their parent Department. However, they remain under the administrative control of Board during their tenure in Board.

Six regular staff members from Police Department of GoK are on deputation to Board and they are working as three Assistant Sub-Inspectors & three Security Head Constables in the Security Section.

K.W.D.T AWARD AND BOARD

The award of the Tribunal came into force from the water year 1976-77. The relevant

extracts of clause IX and clause XVI of the Final Order of the KWDT is at Annexure 2.2.

State wise Water Allocation as per KWDT Award (TMC)

State	Gross allocation	Reservoir evaporation losses	Net allocation
GOK	151.49	12.50	138.99
GOAP	78.51	5.50	73.07
Total	230.00	18.00	212.00

Note: GoT-Allocation at be finalised

As per the KWDT award, the reservoir evaporation losses of 509.7 Mm³ (18 TMC) shall be equally shared by the left canal system and right bank canal system (9.00 TMC each). The share of the reservoir loss of right bank canal system (9.00 TMC) shall be shared by Karnataka and Andhra Pradesh in the ratio of 3.5: 5.5.

Details of the water allocation to various systems are given in Figure 3.1

The Krishna Water Disputes Tribunal (KWDT) award states that the Board would continue to prepare the working table for utilization of the water stored in the reservoir and regulate the sharing of water between the States of Karnataka and Andhra Pradesh as per the allocations made in the award.

PRESENT FUNCTIONS

The project was fully commissioned with completion of the Right Bank High Level Canal in 1970. Since then Tungabhadra Board has not taken up any major construction. The present functions of the Board include:

- 9 Regulation of supplies of water to the States of Andhra Pradesh and Karnataka in accordance with the clause IX E(1) to (5) of Final Order of the Krishna Water Disputes Tribunal relating to the Tungabhadra Project;
- 9 Regulation & monitoring of power from the three power houses on the right side in accordance with such rules as may be made in this behalf by the Board;
- 9 Maintenance of the dam and reservoir of the project, common to both the States viz., right half of the dam and 33 spillway gates including safety aspects of the dam and spillway;
- 9 Maintenance of the common portion of the Right Bank High Level Canal and Low Level Canal including common distributaries of Right Bank Low Level Canal and any other works common to both the States of Andhra Pradesh and Karnataka;
- 9 Maintenance of the two power houses on the right side including renovation and refurbishing;
- 9 Granting of lease of fisheries in the reservoir and in the main canal;

- 9 Proper utilization of land acquired for the purposes of the project;
- 9 Development of new schemes for hydro power generation on common facilities and its regulation;
- 9 Generation of revenue from the assets of the Board and create assets for increasing the revenue;
- 9 Any other function incidental to or connected with the functions specified in above clauses.

ORGANIZATIONAL STRUCTURE

For carrying out its various functions the Board has been divided into the following two main Wings:

- x Irrigation Wing (IW)
- x Hydro Electric Wing (HEW)

In addition the Board comprises a Fisheries Wing, a Park and Gardens Unit, a Health and Medical Unit and a Security Section. All the Wings and Units of the Board are under the administrative control of the Secretary of the Board. The Secretary also functions as Chief Security Officer and Vigilance Officer of the Board. The IW and HEW are headed by part time Chief Engineers of the Karnataka and Andhra Pradesh respectively.

The Organization Chart of the Tungabhadra Board is at Annexure 2.3 & detailed chart is at Annex 2.4.

APPLICABILITY OF RULES TO BOARD EMPLOYEES

The Work charged and Contingent employees of the Board are recruited by the Board from

All figures in TMC

(Figures in parentheses are attributed evaporation losses as per KWDT)

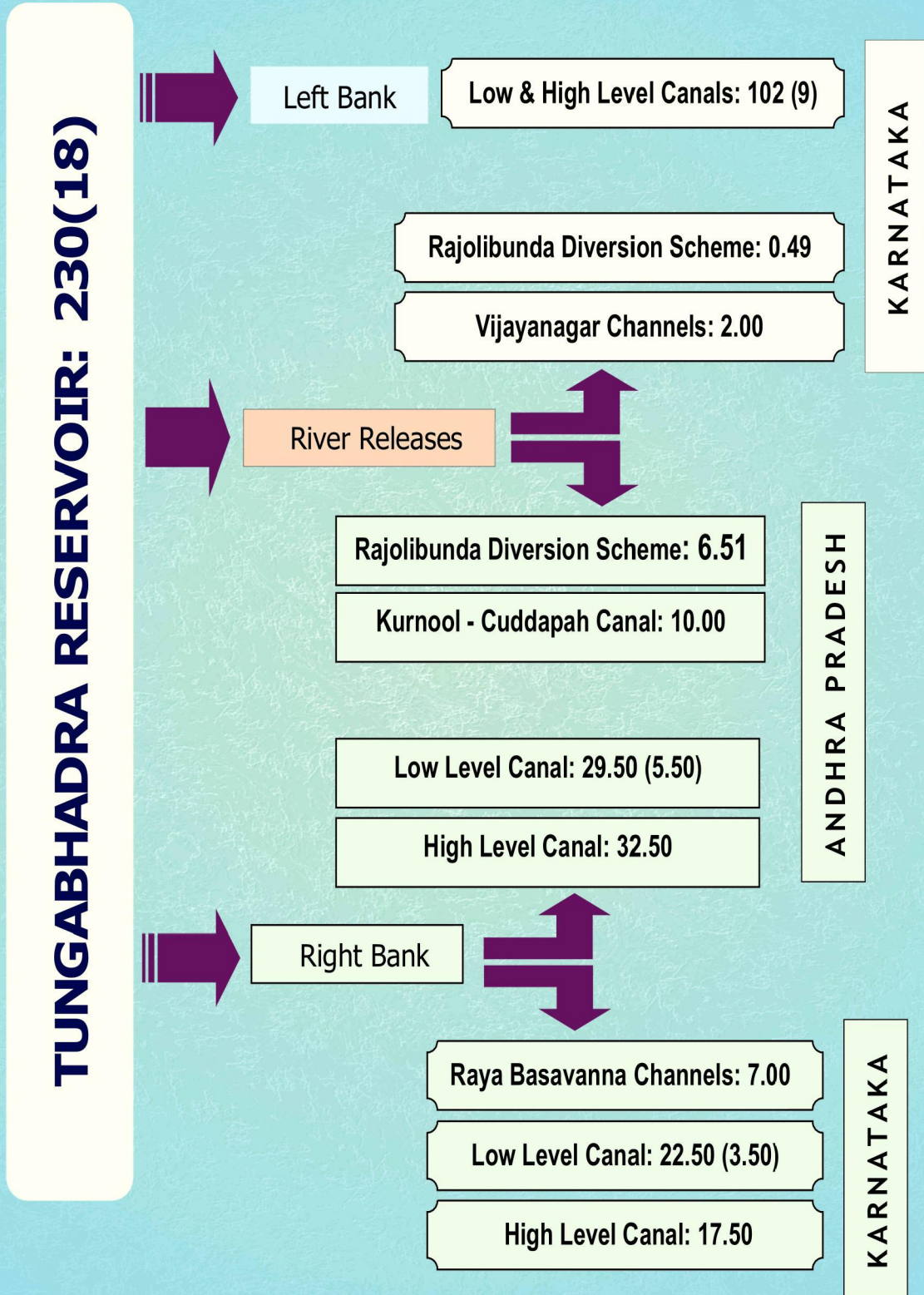


Figure 3.1: Water Allocation in various Irrigation Systems of TB reservoir as per KWDT

Category	Rules Applicable
Work charged staff who have completed 10 years of service	Karnataka Civil Service Rules.
Contingent staff of Health and Medical Unit who have completed 10 years of service	Karnataka Civil Service Rules.
Contingent workers of Fish Net Making Plant (FNMP)	Karnataka Civil Service Rules and Factory Rules in so far as working conditions are concerned.
Work charged & Contingent staff of all wings and units (except FNMP), who have not put in 10 years of Service	Work Charged Service Rules as laid down in the KPWD Code and other orders of Karnataka Government.

the time of construction of project and termed as 'Board employees'. They are governed by the following rules:

ADMINISTRATION

The administrative control of all officers and staff working in the Board rests with the Board. Their appointments, repatriation from the Board and their internal postings and transfers within the Board are decided by the Board. Secretary is the executive head of the Board and authenticates all orders and

decisions of the Board. He is assisted with Secretariat staff (taken from three wings of Board) and exercises administrative control over Irrigation Wing, Hydro Electric Wing and other Units.

Day to day administrative control of all officers and staff working in the various wings of the Board rests with the respective heads of Wings.

BOARD MEETINGS

During the year 2014-2015, 2015-16 & 2016-17 the Board held six meetings and took decisions on issues placed before it.

FINANCE

The budget of Irrigation Wing of Board is allocated out of the AP State budget grants passed by the Legislative Assembly of Andhra Pradesh. On incurring of the expenditure by Board, the Karnataka reimburses its share to AP, which is done through book adjustments by the Accountant.

The budget allocation of Hydro Electric Wing is included in the budget of Department of Energy, Government of Andhra Pradesh and allocated to Board. The expenditure incurred by Board is shared between Andhra Pradesh and Karnataka in the same ratio of sharing of power generated by Hydro Electric Wing.

The budget allocation to the Fisheries Wing is included in the Fisheries Department of Andhra Pradesh State and allocated to Board. The expenditure incurred by Board is shared between Andhra Pradesh and Karnataka in the ratio of 5:13 respectively.

The expenditures and receipts in respect of the IW, HEW and FW are shared by the Governments of Andhra Pradesh and Karnataka as per ratio shown below. The expenditure and receipts in respect of Health and Medical Unit and Security Section are included in the budget of IW.

Share of Expenditure and Receipts

Sl. No.	Wing	Share of	
		GoAP	GoK
1.	Irrigation Wing:		
	RBHLC	71%	29%
	RBLLC	55.55%	44.44%
2.	Hydro Electric Wing	4/5	1/5
3.	Fisheries Wing	5/18	13/18

VIGILANCE CELL

The Vigilance Organization was set up in the Board with effect from June, 1957 to ensure high standard of work to prevent corrupt practices in Board. Secretary, Tungabhadra Board being the Chief Vigilance Officer of the Board enquires into all the complaint/allegations received against the officers/officials working under the Board.

As per the clarifications issued by the Ministry of Water Resources, Government of India vide letter No.16/4/87-PII dated 23-8-91 the Central Vigilance Commission has no jurisdiction over the Tungabhadra Board. As per the decision taken by the Board in its 146th meeting held on 20-2-1993 that all cases of allegations against officials working in Tungabhadra Board shall be investigated by Chief Engineer, IB/Chief Engineer, Elec., TBHES or the Secretary himself as the case may be. Respective Chief Engineers shall send their investigation reports to the Secretary, TB Board who shall decide whether a prima-facie case exist or not. In case prima-facie case is established, Secretary, TB Board shall send his report to the respective Governments of Karnataka/Andhra Pradesh for taking suitable action against the concerned official/officer. Such officials shall be repatriated by the Board to the respective Governments. The Board in its 166th meeting held on 29th June, 1998 resolved that views of the Secretary, TB Board who framed charges against officers/officials on deputation to TB Board shall be ascertained before deciding the cases having financial implications and irregularities.

ESTATE MATTERS

The Board had acquired considerable land for the construction of Dam, Canals, Office buildings, Residential colonies and also for meeting the community requirements. In the beginning, leasing of small extent of areas in

and around the residential colonies was made, facilitating traders to run different types of commercial establishments for the benefit of Project staff. This has created inherent problem of encroachments of vacant lands in the colonies as well as along the canals. Encroachments along the canals restrict the borrow area for closing the breach of the canals. Similarly encroachment in the natural rivulets and drains near the escapes creates problems for operating the shutters of the escapes, whenever necessary.

In order to prevent encroachments, plantation of the vacant land all along the canals has been taken up on a large scale. Some of the vacant lands have been protected by constructing compound walls. This has controlled encroachment of Board's land to a large extent. Efforts have also been made to evict the illegal occupants.

The amount of license fee/rent towards Board land leased, Board quarters allotted to Non-Board/Private persons etc., collected for the year 2014-15 in respect of Irrigation Wing and Hydro Electric Wing is Rs.63.00 Lakhs and Rs.15.00 Lakhs respectively, for the year 2015-2016 in respect of Irrigation Wing and Hydro Electric Wing is Rs.65.00 Lakhs and Rs.14.00 Lakhs respectively and for the year 2016-2017 in respect of Irrigation Wing and Hydro Electric Wing is Rs.64.00 Lakhs and Rs.16.00 Lakhs respectively.

WEBSITE: A new website www.tbboard.gov.in has been developed under Government server (Gov. IN domain) complied with the guidelines of GOI. Daily basis sms & email on status of reservoir and canals are sent through this website. Development of new software program on cash counter. Quarter management system. Employees management system & Local Area Networking-e office is under process.

ACHIEVEMENTS: Tungabhadra Board was conferred with CBIP (Central Board of Irrigation & Power) Award for 'Best Maintained Project' on 29-12-2016.

REDRESSAL OF STAFF GRIEVANCES

All the regular posts of Board are cadre posts of Government of Karnataka and Andhra Pradesh, except that of the Secretary and Assistant Secretary, who are drawn from Government of India on deputation basis. The grievances of all staff in regarding to service matters are thus dealt by their parent departments.

MONITORING OF RESERVATION FOR SC/ST/OBC AND FOR PHYSICALLY HANDICAPPED

All the regular posts of Board are cadre posts of Government of Karnataka and Andhra Pradesh, except that of the Secretary and Assistant Secretary, who are drawn from Government of India on deputation basis. There is no direct recruitment in the Board. The state governments, either Andhra Pradesh or Karnataka have to monitor and deploy their staff as per prevailing rules in the respective State.

COMMITTEE FOR COMPLIANTS ON SEXUAL HARASSMENT

In accordance with the guidelines laid down by the Supreme Court to deal with complaints of sexual harassment of women employees, a Committee has been constituted to look into the complaints of women employees of the Board. The Committee has held its meetings from time to time and also met the women employees of the Board. During the year no formal complaints were received by the Committee during 2014-2015, 2015-16 & 2016-17.

WATER MANAGEMENT OF TB PROJECT

Irrigation Wing (IW) of the Board is in charge of the right half of the main masonry dam, all 33 spillway gates, whole of the reservoir, Right Bank High Level Canal (RBHLC) and Right Bank Low Level Canal (RBLLC) up to Board's limit. The RBLLC also includes Power Canal and certain common distributaries. The Tungabhadra Project has been allocated 212.00 TMC of water by the KWDT, which is excluding reservoir evaporation losses. The utilization for the year is 3503.077 Mm³ (123.710 TMC). As the Left Bank Canals serve command areas exclusively in Karnataka, water regulation and maintenance of these canals are carried out by the Government of Karnataka. The total area benefited by irrigation through the right and left bank canals in the States of Karnataka and Andhra Pradesh is 4.899 Lakh ha (12.43 Lakh acres) apart from about 3.95 lakh acres of existing irrigation systems already established.

It is the responsibility of the Board to release indented quantity of water to the states of Andhra Pradesh and Karnataka at their off-take points beyond which, the responsibility rests with the respective States.

FUNCTIONS

Primary Functions of Irrigation Wing are:

- x To prepare working table for operation of the reservoir on the basis of water indent furnished by States, as well keeping with the KWDT award;
 - x To effect reservoir operation in accordance with the working Table including flood management and dam safety;
 - x To supply indented quantity of water, conforming to the working table, for right bank canal systems and river assistance;
 - x To deliver specific discharges at Board's limits of the RBHLC & RB LLC and at the common distributaries;
 - x To render the water account of the reservoir and canal systems, including collection of daily drawal data for the systems on the left side from GOK.
- In addition, the following maintenance and operation works are also entrusted to the IW:
- x To maintain right side half of main dam from Ch 0.00 to Ch 3069.61 including drainage gallery and operation and maintenance of all the 33 spillway gates;
 - x To maintain common portion of the Right Bank Canal system i.e RBHLC from 0 to 105.437 km and RBLLC from 0 to 250.58 km including the Power Canal from 0 to

20.3 km and their regulators and distributory heads;

- x Common distributories of the RBLLC between 131.50 to 250.58 km serving both Karnataka and Andhra Pradesh;
- x To execute and maintain civil works in the Fisheries Wing;
- x To execute and maintain civil works in the colonies and for all the Board's buildings including Guest House and Inspection Bungalows and
- x To improve the horticultural activities in the dam area, colonies and canal banks.

The IW is headed by a Chief Engineer (part-time), who belongs to the Water Resources Department of GOK. Chief Engineer, Irrigation Central Zone (ICZ), Munirabad is normally deputed by GOK to act as Chief Engineer of the Board in addition to his normal duties. There is one post of Superintending Engineer, which is filled up by an officer from I & CAD Department of GoAP.

There are two Divisions - one at Tungabhadra Dam which is filled by an officer from GOK and the other at Bellary which is headed by an officer from GOAP. All the other officers and staff of the Irrigation Branch of the Board are drawn from the Irrigation/Water Resources Departments of GOAP and GOK on 50:50 basis. Organization chart of Irrigation Wing is at Annexure 3.2

INTER STATE CANALS

The RBLLC and the RBHLC serve the ayacuts in both the States and are termed

as inter-State canals. The Board undertakes water management in these canals at distributory level. Maintenance of these canals together with the distributories serving the two states rests with the Board. There are 92 Nos. off take points in the RBLLC and 26 Nos. at RB HLC for releasing water to the States apart from delivering indented discharge to AP at Board limit of RB HLC and RB LLC.

(i) Right Bank Low Level Canal

The RBLLC under the jurisdiction of the Board serves an ayacut of 37,518 ha (92,670 acres) in Karnataka and 63,588 ha (1,57,062 acres) in Andhra Pradesh. It originates as Power Canal from the tail race pool of the Dam Power House with a designed capacity of 70.79 Cumecs, carries water for a length of 21.09 km and empties into the Hampi Fore bay for power generation at Hampi Power House. The tailrace of Hampi Power House falls into the Gundlakere Lake. The RBLLC continues from the Gundlakere Lake with Km 00.00 as chainage. Its designed discharge was 50.97 Cumecs and is 348.20 Km in length, of which the initial 250.58 Km is under the control of the Board. Though a contour canal, the rocky-undulating terrain in the initial 10 km length called for side walling, tunneling, aqueduct, high embankment, etc.

Before finally entering into the State of Andhra Pradesh, the RBLLC meanders through the States of Karnataka and Andhra Pradesh. The details of the canal reaches in Andhra Pradesh and Karnataka are given below.

RB LLC Reaches in States

Reaches in States (Km)	
Karnataka	Andhra Pradesh
0.000 to 131.500	131.500 to 135.700
135.700 to 147.800	147.800 to 148.000
148.000 to 156.000	156.000 to 188.000
188.000 to 190.800	190.800 to 250.580

The RBLLC generally runs for ten months in a year and is closed during May - June for maintenance works. Originally it was an unlined canal. Subsequently, the lining of the canal has been taken up in a phased manner in identified vulnerable reaches in order to improve the efficiency of the canal. There are 11 common distributories between km 131.81 and 250.53 which serves ayacuts in both the States. The details of these common distributories are given in Annexure 3.3.

As per the KWDT award the water allocated for RBLLC for Karnataka and Andhra Pradesh is 538 Mm³ (19.0 TMC) and 679.6 Mm³ (24.0 TMC) respectively, which is exclusive of pro-rata reservoir evaporation losses of 99.11 Mm³ (3.5 TMC) and 155.74 Mm³ (5.50 TMC) respectively.

As per the design of LLC, transmission losses were envisaged at a rate of 4 cusecs per million square feet of wetted area for unlined reaches and 1.5 Cusecs per million square feet of wetted area for lined reaches. In the Board meeting held on 5th and 6th May, 1989, based on the results of joint gauging, Board

granted approval for adopting transmission losses at 4 cusecs per million square feet of wetted area for the present. The Board has also permitted to make provision towards system losses not exceeding 3.4 Cumecs (120 cusecs).

(ii) Right Bank High Level Canal

The agreement of June, 1956 between Andhra Pradesh and Mysore provided that the quantity of water to be drawn annually in right bank high level canal is to be 1415.84 Mm³ (50 TMC) and is to be shared in the ratio of 35:65 between Mysore and Andhra Pradesh and the cost is to be shared on cusec mile basis between the two Governments. The agreement also provided that the common works of the canal should be undertaken by the Board. Accordingly, the joint scheme submitted by the States, was approved by Government of India in 1958 for executing in two stages. The Board commenced the construction works within its jurisdiction in 1958. This canal passes through a very rough terrain dotted with hillocks, which necessitated deep cuts, high sidewalls, tunnels, etc. It cuts across the Uravakonda ridge through a deep cut and drops into Pennar Valley to join the PABR. The first stage of the canal was commissioned by releasing water on 27th July, 1966. The second stage work was commenced in 1967 and got completed by June 1970. The total length is 196.43 km. The Board's jurisdiction ends at 105.437 km, where it enters Andhra Pradesh territory.

The RB HLC has a design capacity of 113.27 Cumecs (4000 cusecs) at the head. The KWDT has not made any change in the allocation of water to RB HLC for the States. The RB HLC was designed to deliver a maximum of 72.87 Cumecs (2,575 cusecs) at Board's limit for use in Andhra Pradesh. This included a provision of 1.42 Cumecs (50 cusecs) as transmission losses from the dam upto Board's limit. In the meeting held on 22nd October 1974, observing that the carrying capacity of the canal had reduced to 90.56 Cumecs (3,200 cusecs), Board approved pro-rata reduction of the discharges to 29.72 Cumecs (1,050 cusecs) for Karnataka and 60.84 Cumecs (2,150 cusecs) for Andhra Pradesh inclusive of 5.66 Cumecs (200 cusecs) of transmission losses.

RIVER ASSISTANCE

There were fourteen anicuts built by the Rayas down stream of the Tungabhadra Dam up to the Rajolibunda Anicut, constructed in 1960, with independent channels collectively known as Vijayanagar Channels. Water requirements of these channels are met either by the regenerated water and river releases or the releases made through the Raya and Basavanna Channel and Power Canal by the Board. The ayacuts of the Rajolibunda Anicut depend on the regenerated water of the Tungabhadra below the dam and the river releases from the dam. Similarly, the Kurnool-Cuddapah Canal too depends on the regenerated water and river releases made from the dam. The KWDT has awarded

specific allocations to Vijayanagar channels, Rajolibunda Anicut and K.C. Canal system, which are also indicated in Figure 3.1.

LIFT IRRIGATION SCHEMES

There are a number of lift irrigation schemes located on the rim of the Reservoir, which directly draw water for irrigation and other consumptive uses. In order to account for such drawals during rabi season, the Board in its 133rd meeting held on 11th January, 1989 resolved to debit 1.25 TMC water from 15.10.1988 to 31.12.1988 and 0.75 TMC from 1.1.1989 to 15.2.1989 to Karnataka share provisionally. Pending final decision of the Board, debit as well as accounting of inflow of this 2 TMC in the manner aforesaid is continued.

OTHER WATER DEMANDS

The Tungabhadra Project is a major source for meeting domestic and industrial water requirement of the region.

a) Drinking Water

Along with the irrigation demands of the project met through a net work of canal systems, the drinking water demand is also met. Board has permitted drawal of drinking water out of the share of water for the two states. Details of the drinking water schemes approved by board are given in Annexure 3.4

b) Industrial usage

With the overall economic development of the area due to commissioning of the Tungabhadra Project, many industries have come up around the dam. The demands of industries are met out of the share of the

respective States. The details of industries drawing water from various systems of the Project as approved by the Board is given in Annexure 3. 5.

NEGATIVE INFLOWS

The daily inflows into the Tungabhadra reservoir are indirectly computed based on the change in the reservoir levels, evaporation losses and the outflows on account of canal drawals and spillway surplus during preceding 24 hours using the storage equation:

$$I = O + E \pm D, \text{ where}$$

I = Inflows into the reservoir.

O = Outflows from the reservoir.

E = Evaporation losses.

(Measured as per evaporation from standard pan evaporimeter and applying a co-efficient of 0.8 to represent evaporation from the water spread area of the reservoir).

D = Difference in the storage capacity during the preceding 24 hrs. (Computed using the capacity - elevation table obtained through hydro-graphic surveys)

The inflows assessed using the above equation generally becomes negative during the months from December to April of a water year. Earlier the negative inflows were not accounted for and were considered as zero inflow. However, from 1976-77 onwards the negative inflows are accounted for. Negative inflows recorded during the last seven years are given below.

Negative inflows

Sl. No.	Water Year	Negative inflows (TMC)
1.	2007-2008	15.943
2.	2008-2009	18.707
3.	2009-2010	11.669
4.	2010-2011	11.266
5.	2011-2012	13.786
6.	2012-2013	16.779
7.	2013-2014	21.066
8.	2014-2015	18.193
9.	2015-2016	12.390
10.	2016-2017	1.889

LOSSES IN THE CANAL SYSTEM

I) TRANSMISSION LOSSES

Board in its 88th meeting held on 20th August, 1976 has decided that the canal transmission losses are to be apportioned in the ratio of X/2 to Y where the drawals of X is of Karnataka State and drawals of Y is of Andhra Pradesh State. It was also decided that tentatively till more accurate data are collected, the Low Level Canal transmission losses may be taken as 275 Cusecs. The transmission losses in respect of High Level Canal may be taken as 200 Cusecs. At present the transmission's losses are considered as 200 Cusecs for both LLC & HLC.

ii) SYSTEM LOSSES

Whenever piping or breaches occur in the canals a certain quantum of water is allowed to flow through the escapes to deplete the water level at the piping/breach site quickly, to take up repairs. Certain amount of water also flows through the breaches whenever they occur. Board in its 130th meeting held on 29th January, 1988 being aware of the water losses due to certain unauthorized drawals by various means and noting that the law enforcing authorities are not able to effectively prevent/control these unauthorized drawals, permitted to make provision for these losses, termed as system losses. This is in addition to the usual provision of transmission losses. In respect of RB LLC, the Board permitted to account a maximum of 3.4 Cumecs (120 cusecs) as system losses from the water year 1987-88. Similarly during the 165th meeting the Board permitted to account for a maximum of 3.4 Cumecs (120 cusecs) as system losses in RBHLC also with effect from 1998-99.

OPERATION OF RESERVOIR

A Water Review Committee at the level of Superintending Engineers of the participating States with Superintending Engineer, Irrigation Branch of the Board as Chairman has been constituted to assist the Board for assessing the quantum of utilization, distribution and regulation of water in various systems of the project. The Committee holds its first meeting generally in the month of May and recommends the probable utilization for the year and its distribution in various systems as per KWDT award. Based on the suggested

probable inflow and pattern of drawals for each system furnished by the respective States the Working Table for operation of the reservoir on 10 daily basis is prepared and submitted for approval of the Board. The operation of the reservoir is carried out on the basis of approved working table. The working table is reviewed from time to time based on actual inflows received and pattern of drawals indicated by States for various uses.

WATER REGULATION DURING THE YEAR 2014-2015

The first meeting of the Water Review Committee was held on 16th June 2014 and the utilization was suggested as 4077.504 Mm³ (144.000 TMC) for the likely inflow of 181.800TMC. The second meeting of the Water Review Committee held on 12th November 2014 and the committee decided on abstraction of 138.000 TMC.

WATER REGULATION DURING THE YEAR 2015-16

The first meeting of the Water Review Committee was held on 17th June 2015 and the utilization was suggested as 4190.768 Mm³ (148.000 TMC) for the likely inflow of 185.340TMC. The second meeting of the Water Review Committee held on 07th November 2015 & 10th December 2015 and the committee decided on abstraction of 110.000 TMC.

WATER REGULATION DURING THE YEAR 2016-17

The first meeting of the Water Review Committee was held on 22nd June 2016 and the utilization was suggested as 4275.716

Mm³ (151.000 TMC) for the likely inflow of 185.340 TMC. The second meeting of the Water Review Committee held on 05th November 2016 and the committee decided on abstraction of 70.00 TMC.

Date of Opening of the Canals for the year 2014-15, 2015-2016 & 2016-2017

The dates of opening of canals as per Working table and actual dates of opening are given below:

2014-2015

Canal	As per working table	Actual date of opening
RB LLC	24-07-2014	24-07-2014
RB HLC	15-07-2014	15-07-2014
LBMC	28-07-2014	28-07-2014

2015-2016

Canal	As per working table	Actual date of opening
RB LLC	14-07-2015	14-07-2015
RB HLC	25-07-2015	25-07-2015
LBMC	26-07-2015	26-07-2015

2016-2017

Canal	As per working table	Actual date of opening
RB LLC	23-07-2016	23-07-2016
RB HLC	22-07-2016	22-07-2016
LBMC	26-07-2016	26-07-2016

Meeting Irrigation Demands

Khariff Season 2014-2015

The reservoir at the beginning of the Khariff season on 1-6-2014 was 1587.26 feet with storage of 7.944 TMC. The inflows realized were 360.909 TMC as against 181.800 TMC originally considered in the Working Table. The spillway surplussed for about 181.287 TMC in addition to 21.136 TMC of water drawn for extra power generation by the power houses on both the sides without detriment to irrigation interests. A total quantity of 71.351 TMC was drawn by the States of Karnataka and Andhra Pradesh. The reservoir evaporation losses and system losses recorded during the season were 4.796 TMC and 3.064 TMC. At the end of Khariff season on 30-11-2014, the water level in the reservoir was 1629.29 feet with storage of 87.219 TMC.

A second water review meeting at Superintending Engineers level was held on 12-11-2014 and the committee after discussions agreed for a revised abstraction of 138.000 TMC against 144.000 TMC assessed during the first water review meeting.

Khariff Season 2015-2016

The reservoir at the beginning of the Khariff season on 1-6-2015 was 1582.80 feet with storage of 5.432 TMC. The inflows realized were 123.041 TMC as against 181.100 TMC originally considered in the Working Table. The spillway surplussed and water drawn for extra power generation by the power houses on both the sides without detriment to irrigation interests is NIL. A total quantity of 34.751 TMC was drawn by the States of Karnataka and Andhra Pradesh. The reservoir evaporation losses and system losses recorded during the season were 4.738 TMC and 2.709 TMC respectively. At the end of Khariff season on 30-11-2015, the water level in the reservoir was 1612.02 feet with storage of 39.283 TMC.

A second water review meeting at Superintending Engineers level was held on 07-11-2015 and the committee after discussions agreed for a revised abstraction of 110.000 TMC against 148.000 TMC assessed during the first water review meeting.

Khariff Season 2016-2017

The reservoir at the beginning of the Khariff season on 1-6-2016 was 1570.32 feet with storage of 1.207 TMC. The inflows realized were 86.638 TMC as against 181.100 TMC originally considered in the Working Table. The spillway surplussed and water drawn for extra power generation by the power houses on both the sides without detriment to irrigation interests is NIL. A total quantity of 72.933 TMC was drawn by the States of Karnataka and Andhra Pradesh. The reservoir evaporation losses and system losses

recorded during the season were 2.848 TMC and 2.249 TMC respectively. At the end of Khariff season on 30-11-2016, the water level in the reservoir was 1589.95 feet with storage of 9.801 TMC.

A second water review meeting at Superintending Engineers level was held on 05-11-2016 and the committee after discussions agreed for a revised abstraction of 70.000 TMC against 151.000 TMC assessed during the first water review meeting.

Rabi Season 2014-2015

The reservoir level at the beginning of Rabi season was 1629.29 feet with storage of 87.219 TMC. The inflows realized during Rabi season were (-) 12.869 TMC.

During Rabi season a quantity of 64.628 TMC was drawn by Karnataka and Andhra Pradesh. The Reservoir evaporation losses and system losses recorded during Rabi season were 2.612 TMC and 1.678 TMC respectively. Ultimately at the end of the Water Year on 31-5-2015, the Residual storage in the Reservoir was 5.432 TMC. The final annual abstraction came out to be 143.387 TMC.

RB HLC was closed on 27-01-2015, RBLLC on 10-04-2015 and LBMC on 12-04-2015. However the drawals into Raya Basavanna canal were continued till the end of the year i.e upto 31-05-2015.

Rabi Season 2015-2016

The reservoir level at the beginning of Rabi season was 1612.02 feet with storage of 39.253 TMC. The inflows realized during Rabi season were (-) 10.152 TMC.

During Rabi season a quantity of 25.535 TMC was drawn by Karnataka and Andhra Pradesh. The Reservoir evaporation losses and system losses recorded during Rabi season were 1.664 TMC and 0.589 TMC respectively. Ultimately at the end of the Water Year on 31-5-2016, the Residual storage in the Reservoir was 1.207 TMC. The final annual abstraction came out to be 113.816 TMC.

RB HLC was closed on 01-02-2016, RBLLC on 01-02-2016 and LBMC on 16-01-2016. However the drawals into Raya Basavanna canal were continued till the end of the year i.e upto 31-05-2016.

Rabi Season 2016-2017

The reservoir level at the beginning of Rabi season was 1589.97 feet with storage of 9.815 TMC. The inflows realized during Rabi season were (-) 0.919 TMC.

During Rabi season a quantity of 6.915 TMC was drawn by Karnataka and Andhra Pradesh. The Reservoir evaporation losses and system losses recorded during Rabi season were 1.014 TMC and 0.000 TMC respectively. Ultimately at the end of the Water Year on 31-5-2017, the Residual storage in the Reservoir was 0.967 TMC. The final annual abstraction came out to be 85.959 TMC.

RB HLC was closed on 21-11-2016, RBLLC on 23-11-2016 and LBMC on 17-11-2016. However the drawals into Raya Basavanna canal were continued till the end of the year i.e upto 31-05-2017.

WATER UTILIZATION DURING THE YEAR 2014-2015, 2015-2016 & 2016-17.

The quantity of water drawn by the States of Karnataka and Andhra Pradesh through

different systems for the year 2014-2015, 2015-2016 & 2016-17 as against allocations made in the KWDT award are given in Annexure 3.6. The 10 day water indent and actual releases made in RB HLC and RB LLC during 2014-2015, 2015-2016 & 2016-17 are graphically represented in Fig 3.2 and 3.3. The utilization for Karnataka shown in the Annexure is inclusive of water drawn from the canals for other utilizations and water drawn from the reservoir directly for industrial use. The water utilization shown for Andhra Pradesh is inclusive of water drawn for drinking water supply. The water account for the year 2014-2015, 2015-2016 & 2016-17 is given in Annexure 3.7.

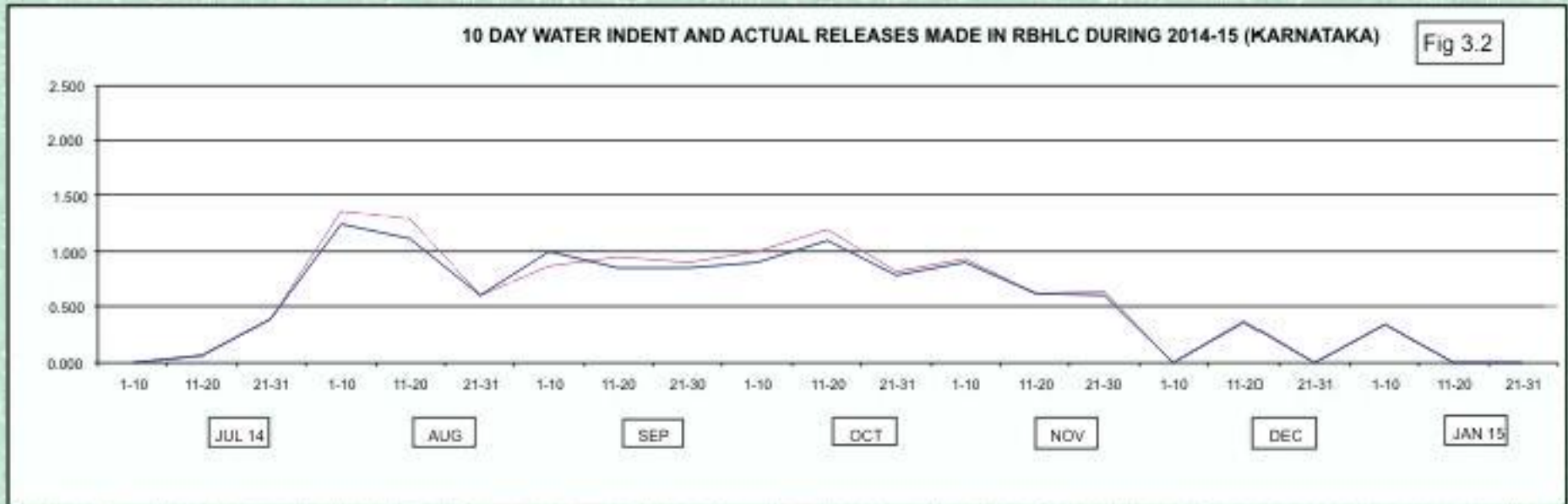
The annual share of Karnataka and Andhra Pradesh on pro-rata entitlement of actual availability and actual drawals for the past 30 years are graphically prepared in figure 3.5.

The year wise utilization for the last 33 years is given in Annexure 3.8 and graphically represented in Figure 3.4.

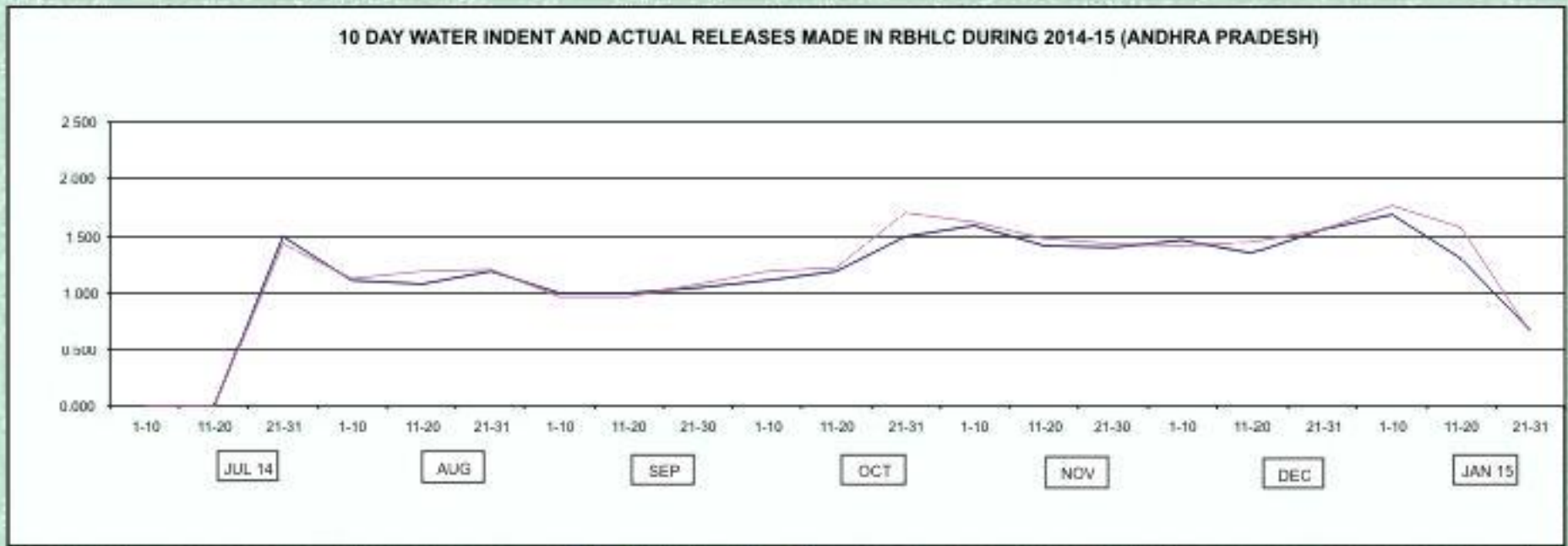
PIPINGS AND BREACHES

For construction of RBLLC and the RBHLC locally available material was used in construction of canal embankments and compaction achieved through dry rolling. At many locations the material used was calcareous, not ideal for the construction of embankments. In reaches where the canal embankments were as high as 8m, homogeneous section of calcareous filling got dissolved with the aging of these canals resulting in formation of large cavities inside the embankment. A number of pipings and

DRAWALS IN TMC

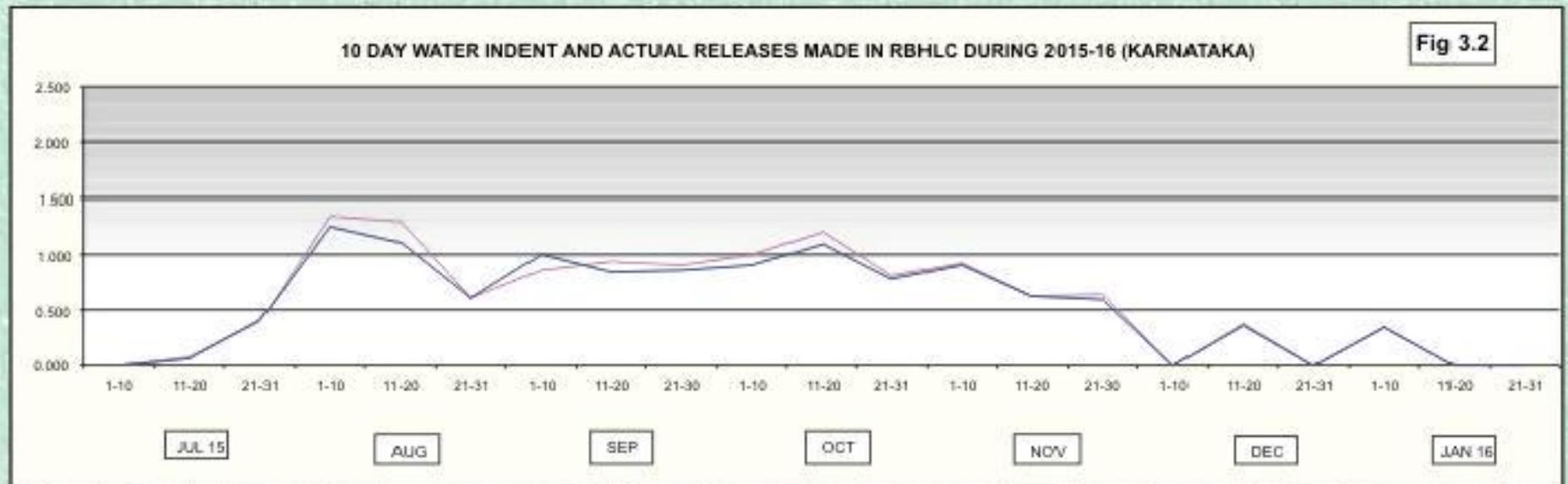


DRAWALS IN TMC

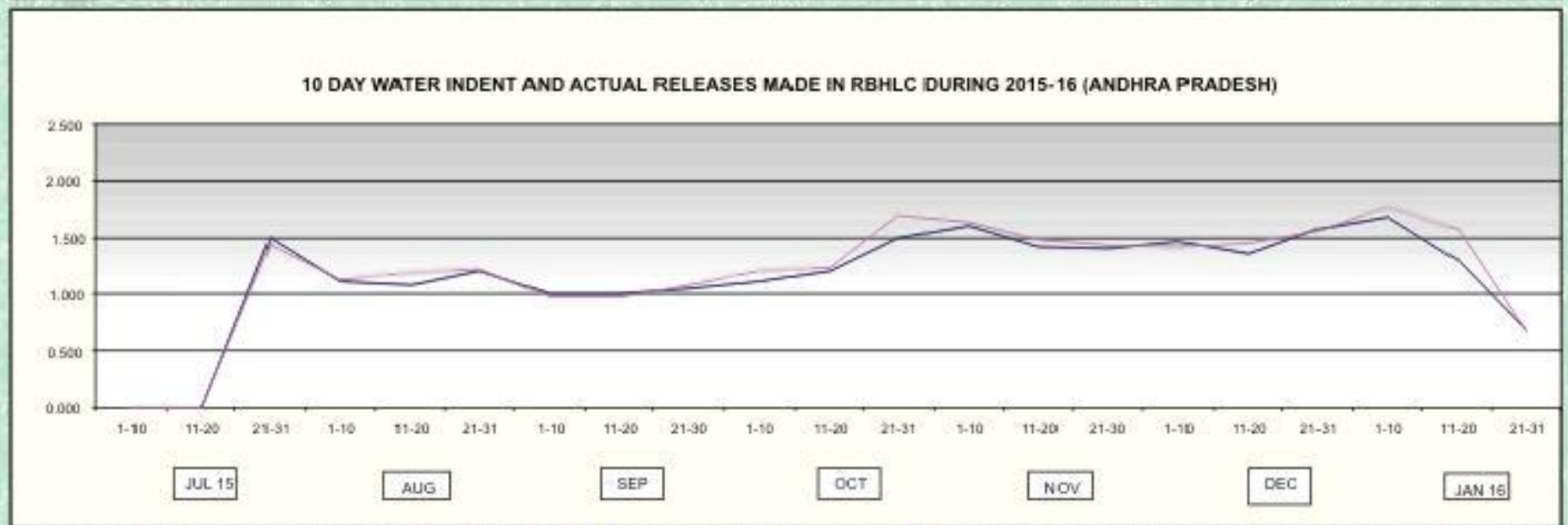


■ INDENT ■ ACTUAL

DRAWALS IN TMC



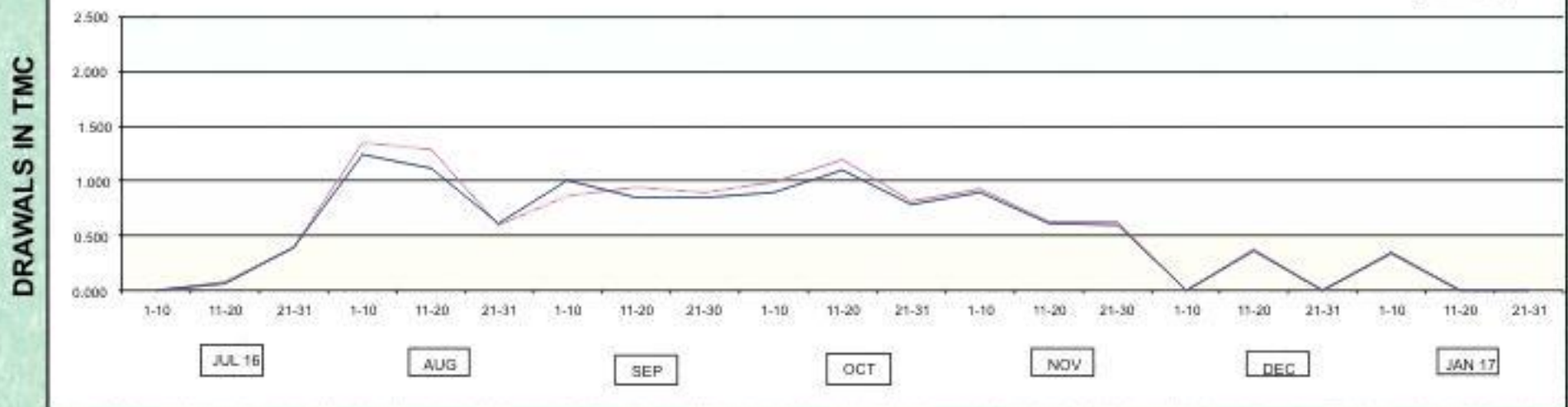
DRAWALS IN TMC



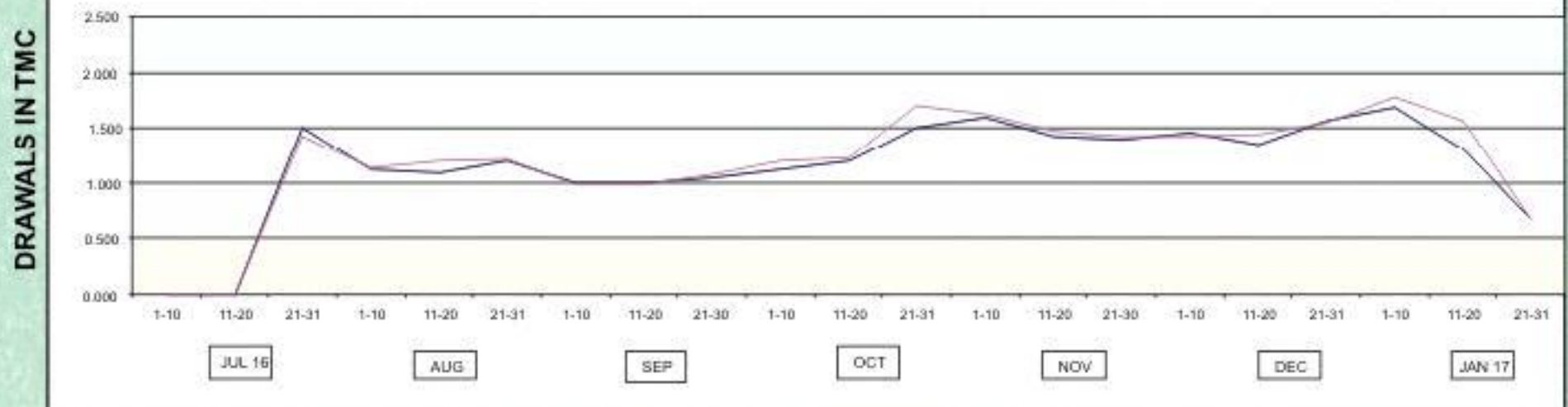
INDENT ACTUAL

10 DAY WATER INDENT AND ACTUAL RELEASES MADE IN RBHLC DURING 2016-17 (KARNATAKA)

Fig 3.2



10 DAY WATER INDENT AND ACTUAL RELEASES MADE IN RBHLC DURING 2016-17 (ANDHRA PRADESH)

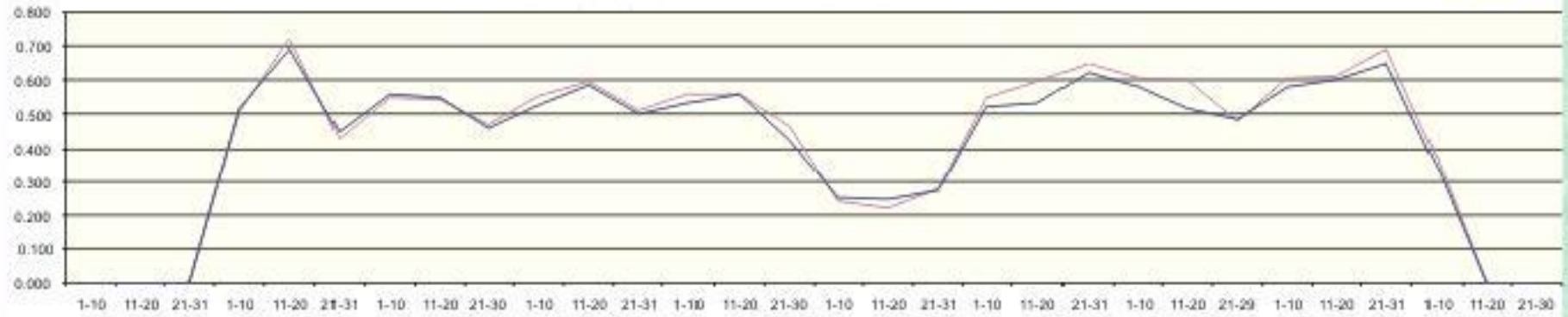


■ INDENT ■ ACTUAL

10 DAY WATER INDENT AND ACTUAL RELEASES MADE IN RBLLC DURING 2014-15 (KARNATAKA)

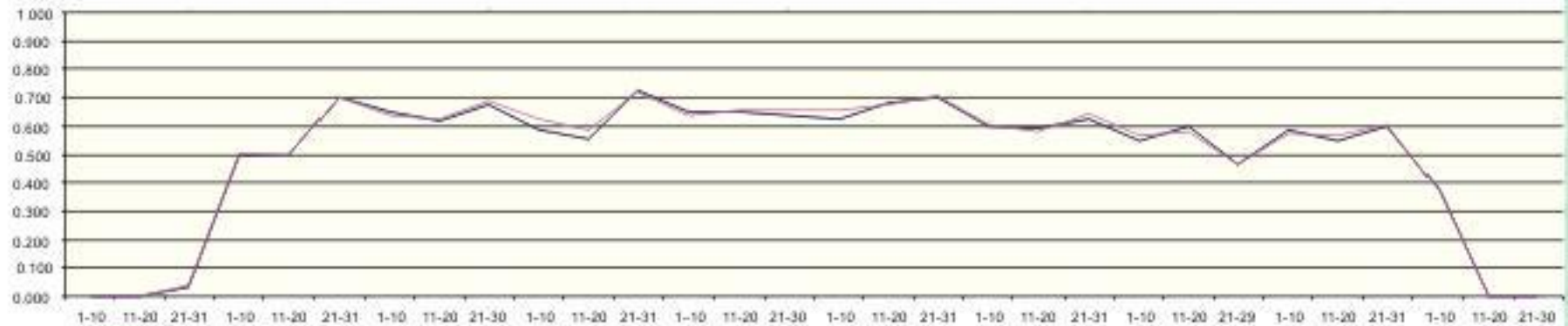
Fig 3.3

DRAWALS IN TMC



10 DAY WATER INDENT AND ACTUAL RELEASES MADE IN RBLLC DURING 2014-15 (ANDHRA PRADESH)

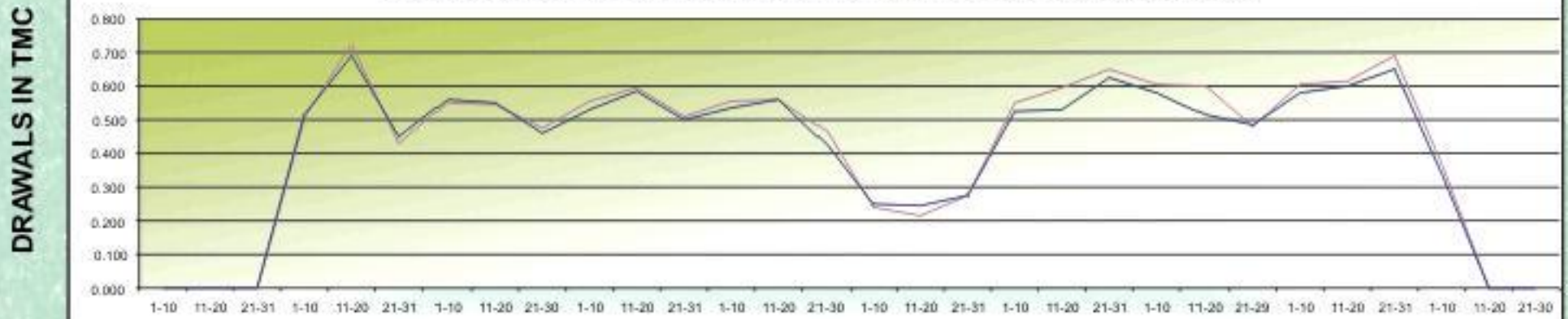
DRAWALS IN TMC



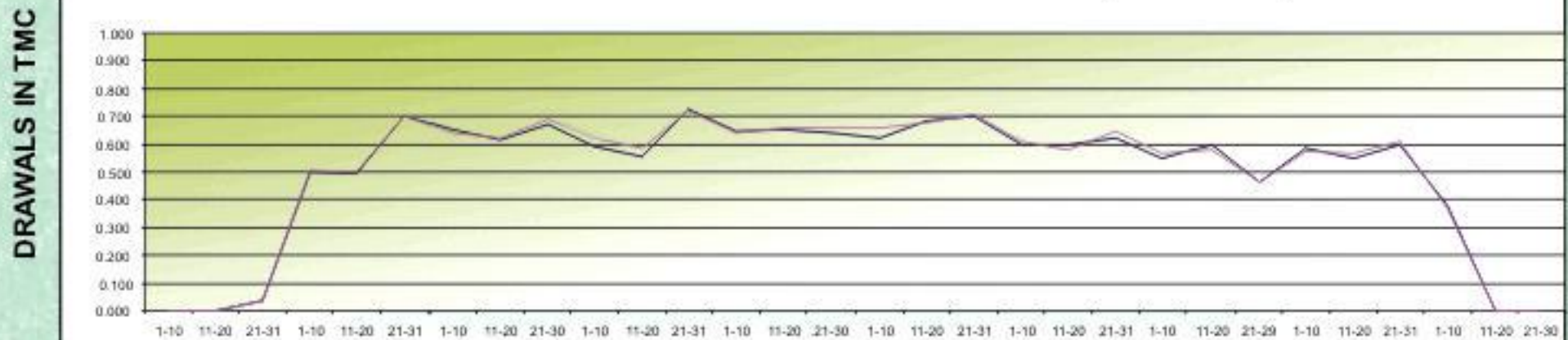
■ INDENT ■ ACTUAL

Fig 3.3

10 DAY WATER INDENT AND ACTUAL RELEASES MADE IN RBLLC DURING 2015-16 (KARNATAKA)



10 DAY WATER INDENT AND ACTUAL RELEASES MADE IN RBLLC DURING 2015-16 (ANDHRA PRADESH)

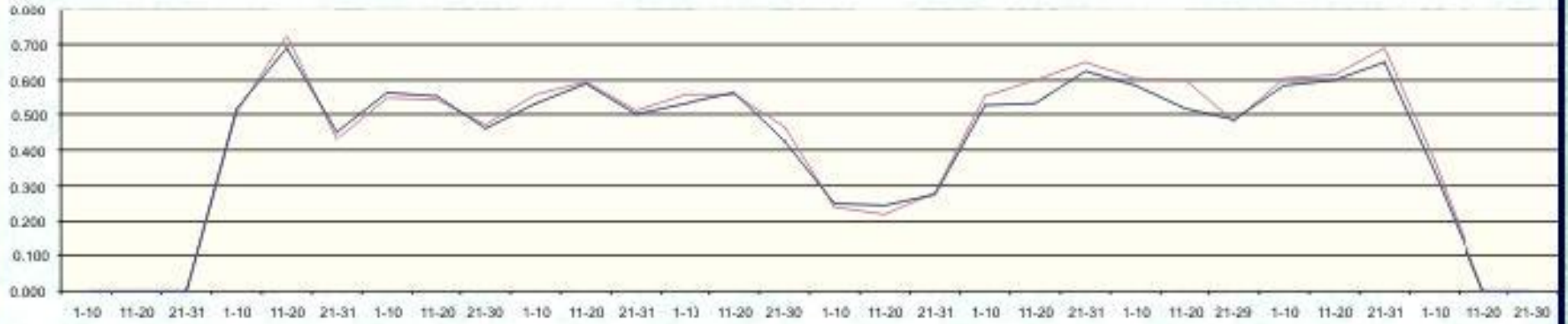


■ INDENT ■ ACTUAL

10 DAY WATER INDENT AND ACTUAL RELEASES MADE IN RBLLC DURING 2016-17 (KARNATAKA)

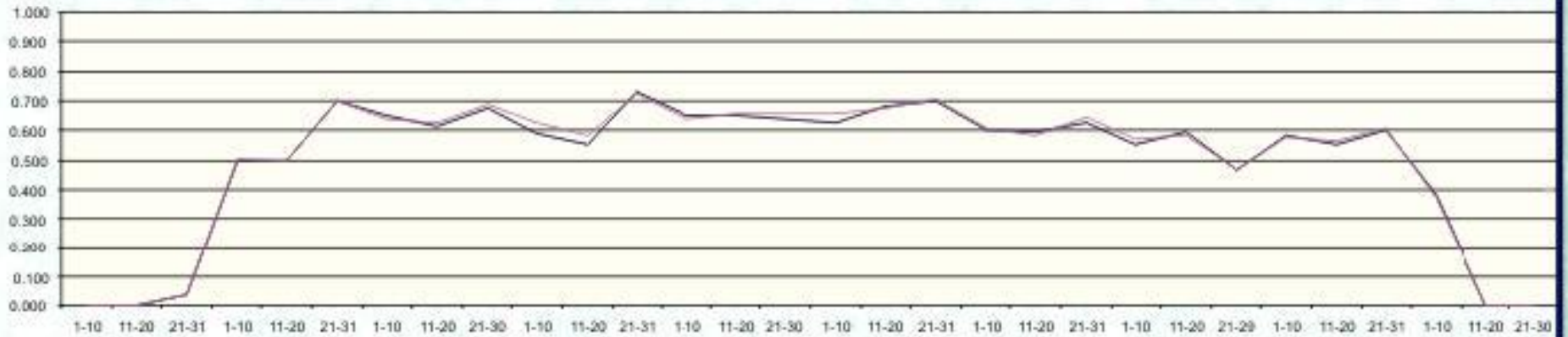
Fig 3.3

DRAWALS IN TMC



10 DAY WATER INDENT AND ACTUAL RELEASES MADE IN RBLLC DURING 2016-17(ANDHRA PRADESH)

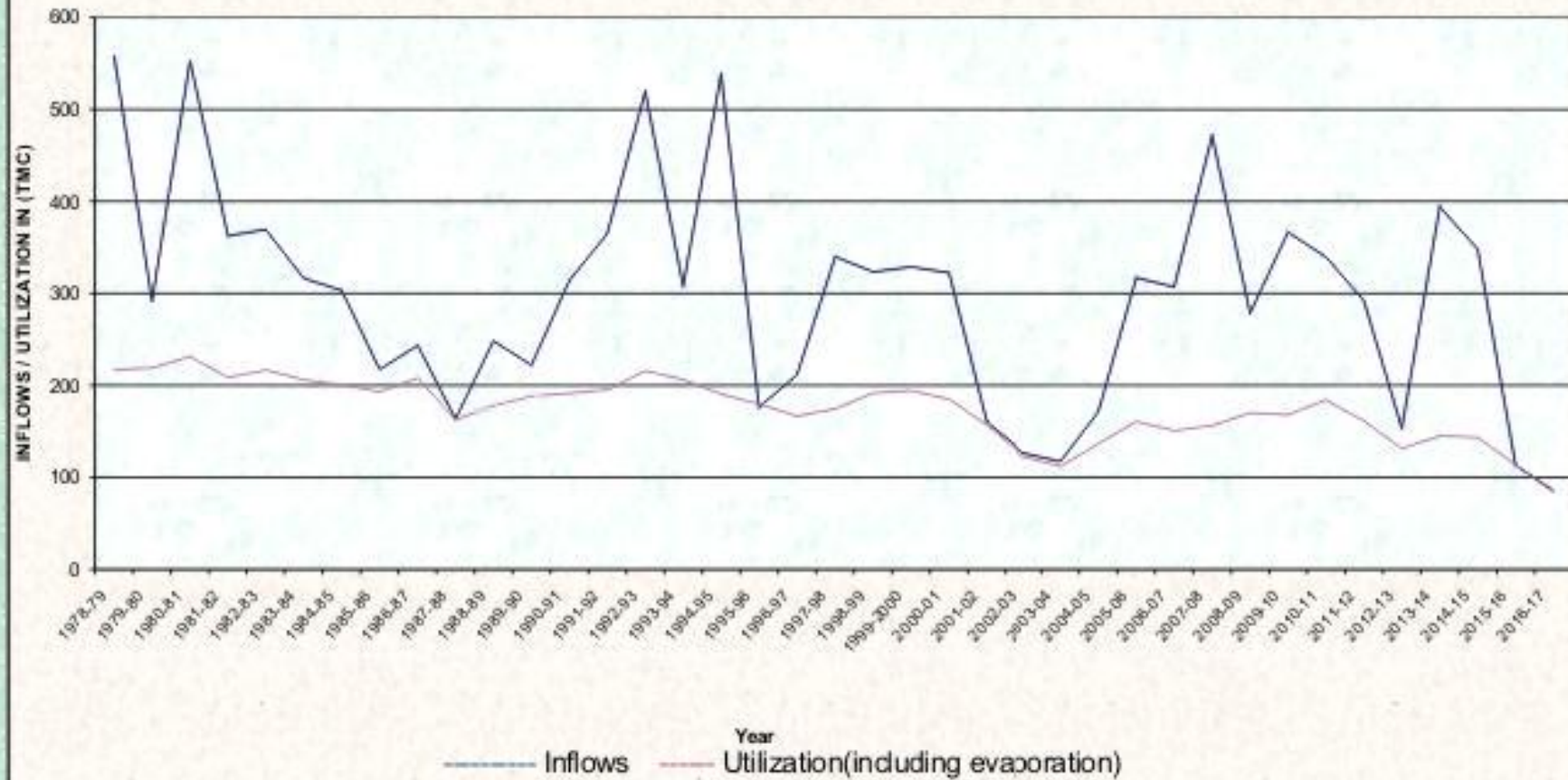
DRAWALS IN TMC



INDENT ACTUAL

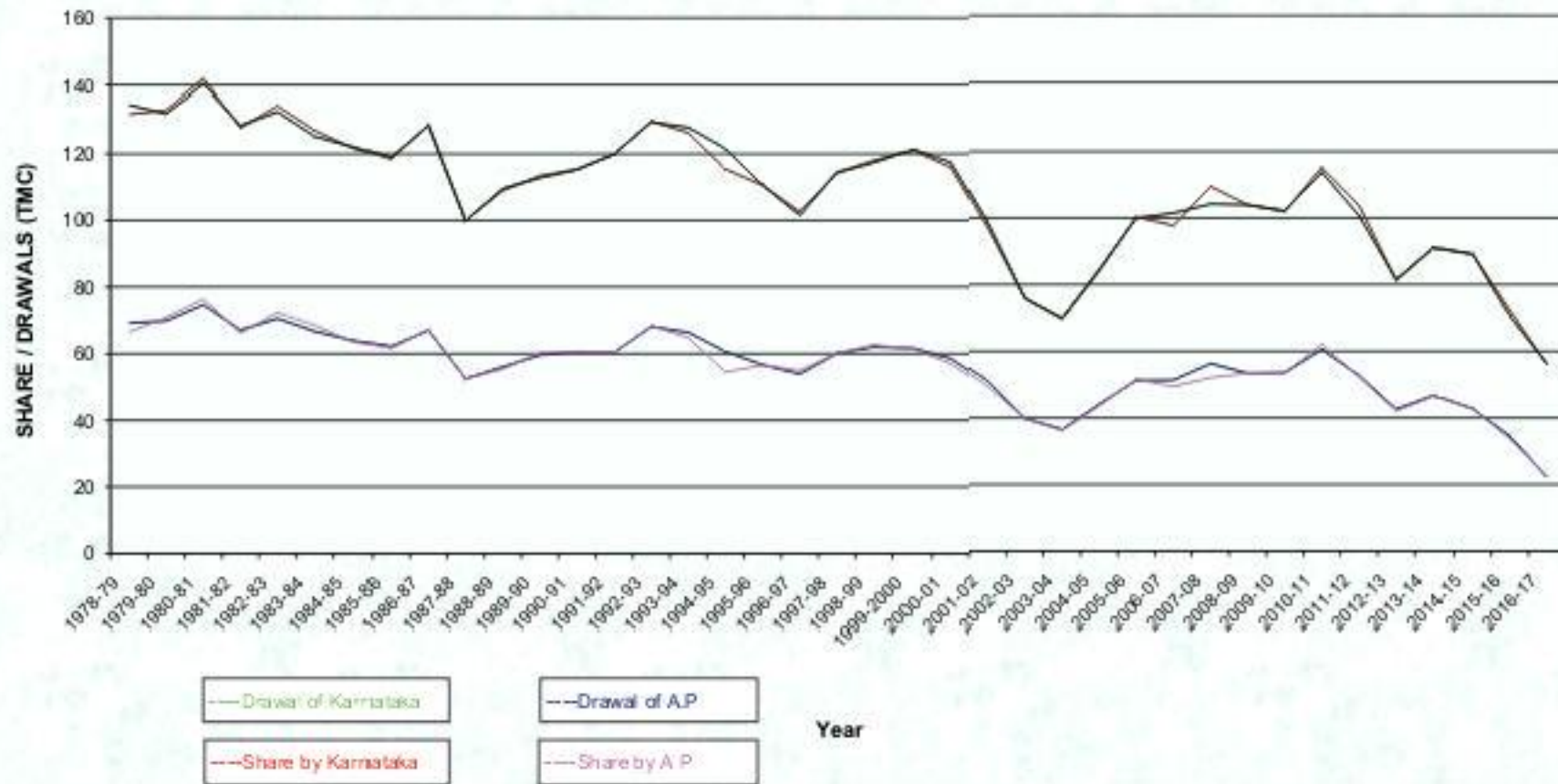
TUNGABHADRA DAM - INFLOWS v/s UTILIZATIONS

Fig. 3.4



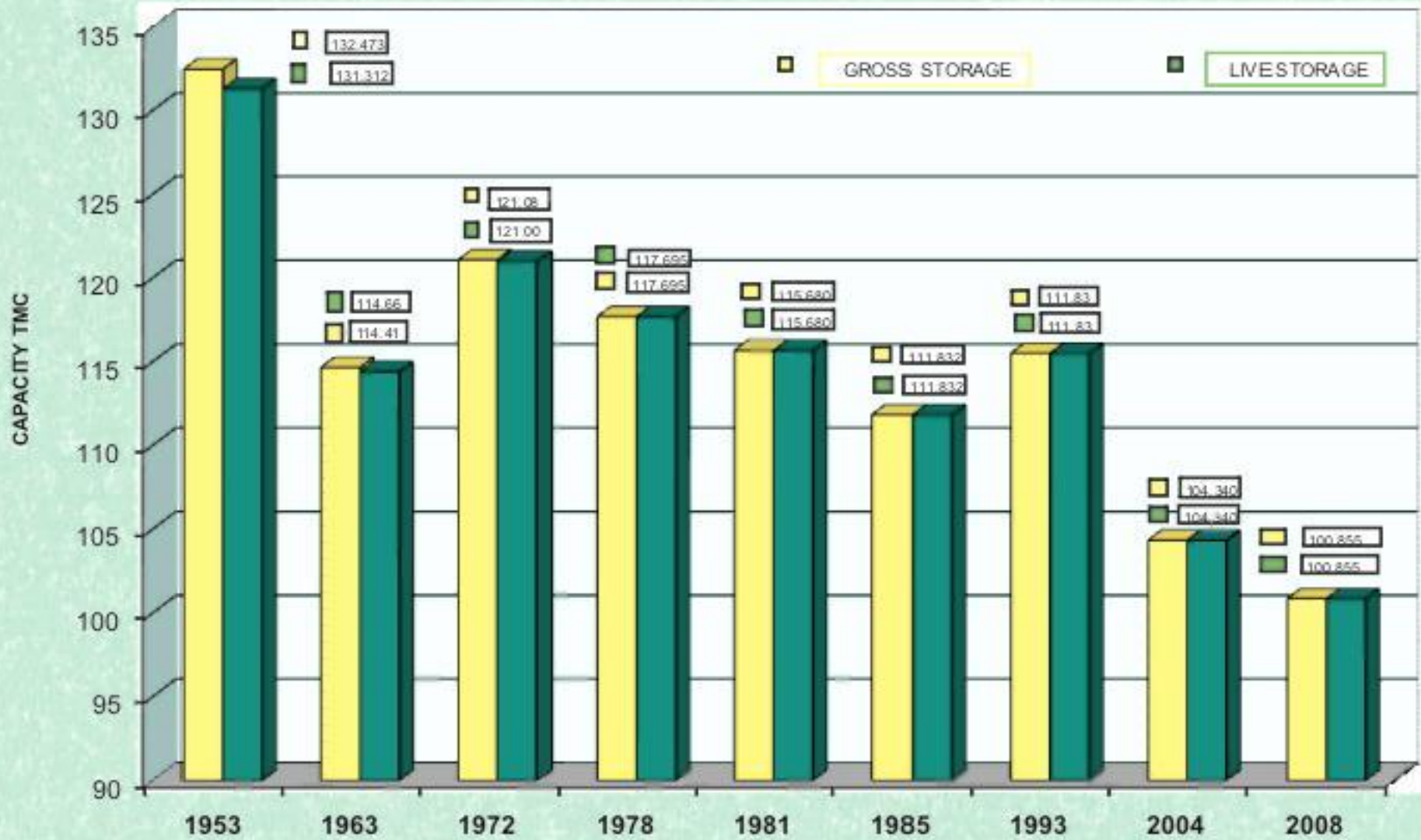
SHARE OF STATES AND ACTUAL DRAWALS

Fig. 3.5



TUNGABHADRA RESERVOIR - REDUCTION IN CAPACITIES

Fig.3.6



breaches have taken place in such vulnerable reaches over the years.

The problem was compounded due to failure of monsoon and canal remaining dry and brittle before letting water. The details of pipings and breaches occurred during 2014-2015, 2015-2016 & 2016-17 are given in Annexure 3.9. Immediate action was taken to close the breaches and plugging the pipings. Patrolling along the canal was intensified with the security staff, labours & Board staff for quick detection of vulnerable points, pipings/siphons if any, and to curtail illegal drawls.

FLOOD MANAGEMENT

The Tungabhadra reservoir has not been provided with flood storage capacity for flood absorption. The FRL and MWL of the Reservoir are same and is at 497.74 (1633.00).

Therefore the entire flood impinging the Reservoir has to be either stored to the extent possible or passed over the spillway. The spillway with 33 gates is designed to allow a maximum discharge of 18,406 cumecs (6,50,000 cusecs) at Full Reservoir Level of 497.738m (1633 ft). The operation of spillway gates is carried out in accordance with approved schedules duly ensuring the safety of the dam.

Central Water Commission provides daily information about the floods and rainfall occurrence at (i) Thirthahalli on the Tunga river, (ii) Harlahalli on the Tungabhadra river and (iii) Marol on the Varada river. Based on the Hydro-Meteorological data of these stations CWC issues inflow forecasts to the Reservoir with a lead time of 24 hours to

enable operation of the spillway gates. The forecasts are communicated to the Board through Wireless.

The maximum level attained during the year 2014-2015, 2015-2016 & 2016-17 was 497.71 M (1633.00 ft.), 495.70 M (1626.40 Ft.) & 493.11 M(1617.91 ft.) respectively. The reservoir level started receding from 15-08-2014, 23-08-2015 & 23-08-2016 respectively.

RESERVOIR SEDIMENTATION

Periodic assessment of the capacity of the Reservoir has been made since impounding of water in 1953. The gross storage capacity of the Reservoir was assessed in 1953 as 3,751.17 Mm³ (132.47 TMC) at FRL 497.738 m (1633 ft) and dead storage capacity as 32.83 Mm³ (1.160 TMC) at 472.440m (1550 ft). A siltation rate of 4.29 ha m/100 km² / year (0.427 TMC / year) was adopted in the design of the project.

Periodic assessment of the capacity of the Reservoir has been made since impounding of water in 1953. In order to update the reservoir capacity at closer intervals, remote sensing technology was tried during 1995-96. The work was got done through Andhra Pradesh State Remote Sensing Application Center. But due to inconsistencies in the reservoir capacity obtained through the remote sensing technique vis-à-vis hydrographic surveys, the board did not approve the same for adoption. The Remote Sensing Directorate of Central Water Commission also evaluated the capacity during 1993-94 and 1999-2000. However, in view of the variation in capacities indicated by the study same has also not been

considered by the Board. As directed by the Board, another joint survey of T.B.Reservoir, by APERL and KERS using the integrated bathymetric system, was completed in December 2004 upto 1626.00 ft and capacity evaluated. It was agreed to complete the capacity in the uncovered region from 1626.00 ft., to 1633 ft., by extracting from the Hydrographic survey 1993 report. The report on the survey of TB Reservoir estimated that the storage now is 2964.584 Mm³ (104.340 TMC) against 3751.17 Mm³ (132.37 TMC).

The annual rate of decrease in Reservoir capacity is 0.652TMC in 51 years.

The capacity of the Reservoir as per various surveys done from 1953 to 2008 with annual rate of decrease are given in Annexure 3.10 and graphically represented in Figure 3.6. The capacity elevation table obtained from 2008 Surveys of the Reservoir approved by the Board is shown in Annexure 3.11.

Modernization of RBHLC & RBLLC (including PC)

TB Board in its 177th meeting held on 18-09-2003 agreed to modernize both RBLLC & RBHLC as canals are more than 50 years old.

Modernization will help to draw states share of water as per KWDT.

During 186th Board Meeting held on 21-9-2007 Board decided to appoint consultancy services for preparation of DPR on modernization of Canals.

A high level meeting was also held between the honourable Chief Ministers of AP and Karnataka at Bangalore on 10/11/2014 and it was mutually agreed to modernize the canals so as to deliver 32.50 TMC of water to AP and 17.50 TMC of water to Karnataka as per KWDT award.

Both the DPR's got vetted by the member states & CWC. The modernization work for Canals has been initiated as per the annual plan as indicated in the below Table 3.2.

ADCP (Acoustic Doppler Current Profiler) & Telemetry in Tungabhadra Project :

Board in its 210th meeting held on 28th January 2017 highlighted the need for transparency in water accounting and directed to measure actual discharges using the latest rating curves as given by CWPRS on all canals of TB Reservoir and to maintain the daily account from 2017-18 water year. And these data may

TABLE - 3.2

(in crores)

Canal Systems	2016-17		2017-18		2018-19		2019-20	
	Physical (Kms.)	Financial Progress	Physical (Kms.)	Financial Program	Phy (Km)	Fin.	Phy (Km)	Fin.
RBHLC (105 Km)	14	23	50	240	41	216	-	-
RBLLC (250 Km)	-	-	89	220	103	400	58	263
PC (21 Km)			21	90				



**MODERNIZATION WORK AT KM.8.000 OF RBHLC
(Slope Compaction with vibrating roller)**



**MODERNIZATION WORK AT KM.5.000 OF RBHLC
(Compaction with plate vibrator)**



**MODERNIZATION WORK AT KM.8.000 OF RBHLC
(Slope Compaction with vibrating roller)**



MODERNIZATION WORK AT KM. 2.500 OF RBHLC



MODERNIZATION WORK AT KM. 6.850. OF RBHLC



**MODERNIZATION WORK
STEEL BRIDGE WITHOUT PIERS**



**QUALITY CONTROL TEST -
CORE TESTING AT 4.400 KM OF RBHLC**

GUAGING WITH ADCP & TELEMETRY ON POWER CANAL AT KM. 0.750





Topographic & Bathymetric Survey of Tungabhadra Reservoir.

be regularly checked jointly with ADCP (Acoustic Doppler Current Profiler) available with Board.

Board also decided to install telemetry at critical points upstream and downstream of dam at all canal off takes, river sluices, all along the canals on both banks including Karnataka - Andhra Pradesh canal borders and on important distributaries, industrial, drinking water drawls.

Topographic Survey of TB Reservoir.

To overcome the inconsistency in the Hydrographic survey data, physical survey i.e., Topographic survey and Bathymetric survey of the reservoir has been taken up to assess the present capacity and status of siltation which will be considered more reliable

and authentic. The survey work was entrusted to M/s Aarvee Associates, Hyderabad during June 2016.

FINANCIAL PERFORMANCE

The budget allocation for the Irrigation Wing during the year 2014-2015, 2015-2016 & 2016-17 under Plan & Non-Plan head MH 4700 & 2700 respectively is indicated below.

(Rupees in Lakhs)

Year	Head of account	Budget allotted	Expenditure
2014-2015	MH 4700	1000.00	2702.81
	MH 2700	4160.00	4024.36
2015-2016	MH 4700	2000.00	1324.46
	MH 2700	6380.00	5548.25
2016-2017	MH 4700	5712.00	3787.26
	MH 2700	6810.00	6358.81

HYDRO POWER MANAGEMENT

The Tungabhadra Hydro Electric Scheme (TBHES) of Tungabhadra Board comprises two power houses, one at the foot of the dam and another at Hampi, located 21 km from the dam. Though the Scheme was sanctioned by the then Government of Madras in the year 1950, work on the Dam Power House was started in 1951 and that of Hampi power house in 1956. The power generated by the two power houses on the right side is shared between Karnataka and Andhra Pradesh in the ratio of 20:80.

Another power house exists at the left bank of the dam and is under the control of Karnataka State. The hydro power generated on the left side is entirely used by Karnataka.

The salient features of the power houses of the Tungabhadra Project (Annexure 1. 2).

RIGHT BANK DAM POWER HOUSE

The right bank Power House is located at the foot of the dam. The gross head available at the dam power house for power generation varies from 13 to 26.8m. Four steel penstocks, each of 3.3 m in diameter carry water from reservoir to generator turbines. In the first stage, two units each of 9 MW were commissioned on 26 January, 1957 and 23 May 1957. Generators and indoor switch gears were supplied and erected by M/s Brown Boveri, Switzerland through Valkart & Bros,

the Indian agents and Turbines with accessories by M/s Escherways Ltd., Switzerland through Kumara Dholi Engineering Works, Calcutta. Generators, indoor switch gears and turbines accessories were supplied and erected by M/s Hitachi Company Ltd., Tokyo, Japan. The two units each of 9 MW of second stage were commissioned on 26th February and 17th June 1964. These two units were supplied and erected by M/s. Hitachi Company Ltd., Japan. The total installed capacity of the Dam Power House is 36 MW.

The main objective of the project being irrigation, electricity generation is dependent on the water releases made for irrigation in the RBLLC and river assistance to the RDS and the KC Canal. Water releases vary from time to time as per irrigation demands furnished by the States. During rainy season, especially when the reservoir is nearing Full Reservoir Level or is overflowing, generation at full capacity of 36 MW is done at the dam power house, drawing water at the rate of 160.27 cumecs (5660 cusecs) with maximum differential head of 26.8 m.

HAMPI POWER HOUSE

The tailrace water of the dam power house is fed through the Power Canal to a fore bay located at Hampi, which has a storage capacity of 0.74 M cum with normal level of

463.1 m (1,519 ft). Water from fore bay is carried to power house through two low-pressure steel pipe lines, each of 5.48 m diameter and 868.3 m in length. At the end of each penstock a steel differential surge tank of 18.3 m diameter and 18.3 m in height exists. Two penstock pipes each 3.66 m diameter with a maximum discharging capacity of 31.15 cumecs (1,100 cusecs) takes off each the surge tank diverting water to four turbines in the power house. Each penstock is provided with a 3.66 m butterfly valve, an air valve at surge tank end and 3.05 m butterfly valve and venturimeter at power house end.

The first unit of 9 MW was commissioned on 10th February 1958 and the second unit of 9 MW on 26th March 1958. The two units were supplied and erected by M/s Brown Boveri Company, Switzerland. The remaining two units, each of 9 MW, were commissioned in April and July 1964 and were supplied and erected by M/s Hitachi Ltd., Tokyo, Japan. The total installed capacity of Hampi Power House is 36 MW.

As the discharge carrying capacity of the Power Canal is limited to 70.79 cumecs (2,500 cusecs), the maximum generation at Hampi Power house is limited to 20 MW against an installed capacity of 36 MW. The generation at Hampi powerhouse is dependent on water discharge through Power Canal. The water discharged from Hampi power house enters to Gundlakere Lake and from there it is led into Low Level Canal and Gundlakeri escape as per demand.

During the months of May and June when the Low Level Canal is closed or when the minimum draw down level of 482.35m (1,582 ft) is reached, the power houses are shut down.

BELLARY SUB-STATION

The Board has installed 66 KV Sub Station at Bellary to evacuate part of power generated from the Dam and Hampi Power Houses to Andhra Pradesh and Karnataka.

HYDRO ELECTRIC WING OF BOARD

A Chief Engineer belonging to APGENCO heads the Hydro-electric (HE) Wing of Board on part time basis. The Chief Engineer (Electricity Generation), APGENCO, Hyderabad is the present part-time Chief Engineer of the HE Wing. A Superintending Engineer belonging to KPTCL heads the TBHES Circle located at T.B. Dam. There are two Divisions, one at TB Dam and the other at Hampi. These Divisions are headed by Divisional Engineers of APGENCO cadre. There are 14 Assistant Divisional Engineers (3 GOK + 11 GOAP) and 28 Assistant Engineers (4 GOK + 24 GOAP). Other staffs are drawn from the APGENCO and KPTCL, in the proportion of 80:20. The Organization Chart of Hydro Electric Wing is at Annexure 4.1

FUNCTIONS

The HE Wing is responsible for generation of hydro electricity, transmission of the hydro-power generated to Andhra Pradesh and Karnataka in the ratio of 80:20, take up special repairs and maintenance of the power houses,

equipment and transmission and distribution of electric power in the Board's colony at TB Dam and Hampi Camp colony and collection of tariff.

HYDRO-POWER GENERATION

Hydro-power generation has been going on at two power houses since commissioning of the plants, by utilizing water released for irrigation purposes. The power generated at both the power houses of Board is shared in the ratio of 80:20 between GoAP and GoK. The extra power used, if any, by GoK/GoAP is paid for by the KPTCL/ APTRANSCO as the case may be.

The plant-wise generation achieved, auxiliary consumption, shares and utilizations by Andhra Pradesh and Karnataka for the last nine years from 2007-2008 to 2015-16 are furnished in Annexure 4.2. The details of the cost of generation per unit for the period from 2004-05 onwards are given in Annexure 4.3, from which it could be seen that the cost of generation per unit during the years

2014 - 2015	87.75 paise
2015 - 2016	171.94 paise
2016 - 2017	292.84 paise

The power generated and costs per unit of generation for the period from 2004-05 to 2016-17 are depicted in figure 4.1

FINANCIAL PERFORMANCE

The budget allocation for the years provided to HEW.

Year	Voted grant	Expenditure
2014-15	1943.59	1872.12
2015-16	2525.30	2006.18
2016-17	3040.71	2353.38

The expenditure towards establishment and other expenses relating to previous years for which advises from Accountant General, Andhra Pradesh, Hyderabad are received during 2014-15, 2015-16 & 2016-17.

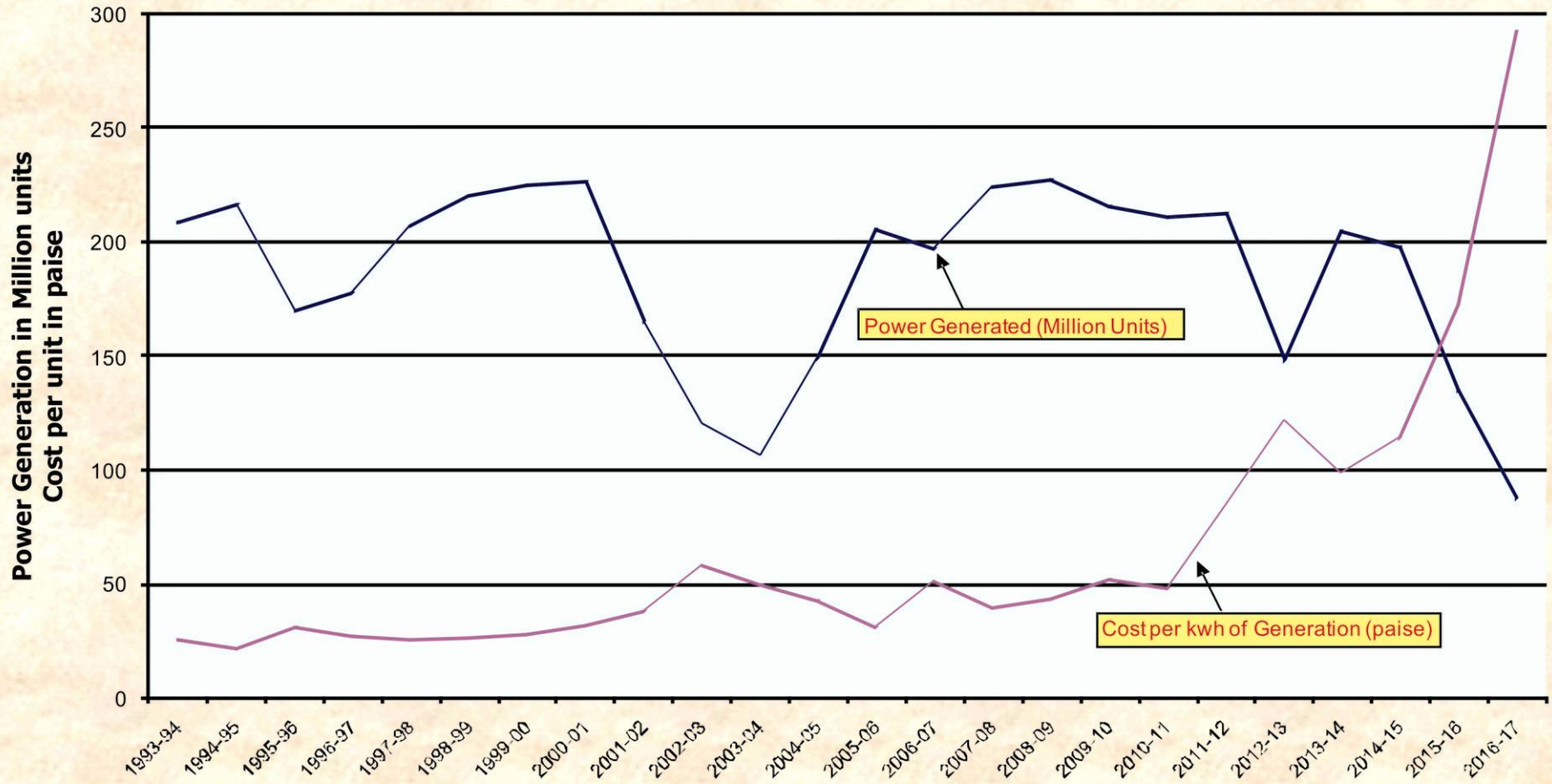
The expenditure on account of salaries of O&M staff, Civil Maintenance works of Colonies and maintenance works in both the power houses is met from the budget allocation under the head of account 272 - 273 Maintenance. The allocation provided under this head of account has been utilized for salary component of O&M staff and very essential maintenance works were taken up during the year.

Royalty to Irrigation Wing of TB Board

The Board in its 202nd meeting has revised the rate of royalty charges payable by HEW to Irrigation Wing (TB Board) from the existing rate of Rs 212.00 per kW year to Rs 429.00 per kW year with effect from the financial year 2012-13 and directed that the royalty charges may be reviewed every five years as per previous decision of the Board. During the years 2014-15, 2015-16 & 2016-17 an amount of Rs.80.4514 lakhs, Rs. 57.139 lakh

TUNGABHADRA HYDRO-ELECTRIC SCHEME
TOTAL POWER GENERATION AND COST PER UNIT (kwh)

Fig. 4.1



& 90.35 lakhs respectively is to be paid to IW as royalty charges.

The Fisheries Wing (FW) is supplied with power by HEW at generation cost. In the 165th meeting of the Board it was decided to revise the tariff rate chargeable from the FW every year, based on the average generation cost for preceding three years. Accordingly rate was revised to 61.50 paise per KWh from 1st January 2012.

MAINTENANCE WORKS

Important repairs and maintenance works attended during the year were:

TB Dam Power House

2014-2015

- ¾ Re-babbiting & Replacement of Turbine Guide bearing, shaft alignment, arresting of water leakage from turbine pit for unit-III & Unit IV (9 MW capacity, Hitachi make) at Dam Power House.
- ¾ Dismantling of 13 Nos., 66 KV towers along with ACSR, Ground conductor and insulators from Loc.No.136 to Loc.No.150 of 66 KV Dam- Bellary feeder.
- ¾ Repairs and commissioning damaged gear box assembly of BF valve of Unit-II at Dam Power House.
- ¾ Cable jointing of 400 Sq.mm, 11KV class armored cable at two locations pertaining to Unit-II of Dam Power House.
- ¾ Re-Babbiting and machining of damaged Turbine Guide Bearing of Stage-II units pertaining to Dam Power House using IS 25 Grade 84 Tin based composition.

- ¾ Providing under water services for arranging gantry crane hook to Unit-IV Cut-off gate at Dam Power House.
- ¾ Machining and supply of precision wheel for 62 HP Dewatering Pump pertaining to Dam Power House.
- ¾ Dismantling of 66 KV Dam-Bellary feeder from BTPS to Bellary SS.
- ¾ Dismantling of 66 KV Hampi – Bellary feeder from Loc.No.108 to Bellary SS.

2015-2016

- ¾ Re-babbiting & Replacement of Turbine Guide bearing, shaft alignment, arresting of water leakage from turbine pit for unit-III (9 MW capacity, Hitachi make) at Dam Power House.
- ¾ Re-babbiting of spare Turbine guide bearing of Stage-II units.
- ¾ Filtration of transformer oil of all generator transformers with outside agency.
- ¾ Gaskets replacement to Stage-I and Stage-II generator transformers.
- ¾ Jelly replacement and earth pits water pipe line in 66 KV outdoor switch yard at Dam Power House.
- ¾ Providing under water services for arranging gantry crane hook to Unit-I intake gate at Dam Power House.
- ¾ Electrical rewiring of certain departmental buildings in HES Colony at TB Dam Power House.
- ¾ Certain length of ground conductor restringing of 66 KV Dam-Hampi feeder.
- ¾ Roof leakage arresting of Pt. E-type, Pt.F-type quarters etc., at HES colony.

- ¾ Replacement of AC Sheet roofs to A – type & Ty. F-type quarters

2016-2017

- ¾ Replacement of cooling water pipe lines for oil coolers of all Generator transformers was carried out.
- ¾ Replacement of missing tower angular and damaged disc insulators, mid span conductor jointing and restringing of ground conductor for 66KV Dam-Hampi double circuit feeder was carried out.
- ¾ Repairs to the gearwheel assembly of Unit-II Butterfly valve at Dam Power House.
- ¾ Rebabbiting of spare Turbine guide bearing for Stage-I unit.
- ¾ HP testing, refilling, reconditioning and repainting of CO₂, mechanical foam & flooding system fire extinguishers pertaining to Dam Power House.
- ¾ Providing under water services for arresting water leakages from intake & draft tube gates of Unit-I at Dam Power House.
- ¾ Overhauling & reconditioning of 22 HP dewatering pump.
- ¾ Supply & fixing of CT operated LT electronic trajectory meters along with CTs meter box, distribution box, protection kit & providing earth pits for distribution transformers in Gardens & Vaikunta Guest Houses of TB Dam.
- ¾ Outsourcing of maintenance works in Electrical & Mechanical Sub-Divisions of TB Dam Power House.

- ¾ Electrical rewiring of administrative building of TBHES Offices & certain departmental quarters in HES Colony at TB Dam Power House.
- ¾ Arresting roof leakage to the Dam Power House building.
- ¾ Repairs to certain TBHES quarters in official colony.
- ¾ Repairs to Pt.E-type & F-type quarters in HES colony.

Hampi Power House

2014-2015

- ¾ Dismantling of 66 KV Hampi – Bellary feeder from Hampi Power House Switch yard to Loc.No.108.
- ¾ Repairs to surge tank No.1 and 2.
- ¾ Annual maintenance of forebay.
- ¾ Replacement of damaged trash rack at intake of forebay.
- ¾ Replacement of damaged wooden and steel doors to the quarters of Hampi Power House Colony.

2015-2016

- ¾ Filtration of transformer oil to the generator transformers.
- ¾ Repairs to surge tank No.1 & 2.
- ¾ Annual maintenance of fore bay.
- ¾ Rewinding of pilot exciter & repairs to main exciter of stage-I units of Hampi Power House.
- ¾ Roof leakage arresting to the departmental quarters of E, F, G and AE type in Hampi Power House colony.



TBHES - DAM POWER HOUSE - CONTROL ROOM



UNIT - I



TBHES - DAM POWER HOUSE - CONTROL ROOM



UNIT - III LC (SERVICING)

- ¾ Repairs and improvements to the Division office, IB & samudaya bhavan of Hampi Power House colony by repainting, roof leakage arrest etc..
- ¾ Repainting to the Hampi power House building.
- ¾ Construction of 2 Nos. watch towers in Hampi Power House.
- ¾ Strengthening of embankment at tail race of Hampi Power House.
- ¾ Replacement of filter bed in filter house of HPC.
- ¾ Repairs to the damaged Soak pits.

2016-2017

- ¾ Gaskets replacement to Stage-I and Stage-II generator transformers.
- ¾ Repairs to surge tank no.1 and 2.
- ¾ Supply and installation of 03 Nos. floor mounted air cooled Air Conditioners in place of existing AC units of water cooled available in control room of Hampi Power House.
- ¾ Outsourcing of maintenance works in Electrical & Mechanical sub divisions of Hampi Power House.
- ¾ Replacement of 40mm jelly with 20mm jelly in outdoor switch yard of Hampi Power House.
- ¾ Reconditioning of intake gates & Draft tube cut off gates by replacing worned out rubber seals, overhauling of roller & applying coal tar epoxy paint.
- ¾ Procurement and replacement of HV bushings to stage-II generator transformers in Hampi Power House.

- ¾ HP testing, refilling, reconditioning and repainting of CO2, mechanical foam & flooding system fire extinguishers pertaining to Hampi Power House.
- ¾ Dismantling & construction of stone masonry between Unit-3 & 4.
- ¾ Improvements to the Hospital.
- ¾ Digging of bore well, supply, erection & commissioning of 5HP submersible pump set at Filter house.
- ¾ Construction of boom barrier and security guard room in HPC & Hampi Power House.
- ¾ Painting to the buildings of Hampi power House, Post office & Hospital.
- ¾ Annual maintenance of forebay.
- ¾ Electrical rewiring of Hospital building at Hampi Power House

NEW MINI HYDEL POWER STATION AT HEAD OF RB HIGH LEVEL CANAL- M/s NCL Energy Ltd.,

Water is released from reservoir to the Right Bank High Level Canal through 10 numbers 6' X 12' high level sluices. Board decided to utilize the head and discharges available at 3 of these 10 sluices for power generation. Accordingly a mini-hydel power plant was contemplated to be setup in private sector under Built, Own, Operate and Transfer (BOOT) basis. The Board identified an Independent Power Producer (IPP) M/s NCL Energy Ltd., Hyderabad and permitted them to set up the plant. Tungabhadra Board has provided required land in RBHLC stilling basin

to IPP on lease for a period of 30 years. The IPP will own the mini power house for 30 years from the date of commissioning and thereafter will transfer the ownership to Tungabhadra Board.

The power plant comprises 3 units of 2.75 MW capacity each. From the consideration of head and power draft horizontal Full Kaplan turbine and synchronous generator was selected. The annual generation available with the installed capacity of 8.25 MW is estimated to be 27.93 million units. The total project capital cost is Rs.22 crores.

As the power plant is located adjacent to the masonry dam and to keep the vibration level within the safe limit, the excavation works were carried out using controlled blasting techniques in technical collaboration with National Institute of Rock Mechanics, Kolar Gold Fields, Karnataka. The guidance of Central Water Commission was also obtained in this regard.

The Civil and Electrical works of the Mini Power Plant were completed in a Record time of 8 months and the Units were commissioned and synchronized with grid on the following dates.

x Unit –I Commissioned on 28-9-2004

x Unit –II Commissioned on 9-10-2004

x Unit–III Commissioned on 25-10-2004

The total generation from the Mini Power House is as below.

As the power plant is located adjacent to the masonry dam and to keep the vibration level

within the safe limit, the excavation works were carried out using controlled blasting techniques in technical collaboration with National Institute of Rock Mechanics, Kolar Gold Fields, Karnataka. The guidance of Central Water Commission was also obtained in this regard.

x Unit –I Commissioned on 28-9-2004

x Unit –II Commissioned on 9-10-2004

x Unit–III Commissioned on 25-10-2004

The total generation from the Mini Powerhouse is as below.

Year	Total generation (Million Unit)
2014-2015	26.9188
2015-2016	12.8913
2016-2017	3.432

Transmission Corporations	Rate of purchase of power
KPTCL	Rs.1.98 per unit for the first 20 years and Rs.1.89 per unit for the balance 10 years, including 10% royalty charges payable to Board.
APTRANSCO	Rs.1.782 per unit for the first 20 years and Rs.1.701 per unit for the balance 10 years, excluding royalty charges.

**NEW MINI HYDEL POWER STATION
M/s. KHANDALERU POWER COMPANY
LTD.**

Water is released from reservoir to the Rayabasavanna canal through a single sluice. Board decided to utilize the head and the discharge available at single vent of sluice for

power generation. Accordingly a Mini Hydel Power Plant was contemplated to be set up in private sector under built, own operate and transfer (BOOT) basis. Independent power producer (IPP) M/s.Khandaleru Power Company limited, Hyderabad was permitted to set up the plant. Tungabhadra Board has provided required land in Rayabasavanna Stilling Basin to IPP on lease for period of 30 years.

The power plant comprises single unit of 1.4MW capacity, from consideration of Head and Power, Horizontal full Kaplan Turbine and

Synchronous Generator was selected. The Annual Generation is available with the installed capacity of 1.4 MW is 7.19 MU. The total project capital cost is Rs.11.5 crores. The project construction was started in September 2012 and commissioned in record time of 11 months i.e., 31-08-2013.

During the year 2014-15, 2015-16 & 2016-2017 the total generation from the Mini Power House is 6.7594, 5.0443 & 3.391 Million Units respectively. Generated Power is purchased by GESCOM and Rate of Power purchase is Rs.2.80 per unit.

DEVELOPMENT OF FISHERIES

INTRODUCTION

Construction of the Tungabhadra dam created a vast reservoir spread over an area of 378 sq km, providing tremendous scope for development of fisheries for social upliftment of the people of the region. The Board thus set up a fish farm for producing quality fish seeds for raising fishery wealth in the Tungabhadra reservoir and for sale to Government and private agencies in Karnataka and Andhra Pradesh. In addition, for the convenience of the fishermen of the area to facilitate preservation of fish catch, Board is running an Ice-cum-Cold Storage Plant.

ORGANIZATION

Fisheries Wing (FW) consists of following three units.

- x Fish Farm Unit (FFU)
- x Reservoir Unit (RU)
- x Ice-cum-Cold Storage Plant

Organization Chart of Fisheries Wing is at Annexure 5.1

The Fisheries Unit works under the control of the Secretary, Tungabhadra Board. The Fisheries Development Officer (FDO), posted by Fisheries Department of GoK, looks after the day to day activities of the Wing. The

staff of the Wing is drawn from GoAP and GoK in the ratio of 5:13 respectively.

FISH FARM

The Fish Farm was set up in the year 1959 in an area of 8.1 ha. This farm is having 20 earthen ponds of different sizes ranging from 15 x 33m to 32 x 80m and 87 cement ponds of size ranging from 3 x 2 m to 24 x 12 m. A glass jar hatchery with a capacity for hatching 50 lakh eggs per day was commissioned in 1982. Two Chinese hatcheries were set in 2011 year apart from two old Chinese hatcheries each with a capacity of 25 lakhs of eggs. The details of fish farm ponds are given below.

Details of Fish Farm Ponds

Water spread area of Farm	4.60 ha
Brood Stock ponds	1.50 ha
Rearing & Nursery ponds.	1.60 ha
Water sedimentation ponds	0.20 ha
Breeding, hatching & conditioning ponds	0.20 ha

The Fish Farm Unit is producing spawn of major carp and common carp utilizing the parent stock (brood stock) raised in fish farm by hypo-physation technique. This method induces the fish to release eggs in stagnant water by injecting pituitary hormone, which



PARNAJA - FISH ACQUARIUM



COLLECTION OF FISH SEEDS IN TB FISH FARM POND



COLLECTION OF FISH SEEDS IN TB FISH FARM POND



FISH SEED PACKING



RELEASING FISH SEEDS TO RIVER



RELEASING FISH SEEDS TO TB RESERVOIR

was first introduced in the unit during 1962-63. The spawn so produced, apart from rearing further to fry stage and then to fingerling stage for supply, are disposed off at spawn stage also. The FFU is a leading producer of Catla fish seed, which is in great demand in the region. It is ideal in respect of its location, design, maintenance of breeders, hatching facilities etc. The fishermen & aqua culturists of this area have great faith in the quality of seeds provided by FFU. Many undergraduate and postgraduate students of Zoology and Fisheries from various colleges pay visit to FFU every year as part of their practical training in fish culture and breeding aspects. Competition from the private fish farms and lack of staff are causing impediments in utilization of full capacity of the fish farm.

RESERVOIR UNIT

The fish wealth in the Tungabhadra Reservoir is auctioned to the Fishermen Co-operative Societies existing on the periphery of reservoir.

The leasing of fishing rights of the Reservoir for the period from 8/2014 to 5/2015, 8/2015 to 5/2016 was awarded to the Tungabhadra Reservoir Fishermen Co-operative Society Ltd., Koppal for Rs.1,04,77,740/-, Rs.1,10,29,200/- respectively & for 8/2016 to 5/2017 was awarded to the Tungabhadra Fisheries Co-operative Society Ltd., Korlahalli, Gadag(Dt) for Rs.90,01,116/-. The full tendered amount has been paid by the said Societies.

PEN CULTURE

Pen culture is being done in Tungabhadra Reservoir in Karnataka since 1982. Pen is an enclosed area in the back water of reservoir to rear fish seeds. Pen is erected by using Casuarina and Bamboo poles with Monofilament cloth (HDPE cloth) of 30 to 40 mesh size. During the year 2014-15 & 2015-16 Pen culture was taken up at Chikkabaganal village in the backwaters of T.B.Reservoir to rear 258.50 & 66.00 lakhs respectively of Major carp Spawn to advanced fingerlings stage (60 mm to 75 mm) for a period of 75 days, which yielded 43.00 & 9.60 lakhs of Fingerlings respectively and the same was released to the reservoir to increase the fishery "Bio mass". Penculture for the year 2016-17 was not taken up.

ICE CUM COLD STORAGE PLANT

Fish is a highly perishable commodity. Its preservation soon after its catch from the water is essential. Icing the fresh fish is the simplest preservation method. In order to meet the ice demand of the fishermen, 5 tonne capacity Ice Plant was set up in the year 1966. At the same time a 10 tonne capacity cold storage plant was also established. As there is no demand for cold storage space, the idle 5 tonne ice and 10 tonne cold storage plant machineries has been disposed off through public auction. Another ice plant of 10 tonne capacity was set up in the year 1986 which is presently functioning and ice is being marketed throughout the year,

with peak season falling between February to May.

THE AQUARIUM "PARNAJA"

As the Tungabhadra Project attracts large number of visitors annually, in order to inculcate the essence of aquatic lives in the visitors, an aquarium by name "Parnaja" was constructed in the Japanese Park at a cost of Rs 45 lakh and through open to the visitors in August, 1999. The aquarium with about 65 varieties of cultivable, indigenous and ornamental fish provides a feast to the eyes and relaxation to the mind. It also provides latest information on the aquatic life to the inquisitive mind. The aquarium is constructed as a thematic building and

equipped with modern aeration and filtration system to maintain good hygiene.

FINANCIAL PERFORMANCE

PHYSICAL PERFORMANCE

The physical performance of all the four units of FW during the year 2014-15, 2015-16 & 2016-17 is given in Annexure 5.2. The Annexure also gives the performance of these Units during the past 10 years.

Year	Budget Allocation	Expenditure	Receipts
2014-15	175.70	127.50	149.88
2015-16	179.73	117.36	143.18
2016-17	207.39	124.21	118.74

HEALTH AND MEDICAL CARE

INTRODUCTION

Health and Medical Unit of the Board is responsible for medical care of Board's employees and for general sanitation of Board's colonies at TB Dam, Hampi and Bellary. Dr. K.M. Anjini, MBBS, D.Ortho, Senior Specialist is in-charge of the post of Health Officer, Class I (Jr.) for the annual period April 2014 to May 2015 & Dr.T.Roopu, MBBS, is in-charge of the Medical and Health Unit of the TB Board, TB Dam from June 2015 to March 2017.

The Health Officer Class-I (Jr.) is assisted by two health Inspectors for the effective discharge of the Public Health Activities i.e., one at Tungabhadra Board, TB Dam and another at Hampi Camp.

ORGANIZATION

Health Officer Class-I (Jr) is In-charge of the Unit. She is in the rank of Deputy Surgeon in Government of Karnataka. For assisting her in health activities there are two Health Inspectors one each from Andhra Pradesh and Karnataka. There are two Civil Assistant Surgeons from Karnataka one each at the Project Hospital and Dispensary. Further, there is one Lady Medical Officer in the rank of Civil Assistant Surgeon (Karnataka) in the

Project Hospital. There are other para medical staff and ministerial staff in the Hospital and Dispensary. All these staff at present is from Karnataka. There are Health Mazdoors born on contingent establishment and they are treated as Board employees. The organization chart of the Health and Medical Unit is at Annexure 6.1.

FUNCTIONS

The important functions of the unit are:

- x General sanitation of Colonies.
- x Immunization programme for child health.
- x Bacteriological and Chemical Examination of drinking water.
- x Prevention of epidemics.
- x Anti-Larval measures.
- x National Malaria Eradication Programme.
- x Collection of vital statistics such as births, deaths etc.
- x Medical facilities for out patients and in patients.
- x pathological testing.
- x Minor operation.
- x Family welfare measures and small family norms.

ACTIVITIES OF THE PUBLIC HEALTH UNIT DURING THE YEAR 2014-15, 2015-16 & 2016-17.

- x **Vital Statistics:** Birth & Death registered promptly in the TB Board and Hampi Camp area. The children have been protected with DPT & Polio, T.T. vaccines etc.
- x **Cholera:** The Tungabhadra Board arepa is free from cholera and other epidemic diseases.
- x **National Malaria Eradication Programme:** The Anti-Malaria drugs supplied by the District Malaria Officer, Bellary and Dist. Health & Family Welfare Officer, Bellary were given to all the fever cases duly collected blood smear (samples) for all the fever cases under active and passive surveillance in the TB Board area. Malaria positive cases are treated with Radical Treatment by 4 Chloroquine and 8 Aminiquine Tablets for each case. General pathological investigations have also carried out in this hospital during 2014-15, 2015-16 & 2016-17.
- x **Spraying:** Malathian 50 EC has been used for spraying, fogging and for controlling adult Mosquitoes. Baytex is also used for spraying in the controlling mosquitoes in the TB Board colonies in the TB Dam / Hampi Camp / Tornagallu and Bellary. "Baytex" is being used in the TB Board colonies to kill the Larvae of the Mosquito. This has been sprayed

on the water surface area as a measure of Anti Larval Operations. Responsar insecticide is also used for destroying mosquitoes, cockroaches and flies of indoors.

- x **Bacteriological and Chemicals analysis of water:** The water samples of TB Dam and Hampi Camp were sent periodically for conducting Bacteriological and Chemical analysis at Public Health Institute, Bangalore & Gulbarga during the years 2014-15, 2015-16 & 2016-17. The Drinking water samples from TB Dam & HPC will be sent for Chemical & Bacteriological examination sent once in every 3 months.
- x **Killing of stray dogs in the colonies:** Stray dogs were killed in the T B Dam and Hampi Camp colonies to prevent Rabies Diseases.
- x **General sanitations:** TB Dam / Hampi Camp colonies are kept clean and tidy. The drains are cleaned on alternate days, apart from the sanitations. Malathian issued for controlling the adult mosquitoes.
Regular sanitations work is carried out during the year 2014-15, 2015-16 & 2016-17. Removal of Juli flora and parthenium weeds has been cleared of during the years 2014-15, 2015-16 & 2016-17 on job work basis.
- x **Immunizations:** The children of the TB Board were immunized to prevent the

communicable diseases by giving them 'O' Polio, BCG, DPT, Hep 'B', Measles, Vit A Booster to the extent of 583 nos. for average 48 children during 2014-15, 697 nos. for average 58 children during 2015-16 & 612 nos. for average 51 children during 2016-17.

TBP Hospital, TB Dam & HPH Dispensary

Activities of the Medical Unit of the TP Hospital and TBHES Dispensary, Hampi Camp during the year 2014-15 , 2015-16 & 2016-17.

TBP Hospital, TB Dam:

- x Outpatient Department – Nearly 42684, 41215 & 45764 patients were treated as out patients during the years 2014-15, 2015-16 & 2016-17 respectively.
- x 190,169 & 367 Patients were treated as inpatients in the Hospital during the years 2014-15, 2015-16 & 2016-17 respectively.
- x Family Welfare Programme – Most of the couples in the TB Board area advised to adopt small family welfare norms.

TBHES Dispensary, Hampi Camp:

- x Outpatient Department – Nearly 11605, 9956 & 11358 patients were treated as outpatients during the years 2014-15, 2015-16 & 2016-17 respectively

- x In patients are not treated in the TBHES dispensary, Hampi Camp.

Operation and Maintenance by the different units:

The Health Inspector, TB Dam is kept for Health and sanitation work in the TB Dam and one Health Inspector is kept at Hampi Camp for smooth functioning of the scheme.

FINANCIAL PERFORMANCE

The budget for the Health and Medical activities at TB Dam, Torangallu and Bellary is provided under Irrigation, whereas that for Hampi Camp is provided under HEW. The Health Officer, Class-I (Junior) renders separate accounts to IW and HEW for the years 2014-15, 2015-16 & 2016-17.

Year	Wing	Budget allocation	Expnd incurred
2014-15	Health Unit	55.51	149.00
	Health unit HPC		24.66
	Medical Unit	42.38	41.25
2015-16	Health Unit	86.92	147.63
	Health unit HPC		28.30
	Medical Unit	62.78	48.21
2016-17	Health Unit	108.86	144.59
	Health unit HPC		33.16
	Medical Unit	80.85	62.38

PARKS AND GARDENS TOURIST ATTRACTION

FOREWORD

The Tungabhadra Gardens in the downstream of Dam area is the main source of attraction for the tourists/visitors, who are visiting TB Dam. It is one of the oldest and famous biggest existing gardens since 1956-57 in the North Karnataka area. About more than 5 lakhs tourists/visitors are visiting the gardens per annum, out of the 10 to 12 lakhs visitors who are visiting the TB Dam. The Garden Unit (GU) under the Irrigation Wing is in charge of all horticultural activities in the Dam area, colonies and canal banks maintained by the Board. It is also responsible for the development and maintenance of plant wealth in the Board's area.

ESTABLISHMENT

The Senior Assistant Director of Horticulture who is deputed from the Department of Horticulture, GOK working as Superintendent of Gardens in TB Board is looking after all the technical / scientific matters of GU. The GU has upgraded in the year 1999 vide 167th Board meeting, on par with Sub Divisional Officer, until then it was acted as a Garden section.

Superintendent of Gardens of GU is assisted by one Assistant Horticulture Officer in Horticultural activities and one Section Officer for Civil works of the Garden Unit. For administrative, accounting and execution of the works, the Garden Unit is functioning as a Sub Division under the Administrative and

financial control of Executive Engineer, HW & HLC Division, TB Dam.

TASKS

The tasks of the Garden Unit are given below:

- x To maintain the existing parks, gardens and Children's park
- x To maintain still fountains, Musical Dancing Fountains.
- x To maintain Boating pond, vehicle parking, Garden Entrance fee collection etc.,
- x To maintain and looking after the TB Dam Mini Zoo and Aviary.
- x To looking after and maintenance of the Mini Bus facility, Canteens Toilets etc.,
- x To maintain canal plantations, woodlots and Vaikunt Guest House hillock plantations;
- x To rejuvenate existing lawns in various parks and gardens;
- x To raise new plantation in vacant land of the Board.
- x To raise seasonal and annual flower beds in parks and gardens and to make floral arrangements; and
- x To maintain the Malyavantha Coconut Garden at Hampi Power House colony.

PARKS AND GARDENS

Since completion of the Dam, the Board has developed and maintained many parks, gardens at downstream of the Dam, canal plantations and in the TB Dam colonies on

the right side. These gardens are attracting many tourists. A brief description of the important parks and gardens, maintained by the Board is given below:

Nandanavana

Nandanavana was developed during the year 1956-57 soon after completion of the Dam. This garden is located just below the Dam running parallel to it. It has an area of about 2.43 ha and is designed and developed on the lines of Brindavan Gardens at Krishna Raja Sagar near Mysore. It is well laid with four terraces at different elevations. The first terrace is housing circular type fountain with a Nandi statue at the center. All terrace is provided with fountains of various designs, with different colour lights running parallel and perpendicular to the layout of the garden. At the end of the last terrace Lord Shiva statue is placed at the top of the artificially created hillock. A water fall is also provided utilizing the height of the hillock. This garden has well maintained lawns, lantana on the slopes, seasonal and annual flower beds, Christmas trees, cypress plants and topiary arches.

Japanese Park

Japanese Park was developed in the year 1968-69 with a total area of 7.29 ha and is located adjacent to Nandanavana garden. It has got 3 water ponds, namely mango shaped pond, bean shaped pond and children peddle pond. This park has arches, ornamental flowering trees, flower beds, well laid out lawns, etc., Play facilities to the children are provided in the park. A musical dancing fountain and aquarium are also located in this park.

Vaikunta Guest House Garden

Garden at Vaikunta Guest House was developed during the year 1960-61. It is a

formal garden with well-designed fountains, flower beds, topiary arches, flowering trees, aesthetically cut lawns etc.

Chakravana and Triveni Bagh

A Circular Park called as CHAKRAVANA and a TRIANGULAR PARK called as TRIVENI BAG are located in front of the administrative building. They are developed at the time of construction of the Dam. It is also a formal garden with lawns, flowering trees, shrubs, arches etc. In the centre of the Chakravana the concept of 'GOVARDHANA GIRI GOPALA' and art is created and it is provided with jet and flower fountains with colour lights. The concept is suitably illuminated. The entire periphery of the Chakravana is provided with ornamental grill which provides protection and looks beautiful.

Afforestation / Plantation

As a mark of World Environment Day, Garden Wing has developed tree plantations by planting about 6000 during 2014-15 & 3000 during 2015-16 plants in TB Board vacant areas to safeguard the Board land from unauthorized encroachments as well as to enriching the greenery as mark of minor contribution in reducing the Global Warming.

Boating facility

During 2010-11, the boating facility in pond of 200 x 90 Mtrs size, created at old TSP yard with beautified surrounding area. Later, it has been renovated during 2012-13 and has been made available to tourists visiting the gardens through tender for Rs.7100/- pm for a period of three years from 1/9/2012 to 31/8/2015 for total Rs.2,55,600.00. Further it is extended upto 31-01-2016 for administrative grounds with increase in monthly license fee of Rs.7,455/-pm.

Rose Garden

A new rose garden with about 500 rose plants was established by the side of Japanese park in 2001. The rose garden has varieties of blooming plants aesthetically arranged.

OTHER ATTRACTIONS

The gardens, parks and lush green surrounding of the Dam attract a lot of visitors every year. In addition to the parks and gardens the visitors are much fascinated by seeing and enjoying the Aquarium, Musical Dancing Fountains, TB Dam Mini Zoo, Aviary and Children's park.

Musical Dancing Fountain

A set of fountains dancing to the rhythm of the music with varying colored light using the state of art technology has been provided as a source of attraction and entertainment to the visitors. The musical dancing fountain was constructed in the year 1992 in the Japanese Park. The computerized operation to synchronize with the music was introduced in 1999. The reverberating music, fascinating colorful light and vivacious fall of water droplets dancing to the tune of music from the fountains take away the stress of the mind and offers full recreation to the young and old people alike. The visitors assemble around to enjoy the fountain as soon as the dusk falls.

AMUSEMENT FOR KIDS:

9D VR Cinema & Kiddy Boating has been established for amusement of kids in Japanese Garden.

TB Dam Mini Zoo

The TB Dam Mini Zoo is located by the side of Japanese Park. It was developed in the year 1982, with an approximate area of about

6.07 ha. At present, it has got about 93 spotted dears, 9 black bucks.

Children's Park

Children's park is located in the township area of TB Dam on the main road and was developed during 1984. It has got latest type of sea-saws, bars, swings and other items for children.

Aviary

A small aviary is housed near the Rose Garden and was developed in the year 1989. Presently, it has got about 6 Peacocks and 8 ducks. An additional Aviary cell has been constructed during 2013-14 to accommodate new variety of birds.

Vermi Culture Compost unit

The Gardens are known for their healthy atmosphere and as a result many people wish to spend some time in the Gardens. But the use of inorganic fertilizers and plant protection chemicals for day to day maintenance adversely affected healthy environment of gardens. In order to keep the garden free from pollution and at the same time provide eco-friendly manure for the health of the plants Garden Unit has established vermin culture compost units in the TB Dam garden. So far 12 units of 20 m x 0.9 m x 0.6 m size compost pits were constructed with the production capacity of 100 tons Vermicompost per year, which will be sufficient for the maintenance of the garden. Provision for production of Vermicompost has also been made, which can be used for plant protection. The establishment and production of Vermicompost Unit has resulted in beneficial use of garden waste as well as other biologically degradable waste from TB Dam colony.



CHAKRAVANA- GOVARDHANA GIRI GOPALA



MUSICAL FOUNTAIN

9D VR Cinema in Japanese Garden





Kiddy Boating in Japanese Garden



MINI ZOO

PLANTATION IN BOARD LANDS



AFFORESTATION IN BOARD VACANT LANDS



**Swacha Bharath Pakhwada -2017
Fore-bay of Hampi Power House**



**Swacha Bharath Pakhwada -2017
Fore-bay of Hampi Power House**



After Cleaning



Swacha Bharath - Munirabad Damside - Earthen Bund



Swacha Bharath - Munirabad Damside - Earthen Bund



Swacha Bharath - Munirabad Damside - Earthen Bund



After Cleaning



Implementation of 'Swacch Bharat Abhiyan'

As part of 'Swacch Bharat Abhiyan' a Nationwide programme, the Garden Wing has taken up 'Cleanliness Campaign' at regular intervals in an around TB Dam with the active participation of the TB Board staff with the objective to promote the cleanliness awareness among the public.

Swacha Bharath Pakhwada - 2017

Cleaning of Fore-bay of Hampi Power House was done on 30-3-2017. Sri S.N.Pande, Senior Joint Commissioner from Ministry of Water Resources also participated in the programme on behalf of Government of India.

Cleaning / Jungle Cutting at Munirabad Dam Side - Earthen Bund during April 2017.

Malyavantha Coconut garden

In order to avoid unauthorized encroachment of Board land and to utilize the same in a better way 18.0 ha of vacant land at Fore bay and on either side of Power Canal at Hampi Power House Colony is planted with coconut, sapota, Amla, Jack etc., during the year 2001. All the plants have good growth and the production is started during the year 2009-10. This Garden is maintained by Garden Unit under the administrative and financial control of the Executive Engineer, LLC Division, Ballari. During the year 2014-15, 2015-16 & 2016-17 the coconut produce has been disposed off by auction sale for Rs.1,50,000/-, 1,51,000/- & Rs.65,000/- respectively.

PUBLIC AMENITIES BUILDING TO VISITORS

Tungabhadra Dam, being 6 km away from the Taluk headquarters Hosapete, is well connected by rail and road. The national

highways 13 and 63 pass through TB Dam. In addition to the Vaikunta Guest House and Inspection Bungalow maintained by the Board, dormitory accommodation is provided in M.S.Tirumala Iyengar Hall for the visitors. Further, there is accommodation provided by Karnataka State Tourism Development Corporation. The Board for the benefit of common visitors provides a free tourist shelter at the main entrance of TB Dam which facilitates canteen, cloak room, braveries/ bakery items and bath & toilets rooms etc. The salubrious climate, amenities available, beautiful surroundings, variety of attractions in the gardens and parks attract the visitors and they happily pay repeated visits year after year.

Mini Bus Facility

Mini Bus facility has been provided to the tourists to enable them to enjoy stress less journey in site seeing the beauty of the TB Dam, Gardens and places like Vaikunta Guest House, Dam model house, Dam crust gates, Boating pond area at the cost of Rs.20/- for adults and Rs.10/- for children.

Entry fee for Gardens

During 2014-15, 2015-16 & 2016-17

<input type="checkbox"/> Adults	Rs.20/-
<input type="checkbox"/> Children (below 12 years	Rs.10/-
<input type="checkbox"/> School and College Students visiting on education tour	Rs.05/-
Children below 5 years of age and the primary school children visiting the Gardens under Chinnara	No Entry fee

Karnataka Darshan programme as per the Government Order.

The Board in the 206th meeting held on 29th November 2014, decided to levy entry fee for Gardens at the following rates:

**Entry fee for vehicle parking
During 2014-15, 2015-16 & 2016-17**

The Board in the 204th meeting held on 3rd August 2013, decided to levy vehicle parking fee at the following rates:

- Cycle Rs.02/-
- Motor Cycle / Cycle Rickshaw Rs.06/-
- Auto Rickshaw Rs.10/-
- Car, Jeep, Van, Mini Bus and such other light vehicles Rs.20/-
- Bus / Truck and such other heavy vehicles. Rs.40/-

REVENUE GENERATED:

The budget of the garden unit is included in the Budget of Irrigation Branch. The Garden Unit generated revenue Rs. 57.12 lakhs during 2014-15 as against the maintenance expenditure of Rs.40.00 lakhs approximately Rs.100.28 lakhs during 2015-16 as against the maintenance expenditure of Rs.26.00 lakhs approximately and 102.98 lakhs as against the maintenance expenditure of Rs.35.00 lakhs during 2016-17.

The details of Revenue generated from all sources for the year 2014-15, 2015-16 & 2016-17 under Garden Wing are given below.

Revenue receipts during the year 2014-15, 2015-16 & 2016-17.

Sl. No	Particulars of source of revenue	2014-15	2015-16	2016-17
1	Collection of Garden entry fee from Tourists	43,78,088	73,99,999	66,64,999
2	Collection of vehicle parking fee from Tourists.	10,02,000	16,32,649	12,72,700
3	Providing Canteen facility in Nandanavana Garden, Main Gate entrance, near Deer park, Tea Staff, TBDam.	1,68,000	7,44,348	6,14,977
4	Providing boating facility for Tourists visiting TB Board Gardens at TB Dam	85,200	1,69,200	1,67,712
5	Providing Mini Bus service to the tourists visiting TB Dam	55,200	55,200	13,07,988
6	Installation of coin operated weighing machine at Fish Aquarium, Japanese park at TB Dam	6,720	6,720	7,980
7	Permission for in-house photo-grapher to take photos of Tourists / visitors desiring in the TB Board Gardens at Nandanavana of TB Dam.	6,000	9,000	9,600
8	Running Toilet Block on pay and use system near Boating Pond, TB Dam	3,600	3,600	28,504
9	Running Toilet Block on pay and use system near MDF, TB Dam	3,840	3,840	1,99,992
10	Running Toilet Block on pay and use system near RBHLC, TB Dam	3,240	3,240	24,125
	Grand Total	57,11,888	10,027,796	10,298,577

SECURITY SYSTEM

INTRODUCTION

The Security Section is in charge of the overall security of various structures, installations, canals and colonies maintained by the Board. Even though the Board has the status of a State Government with regard to the operation and maintenance of the project within the limits of the Board, it has no police staff of its own to deal with the law breakers, criminals, etc. Also, it has no judicial powers to punish anyone taking water without authorization either from the reservoir or along any of the canals maintained by the Board. For these matters, the local revenue and police authorities of Karnataka assist the Board.

ORGANIZATION

The Secretary, Tungabhadra Board is also designated as Chief Security Officer and the Assistant Secretary as Security Officer. The Security Section functions under the direction of Chief Security Officer. Four Assistant Security Officers and four Head Constables assist the Security Officer. These posts are filled through deputation from the Police Department, Government of Karnataka. The Organization Chart of Security Section is at Annexure 8.1.

In addition to this, DAR Police security guards are provided by the Police Department, GoK to man five security posts one each at the three power houses and one at each end of the main dam. One Head Constable and 4 Police Constables man each security post on a ten-day rotational basis. As the number of watchmen in the Board decreased over the years, private security agency is entrusted with watch and ward of vulnerable areas, office premises, stores, etc.

FUNCTIONS

The security staffs are assigned the following duties:

- x check entry of visitors in the restricted areas;
- x perform day and night patrolling duties;
- x carryout night checking of security guards, night watchmen and private security guards;
- x collect intelligence information regarding activities against the interest of the Board;
- x take part in prevention of encroachment or unauthorized occupations etc., in the Board's colonies;
- x carryout special work of investigation on complaints;

- x render assistance to the officers in the issue of passes for vehicles to ply over the dam and passes for visitors, tourists, etc; and
- x Perform any other duties assigned by the Chief Security Officer.

SECURITY OF DAM AND POWER HOUSES

The Dam and the Power Houses situated on the right and left banks of the river and at Hampi have national importance. Realizing the need to provide security at these places, GoK approved Industrial Security Scheme covering these installation vide Order No HD 68 SGD 63 dated 10-05-1963. This scheme has laid down detailed security instructions. The Sub-Station at Bellary also came under the Industrial Security Scheme since 1973 vide GoK Order No HDIS/SCD 73 dated 27-09-1973. This was completely revised and fresh Scheme was approved by GoK vide their Order No HD 779 SST 81 dated 25-11-1981. The dam, the three power houses and the Sub-Station at Bellary have been declared as prohibited places by the GoK. Under the Industrial Security Scheme, five security posts have been established at following locations:

- x Left Bank gate of Dam
- x Right Bank gate of Dam
- x Left Bank Power House, Munirabad
- x Right Bank Dam Power House
- x Right Bank Hampi Power House

These security posts are manned by the personnel of the District Armed Reserve (DAR) guards, who are deputed by the

Superintendent of Police, Bellary, GoK. The expenditure for their deployment at the right bank gate of the Dam and at the Dam Power House and Hampi Power House is borne by the Board. Expenditure for the security personnel at the left bank gate of the Dam is initially met with by the Board, but is fully reimbursed by the Chief Engineer, ICZ, Munirabad. For the left bank power house, the expenditure is directly paid by KPCL to the Police Department.

SECURITY OF CANALS

Many a times farmers resort to forcible excess drawals of canal water and also damage Board's properties, thereby disrupting the entire irrigation system. To prevent such activities and also to give protection to its staff, from 1994-95 onwards the Board had sanctioned 14 District Armed Reserve Police force. Government of Karnataka had also accorded approval for 30 KSRP personnel and directed D.I.G., Bangalore, to provide assistance to the Board, as and when required, for water regulation of LLC. The lent establishment charges for 14 DAR personnel only are borne by the Board and for the 30 KSRP, the wages are borne by Government of Karnataka. The DAR is deployed for assisting water regulation on the RB HLC and RB LLC wherever required.

In order to safeguard various structures on the canals from vandalism and damage, Governments of Karnataka and Andhra Pradesh were requested by the Board to declare certain areas around these structures

as prohibited areas. Government of Karnataka vide their notification No. HD/268/SST/95 dated 17-10-97 has declared 140 such structures falling within the territory of Karnataka as prohibited areas. Similar action is pending from Government of Andhra Pradesh who has called for certain clarifications. Arrangements are being made to restrict the movement of general public in these prohibited areas.

OTHER SECURITY INTERESTS

Government of Karnataka has established a regular police station at TB Dam under the control of one Sub-Inspector, which is catering to the requirement of the Board and its employees living in the colonies at TB Dam.

The Board in its 135th meeting decided to entrust the job of watch and ward of vulnerable areas, office premises, stores, etc., to private security agency as the watchman employed by the Board were very few. Accordingly, a private security agency M/s. Professional Security Service, Bangalore has been engaged for the security of the drainage gallery, office premises, rounding Official colony, rounding Hampi camp colony etc., with effect from 16th January, 1997. During the years 2014-2015 & 2015-16 there are 80 Nos., private security guards - Men, 2 Security guards – Women, 2 security Supervisors and 1 Security Driver and for the year 2016-2017 a private security agency M/s. Security & Intelligence Service (India Limited), Hosapete Branch has been engaged. There are 89 Nos., private security guards -

Men, 2 Security guards – Women, 2 security Supervisors and 2 Security Drivers.

As advised by Central & State Intelligence Bureau 22 Nos. of C.C.Camaras were installed at vulnerable sensitive places and also Hand Held Metal Detector (HHMD) & Door Frame Meter Detective are also provided for the safety and security of the vital installations and monitored daily by Security Section of Tungabhadra Board.

FINANCIAL PERFORMANCE

The Budget of the Security Section is included in the Irrigation Branch grant. Irrigation wing of the Board will fix-up the private security agency once in three years by calling open tenders and the total expenditure is borne by Irrigation wing of the Board.

The expenditure incurred is shared between the IW, HEW and KPCL of the Government of Karnataka. The expenditure of Security Section (excluding the expenditure of Private Security Agency) incurred during the years 2014-2015 is Rs.29.00 lakhs, 2015-16 is Rs.27.94 lakhs & 2016-2017 is Rs.25.93 lakhs.

PHYSICAL PERFORMANCE

The routine duties assigned to the Security staff were accomplished. Vigilance to safeguard the properties of the Board was increased. As advised by the Police Department, Government of Karnataka and movement of vehicles near to the dam was stopped and visitors were allowed to go near the dam by walking.

COMPREHENSIVE DAM SAFETY PROGRAMME

DAM SAFETY

The Tungabhadra Dam and its appurtenant structures are being inspected routinely by the officers of Board. Detailed inspection of the dam and appurtenant structures are also done once before the monsoon and once after the monsoon. So far no distress of serious nature has been noticed.

The Board in its 161st meeting held on 6 July, 1996 decided that for assessment of the safety of the dam Central Water Commission (CWC) may be approached for taking up comprehensive safety review. Dr. Y.K. Murthy, Retired Chairman, Central Water Commission, New Delhi provided expert guidance in Dam Safety Review. The terms of reference for the Dam Safety Review were finalized and provided to CWC. The experts from CWC and Dr. Y.K. Murthy conducted detailed inspection of the dam and appurtenant structures in September 1997 and May 1998.

OBSERVATIONS OF REVIEW TEAM

The observations in identified areas are as under:-

1. Silt and Sedimentation in the Reservoir

From the various Hydro Graphic surveys conducted from 1963 to 1977, it can be observed that the rate of siltation in the

Tungabhadra Reservoir is of the order of 1.78 TMC ft/year during the first ten years.

However during the period from 1981 to 1996 the rate of siltation has come down to the order of 0.410 TMC ft/ year. Overall for the last 40 years it works out to 0.52 TMC ft./ year.

2. Masonry Dam

After impounding of the water in 1953 several officers and teams have inspected the dam and given their suggestions.

i) Non-overflow Section

In general the function of the non-overflow section is quite satisfactory right from the beginning except a small crack at chainage 4847 in block No.37, at the junction of the masonry and earthen dam on left flank.

ii) Over-flow Section

The function of the over-flow section of the dam right from beginning is quite satisfactory. A few stones in the stilling basin have been eroded/dislodged. At the base of the spillway it is observed few seepage marks in the glacis of the spillway.

iii) Drainage Gallery

The seepage from the drainage gallery both from porous drains and drainage holes is observed to be at normal level. The Drainage

hole at chainage 110' is releasing a jet of water under high pressure. The cumulative lime leached out from different zones of the drainage gallery, such as red cement mortar zone and lime surki mortar zone were analysed and the leaching is of negligible order of 0.007% per year.

3. Composite Dam 267' at the left end of non-over flow section

Minor settlement in the earth dam portion of composite dam was noticed in this reach and no records were available regarding the details when it has started.

4) Earth Dam (in saddle No.1)

Some patches of erosion of stones in the upstream face of the dam were appears to be due to heavy wave action.

5) Composite Dam 1550' long situated on extreme left flank

It was observed from time to time that settlement has been noticed in the earth dam portion of the composite dam. Often seepage of water is observed around the barrel of left canal sluice.

6) Sluice gates in the Right Bank

The sluice gates located in the low level canal in the right bank are not properly closing leaving a small gap at the bottom. Enormous sound is also observed in the sluices.

7) Spillway gates

No major structural deficiencies were noticed in the spillway gates. Some problems have been encountered in side guide rollers as they

are worn out/jammed or misaligned. The structural steel portion of some of the roller tracks are reported to be in heavily pitted condition.

8) Special Studies

In addition to the visual observation of the Inspection Team, studies on specific areas were entrusted to specialists. The evaluation of physical properties of the masonry dam was entrusted to a reputed private consultant. The geological features were studied by Director, Engineering Geology Hyderabad. The seismic design parameters were studied by Central Water and Power Research Station (CWPRS), Pune. The Joint Director, CWPRS, Pune, who had carried out the specific study for the project at site and arrived the results on design response spectra and accelerograms for MCE and DBE condition for the focal depths of 10 km and 15 km respectively at the WCSDP meeting held in December 2003. The Committee has recommended that a Peak Ground Acceleration (PGA) of 0.27 g for MCE condition and 0.14 g for DBE condition, along with the response spectra given in the site specific seismic report (Technical Report No. 3549, October 1998, CWPRS, Pune) may be adopted for the safety review of the project. All the remaining studies were carried out by the CWC.

After completing the studies CWC submitted the draft report. Dr. Y.K. Murthy, Consultant to the Board, examined this report.

The comments of the Consultant were sent to CWC for finalizing the report. The final report submitted by CWC was made into two volumes, Volume I containing the detailed report and Volume II (Annexure) containing the studies made by various expert agencies involved in the work. The recommendations for remedial measures contained in section XIV of the report are at Annexure 9.1

Present Stage:

The Hydrographic Survey was conducted during 2008 and the Reservoir Capacity of 100.855 TMC.

The stilling basins in the over flow section are dewatered every year after monsoon season for the damages occurred if any during spilling. The stones eroded / dislodged if any are reset / filled with Concrete and joints pointed to avoid further damages.

The sluice gates located in the Low Level Canal (Power Canal) in the Right Bank are maintained in good condition and there is no problem in operation.

The pitted roller tracks of spillway gates are replaced and side guide rollers of all the 33 Spillway Gates are replaced with new ones.

REPLACEMENT OF END BOXES AND ROLLERS OF SPILLWAY GATES

Because of aging process there is deformation of end box rollers and side rollers and were not functioning properly.

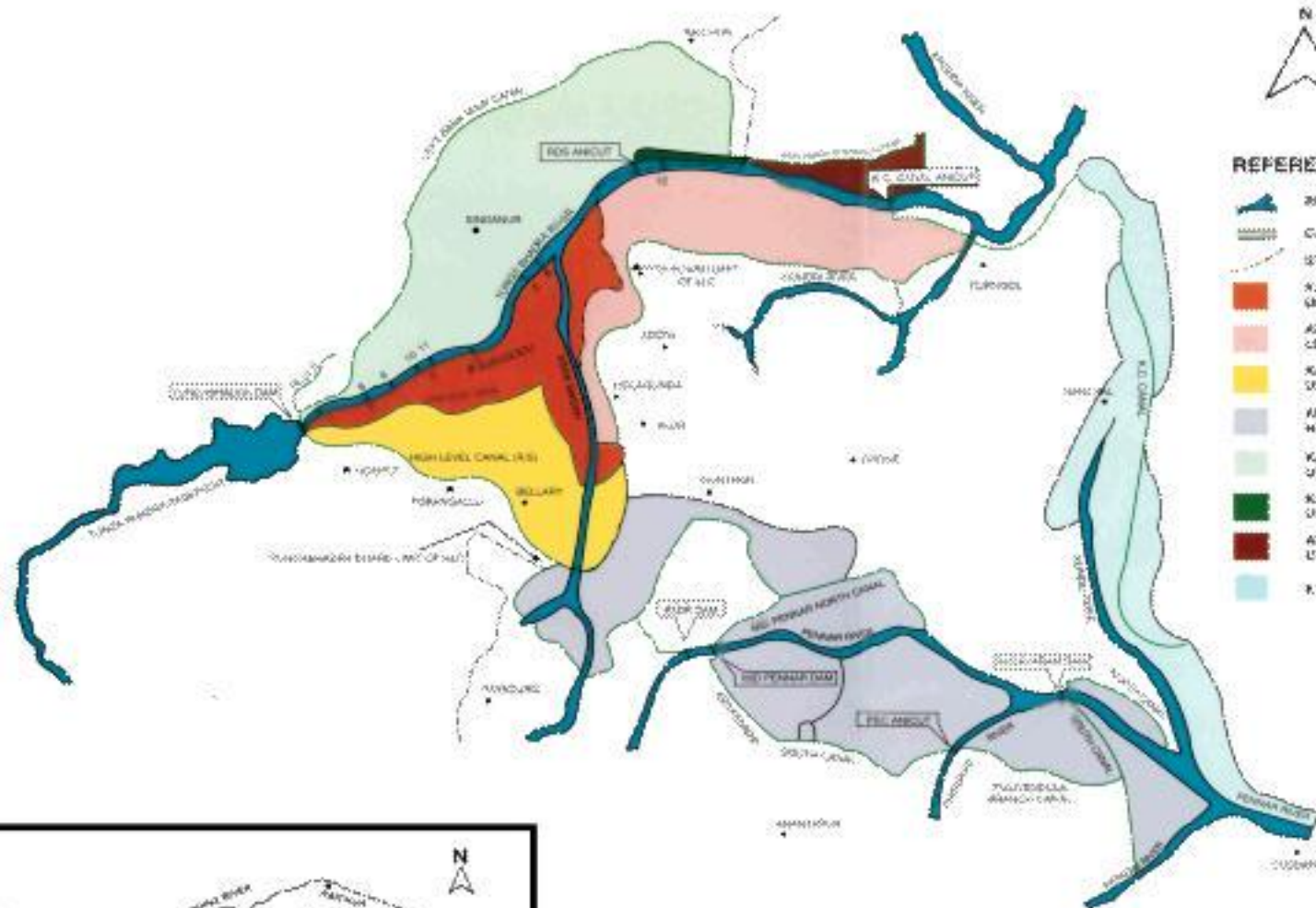
M/s Tungabhadra Steel Products Ltd., TB Dam suggested replacement of the end box and guide roller assembly of gates with allied works for smooth functioning. As per the recommendations made, the replacement of end box assembly and guide rollers for 33 Nos spillway gate were completed during the year 2007-08.

The Board in its 188th Board meeting held on 27-9-2008 decided to engage consultancy services for preparation of Detailed Project Report (DPR) for Comprehensive safety of Tungabhadra Dam.

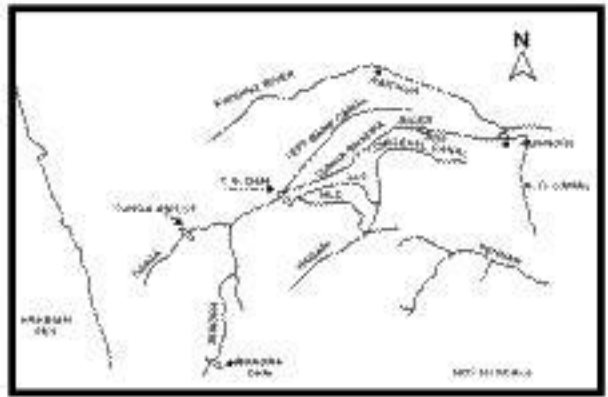
The standard tender document for consultancy services for preparation of DPR for comprehensive safety of T.B.Dam was circulated to both Members of Karnataka and Andhra Pradesh and the same was approved by both the governments.

The work for preparation of DPR for Comprehensive Safety of Tungabhadra Dam was entrusted to M/s Aaree Associates Architects Engineers and Consultants Pvt. Ltd., Hyderabad vide Superintending Engineer, IB, T.B.Board Agreement No.48/2010-11, dated 3-3-2011 for Rs.81-00 lakhs, and the firm has started the survey work.

ANNEXURES



- REFERENCE**
- RIVERS
 - CANALS
 - STATE BOUNDARY
 - KARNATAKA AYACUT UNDER I.L.C. OF BOARD
 - ANDHRA PRADESH AYACUT UNDER LOW LEVEL CANAL
 - KARNATAKA AYACUT UNDER I.L.C. OF BOARD
 - ANDHRA PRADESH AYACUT UNDER HIGH LEVEL CANAL
 - KARNATAKA AYACUT UNDER LEFT BANK CANAL
 - KARNATAKA AYACUT UNDER R.R.
 - ANDHRA PRADESH AYACUT UNDER R.R.
 - K.C. CANAL AYACUT



- BENEFITTING AREAS ON THE RIGHT SIDE**
- 1 Haveli Area
 - 2 Natta Area
 - 3 Hanasagar Area
 - 4 Kumpi Area
 - 5 Srirangapatna Area
 - 6 Dattur Area
- BENEFITTING AREAS ON THE LEFT SIDE**
- 7 Thalgi Area
 - 8 Shivapur Area
 - 9 Anupuri Area
 - 10 Upper Gogaveti Area
 - 11 Lower Gogaveti Area
 - 12 Rona Area

TUNGABHADRA BOARD
INDEX MAP OF
TUNGABHADRA PROJECT

SALIENT FEATURES OF TUNGABHADRA PROJECT

1. LOCATION

River	Tungabhadra
Village	Mallapuram
Taluk	Hospet
District	Bellary
State	Karnataka
Longitude	76° – 20' – 10" E
Latitude	15° – 15' – 19" N

2. RESERVOIR

Catchment area	28177 Sq Km (10880 Sq M)
Gross storage (1953)	3751.17 M Cum (132.471 TMC)
Live Storage (1953)	3718.34 M Cum (131.312 TMC)
Dead storage (1953)	32.83 M Cum (1.159 TMC)
Live storage (1993)	3157.53 M Cum(111.507 TMC)
Gross storage(1993)	3157.53 M Cum(111.507 TMC)
Dead storage (1993)	0
Live storage (2008)	2855.869 M Cum(100.855 TMC)
Gross storage(2008)	2855.869 M Cum(100.855 TMC)
Dead storage (2008)	0
Water spread	378.1 Sq Km
Length of reservoir	80 Km (50 M)
Estimated Annual yield (average)	11,528 M Cum (407.107 TMC)
75% Dependable Annual yield	7263.2 M Cum (256.50 TMC) (336 TMC – upstream abstractions of 79.50 TMC = 256.50 TMC)
Maximum observed flood discharge	10453 Cumecs (369152 cusecs) (Nov 92)
Designed flood discharge	18406 cumecs (650000 cusecs)
Villages affected in (1953)	90 Nos.
Population displaced in (1953)	54,452 Nos.

3. DAM

Length:	
a) Masonry Dam, including Spillway of 2300' (701 m)	1040 m (3412')
b) Composite Dam	546.8 m (1794')
c) Earthen Dam	152.4 m (500')
Average height above Foundation level	49.39 m (162')
Average height above river bed	35.37 m (116')
Average height of Composite Dam	21.34 m (70')
Average height of Earthen Dam	9.14 m (30')
Width of roadway on top of Dam	6.71 m (22')
Width of Dam at base	28.5 m (93.5')
Lowest foundation level	Plus 450.50 m (+1,478.00')
Sill of spillway crest gate	Plus 491.64 m (+1,613.00')
Full reservoir level	Plus 497.74 m (+1,633.00')

SALIENT FEATURES OF TUNGABHADRA PROJECT (Contd.)

Maximum Water level	-do-
Top level of dam or road level	Plus 499.88 m (+1,640.00')
Number of spillways and size of each	33 Nos., 18.29 m x 6.10 m (60' x 20')

4 SLUICES

SLUICE (RIGHT SIDE)	Number	Size	Sill level
High level sluices	10	6'x12'	1585
24" dia pipe	1	24" dia	1579
Raya basava channel	1	6'x12'	1550
Hydro electric turbine pipes	4	11'dia	1550
Irrigation & River sluices	2	6'x12'	1550
SLUICE (LEFT SIDE)			
Irrigation & Hydro electric			
Sluice	10	8'9"x11'6"	1560
24" diameter	1	24" dia	1579
High level sluices	2	4'x5'	1585

5 DAM POWER HOUSE - RIGHT SIDE

Head range	11.9 m to 25.9m (39' to 85')
Number of Power Units	4 numbers 9,000 KW each
Installed capacity	36,000 KW
Energy per day	0.864 MU
Turbines	4 Nos vertical Kaplan reaction type
Generators	4 Nos of 9,000 KW each
Transformers:	
a) 4 Numbers of 10,600 KVA step up transformers	11/66 KV
b) 2 Numbers of 1,500 KVA step down transformers	66/11 KV
c) 1 Number 1,000 KVA step down transformer	66/11 KV

6 HAMPI POWER HOUSE

Power canal (Head reach of RBLLC):	
a) Length	Km 20.2 (13 Miles 570 feet)
b) Capacity	70.79 Cumecs (2,500 cusecs)
No. of Power units	4 Nos 9,000 KW each
Installed capacity	36,000 KW
Energy per day	0.480MU
Approach canal to forebay:	
a) Length	301.8 m (3 Furlongs)
b) Width	13.41 m (44')
c) Velocity	1.2m/Sec (4.01'/second)
c) Discharge	70.79 cumecs (2,500 cusecs)
d) Full supply depth	3.2 m (10.5')

Forebay:

e) Total Length	1,557.5 m (5,110')
f) Composite Dam	378.3 m (1,241')
g) Earthen Dam with puddle Core	1,100.95 m (3,612')
h) Earthen Dam with Masonry Core	78.33 m (257')

SALIENT FEATURES OF TUNGABHADRA PROJECT (Contd)

i) Maximum Height of Dam	24.38 m (80')
Intake structure:	
j) Number of vents	2 No. each 5.49 m x 5.49 m (18' x 18')
k) Sill of pipe	Plus 451.72 m (+1,482')
Pipe Line:	
l) Length Low Pressure	797.98 m (2,618')
m) Number of pipes	2
n) Internal diameter	5.49 m (18' – 0") and 12 mm (½") MS shell
o) Maximum discharge	63.71 cumecs (2,250 cusecs)
p) Maximum velocity	2.68 m/sec (8.8 ft per second)
Surge Tank:	Steel tank of the differential type
q) Shell	18.29m internal diameter (60')
r) Height	18.29 m (60')
s) Port Holes	6 Nos. each 1.83 m x 1.45 m (6'-0" x 4'-9")
t) Riser	5.49 m (18')
Penstock Pipes:	
u) Penstock pipes	4 Nos.
v) Penstock length	103.6 m (340')
w) Penstock internal diameter	3.65 m (12'-0') of 12mm (½") thick MS shell.
x) Penstock maximum discharge	31.9 cumecs (1,128 cusecs)
y) Penstock maximum velocity	About 3.04m/Sec (10 ft/sec)
z) Gross head – range	31.7m to 36.3m (104' to 119')
Tail Race:	
aa) Pond Length	50.6 m (166')
bb) Channel Length	967.5 m (3,174')
cc) Bed width	50' to 120'(15.2m to 36.6m)
dd) Discharge – range	(70.7 - 118.9 cumecs) 2,500 - 4,200 cusecs
Turbines	4 Nos. vertical Francis reaction type.
Generators	4 Nos. of 9,000 KW each
Transformers	4 Nos. of 10,600 KVA step-up transformer 11/66 KV 2 Nos. of 20,000 KVA step-up Transformer 66/132 KV.
Transmission lines:	
ee) 66 KV double circuit lines	20.86 Km (13 Miles) from Dam P.H to Hampi P.H, 67.4 Km (42 Miles)
ff) 66 KV single circuit lines	From Dam Power House to Bellary Sub-Station.

Total Power Development:

gg) Firm	32,000 KW
hh) Seasonal	58,300 KW

7. DAM POWER HOUSE - LEFT SIDE

Number of Twin Penstocks , Including one for irrigation	5 sets.
Size of each penstock	3.2m x 4.01m (10'-6" x 13'-2")
Approximate length of each penstock	23.41 m (77')
Maximum tail race level	Plus 476.71 m (1,564')
Minimum draw down level	Plus 482.20 m (1582')
Minimum tail race level	Plus 477.32 m (1,566')
Maximum capacity of tail race channel	98.21 Cumecs (7,000 cusecs)
Turbines Installed capacity	3 Nos. Kaplan type verticle 27,000 KW
Generators	3 Nos. 9,000 KW verticle
Generator transformers	2 Nos. 11 KV/110 KV/10,000KVA
Interconnecting transformers	2 Nos. 15,000 KVA, 66 KV/110 KV/11 KV, 3 phase
Transmission lines	
a) 110 KV double circuit	304.9 Km (190 miles)
b) 33 KV	163.7 Km (102 miles)
c) 11 KV	401.2 Km (250 miles)
Number of Sub-Stations	8 Nos.

CONSTITUTION OF TUNGABHADRA BOARD

(Extract of Notification No. DW VI 4 (9) dated 10.3.1955)

In pursuance of sub-section (4) of section 66 of the Andhra State Act, 1953 (30 of 1953), and in suppression of the Notification of the Government of India in the Ministry of Irrigation and Power dated the 29th September, 1953, the President hereby gives the following directions in regard to the Tungabhadra Project namely:

1. There shall be established with effect from the 15th March 1955, a Board by the name of the Tungabhadra Board consisting of:

Chairman:

Nominated by the Government of India.

Members:

- i. Representative of the Government of Andhra Pradesh
- ii. Representative of the Government of Karnataka
- iii. Representative of the Government of India

2. The Chairman, if present, shall preside over a meeting of the Board but if the Chairman is absent from any meeting of the Board the Members shall choose one of their member to preside.

3 (i) All matters relating to the project works of common interest to the States of Andhra Pradesh and Karnataka, brought before any meeting of the Board shall be decided by a majority of the Members of the Board present and voting at the meeting before which such matters are brought and the decision of the Board shall be final.

Provided that where with reference to any matter brought before the Board, the Chairman is satisfied that there is a difference of opinion among the Members on any question of policy or the rights of the States

concerned involved in the consideration of such matter, the Chairman shall refer the matter to the Central Government whose decision thereon shall be final.

Explanations: I. If any Member raises at any meeting of the Board any point as to whether a question is a question of policy or whether any rights of the States concerned are involved in the consideration of a matter before the Board, a decision on the points so raised shall be given by the Chairman.

II. Where any Member dissents from any decision so given by the Chairman, it shall be lawful for the State Government, whose representative that Member is, to represent to the Government of India through the Chairman the matter on which a decision has been given by the Chairman and where this is so done, the Chairman shall refer the matter to the Central Government whose decision thereon shall be final.

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(ii) Subject to the provisions of sub-paragraph (i), the Board may make rules for the conduct of its own business.

(iii) No act or proceedings of the Board shall be invalid merely on the ground of the existence of any vacancy in, or the absence of any member of, the Board.

4. (i) The Board shall take charge of, and deal with, all matters relating to works on, or connected with, the Tungabhadra Project which are common to both the States of Andhra Pradesh and Karnataka, but nothing in this sub-paragraph shall be deemed to authorize the Board to deal with any matter in respect of works which relate to only one of the States or in which only one State is interested.

(ii) In particular, and without prejudice to the generality of the foregoing powers, the functions of the Board shall include:

- (a) the completion of the construction of the sanctioned Tungabhadra Project;
- (b) the regulation of supplies of water and power in accordance with such rules as may be made in this behalf by the Board;
- (c) the maintenance of the main canal and of other works common to both the States of Andhra Pradesh and Karnataka.
- (d) maintenance of the dam and reservoir of the Project;
- (e) the granting of leases of fisheries in the reservoir and in the main canal;
- (f) the proper utilization of land acquired for the purposes of the Project; and
- (g) any other function incidental to, or connected with, the functions specified in clauses (a) to (f).

5. (i) For the efficient performance of its functions, the Board may appoint a whole-

time Secretary and such other officers and servants as it considers necessary.

(ii) During any absence on leave of the Secretary, the Board shall appoint a person to act as Secretary and every person so appointed shall exercise the powers conferred and perform the duties imposed on the Secretary by or under this notification.

(iii) All orders and decisions of the Board shall be authenticated by the signature of the Secretary of the Board.

6. (i) The Government of Andhra Pradesh and Karnataka shall provide at all times the necessary funds for the construction and maintenance of the Tungabhadra Project:

Provided that the liability for the expenditure on the Tungabhadra Project shall be apportioned between the States of Andhra Pradesh and Karnataka in such proportion as may be agreed upon between the two state Governments, and in the absence of any such agreement, in such proportion as may be fixed in this behalf by the Central Government.

(ii) The Governments of Andhra Pradesh and Karnataka shall continue to give the same facilities to the Audit Officer of the Project and other officers engaged in connection with the Project for the payment of moneys into, and withdrawal of the moneys from, the treasuries and sub-treasuries located in their respective territories as were enjoyed by such officers immediately before the commencement of the notification.

7. The Board shall, in relation to the technical sanction, administrative approval, and other sanctions required for the construction and maintenance of the Tungabhadra Project, and in relation to any other administrative matters concerning the Project, exercise the powers of a State Government under the various Codes, Manuals, Rules, and Regulations,

specified in the Schedule annexed hereto, as in force in the State of Madras immediately before the 1st day of October, 1953, and may adopt such of the amendments made thereto, or executive instructions, orders, and directions issued there-under, by the Government of Andhra Pradesh from time to time, which the Board considers necessary:

Provided that, in relation to administrative matters concerning the Government servants of the State of Andhra Pradesh employed by the Board in connection with the Project, the various Codes, Manuals, Rules and Regulations as in force in the Madras State immediately before the 1st October, 1953, and any amendments made thereto or any executive instructions, orders, and directions issued there-under by the Government of Andhra Pradesh from time to time after the said date shall apply:

Provided also that, in relation to administrative matters concerning the Government servants of States other than Andhra Pradesh employed by the Board in connection with the project, the corresponding Codes, Manuals, Rules, and Regulations as in force in the State concerned and any amendments made thereto or any executive instructions, orders, and directions issued there-under by the Government of the said State from time to time shall apply.

8. All contracts to be made in connection with the Tungabhadra Project shall be expressed to be made jointly by, and in the names of, the Governments of Andhra Pradesh and Karnataka and all such contracts shall be executed on behalf of the said Governments by the Secretary of the Board or such other officer as may be authorized by the Board in this behalf but neither the Secretary nor the authorized officer shall

be personally liable in respect of anything under such contracts.

9. (i) The staff which immediately before the commencement of this notification was engaged in the construction and maintenance of the Tungabhadra Project shall, after such commencement, continue to be so employed by the Board in connection with the said Project but the Governments of Andhra Pradesh and Karnataka may, if they so think fit, replace any members of the existing staff by other persons in such manner and in such proportion as may be agreed upon between the said State Governments and in the absence of any such agreement as may be determined in this behalf by the Board:

Provided that all correspondence between the State Governments with respect to such

agreements shall be carried on through the Chairman.

(ii) The staff for the time being employed in connection with the Project shall be deemed to be employed under the administrative control of the Board.

10. Plant, machinery, equipment and stores purchased for and in connection with the Tungabhadra Project shall be under the control of the Board and shall be used on the entire Project under the directions of the Board.

11. The Government of Andhra Pradesh and Karnataka may depute such persons as they may nominate or designate either generally or specially to inspect the works on or connected with the Tungabhadra Project which are common to both the States of Andhra Pradesh and Karnataka.

SCHEDULE

(See paragraph 7)

1. Madras Public Works Account Code with Appendices.
2. Madras Public Works Department Code.
3. Madras Detailed Standard Specifications.
4. Madras Account Code.
5. Madras Electricity Manual.
6. Madras Financial Code.
7. Madras Treasury Code.
8. Madras Budget Manual.
9. Fundamental Rules and Subsidiary Rules of the Madras Government.
10. Madras Manual of Special Pay and Allowances.
11. Madras Pension Code.
12. General Provident Fund (Madras) Rules.
13. Contributory Provident Fund (Madras) Rules.
14. Madras Contributory Provident Fund-Pension Insurance Rules, 1950.
15. Madras Security Rules 1937.
16. Madras Services Manual.
17. Madras Commercial Taxes Manual, Volume I to III.
18. Madras Port Manual.
19. Madras Stationery Manual.

Sd/- S. Venkataraman
Deputy Secretary

**EXTRACT OF FINAL AWARD OF KRISHNA WATER DISPUTE
TRIBUNAL (CLAUSE IX AND CLAUSE XVI)**

Clause IX

(A) Out of the water allocated to it, the State of Maharashtra shall not use in any water year

(i) More than 7 TMC from the Ghataprabha (K-3) sub-basin.

(ii) More than the quantity of water specified hereunder from the main stream of the river Bhima.

(a) As from the water year commencing on the 1st June next after the date of the publication of the decision of the Tribunal in the Official Gazette up to the water year 1989-90: 90 TMC.

(b) As from the water year 1990-91: 95 TMC.

(B) Out of the water allocated to it the State of Karnataka shall not use in any water year

(i) more than the quantity of water specified here under from the Tungabhadra (K-8) sub-basin.

(a) as from the water year commencing on the 1st June next after the date of the publication of the decision of the Tribunal in the Official Gazette up to the water year 1982-83:

295 TMC.

(b) as from the water year 1983-84 up to the water year 1989-90:

295 TMC plus a quantity of water equivalent of 71/2 per cent of the excess of

the average of the annual utilizations for irrigation in the Krishna river basin during the water years 1975-76, 1976-77 and 1977-78 from its own projects using 3 TMC or more annually over the utilizations for such irrigation in the water year 1968-69 from such projects.

(c) as from the water year 1990-91 up to the water year 1997-98:

295 TMC plus a quantity of water equivalent to 71/2 per cent of the excess of the average of the annual utilizations for irrigation in the Krishna river basin during the water years 1982-83, 1983-84 and 1984-85 from its own projects using 3 TMC or more annually over the utilizations for such irrigation in the water year 1968-69 from such projects.

(d) as from the water year 1998-99 onwards:

296 TMC plus a quantity of water equivalent to 71/2 per cent of the excess of the average of the annual utilizations for irrigation in the Krishna river basin during the water years 1990-91, 1991-92 and 1992-93 from its own projects using 3 TMC or more annually over the utilizations for such irrigation in the water year 1968-69 from such projects.

For the limited purpose of this sub- clause, it is declared that the utilizations for irrigation in the Krishna river basin in the water year 1968-69 from projects of the State of Karnataka using 3 TMC or more annually shall be taken to be 176.05 TMC.

Annual utilizations for irrigation in the Krishna river basin in each water year after this Order comes into operation from the projects of the State of Karnataka using 3 TMC or more annually shall be computed on the basis of the records prepared and maintained by the State under Clause XIII.

Evaporation losses from reservoirs of projects using 3 TMC or more annually shall be excluded in computing the 71/2 per cent figure of the average annual utilizations mentioned above.

(i) more than 42 TMC from the Vedavathi (K-9) sub-basin, and

(ii) more than 15 TMC from the main stream of the river Bhima.

(C) Out of the water allocated to it, the State of Andhra Pradesh shall not use in any water year:

(i) more than 127.5 TMC from the Tungabhadra (K-8) sub-basin and more than 12.5 TMC from the Vedavathi (K-9) sub-basin.

(ii) More than 6 TMC from the catchment of the river Kagna in the State of Andhra Pradesh.

(D) (i) The uses mentioned in sub-Clauses (A), (B) and (C) aforesaid include evaporation losses.

(ii) The use mentioned in sub-clause (C) (i) does not include use of the water flowing from the Tungabhadra into the river Krishna

(E) (1) The following directions shall be observed for use of the water available for utilization in the Tungabhadra Dam in a water year

(a) The water available for utilization in a water year in the Tungabhadra Dam shall be so utilized that the demands of water for the following projects to the extent mentioned below may be met :

i) Tungabhadra Right Bank Low Level Canal	52.0 TMC
Water available for Tungabhadra Right Bank Low Level Canal shall be shared by the States of Karnataka and Andhra Pradesh in the following proportion:	
State of Karnataka	: 22.50
State of Andhra Pradesh	: 29.50
(ii) Tungabhadra Right Bank High Level Canal-Stage I & II:	50.0 TMC
Water available for Tungabhadra Right Bank High Level Canal shall be shared by the States of Karnataka and Andhra Pradesh in the following proportions.	
State of Karnataka	17.50
State of Andhra Pradesh	32.50
(iii) Tungabhadra Left Bank Low Level and High Level canals	102.00 TMC
(iv) Raya and Basavanna Channels of the State of Karnataka	7.0 TMC
(v) Assistance by way of regulated discharges to Vijayanagar Channels other than Raya and Basavanna Channels of the State of Karnataka.	2.0 TMC
(vi) Assistance by way of regulated discharges to the Rajolibunda Diversion Scheme for use by the States of Karnataka and Andhra Pradesh in the proportion mentioned in Clause XI.	7.0 TMC
(vii) Assistance by way of regulated discharges to the Kumool-Cuddapah Canal of the States of Andhra Pradesh.	10.0 TMC

	230.00 TMC

The utilizations of the Projects mentioned in Sub-Clauses (a) (i) (ii) and (iii) above include the evaporation losses in the Tungabhadra Dam, which will be shared in accordance with Clause XI (D).

- (b) If, in any water year, water available for utilization in the Tungabhadra Dam is less than the total quantity of water required for all the Projects as mentioned above, the deficiency shall be shared by all the Projects proportionately. The proportions shall be worked out after excluding the evaporation losses.
- (c) If, in any water year, available for utilization is more than the total quantity of water required for all the projects as mentioned above, the requirements for all the Projects for the month of June in the succeeding water year as estimated by the Tungabhadra Board or any authority established in its place shall be kept in reserve and the State of Karnataka shall have the right to utilize the remaining water in excess of such reserve in the Tungabhadra Dam for its Projects mentioned in Sub-Clauses (a)(i),(ii) and (iii) above drawing water from that dam even though thereby it may cross in any water year the limit on the utilization of water from Tungabhadra (K-8) sub-basin placed under Clause IX(B) of the Final Order but in no case such utilization shall exceed 320 T.M.C.

- (d) The balance water, if any, shall be kept stored in the dam for use in the next year.
- (2) The working tables for the utilization of the water in the Tungabhadra Dam shall be prepared as hithertofore by the Tungabhadra Board or any other authority established in its place so as to enable the States of Karnataka and Andhra Pradesh to utilize the water available for utilization in the Tungabhadra Dam as aforesaid.
- (3) If, in any water year either of the two States of Karnataka and Andhra Pradesh finds it expedient to divert the water available to it in the Tungabhadra Dam for any one of its Projects to any other of its Project or Projects mentioned above for use therein, it may give notice thereof to the Tungabhadra Board or any other authority established in its place and the said Board or authority may, if it is feasible to do so, prepare or modify the working table accordingly.
- (4) The States of Karnataka and Andhra Pradesh may use the water available in the Tungabhadra Dam in accordance with the aforesaid provisions and nothing contained in Clause V shall be construed as overriding the provisions of Clause IX (E) in the matter of utilization of the water available in the Tungabhadra Dam nor shall anything contained in Clause IX (E) be construed as enlarging the total allocation

to the State of Karnataka or as enlarging the limit of acquisition of any right by the State of Andhra Pradesh in the waters of the river Krishna.

- (5) The States of Karnataka and Andhra Pradesh may by agreement without reference to the State of Maharashtra alter or modify any of the provisions for the utilization of the water available in the Tungabhadra Dam mentioned above in any manner.

Clause XVI

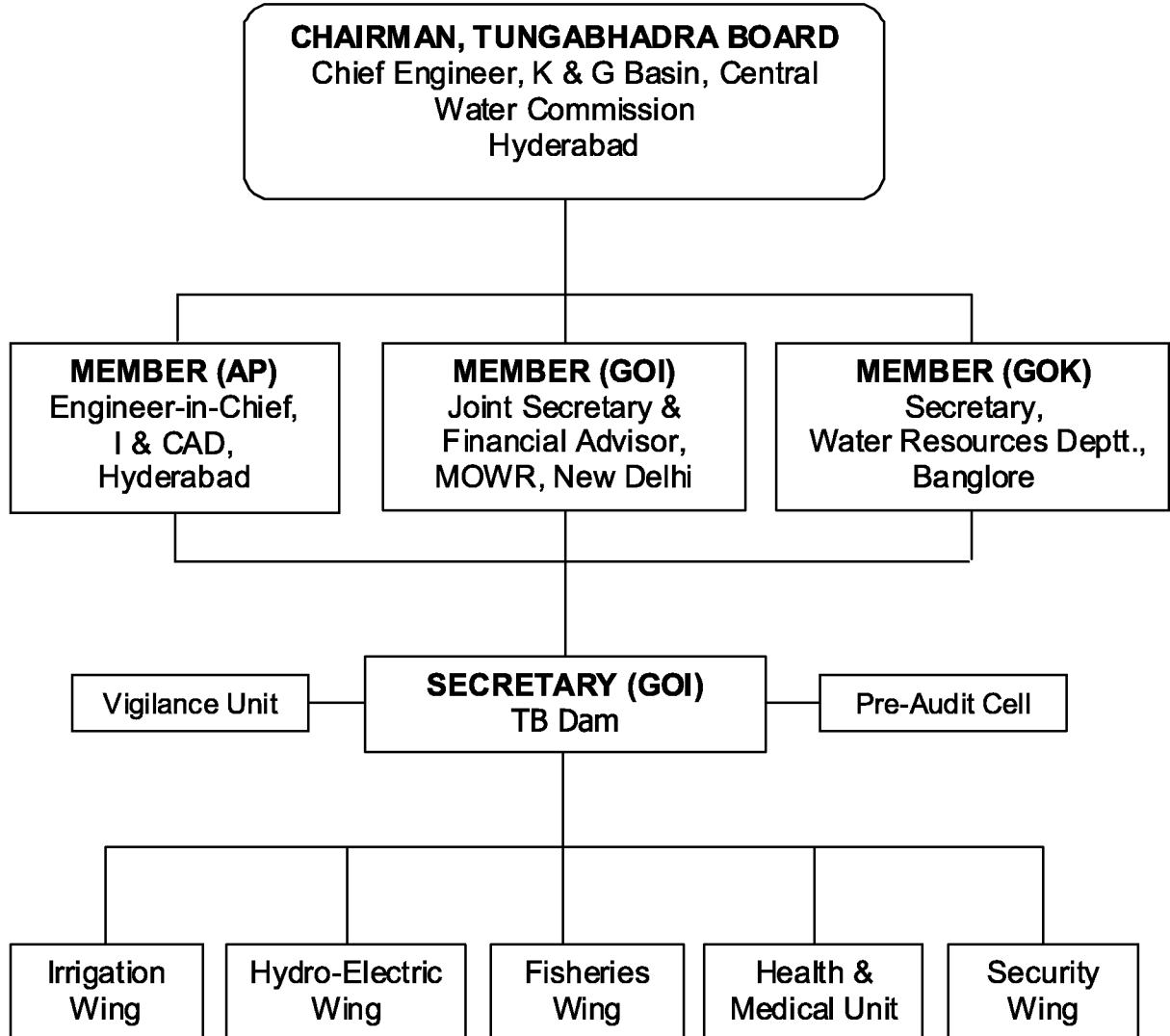
In this Order

- (a) Use of the water of the river Krishna by any person or entity of any nature

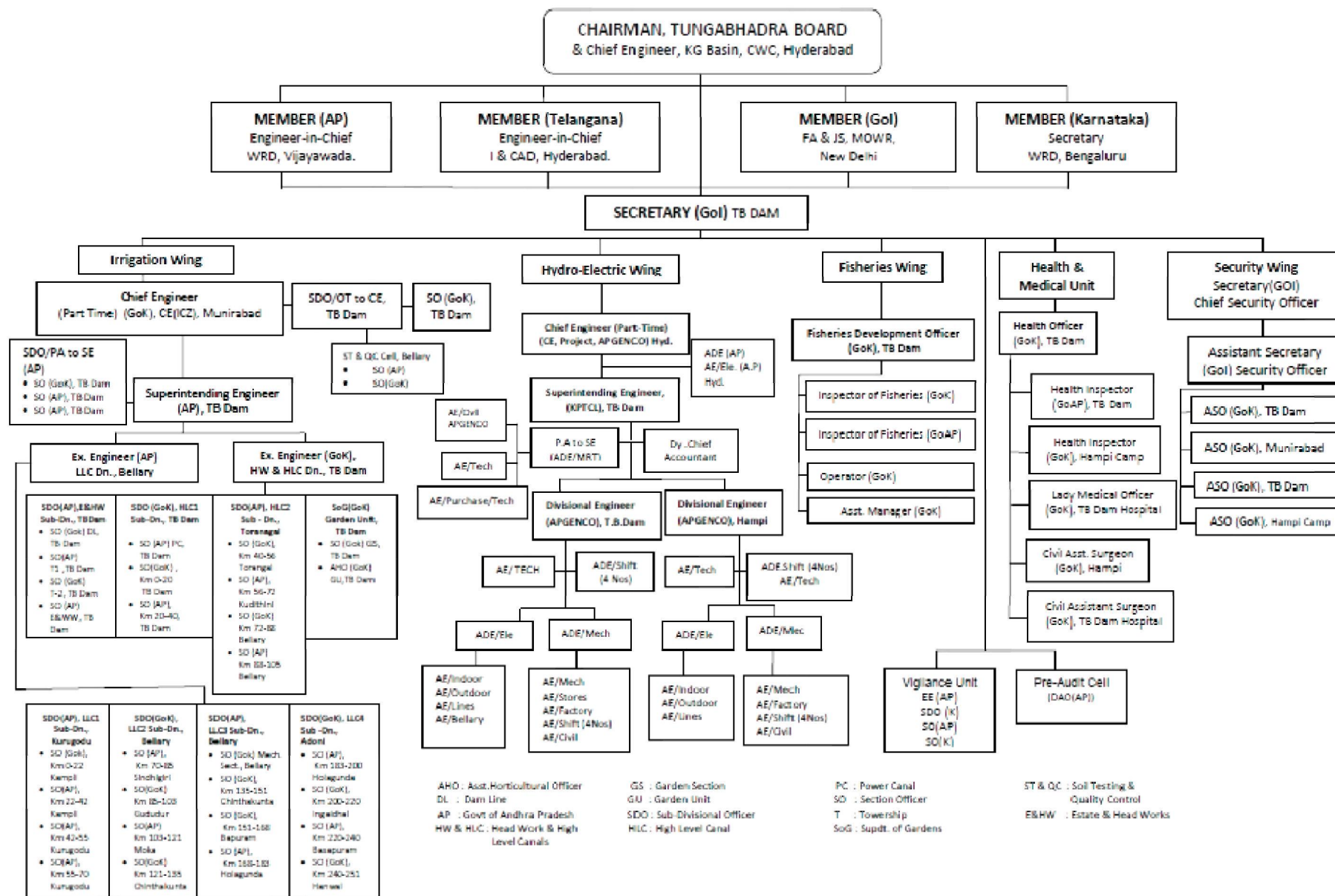
whatsoever within the territories of a State shall be reckoned as used by that State.

- (b) The expression 'Water Year' shall mean the year commencing on 1st June and ending on 31st May.
- (c) The expression 'Krishna River' includes the main stream of the Krishna river, all its tributaries and all other streams contributing water directly or indirectly to the Krishna River.
- (d) The expression 'TMC' means Thousand million cubic feet of water.

ORGANIZATION CHART OF TUNGABHADRA BOARD



DETAILED ORGANIZATION CHART OF TUNGABHADRA BOARD



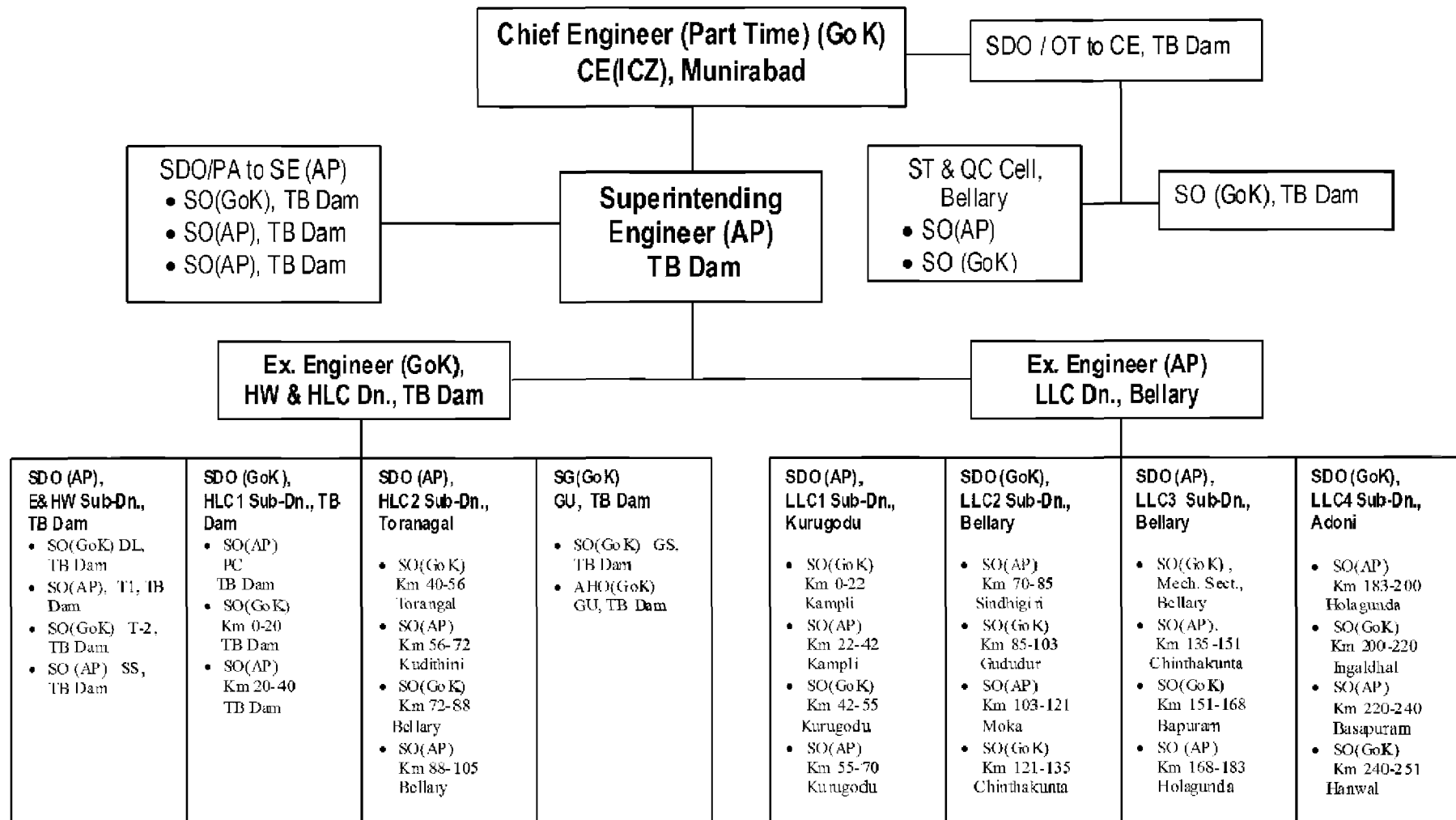
IRRIGATION BENEFITS OF TUNGABHADRA PROJECT

Sl No.	Canal System	Irrigation benefits (in acres)		
		Karnataka	Andhra Pradesh	Total
1	2	3	4	5
1	Right Bank Low Level Canal (RBLLC)	92,670	1,57,062	2,49,732
2	Right Bank High Level Canal (RBHLC)	1,99,920	1,90,035	3,89,955
3	Left Bank Main Canal (LBMC)	6,02,706	-	6,02,706
4	Left Bank High Level Canal (LBHLC)	1,160	-	1,160
			Total	12,43,553
	EXISTING AREA BENEFITED			
5	Raya & Basavanna Channels (RBC)	7,468	-	7,468
6	Vijayanagar Channels other than RBC	17,000	-	17,000
7	Rajolibunda Diversion Scheme (RDS)	5,900	87,000	92,900
8	Kurnool– Cuddapah Canal System	-	2,78,000	2,78,000

Details of RDS Anicut and Sunkesula Anicut

Sl. No.	Description	Rajolibunda Diversion Scheme	Sunkesula Anicut (KC Canal)
1)	Length of Anicut	819.9 m (2690 ft)	1328.3 m (4358 ft)
2)	Catchment area	53,634 sq km (20719 sq miles)	64,083 sq km (24,985 sq miles)
3)	Crest level	Plus 332.2m (1090 ft)	Plus 288.650m (947.06 ft)
4)	Maximum Design Flood discharge	21,237 Cum (7,50,000 cusecs)	14.864 cum (5,25,000 cusecs)
5)	Year of completion	1958	1870

ORGANIZATION CHART OF IRRIGATION WING



పరిశ్రమ విభాగం
 మునిరాబాద్

పరిశ్రమ విభాగం
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COMMON DISTRIBUTARIES OF RIGHT BANK LOW LEVEL CANAL

Sl. No	Name of Distributory	Location	Designed Discharge in Cusecs	Length in Km	Ayacut (Acres)		
					Wet	Dry	Total
1	DP No 37A	131.81	1.84	3.20	62	192	254
2	DP No 44	154.000	8.78	1.64	66	213	279
3	DP No 45	154.837	10.27	0.70	256	816	1,072
4	DP No 60	191.540	1.98	1.00	51	160	211
5	Kotehal Distributory	193.820	47.94	2.50	1,207	3,842	5,049
6	DP No 62	196.700	5.29	3.40	154	466	620
7	Hatcholli Distributory	205.267	96.2	16.00	2,853	9,115	11,968
8	DP No 65	206.980	23.69	21.00	457	1,583	2,040
9	DP No 72	240.388	14.28	7.50	300	961	1,261
10	DP No 73	247.530	12.31	3.00	330	1,040	1,370
11	T.S. Distributory	250.530	108.82	31.20	2,683	7,955	10,638
	Total		331.40	91.14	8419	26343	34762

DRINKING WATER SCHEMES APPROVED BY BOARD

SI.No.	Description	Location	Rate of drawal
1	2	3	4
I	<u>TB RESERVOIR</u>		
	i. Providing Raw water supply to the filter house for supply of drinking water to Right Bank official colony through 24" pipe from TBR.	LS 590 of Dam	0.70 MGD
	ii. Providing Raw water supply to the filter house for supply of drinking water to Left Bank colonies through 24" pipe from TBR.	LS 5700 of Dam	0.70 MGD
	iii. Water supply to Hankunt, Akkapura and 15 other villages in Raichur Dt.from TBR.	TBR	1.50 cusecs
	iv. Water supply to H.B.Halli, Kudligi, and Kottrur Town	TBR	4.307 cusecs
II	<u>POWER CANAL</u>		
	i. Water supply to Hospet Town	Km 5.334 (right side)	1.7 cusecs
	ii. Water supply to Kamalapur Town	Km 20.360 (left side)	0.3 cusecs
III	<u>RIGHT BANK LOW LEVEL CANAL</u>		
	i. Supply of water to Pompa Vidya Peetha	Km 7.946	1.0 cusecs
	ii. Supply of water to Bellary city	Km 115.800	8.0 cusecs
	iii. Supply of water to Chintakunta	Km 134.850	1.0 cusecs
	iv. Supply of water to Bapuram village	Km 158.000	1.0 cusecs
	v. Supply of water to Adoni Town	Km 235.250	4.0 cusecs
	vi. Supply of water to Sammatageri tank for drinking water to 6 villages under CPWS scheme.	Km 176.200	0.01 cusecs
	vii. Supply of water to Sirigeri and 3 other villages in Siruguppa taluk.	Km. 64.967	0.50 cusecs
IV	<u>RIGHT BANK HIGH LEVEL CANAL</u>		
	i. Water supply - Release of water for Bellary city for drinking purpose.	Km 82.260	53.06 cusecs
	ii. Sandur Town & 8 other villages (Kurekuppa 2A Sluice)	Km 46.50	9.00 cusecs

INDUSTRIAL WATER USERS APPROVED BY BOARD

Sl.No.	Name of the Scheme	Source	Qty/Rate
A	From Left Bank of TB Reservoir		
	i) M/s Tungabhadra Fibers Limited (TUFIL)	Left Bank of TB Reservoir	36 cusecs (19.38 MGD)
	ii) M/s Kirloskar Ferrous and iron Ltd.(KFIL)	-do-	3.71 cusecs (2 MGD)
	iii) M/s Kalyani Steels Ltd.	-do-	9.29 cusecs (5 MGD)
	iv) MSPL Halavarti. (2.55 MGD to M/s MSPL Ltd & 10.00 MGD M/s Aarees Iron and Steel Ltd)	-do-	23.32 cusecs (12.55 MGD)
	v) M/s Dhruvdesh Meta Steel Pvt Ltd	-do-	3000 KL/day (39 MCFT per year)
B	FROM POWER CANAL		
	i) Locomotives at Hospet Railway Station	Power canal	0.3 cusecs (0.16 MGD)
	ii) M/s ISR, Hospet during the closure of Raya and Basavanna channel	-do-	0.67 cusecs (0.36 MGD)
	iii) M/s Pampasar Distillery Ltd.Hospet	-do-	1.93 cusecs (3.59 MGD)
	iv) M/s Jindal Vijayanagar Steel Ltd.	Power canal (ROFS)	60.95 cusecs (32.80 MGD)
C	From Right Bank of TB Reservoir		
	i) M/s BMM Ispat Ltd,Danapur.	Right Bank of TB Reservoir	4.64 cusecs (8.62 MGD)
	ii) M/s SLR Metaliks Company	-do-	0.19 TMC per year (above FRL of 1633)
D	Raya Basavanna Channel		
	i) M/s Sandur Manganese and Iron Ore Ltd	Raya Basavanna channel	1.8 cusecs (3.34 MGD)

**STATEMENT SHOWING THE CANALWISE DRAWALS OF WATER AGAINST PRO-RATA ENTITLEMENT
FOR THE WATER YEAR 2014-15, 2015-16 & 2016-17
(INCLUDING CANAL TRANSMISSION LOSSES)**

(All figures are in TMC.)

SL No.	Name of the Canal System	Allocation based on KWDT Award	Actual drawals during the period from			Pro-rata entitlement on KWDT award			Excess(-) / Less(+) drawals against pro-rata entitlement out of 138.000 TMC (Col. 7-4),(Col. 8-5) & (Col. 9-6)		
			01/06/2014 to 31/05/2015	01/06/2015 to 31/05/2016	01/06/2016 to 31/05/2017	2014-15	2015-16	2016-17	2014-15	2015-16	2016-17
1	2	3	4	5	6	7	8	9	11	12	13
	KARNATAKA STATE										
1)	Right Bank Power Canal + Low Level Canal.	19.000	12.955	9.204	9.286	11.918	9.409	5.824	-1.037	0.205	-3.462
2)	Right Bank High Level Canal	17.500	12.321	13.114	11.453	10.977	8.666	5.364	-1.344	-4.448	-6.089
3)	Raya Basavanna Channel	7.000	4.14	4.067	2.553	4.391	3.466	2.146	0.251	-0.601	-0.407
4)	River Releases (VNC+RDS)	2.490	1.567	2.195	2.172	1.562	1.233	0.763	-0.005	-0.962	-1.409
		(2.000 + 0.490)									
5)	Left Bank Main Canal + H.L.C. (L.B.)	93.000	54.888	38.529	28.279	58.336	46.053	28.506	3.448	7.524	0.227
6)	Debit for lift Irrigation Schemes	0.000	2	2	2	2	2	2	0	0	0
7)	Debit for drawls by JVSL	0.000	1.174	1.282	0.319	1.29	1.29	1.29	0.116	0.008	0.971
	Sub-Total:	138.990	89.045	70.391	56.062	90.474	72.117	45.893	1.429	1.726	-10.169
	ANDHRA PRADESH										0
1)	Right Bank Low Level Canal	24.000	15.174	11.278	7.029	15.623	12.453	7.925	0.449	1.175	0.896
2)	Right Bank High Level Canal	32.500	25.096	17.866	11.908	21.156	17.863	10.731	-3.94	-0.003	-1.177
3)	River Releases (RDS+KCC)	16.510	6.664	7.879	4.849	10.747	7.567	5.452	4.083	-0.312	0.603
		(6.510+10.000)			(1.638+3.211)						
	Sub Total:	73.010	46.934	37.023	23.786	47.526	37.883	24.108	0.592	0.86	0.322
	Grand Total:	212.000	135.979	107.414	79.848	138.000	110.000	70.000	2.021	2.586	-9.848

TUNGABHADRA RESERVOIR WATER ACCOUNT FOR THE YEAR 2014-15**YIELD****TMC**

i	Opening balance as on 01/06/2014 (as per Capacity Table of 2008 surveys)	7.944
ii	Inflows recorded at TB.Dam considering 2 TMC of water debited towards drawals by Karnataka State for Lift Irrigation Schemes on the periphery of Tungabhadra Reservoir for the water year 2014-15.	348.04
	Total	355.984
	<u>UTILISATION</u>	
a)	Drawals for Irrigation by both the States during the water year 2014-15.	135.979
b)	Spillway surplus	181.287
c)	Drawals for extra power generation during surplussing period without jeopardizing Irrigation interests	21.136
d)	System losses	4.742
e)	Reservoir evaporation losses.	7.408
f)	Closing balance i.e. residual storage as on 01/06/2014	5.432
	Total	355.984
	<u>WATER YEAR 2014-15</u>	
1	Actual quantum of water drawn by both the States during the water year 2014-15.	135.984
2	Actual Reservoir evaporation losses to be shared by both the states.	7.408
	Total	143.392

TUNGABHADRA RESERVOIR WATER ACCOUNT FOR THE YEAR 2015-16

	<u>YIELD</u>	<u>TMC</u>
i	Opening balance as on 01/06/2015 (as per Capacity Table of 2008 surveys)	5.432
ii	Inflows recorded at TB.Dam considering 2 TMC of water debited towards drawals by Karnataka State for Lift Irrigation Schemes on the periphery of Tungabhadra Reservoir for the water year 2015-16.	112.889
	Total	118.321
	<u>UTILISATION</u>	
a)	Drawals for Irrigation by both the States during the water year 2015-16.	107.414
b)	Spillway surplus	0
c)	Drawals for extra power generation during surplussing period without jeopardizing Irrigation interests	0
d)	System losses	3.298
e)	Reservoir evaporation losses.	6.402
f)	Closing balance i.e. residual storage as on 01/06/2015	1.207
	Total	118.321
	<u>WATER YEAR 2015-16</u>	
1	Actual quantum of water drawn by both the States. during the water year 2015-16.	107.414
2	Actual Reservoir evaporation losses to be shared by both the states.	6.402
	Total	113.816

TUNGABHADRA RESERVOIR WATER ACCOUNT FOR THE YEAR 2016-17

	<u>YIELD</u>	<u>TMC</u>
i	Opening balance as on 01/06/2016 (as per Capacity Table of 2008 surveys)	1.207
ii	Inflows recorded at TB.Dam considering 2 TMC of water debited towards drawals by Karnataka State for Lift Irrigation Schemes on the periphery of Tungabhadra Reservoir for the water year 2016-17.	85.719
	Total	86.926
	<u>UTILISATION</u>	
a)	Drawals for Irrigation by both the States during the water year 2016-17.	79.848
b)	Spillway surplus	0
c)	Drawals for extra power generation during surplussing period without jeopardizing Irrigation interests	0
d)	System losses	2.249
e)	Reservoir evaporation losses.	3.862
f)	Closing balance i.e. residual storage as on 01/06/2017	0.967
	Total	86.926
	<u>WATER YEAR 2016-17</u>	
1	Actual quantum of water drawn by both the States during the water year 2016-17.	79.848
2	Actual Reservoir evaporation losses to be shared by both the states.	3.862
	Total	83.710

UTILIZATION OF WATER DURING THE YEARS FROM 1976-77 TO 2016-17

(in Tmcft)

Water Year	Inflow (June-May)	Total Utilisation (including evaporation)	Drawals for Irrigation			Drawals for Extra Power Gen.	Water let out over Spillway	Reservoir evaporation losses	Remarks
			Karnataka	Andhra Pradesh	Total				
1	2	3	4	5	6	7	8	9	10
1976-77	189.154	198.147	120.231	61.651	181.882	0.000	0.000	15.388	Capacities are as per 1972 surveys
1977-78	275.408	214.677	131.874	65.902	197.776	17.426	35.241	16.804	do
1978-79	558.775	216.916	134.483	66.391	200.874	47.093	300.809	15.637	do
1979-80	291.341	218.758	131.895	70.788	202.683	26.415	43.570	15.705	do
1980-81	553.100	231.383	140.367	76.279	216.646	42.194	292.187	14.711	do
1981-82	362.649	208.680	128.463	66.159	194.622	32.859	126.145	12.824	do
1982-83	369.482	216.660	132.363	72.205	204.568	22.726	130.462	12.062	Capacities are as per 1978 surveys
1983-84	316.253	206.149	125.182	68.412	193.594	25.373	82.426	12.422	Capacities are as per 1981 surveys
1984-85	303.183	200.562	122.098	63.570	185.658	40.485	66.000	12.446	do
1985-86	217.267	192.833	119.026	61.570	180.596	10.723	14.329	11.302	do
1986-87	243.331	207.841	128.359	67.228	195.587	8.261	27.041	12.163	do
1987-88	163.482	162.491	99.919	52.495	152.414	0.000	0.000	9.006	do
1988-89	248.134	178.113	109.565	55.373	164.938	23.876	52.180	11.045	do
1989-90	222.061	188.216	112.701	60.205	172.906	12.633	18.052	12.465	do
1990-91	314.036	191.300	115.183	60.599	175.782	17.473	102.163	12.518	do
1991-92	364.912	195.314	119.798	60.344	180.142	24.855	159.282	13.105	do
1992-93(*)	519.609	215.702	129.415	68.381	197.796	36.636	267.915	14.190	do
1993-94	307.868	206.305	127.795	64.717	192.512	15.811	90.141	9.700	do
1994-95	538.598	190.504	121.451	54.463	175.914	39.403	311.414	10.330	do
1995-96	176.307	179.767	110.532	56.575	167.107	0.434	0.000	9.232	Capacities are as per 1993 surveys
1996-97	211.524	166.394	101.508	54.899	156.407	12.960	28.704	9.987	do
1997-98	339.815	174.373	114.321	60.052	174.373	18.839	130.887	10.688	System losses 4.171
1998-99	323.181	191.742	117.320	62.582	179.902	35.485	85.597	11.84	System losses 4.911
1999-2000	328.877	194.356	121.167	61.301	182.468	22.341	114.93	11.888	System losses 4.117
2000-01	322.254	184.832	117.378	56.978	174.356	35.495	96.642	10.476	System losses 5.489
2001-02	160.082	156.751	98.694	49.474	148.168	Nil	Nil	8.683	System losses 4.715
2002-03	126.371	122.660	75.909	39.766	115.675	Nil	Nil	6.985	System losses 3.581
2003-04	117.095	112.142	69.905	36.232	106.137	Nil	Nil	6.005	System losses 4.156
2004-05	171.145	136.353	84.560	43.571	128.131	6.768	23.1	8.22	System losses 4.846
2005-06	316.786	160.799	99.918	51.583	151.501	30.435	119.411	9.298	System losses 4.846
2006-07	296.274	160.694	101.463	49.354	150.817	18.978	110.916	9.877	System losses 5.369
2007-08	476.018	166.231	104.149	52.025	156.174	41.706	252.121	10.057	System losses 5.393
2008-09	278.719	165.363	103.940	53.341	157.281	20.313	98.214	8.082	System losses 4.506
2009-10	366.598	164.383	102.098	53.432	155.53	27.819	169.983	8.853	System losses 4.329
2010-11	339.651	184.133	113.659	61.91	175.569	27.823	121.416	8.564	System losses 5.020
2011-12	292.089	161.373	100.615	52.232	152.847	26.679	99.605	8.526	System losses 4.618
2012-13	153.252	131.18	81.616	42.094	123.71	5.769	13.948	7.47	System losses 5.817
2013-14	394.225	145.1	91.121	46.454	137.515	26.613	211.146	7.525	System losses 5.440
2014-15	348.04	143.387	89.045	46.934	135.979	21.136	181.287	7.408	System losses 4.742
2015-16	117.889	113.816	70.391	37.023	107.414	Nil	Nil	6.402	System losses 3.298
2016-17	85.719	83.71	56.062	23.786	79.848	Nil	Nil	3.862	System losses 2.249

(*) Heavy Floods occurred in November 1992

Bhadra Assatance: 1986-87 - 0.744 Tmcft, 1988-89 - 2.300 Tmcft, 1991-92 - 5.163 Tmcft, 1995-96 - 2.688 Tmcft and 1999-2000 - 3.731 Tmcft. 2000-2001 = 4.651 Tmcft, 2001-2002 = 0.746 Tmcft,

2005-2006 = 2.683 Tmcft, 2006-07 = 4.360 Tmcft, & 2007-2008 = 2.300 Tmcft & 2008-09 = 2.359 TMC

Annexure - 3.9

**Statement showing the Pippings / Breaches occurred during the year 2014-2015
(From 1-6-2014 to 31-5-2015).**

Sl. No.	Name of the Canal	Piping / Breaches occurred at Km.	Date of occurrence	Date of closing
1	2	3	4	5
I	Power Canal	(a) Pippings		
		i) closing of pipping work at Km.2/380 of L/s of	28-07-2014	30-07-2015
		ii) closing of pipping/bonga work at Km.2/400 on	31-07-2014	02-08-2014
		(b) Breaches ----- Nil -----		
II	RB HLC	(a) Pippings.		
		i)		
		(b) Breaches. ----- Nil -----		
III	RB LLC	(a) Pippings:		
		i) Closing of piping at Km.119/700 R/s of RBLLC.	17-08-2014	19-08-2014
		ii) Closing of piping at Km.120/220 R/s of RBLLC.	21-12-2014	23-12-2014
		(b) Breaches. ----- Nil -----		

**Statement showing the Pippings / Breaches occurred during the year 2015-16
(From 1-6-2015 to 31-5-2016).**

Sl. No.	Name of the Canal	Piping / Breaches occurred at Km.	Date of occurrence	Date of closing
1	2	3	4	5
I	Power Canal	(a) Pippings --Nil ---		
		(b) Breaches -- Nil ---		
II	RB HLC	(a) Pippings		
		Arresting leakages at Km.46/050 of RBHLC.	27-07-2015	29-07-2015
		Arresting leakages R/s U/s wing wall of UT at Km.67/377 of RBHLC.	08-12-2015	15-08-2015
		(b) Breaches. --Nil ---		
III	RB LLC	(a) Pippings		
		Closing of piping on L/s bank at Km.62/469 of RBLLC.	07-08-2015	09-08-2015
		Closing of piping on L/s bank at Km.52/990 of RBLLC.	27-08-2015	30-08-2015
		(b) Breaches. --Nil ---		

Statement showing the Pipings / Breaches occurred during the year 2016-2017

(From 1-6-2016 to 31-5-2017).

Sl. No.	Name of the Canal	Piping / Breaches occurred at Km.	Date of occurrence	Date of closing
1	2	3	4	5
I	Power Canal	(a) Pipings	--Nil ---	
		(b) Breaches	-- Nil ---	
II	RB HLC	(a) Pipings	--Nil---	
		(b) Breaches. R/s Skinwall on D/s of bridge is collapsed during water flow causing erosion of banks at Km.90/697 of RBHLC	03-04-2016	18-04-2016
III	RB LLC	(a) Pipings Closing of piping at km 6/850 of RBLLC.	23-07-2016	05-08-2016
		(b) Breaches. Arresting spill water and raising and strengthening of left side bank in between km 8/550 to km 8/830 of RB LLC.	01-09-2016	06-09-2016

CAPACITIES OF TUNGABHADRA RESERVOIR FROM 1953 TO 2008

Year of Survey	Dead storage capacity	Live Storage (M. Cum)	Gross storage (M. Cum)	Annual rate of decrease in reservoir capacity (between successive surveys) (M. Cum)	Remarks
1953	32.83 (1.159 TMC)	3718.34 (131.312 TMC)	3751.17 (132.473 TMC)	-	Original survey
1963	7.04 (0.249 TMC)	3239.75 (114.411 TMC)	3246.79 (114.66 TMC)	50.438 (1.7812 TMC)	To find annual rate of decrease in reservoir capacity for the year 1972, the original capacity of the reservoir in 1953 has been considered.
1972	2.07 (0.073 TMC)	3246.53 (121.007 TMC)	3428.6 (121.08 TMC)	16.98 (0.5995 TMC)	
1978	Nil	3332.75 (117.695 TMC)	3332.75 (117.695 TMC)	15.98 (0.5642 TMC)	
1981	Nil	3275.68 (115.680 TMC)	3275.68 (115.680 TMC)	19.02 (0.6717 TMC)	
1985	Nil	3166.74 (111.832 TMC)	3166.74 (111.832 TMC)	27.24 (0.9620 TMC)	
1993	Nil	3157.53 (111.50 TMC)	3157.53 (111.50 TMC)	0.87 (0.0415 TMC)	
2004	Nil	2954.585 (104.340 TMC)	2954.585 (104.340 TMC)	18.45 (0.652 TMC)	
2008	Nil	2855.869 (100.855 TMC)	2855.869 (100.855 TMC)	24.679 M.cum (0.871 TMC)	

Notes:

1. Dead storage is below RL 472.440 m
2. Live storage is in between RL 472.440m and RL 497.738m.

TUNGABHADRA RESERVOIR PROJECT

Annexure 3.11

TABLE - 3.2 : WATER SPREAD AREAS AND CAPACITIES AT 0.3048 METRE (ONE FOOT) INTERVAL - FOR CAPACITY SURVEY 2008

SL No.	Elevation		Contour interval Metres	Water Spread Area M Sqm.	Capacity Between Contours M Cum.	Cumulative Capacity M Cum.	Cumulative Capacity TMCft.
	Feet	Metres					
1	1540.000	469.392					0.000
2	1550.000	472.440	3.0480				0.000
3	1555.000	473.964	1.5240	0.0008	0.000	0.000	0.000
4	1556.000	474.269	0.3048	0.0019	0.000	0.000	0.000
5	1557.000	474.574	0.3048	0.2330	0.026	0.026	0.001
6	1558.000	474.878	0.3048	0.7824	0.147	0.173	0.006
7	1559.000	475.183	0.3048	1.9259	0.400	0.573	0.020
8	1560.000	475.488	0.3048	3.1859	0.771	1.344	0.047
9	1561.000	475.793	0.3048	4.5030	1.166	2.510	0.089
10	1562.000	476.098	0.3048	5.6610	1.546	4.056	0.143
11	1563.000	476.402	0.3048	6.9584	1.920	5.975	0.211
12	1564.000	476.707	0.3048	8.4757	2.348	8.324	0.294
13	1565.000	477.012	0.3048	9.8713	2.793	11.117	0.393
14	1566.000	477.317	0.3048	11.2357	3.214	14.332	0.506
15	1567.000	477.622	0.3048	12.8202	3.663	17.995	0.635
16	1568.000	477.926	0.3048	14.8783	4.217	22.212	0.784
17	1569.000	478.231	0.3048	16.6878	4.808	27.020	0.954
18	1570.000	478.536	0.3048	18.1551	5.308	32.329	1.142
19	1571.000	478.841	0.3048	19.6529	5.760	38.089	1.345
20	1572.000	479.146	0.3048	21.4612	6.264	44.353	1.566
21	1573.000	479.450	0.3048	23.3766	6.831	51.184	1.808
22	1574.000	479.755	0.3048	25.3898	7.430	58.614	2.070
23	1575.000	480.060	0.3048	27.5772	8.070	66.684	2.355
24	1576.000	480.365	0.3048	30.1176	8.790	75.474	2.665
25	1577.000	480.670	0.3048	32.4401	9.532	85.005	3.002
26	1578.000	480.974	0.3048	34.4064	10.186	95.191	3.362
27	1579.000	481.279	0.3048	36.6020	10.820	106.011	3.744
28	1580.000	481.584	0.3048	38.9709	11.515	117.527	4.150
29	1581.000	481.889	0.3048	41.4093	12.248	129.775	4.583
30	1582.000	482.194	0.3048	43.9299	13.004	142.779	5.042
31	1583.000	482.498	0.3048	46.5943	13.794	156.573	5.529
32	1584.000	482.803	0.3048	49.1560	14.591	171.163	6.045
33	1585.000	483.108	0.3048	51.9896	15.413	186.576	6.589
34	1586.000	483.413	0.3048	55.1295	16.323	202.898	7.165
35	1587.000	483.718	0.3048	58.4508	17.307	220.206	7.776
36	1588.000	484.022	0.3048	61.9570	18.348	238.553	8.424
37	1589.000	484.327	0.3048	65.6226	19.440	257.994	9.111
38	1590.000	484.632	0.3048	69.3094	20.561	278.555	9.837
39	1591.000	484.937	0.3048	73.3275	21.735	300.290	10.605
40	1592.000	485.242	0.3048	77.6079	22.999	323.289	11.417
41	1593.000	485.546	0.3048	81.9009	24.306	347.595	12.275
42	1594.000	485.851	0.3048	86.1029	25.601	373.196	13.179

43	1595.000	486.156	0.3048	90.4067	26.897	400.094	14.129
44	1596.000	486.461	0.3048	94.9337	28.243	428.337	15.127
45	1597.000	486.766	0.3048	99.5274	29.633	457.970	16.173
46	1598.000	487.070	0.3048	104.3273	31.065	489.035	17.270
47	1599.000	487.375	0.3048	109.3943	32.568	521.603	18.420
48	1600.000	487.680	0.3048	114.8482	34.171	555.774	19.627
49	1601.000	487.985	0.3048	120.6461	35.886	591.660	20.894
50	1602.000	488.290	0.3048	126.3723	37.642	629.302	22.224
51	1603.000	488.594	0.3048	132.1583	39.397	668.699	23.615
52	1604.000	488.899	0.3048	138.1941	41.198	709.897	25.070
53	1605.000	489.204	0.3048	144.4713	43.075	752.971	26.591
54	1606.000	489.509	0.3048	150.7212	44.984	797.955	28.180
55	1607.000	489.814	0.3048	157.0968	46.908	844.864	29.836
56	1608.000	490.118	0.3048	163.9230	48.920	893.783	31.564
57	1609.000	490.423	0.3048	170.7960	51.008	944.791	33.365
58	1610.000	490.728	0.3048	177.8007	53.123	997.913	35.241
59	1611.000	491.033	0.3048	184.0812	55.148	1053.061	37.189
60	1612.000	491.338	0.3048	191.7839	57.278	1110.339	39.211
61	1613.000	491.642	0.3048	198.6240	59.495	1169.834	41.312
62	1614.000	491.947	0.3048	205.6441	61.607	1231.442	43.488
63	1615.000	492.252	0.3048	212.8283	63.772	1295.214	45.740
64	1616.000	492.557	0.3048	220.3185	66.008	1361.222	48.071
65	1617.000	492.862	0.3048	227.7614	68.284	1429.506	50.483
66	1618.000	493.166	0.3048	235.7629	70.638	1500.144	52.977
67	1619.000	493.471	0.3048	242.5029	72.885	1573.029	55.551
68	1620.000	493.776	0.3048	251.9472	75.350	1648.379	58.212
69	1621.000	494.081	0.3048	260.0748	78.029	1726.408	60.968
70	1622.000	494.386	0.3048	268.5920	80.565	1806.973	63.813
71	1623.000	494.690	0.3048	277.3769	83.202	1890.175	66.751
72	1624.000	494.995	0.3048	286.2312	85.890	1976.066	69.784
73	1625.000	495.300	0.3048	294.1436	88.446	2064.512	72.908
74	1626.000	495.605	0.3048	301.6550	90.797	2155.309	76.114
75	1627.000	495.910	0.3048	308.7987	93.031	2248.340	79.399
76	1628.000	496.214	0.3048	315.8174	95.189	2343.530	82.761
77	1629.000	496.519	0.3048	322.9969	97.353	2440.883	86.199
78	1630.000	496.824	0.3048	330.4654	99.585	2540.468	89.716
79	1631.000	497.129	0.3048	338.4071	101.934	2642.402	93.316
80	1632.000	497.434	0.3048	347.7040	104.560	2746.962	97.008
81	1633.000	497.738	0.3048	367.1100	108.924	2855.887	100.855

F.R.L. & M.W.L. = 497.738 m (1633 ft)

Dead Storage Level= 472.440 m (1550 ft)

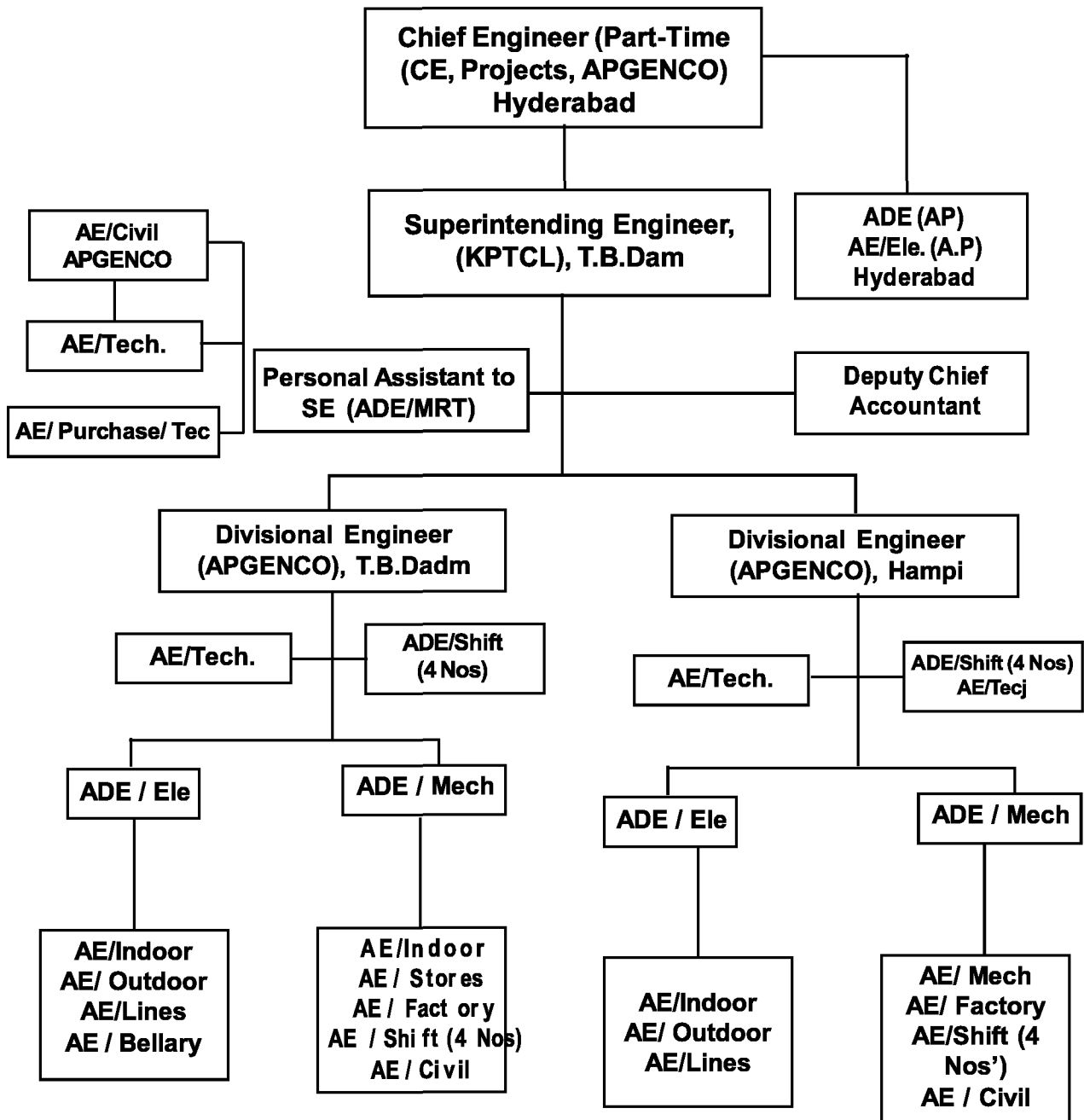
Crest Level = 491.642 m (1613 ft)

Note: 1. The Water spread areas for the elevations upto 1632 ft. is generated using Surfer Software.

Note: 2. The Water spread areas at 1633 ft is reckoned from Satellite Imagery extract furnished by NRSA, Hyderabad.

Note: 3. Capacities between 1555 ft and 1624 ft contours are computed using Prismoidal Formula.

ORGANIZATION CHART OF HYDRO - ELECTRIC WING



POWER GENERATION AND UTILISATION (Million Units)

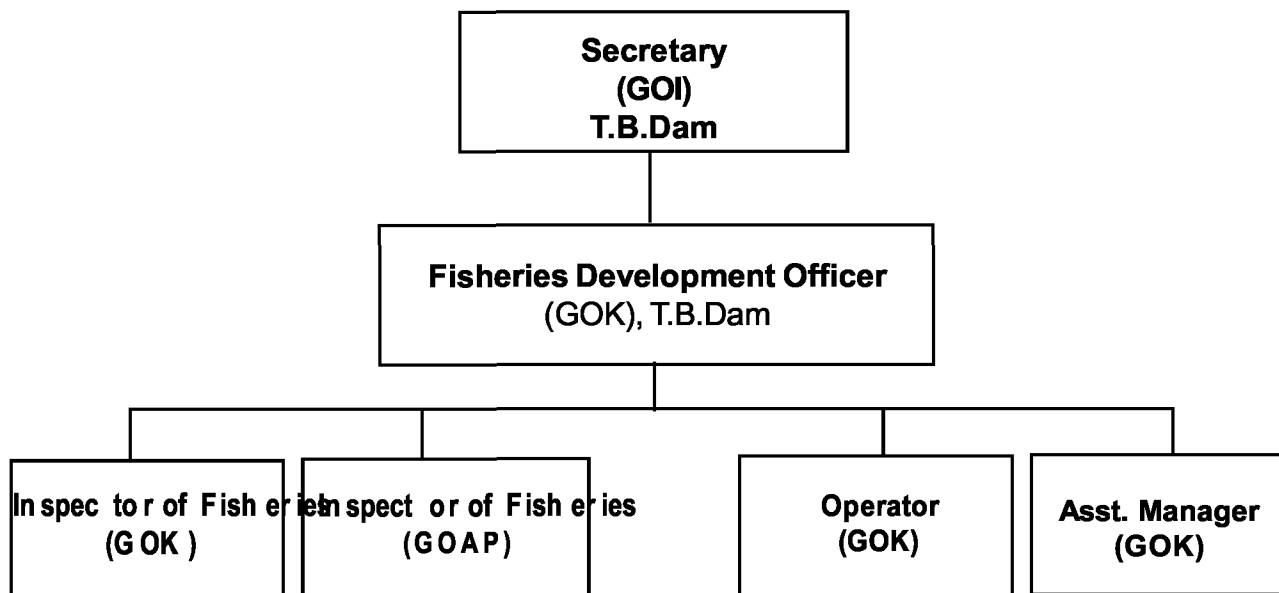
Sl.No.	Description	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
1	POWER GENERATION										
	i. Dam Power House	124.62191	97.9404	96.1195	98.3876	100.9765	59.7209	81.245	73.130	49.927	30.0302
	ii. Hampi Power House	99.515	107.69	93.941	86.424	87.163	68.364	93.709	91.148	66.748	50.335
	iii. Ncl Mini Hydrel Power House	27.8298	21.6504	25.4079	26.2684	24.8874	20.1279	25.5666	26.919	12.8913	3.432
	iv. Khandaleru Power House	--	--	--	--	--	--	4.1816	6.759	5.0443	3.391
	TOTAL	251.96671	227.2808	215.47	211.08	212.8269	148.2128	204.7031	197.957	134.611	87.1882
2	AUXILIARY CONSUMPTION (Consumption of common loads including station auxiliary)	7.03125	7.14742	6.96	7.32066	7.81632	7.20428	7.119037	7.0835	6.80904	6.2033
3	POWER GENERATED FOR SHARING	244.9354	220.13338	219.07404	203.75934	205.01058	141.00852	197.58406	190.8735	122.2761	78.4613
4	IMPORTION OF POWER										
	i. Govt. of A.P.	2.709	0.659	2.133	2.6540	1.169	2.5235	1.017	1.954	2.1535	1.9000
	ii. Govt. of KTK	0.35874	1.1246	1.869	0.7705	1.467	0.648	1.445638	0.293	0.881	1.9943
	iii. Total	3.06774	1.7836	4.002	3.4245	2.636	3.1715	2.4626	2.247	3.0345	3.8943
5	GOVT. OF KARNATAKA										
	i. Share in Generation	47.97552	42.71829	40.33412	39.4048	39.67774	27.87286	43.855651	43.6005	24.7262	16.9052
	ii. Utilisation	53.92181	40.25189	41.22076	41.05881	35.56872	24.49896	42.841190	42.1914	24.4444	13.9347
6	GOVT. OF ANDHRA PRADESH										
	i. Share in Generation	191.90209	170.87316	161.33651	157.61921	158.71097	111.49144	153.95265	148.1755	97.53438	61.5434
	ii. Utilisation	185.95580	173.33956	160.44988	155.96520	162.820	114.86534	154.96711	149.5846	97.81620	61.5138
7	TOTAL UTILISATION	239.8776	213.59145	201.67064	197.02401	198.38872	139.3643	197.81	191.776	122.2606	78.4486
8	System losses	5.89165	8.3255	6.36118	7.48645	7.26286	2.26867	2.1832	1.3321	3.51656	3.0269
9	% System losses	2.27	3.75	3.01	3.49	3.37	1.50	1.054	0.67%	2.55%	3.32%

Annexure 4.3

GENERATION COST PER UNIT

Sl.No	Year	Water utilization TMC	Power generated M.Units	Direct expenditure	Indirect expenditure		Total expenditure	Cost of generation (paise)
					Depreciation	Interest on Capital		
1	2	3	4	5	6	7	8	9
1	2004-05	39.200	148.521	599.67	2.29	34.19	636.15	42.83
2	2005-06	61.363	205.221	597.89	2.29	34.19	634.37	30.91
3	2006-07	50.820	196.8737	975.41	2.29	34.19	1011.89	51.40
4	2007-08	57.858	224.13691	846.48	2.29	34.19	882.96	39.40
5	2008-09	54.08	205.6304	848.43	2.29	34.19	884.91	43.03
6	2009-10	57.828	190.0605	952.58	2.29	34.19	989.06	52.04
7	2010-11	62.533	184.8116	849.04	1.9	34.19	885.13	47.89
8	2011-12	67.17	188.1395	1555.03	1.9	34.19	1591.12	84.57
9	2012-13	42.748	128.0849	1527.35	1.9	34.19	1563.44	122.06
10	2013-14	50.438	174.955	1688.87	1.9	34.19	1724.96	98.59
11	2014-15	81.163	164.2784	1849.81	0	22.31	1872.12	113.96
12	2015-16	56.274	116.6759	2006.18	0	0	2006.18	171.94
13	2016-17	39.86	80.3652	2353.38	0	0	2353.38	292.84

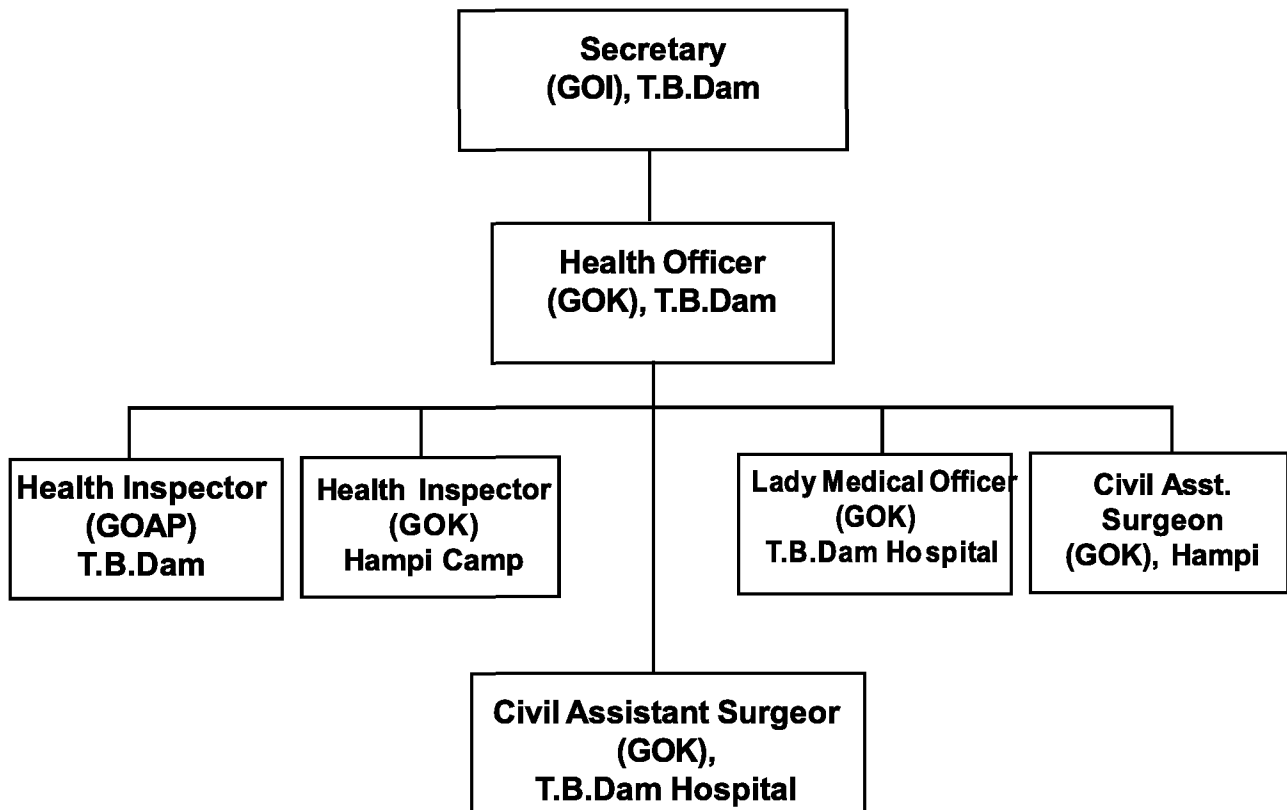
ORGANIZATION CHART OF FISHERIES WING



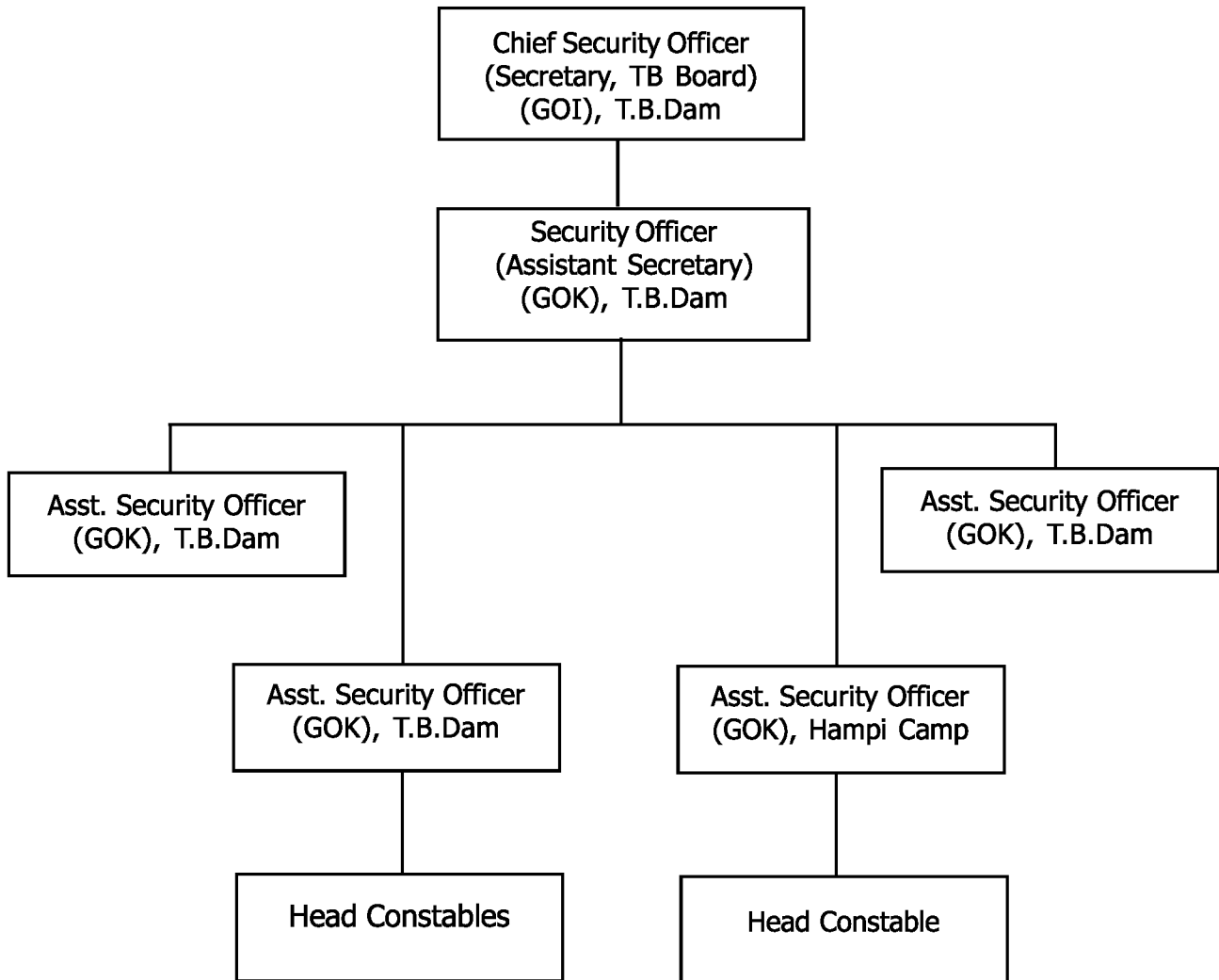
PHYSICAL PERFORMANCE OF FISHERIES WING

Period	Fish Farm Unit		Reservoir Unit			Ice cum Cold storage plant	FishNet Making Plant					
	Production of spawn (lakhs)	Supply of fish seed (lakhs)	Area of Pens erected (ha.)	Spawn (lakhs)	Direct stocking of fingerlings (lakh)		Production			Sales		
						Production of ice (Tonnes)	Twines (kgs)	Knotted Net (kgs)	Knotless Net in kgs	Twine (kgs)	Knotted Net (kgs)	Knotless Net (kgs)
1	2	3	4	5		6	7	8	9	10	11	12
2005-2006	431.80	24.04 Spawn 73.69 Fry 53.93 Fingerlings	Nil	Nil	31.20	1800.65	0	732.90	1,019.10	96.9	1671.60	1051.70
2006-2007	444.00	273.33 Spawn 35.33 Fry 22.71 Fingerlings	3	226.6	9.90	2049.90	0	2793.70	2252.90	209.579	2960.47	2191.70
2007-2008	477.30	268 Spawn 36.90 Fry 28.49 Fingerlings	3	240	11.42	2118.55	0	1801.20	1160.40	174.25	2019.30	897.10
2008-2009	315.85	130.35 Spawn 27.34 Fry 26.26 Fingerlings	3	114.4	11.62	2483.65	0	1421.8	819.5	212.30	1532.1	1109.65
2009-2010	527.40	301.4 Spawn 30.67 Fry 35.52 Fingerlings	3	231	9.89	2702.3	0	811	253.2	193.916	977.61	277.70
2010-2011	615.90	454.85 Spawn 12.02 Fry 33.56 Fingerlings	3	223	11.00	2447.05	0	0.00	0.00	0.00	0.00	0.00
2011-2012	649.25	480.10 Spawn 12.40 Fry 35.92 Fingerlings	3	265.1	14.12	2823.45	0	0.00	0.00	0.00	0.00	0.00
2012-2013	494.98	330.00 Spawn 7.77 Fry 43.56 Fingerlings	5	190	15.97	2358.95	0	0	0	0	0	0
2013-2014	659.95	447.90 Spawn 10.63 Fry 45.71 Fingerlings	5	230	24.85	2236.33	0	0	0	0	0	0
2014-2015	569.00	322.84 Spawn 2.73 Fry 56.54 Fingerlings	5	258.5	28.94	2069.3	0	0	0	0	0	0
2015-2016	465.10	247.50 Spawn 2.06 Fry 52.82 Fingerlings	1	66.00	30.43	1707.65	0	0	0	0	0	0
2016-2017	444.87	151.80 Spawn 2.65 Fry 47.9 Fingerlings	-	-	35.15	1305.55	0	0	0	0	0	0

ORGANIZATION CHART OF HEALTH AND MEDICAL UNIT



ORGANIZATION CHART OF SECURITY SECTION



COMPREHENSIVE SAFETY REVIEW OF TUNGABHADRA DAM RECOMMENDATIONS FOR REMEDIAL MEASURES

The dam safety team, after evaluating various parameters affecting the safety of the dam, recommended the following:

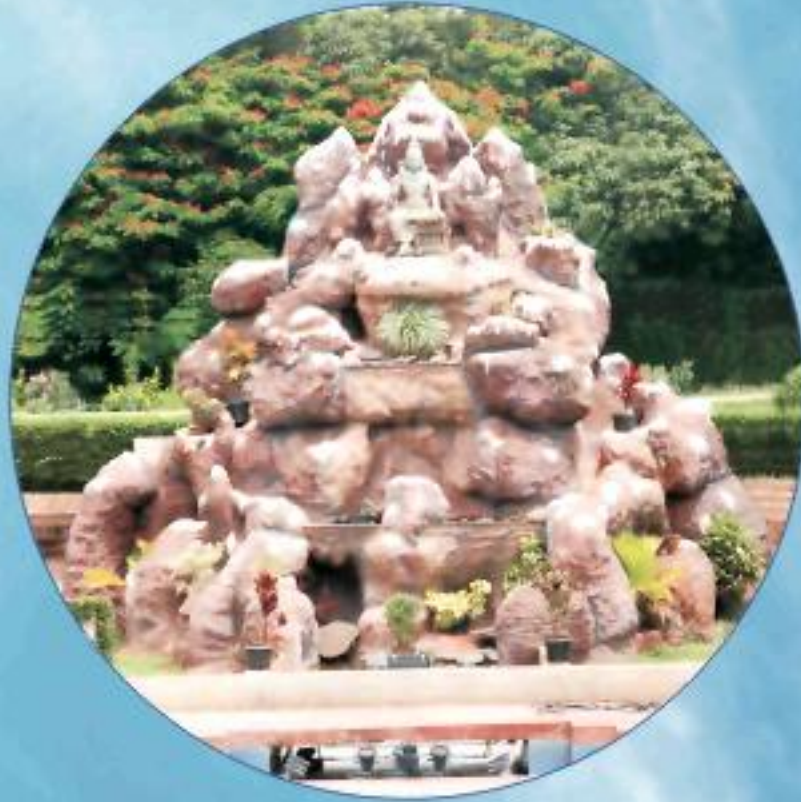
- The dam and reservoir are in need of hydrological rehabilitation in view of the inability of the dam to handle revised PMF. The options available for the rehabilitation measures are:
 - x To increase the spillway capacity by identifying a suitable site for additional spillway. In this case, the composite dam on the left flank can be considered. This will avoid any revision of MWL for the dam.
 - x Currently, the FRL and MWL for the dam are coincident. The MWL for the dam can be raised to 499.7 m to handle the PMF through the existing spillway. In this case, the dam will have to be raised by 4.82 m and the gates and operating mechanisms will need to be modified.
 - x A detailed study of the warning time available and capability of the existing structure to handle PMF without increasing FRL/MWL can be established. If proved feasible, a real time data acquisition and flow forecasting system may be designed and installed for ensuring the safety of the dam for an occurrence of PMF.
- The masonry dam does not satisfy the stability criteria under static loading conditions due to lesser density of the dam body. The sample size being inadequate, it is recommended that a more detailed investigation programme may be taken up for establishing the in-situ prevalent density of the dam. For this purpose, non-destructive testing methods suitable for such a large-scale operation may be adopted. If the overall density is found to be in the lower range, remedial measures to strengthen the dam by buttresses or other means may have to be considered.
 - The permeability values of the masonry dam in the upper portion are quite high and the sweating and isolated patches of seepage are visible on the d/s face of the dam. It is recommended that provision of an impervious u/s membrane may be considered by surface grouting of u/s face with suitable sealing compounds.
 - The masonry dam does not satisfy the stability criteria under earthquake loading. The strengthening of the dam of ensuring adequate safety against the earthquake by buttressing may be considered.
 - Earth dam appears to have adequate safety in static as well as dynamic conditions. The assessment is based on the material property values as obtained from limited field investigations. An attempt may be made to test the core area of the earth dam preferably at mid height to confirm the compliance to the stability criteria.
 - The safety of composite dam under earthquake conditions need be investigated further as the structure is complex structure and the simplified analysis has indicated some tensile stresses in the body of the masonry dam. A detailed soil structure simulation using non-linear finite element model may be taken up.
 - The safety assurance of the dam will require detailed design of the remedial measures alternatives and their techno-economic analysis for selecting the suitable measure. The work is quite extensive in nature and has to be taken up as a separate exercise. It is recommended that a suitable agency for the same may be identified and the designs may be taken up at an early date.

ABBREVIATIONS

BOOT	Built Own Operate and Transfer
IW	Irrigation Wing
HEW	Hydro Electric Wing
FW	Fisheries Wing
GOK	Government of Karnataka
GOAP	Government of Andhra Pradesh
KPTCL	Karnataka Power Transmission Corporation Limited
TBHES	Tungabhadra Hydro Electric Scheme
RBHLC	Right Bank High level Canal
RBLLC	Right Bank Low Level Canal
ICZ	Irrigation Central Zone
KWDT	Krishna Water Dispute Tribunal
Km	Kilometer
m	Metre
Sq. Km	Square Kilometre
mm	Millimetre
Cumecs	Cubic Metre per second
Cusecs	Cubic feet per second
TMC	Thousand Million Cubic feet
M. Cum	Million Cubic metre
ha	Hectare
RWT	Revised Working Table
KC Canal	Kurnool Cuddapah Canal
RDS	Rajolibanda Diversion Scheme
Ft.	Feet
FRL	Full Reservoir Level
MWL	Maximum Water Level
CWC	Central Water Commission
MOWR	Ministry of Water Resources
KERS	Karnataka Engineering Research Station
APERL	Andhra Pradesh Engineering Research Lab
CWPRS	Central Water and Power Research Station
AP	Andhra Pradesh
MW	Mega Watt.
KV	Kilo Volt
APTRANSCO	Andhra Pradesh Transmission Corporation
APGENCO	Andhra Pradesh Generation Corporation
KPCL	Karnataka Power Corporation Limited
O&M	Operation & Maintenance
RM & U	Renovation Modernization & Up-gradation
CEA	Centre Electricity Authority
TB Dam	Tungabhadra Dam
GU	Garden Unit
FFU	Fish Farm Unit
RU	Reservoir Unit
FNMP	Fish Net Making Plant

TBHS - DAM POWER HOUSE





NANDANAVANA GARDEN



Wildlife & Birds of Tungabhadra Project Area