PLANNING & DESIGN OF LIFT IRRIGATION SCHEMES

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Introduction

Rain is decentralized and so is the demand but the supply has not been decentralized.

Prevailing situation is widening socio-economic conditions between regions resulting imbalance.

There are regions situated at higher altitudes to which gravity is not possible or site conditions at source do not permit dam / barrage.

Lift irrigation schemes gained greater significance in the changed scenario as provision of conventional irrigation structures is exhausted.
Dams & Barrages have problems of:

- Submersion
- Rehabilitation
- Land Acquisition
- Environment Clearance
- Inter-state disputes
- Most important they consume more time for completion.

Major irrigation structures need huge financial support and often the estimated cost gets multiplied due to delay in the completion.
• Reasons for Opting Lift Schemes Over Gravity Schemes:

• In the present circumstances, lift irrigation schemes assumed greater significance and seems to be the only viable solution to meet the aspirations of the upland people for the following reasons:
  
  • Speedy Completion of the Scheme
  • Lesser initial Cost
  • No need of extensive and time investigation
  • Flexibility of Location of Head works
  • Does not have foundation problems
  • Environmental friendly

• Though lift irrigation schemes have some drawbacks and are costly, in the prevailing situation, they are inevitable since the situation demands them in the contemporary irrigation planning, but ought to be taken up judiciously.
Limitations of L.I. Scheme

✦ They are costly with respect to benefit cost ratio compared to Gravity schemes
✦ Require assured un-interrupted power supply. Always dependent on power supply
✦ Require assured flows from the source
✦ Recurring cost on power bills
✦ Regular maintenance is required for civil as well as mechanical works. Any problems in pipes or pumps lead to grinding halt to the system
✦ Life of L.I. scheme is shorter than dams & barrages
✦ Need periodical replacement of mechanical & electrical components
Objectives of LI Schemes

- Diversion of flood water to upland areas
- Supplying water to needy regions located far away from source
- Feeding tanks for future needs
- Effective usage of water stored in reservoirs
- Optimum utilization of water by supplying designed quantity
- Interlinking of rivers
- Transfer of surplus water from reservoirs to the required regions.
VARIOUS COMPONENTS OF LI SCHEMES

➢ I) Civil Structure & Associated components / provisions

➢ II) Electro-Mechanical and

➢ III) Hydro-Mechanical
I) Civil Structure & Associated components / provisions

- Approach Canal
- Intake / Sump / Fore bay / Surge pool
- Sub structure / sump
- Super structure to accommodate Pumps & Motors
- Service / maintenance bay
- Control panel room
- Dewatering Pumps chamber arrangement
Balancing Reservoirs / tanks

✦ Delivery Cistern

✦ Gravity Canal with CM & CD works
II) Electro – Mechanical

- Pumps & Motors
- Control Panels
- SCADA
- Transformers
- Dewatering Pumps
- EOT crane for Pumps
- HOPDV / NRV / EOPDV etc within pump house
III) Hydro – Mechanical

- Pressure mains with design diameter and thickness
- Surge Protection Devices based on the surge analysis
- Valves such as air valves at regular intervals
- Stop logs & Trash racks
- Manifold to connect for smooth distribution of discharge from delivery pipes of pumps into pressure mains
- Semi Portal crane for Stop logs & Trash racks
Pump House for Wet Pit / VT Pump in River
Planning & Design Of LI Schemes

I. Hydrology
II. Alignment
III. Hydraulic Particulars
IV. Pumps – type, number & capacity
V. Intake Sump / Surge pool / Fore bay
VI. Design of Pump House
VII. Pressure mains / Water conductor system
Planning & Design Of LI Schemes

VIII. Surge protection system
IX. Delivery Cistern / Out fall structure
X. SCADA – Supervisory (Sequential) Control And Data Acquisition
XI. Canal networking system
HYDROLOGY

Design Discharge shall be computed for:

- Crop Water requirement
- Seepage & Evaporation Losses
- Drinking Water requirement
- Operation period of Pumps (Preferably 24 hrs)

Low Water Level shall be:

- Above bed level of source
- Above MDDL of reservoirs at river intake
- For pump houses far away from source, conveyance losses shall be deducted from LWL / MDDL of source
PAIDIPALEM RERSERVOIR-GK Lift Scheme
GKLI Scheme – Stage-I Pump House:
A.M.R.P. - DELIVERY MAINS

655m Long 2500 Dia Pipes of 14 & 16thick
ALI SAGAR L.I.S. DELIVERY CISTERN STAGE - I

Delivery Cistern of Stage - I of Alisagar Lift Irrigation Scheme
Fixing of LWL

Whenever pumping is proposed from a reservoir, LWL shall be above the MDDL, otherwise the following drawbacks will be there:

✦ Encroachment into dead storage
✦ Has impact on already committed ayacut of project
✦ Reservoir takes extra time to get filled up and cannot give water to committed ayacut in time, during next season
✦ Increases pumping head, pump capacity and also project cost
The alignment finalisation consists of:

- Fixing of Pump house location in the foreshore of river / reservoir
- Approach and gravity canal lengths
- Length of Pressure mains
- Utilization of tanks en route the alignment
- Number of Lifts / Pump houses
Fixing of Pump House Location

Pump house location shall be located such a way that it needs:

✓ Smaller length of approach canal
✓ Smaller length of approach bridge from TBL

Approach Canal and Gravity Canal

Approach canal capacity should be 50% more than required for river intake:

✓ Off take point of approach shall not be silt accumulation region as it is the gate way of the LIS
✓ Greater length of gravity canals has to be explored to achieve economy by reducing pipe length.
Length of Pressure mains

Shorter length of Pressure main shall be provided since length has bearing on cost of the scheme.

If length increases:

- Pumping head increases thereby by pump capacity
- Pipe thickness increases
- Surge protection devices required more
- Capital cost increases
Balancing Reservoirs make the scheme economical as well as efficient as:

- Design discharge of pumps can be reduced which reduces pump capacity, pipe dia and canal sizes
- Flood waters can be stored in the balancing reservoirs for future needs
- Better Synchronization of lifts is possible in multiple stages of lifts
**Number of Lifts / Pump houses**

Number of lifts / pump houses depend on:

- ✴ Length of the canal
- ✴ Total Pumping head required
- ✴ Presence of command en route the canal
- ✴ Capacity and type of proposed pumps

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**Fig 1: SCHEMATIC DIAGRAM SHOWING 3 - LIFTS OF CHAGALNADU L.I. SCHEME**

<table>
<thead>
<tr>
<th>No</th>
<th>Lift</th>
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<th>Delivery</th>
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HYDRAULIC PARTICULARS

After finalising the pump house location, the length of canal, pressure mains are to be calculated.

- HPs of the scheme w.r.t. LWL and FRL of proposed sumps
- HPs of approach & gravity canals and pipe alignment.
- Total quantity of water required to be lifted in specified period
- Discharge at pump house considering water requirement at various locations en route the alignment.
- If period of water availability in source is less than operation period of scheme, balancing reservoir ought to be provided.
PUMPS

★ Pumps act as heart of LI Scheme and play important role in the performance as well as efficiency of the LIS.

★ Designer should have a comprehensive knowledge on availability of various types of pumps and their applications along with their limitations.

★ Any wrong judgment in selection of pumps may lead to procurement of unsuitable pumps and the scheme may face threat of repairs & maintenance along with non-functionality to the design requirement of the scheme.

★ Higher capacity increases unnecessarily the capital cost and power consumption. On the other hand lower capacity will not deliver design discharge.
Number of Pumps

Number of pumps and pump houses to be proposed depend on:

- Capacity of Pumps
- **Suction Lift** and
- Type of pumps
Design Discharge

Total quantity of water to be pumped in the specified period shall be computed based on

1. Crop water requirement
2. Seepage & Evaporation Losses
3. Drinking water requirement
4. Pumping hours
Determination Of Pumping Head

- Total pumping head should be arrived with care since any wrong calculation has a bearing on the performance of the pump.
- Excess head may lead to un-necessary increase in pump capacity and power consumption
- Lesser head may lead to non-functionality of the pumps to design efficiency as well as design discharge.
Total Pumping Head is obtained on summation of:

- Static head between LWL & delivery level
- Frictional losses
- Losses due to exit, entry and bends
- System resistance losses due to the combined / operation of pumps and pressure mains
Capacity of Pumps

Capacity of pump can be calculated using formula:

Pump capacity in KW = \( \frac{9.81 \times Q \times H}{\eta} \)

Pump capacity in HP = \( \frac{9.81 \times Q \times H}{0.746 \times \eta} \)

(Motor capacity may be 10% to 20% more than pump capacity)

Where  
\( Q \) = Discharge in cumecs  
\( H = H_{st} + H_{f} + H_{b} \) = Total pumping head in m  
\( \eta \) = Efficiency of pump
The frictional losses in the pressure main is to be calculated using Hazen-William’s formula:

\[ H_f = L \left( 1.778 \frac{V}{C R^{0.63}} \right)^{1.852} \]

Where

- \( V \) = Velocity in pipe (m/s)
- \( R \) = Hydraulic Radius (m) = \( D/4 \)
- \( C \) = Hazen William’s Coefficient
  - = 130 for PSC pipes
  - = 130 + 0.17 \( d \) (dia in inches) for MS pipes with lining

It is desirable to limit the \( C \) value to 130 only.
Types of Pumps

**Horizontal Centrifugal Pumps** - Applicable for medium heads and discharges and has the limitation of suction lift and hence may be better suited for LIS on canals or tanks with total suction lift less than 6.0m.

**Vertical Turbine Pumps** - Applicable for schemes with high heads and discharges. Best suited for the schemes where the suction lift is more than 6.0m and more applicable to schemes on rivers.

**Concrete / Metallic Volute Pumps** - Applicable for schemes with high heads and huge discharges.

**Francis turbine Pumps** - Applicable for very high heads and very huge discharges.
Factors for deciding type Of Pumps

Type of pumps to be adopted is governed by:

✶ Hydraulic requirement such as discharge and total pumping head
✶ Pump house location
✶ Suction lift
✶ Total pumping head
✶ Pump capacity
✶ Manufacturing limitations of respective pumps
Horizontal Centrifugal Pumps

➢ Used for medium head & discharges.
➢ Useful to lifting from canals or for smaller discharges.
➢ Have limitation of suction lift.
➢ Usually the suction lift is not allowed more than 6.0 – 6.5m
Arrangement of Horizontal Centrifugal Pump House
Vertical Turbine Pumps

When the site conditions are not favourable for horizontal centrifugal pumps, i.e., whenever the suction lift is more than 6.0m, VT pumps are more suitable.

★ Vertical Turbine pumps are most widely used in the LI schemes due to their capacity to lift wide ranges of discharges & heads.
Limitations Of VT Pumps:

- They are not preferred for discharges more than 10 cumecs and total head more than 75.0m.
- If the head fluctuation is more than 20m, they may not function efficiently with shaft length more than 20.0m, they develop operational & vibration problems.
GKLI Stage – I: VT Pumps & Motors:
Arrangement of Vertical Turbine Pump House

- When suction lift is more than 6.0m
- Applicable for lifting from reservoirs & rivers
- For medium heads and medium discharges
Concrete Volute Pumps

✿ These pumps are almost similar to dry pit pumps arrangement
✿ Cannot be used for unlimited capacities / huge magnitudes though can be used for capacities more than Vertical turbine pumps.
✿ Technically, they are end suction pumps erected vertically with extended / lengthy shaft in between pump and motor.
✿ Useful for discharge of each pump upto 10 cusecs and head is less than 150m
✿ Volute Pumps with head more than 50.0m need metallic lining of volute and may be imported.
✿ Discharge control is not possible and need more power even for reduced discharge ( unlike Francis turbine )
CONCRETE VOLUTE PUMPS
Applicable for lifting from reservoirs & rivers
For high heads and high discharges
Pump rating may be upto 15.0 MW
When fluctuation of water levels is > 25.0m
LI-01  Pump House inner view (Gandikota – CBR Lift)
These pumps are also termed as reversible turbines since they operate in reverse direction for pumping.

Useful and economical for very high heads (>100m) and high discharges (>10 cumecs).

Considerable economy can be achieved by reduction in number of pumps, lifts.

O & M problems are minimum in Dry pit pumps as the components are in dry condition.
These pumps are going to play vital role in the interlinking of rivers where it is required to lift huge quantity of water to very high heads.

Lift requirement of head less than 100m and discharge less than 10 cumecs, adoption of these pumps are un-economical for following reasons:

➢ Require very big pump house
➢ Need surge pool (not required for other pumps)
➢ Huge concreting
➢ Heavy gantry

These pumps were installed in AMRP to lift 68 cumecs to a head of 102m to irrigate 2.2 lakh acres using 4 pumps of 19 MW(each)
INTAKE SUMP / FOREBAY

- The objective of sump and approaches is to provide storage and good/smooth flow conditions in sump.
- If the design is with poor geometric features, undesirable flow conditions develop in the sump which reduces the pump efficiency.
- To develop uniform, steady and non-turbulent flow conditions in the sump, it is recommended to allow max velocity of 1.2 m/s at the entry of forebay and 0.30 m/s near the pumps.
- Forebay may be tapered with limiting enlargement angle in plan to 20 degrees and bed slope in elevation 10 degrees.
- However, it is desirable to provide 15 degrees in plan and bed slope of 8 degrees.
Good features of sump design:

Where

\( d = \text{Diameter of column assembly} \)
\( D = \text{Diameter of bowl assembly} \)
which is usually in the range \(1.5d\) to \(1.8d\).
\( T = \text{Thickness of baffle wall/pier} \)

Good features:

- Bell mouth near to sump floor, \( c = 0.5D \).
- Flat sump floor.
- Width about \(2D\).
- Submergence below LWL not less than \(1.5D_{(\text{min})}\).
- Length of approach shall not be less than \(4D\) and preferably up to \(10D\) in case of single pump sump and \(2/3W\) in case of multiple pumps sump.
- Distance of rear wall from pump \(X = 0.25D\) in case of single pump sump and \(0.75D\) to \(1.0D\) in case of multiple pumps sump.
- In any case, mean velocity of flow approaching bell mouth should be \(0.3\text{ m/sec}\) or less.
Forebay sides on water side shall be vertical (atleast upto LWL) as slopes will cause off sets at pump house generating vortices.

Jump formation shall be strictly avoided near pumps as it creates turbulence.

Proposals of intake sump for major LIS shall be ascertained by physical sump model studies for fine tuning of the flow conditions and satisfied, before commencement of execution.

Intake sumps in the river foreshore shall be provided with controlling arrangement at entry of forebay also to facilitate maintenance of the sump, in addition to gates provision in front of the pumps.
DESIGN OF PUMP HOUSE

**Wet Pit Pump House**- The pump will be submerged in water. Substructure will be always in water
Ex: Pump house with Vertical turbine pumps.

✓ **Dry Pit Pump House**- It is also called as reversible turbine. Access can be there to all the components including pumps. Substructure will be without water and in dry condition. Hence maintenance is very easy.
✓ Ex: Francis turbines and Volute Pumps
I) Pump House / Pumping Station

- Approach Canal
- Intake / Sump / Forebay / Surge pool
- Sub structure / sump
- Super structure to accommodate Pumps & Motors
- Service / maintenance bay
- Control panel room
- Gantry for Pumps, Stop logs & Trash racks
Hydraulic Provisions of VT Pump House

- Distance between the pump rear wall and the trash rack shall be between 4D to 8D depending upon the percentage of obstruction through trash rack (Generally it may be 6D)
- Breast wall (upto LWL from top) in front of pumps improves hydraulic condition and also reduces height of stoplog & trash racks.
- Pumps shall be located 4.5m (app) away from stiening wall to accommodate non-return valve & butterfly valve
- 1m thick RCC piers are generally provided in between pumps to support pumps and to accommodate stop logs & trash rack grooves and also to act as baffle walls in between pumps to improve hydraulic conditions.
- Dewatering / Silt removal pit is to be provided adjacent to the stop log groove within the sump for maintenance purpose
Design of Stop logs:

➢ Stop logs for VT pump house may be designed for LWL operation and may be procured for single vent only.

➢ Stop logs for dry pit pump houses shall be designed for FRL condition to facilitate maintenance of pumps above LWL also.

Motor Floor Level: In absence of Balancing Reservoir, multiple lifts with lengthy approach canal need proper drainage system / escape regulator to avoid inundation of drawing pumping station during power failure. The motor floor level shall be kept above the possible inundation level.

Design of Pump House Raft: Raft of dry pit Pump house shall be designed for uplift pressure of water on fore bay side.
PRESSURE MAINS

- *Pressure mains function as nerves of LI scheme* and they consume lion’s share of the project cost, if pipe lengths are longer.

- Length of pipe has direct bearing on pumping head thereby on pump capacity & Surge protection system.

- MS pipes and PSC pipes are under more usage in LIS.

- It is desirable to limit the velocity 2m/sec in MS pipes and 1.5 m/sec in PSC pipes.

- Velocity more than 2.0 m/s in MS pipes may be considered for the schemes with shorter length of pipeline duly examining the impact on pump capacity.
MS pipe thickness is to be calculated based on:

- **Stress Criteria:**- Compressive Stress & Tensile Stress
- **Buckling**
- **Deflection Criteria**

- Minimum thickness of MS pipe shall be as per recommendations given in IS : 1916.
- As a thumb rule, \( D/t \) ratio may be provided 185 for pipes with shorter length & medium heads and \( D/t \) ratio between 185 to 150 for high heads with lengthy pipes, subject to satisfying the surge conditions.
Pipe Testing for Thickness

- Radiography test
- UV Test
- Hydraulic Test

**Hydraulic test** may be 1.5 times design pressure as per codal provisions and 1.25 times as per AWWA. For shorter length and smaller heads, the hydraulic test may not be governing for pipe thickness, however for lengthy pipes with high heads, it has bearing on the scheme cost and hence shall be careful in adopting.

In **GLIS**, for 130 KM length with 135m head 14mm and 16mm are provided for 2500 mm dia & 3000 mm dia respectively. If it is **TWICE**, the pipe cost could be 25% more than actual cost.
Whenever power failure occurs, rapid changes in velocity and any change in pressure results in the pipeline causing surge pressure.

Power failure leads to movement of upsurge and down surge waves along the rising main and the waves travel with high speed developing low & high pressures all along the pipe line.

Down Surge - Related to pressure drop or minimum pressure. Pressure drop immediately after power failure at peak locations causes negative pressure, which may even go down to vapour pressure.

Up Surge - Related to pressure rise or maximum pressure. When separated water column rejoins, sudden pressure rise occurs
Surge analysis is a very complicated phenomenon and needs thorough analysis of the pipe line profile w.r.t surge heads to assess type and number of surge protection devices to be provided at appropriate locations.

Due attention shall be given to the surge analysis of pipe lines for schemes with high heads and lengthy pipes.

The surge generated can be controlled by providing combination of surge protection devices at various locations.
Surge Protection Devices & Their Function

- **Air Vessel** - Controls upsurge and down surge
- **One way Surge tank** - Controls down surge directly and upsurge indirectly
- **Two way Surge tank** - Controls both down surge and upsurge
- **ZVV & Surge relief valve** - Controls upsurge
- **Air valves / Air cushion Valves** - Controls down surge directly and upsurge indirectly
- **Stand pipe** - Controls down surge
Elevated OST
ONE WAY / TWO WAY SURGE TANKS
FIG. 5 SCHEMATIC DIAGRAM OF AIR VESSEL
Water Hammer Conditions

Surge effect depends on topography / terrain, velocity and pipe length and is predominant when frictional losses are more.

- High Points in the pumping main alignment
- Possibility of Water column separation in the main due to sudden power failure
- Pipe line gradient is steeper than 1 : 20
- Ratio of frictional loss to working head is less than 0.7
- Presence of Check valve with slow closing arrangement
- Velocity of normal flow exceed 1.0 m/s
DELIVERY CISTERN

✓ Delivery cistern is to be provided to dissipate the energy of water falling freely from the pressure mains and delivers into the canals.

✓ Cistern shall be designed as vertical drop.

✓ To have better energy dissipating arrangement, the bed level of the cistern should always be kept below the bed level of the leading canal.
Delivery Cistern
Delivery Cistern
SCADA ( Supervisory Control And Data Acquisition )

LIS with Multiple pumping stations needs proper monitoring and vigilance for better synchronization, for which SCADA installation is mandatory. SCADA collects and detects data such as:

- Non-functioning of pumps in any of the pumping stations
- Non performance of any of the surge protection devices such as air vessels / One way surge tanks (OWST) etc.
SCADA

- Records data during operation of the scheme
- Monitors inflow and outflow discharges of pumps
- SCADA will be controlled at one station monitoring total alignment. Origin of failure of any component of the system enroute the alignment can be detected using SCADA, with the help of which operation of other pumping stations can be controlled.
**IMPORTANT ASPECTS IN DESIGN OF L.I.S.**

★ *Influence of Velocity in Pressure main*

★ With increase in velocity of pipe, frictional loss increases thereby increasing pump capacity along with pipe thickness due to pumping head as well as surge head

★ For every 0.50 m/s rise in Velocity of pipe, frictional loss rises by 75% to 100% with reduction of dia by 11% to 13% only.

★ Smaller dia is economical during initial stage of construction but power consumption will be high. Higher dia needs less power but with high initial cost.

★ *Hence, it is desirable to allow higher velocities in shorter length of pipes and lower velocities in lengthy pipes (particularly when the length of pipe is in KM) owing to the recurring power consumption annually.*
Advantages of Minimum number of Rows

✵ More number of pipes with smaller dia leads to more frictional losses as well as enhanced pumping heads / pumping capacities and more quantity of steel.

✵ More pipes with smaller dia causes more frictional losses and initial cost as well as recurring power cost over lesser no. of pipes with bigger dia with same velocity.

✵ Further, more number of rows need more land acquisition and CM & CD works.

✵ Hence, it is desirable to provide bigger dia with less number of rows of pipes, particularly for the schemes with lengthy pressure mains.
Pipe lines in Soft Soils

Care shall be taken in designing and laying of pipes in soft soils / BC soils etc., Either pipe shall be designed for the soil condition or the refilling has to be done with selected soils as the soil modulus is also one of the parameter in design of pipe thickness for buried condition.

Since soil modulus is also one of the major property influencing pipe thickness, it is desirable to have refilled soil gets compacted to achieve minimum 90% Proctor’s density.

Water logged areas causes settlement of pipes or uplifting of pipes, which shall be designed accordingly.

Hence the above field conditions shall be conveyed to the designer wherever the pipes pass through such areas.
Clearance between bigger dia pipes with more than two rows may be min of 5.0m for inspection:

- When multiple number of rows of pipes are laid and some of the pipes are only in operation, then empty pipes may create instability among the combined trench or when pipes are closely placed.

- Scour sluices / washouts with projections to flush out the water in pipes get overlapped when pipes are closely placed.

- It is desirable to have independent thrust blocks to avoid problems during O & M in the vicinity.
If adequate clearance is not provided in water logged areas, whenever any one of the pipe is empty, imbalance condition develops which results in settlement or uplifting of pipe.

Handling of heavy / bigger dia pipes need crane for erection & maintenance which needs 5.0 m ( min ) clearance in between pipes

Whenever pipe is to be laid adjacent to the existing pipe in operation, new pipe needs excavation and disturbs existing pipe trench. Thus weakening the degree of compaction made to already existing one and resulting imbalance of earth pressure on existing pipe. If sufficient gap is provided, the effect can be minimized.
Connection of Pump delivery pipe and Pressure mains

- When multiple number of rows of delivery pipes are required to be connected to a pressure main, a manifold is required. In which case, the design discharge may be increased by 2.5% for each pump to account for system resistance losses in manifold.

Types of Manifolds

- WYE type – May be useful when one or two delivery pipes need to be connected to a single pressure main
- Cylindrical – When rows of pressure mains is less than no. of pumps
- Whenever stand by pump is provided, cylindrical manifold may be mandatory (twice the dia but not less than equivalent dia of pressure mains) as rotation of stand by pump in wye junction is not possible to satisfy equal discharge in pressure mains.
CONCLUSIONS

✶ L.I. schemes are going to play major role in coming days and due attention shall be given to the planning and design of LIS for better performance and efficiency of schemes.

✶ Alignment shall be so chosen comprising shorter length of approach channel and shorter length of pressure mains. As far as possible, greater length of gravity canal shall be provided for economy in LIS.

✶ Pumps function as heart of LIS and hence attention shall be given in fixing the duty point of the pump. For optimization of the scheme, duty point shall be with respect to level above LWL.

✶ Pumping discharge shall be designed for mean average of crop water requirement wherever intermediate balancing reservoirs are present with pumping stations.
Importance shall be given in design of sump dimensions and arrangement to avoid undesirable flow condition. Physical model studies shall be conducted for LIS and shall be mandatory for river intake lifts.

As the pressure mains act as nerves of LIS, care shall be taken for pipes to be laid in BC soils, water logged area and at crossing of vagus/drains.

Low velocity in pipes may be economical for the schemes with lengthy pressure mains, however higher velocity in pipes may be permitted for schemes with shorter length.

Larger dia with less number of rows may be economical with respect to installation cost as well as running cost.

Adequate clearance shall be maintained between pipes for stability as well as maintenance purpose.

Due attention shall be given to surge parameters which are vital aspects for proper functioning of the pipe line.

LI Scheme comprising multiple pump houses shall be provided with SCADA for observing & monitoring entire system.
AYACUT DETAILS OF L.I.SCHEMES

- PUSHKARA L.I.S. - 1,85,906 Ac
- TADIPUDI L.I.S. - 68,600 Ac
- RAJIV SAGAR L.I.S. - 4,00,000 Ac
- ALISAGAR L.I.S. - 53,793 Ac
- GUTPAH L.I.S. - 38,793 Ac
- RAJIV BHIMA L.I.S. - 2,03,000 Ac
- NETTAMPADU L.I.S - 2,00,000 Ac
- KALWAKURTHY L.I.S. - 3,40,000 Ac
- H.N.S.S. L.I.S. - 6,21,000 Ac
POWER GENERATION IN A.P.

1. THERMAL  2973MW
2. HYDRO    3586MW
3. GAS      999MW
4. BIO MASS  312MW
5. WIND     98MW
6. MINI HYDEL 91MW
7. SHARE FROM CENTRAL SECTOR 2465MW
8. OTHERS   182MW

Total  10706MW
# POWER PLANTS NEARING COMPLETION

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# POWER PLANTS PROPOSED

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Total Capacity: 1284MW
Thank You