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Sub: Design & Construction Management System: Circular –3.
Ref: Guidelines for Water Supply sector for the works to be taken up under RUSDIP.

Drinking Water Supply is one of the most important sectors for intervention. There are existing water supply systems in the towns proposed to be covered. The demands for the system improvements in these towns can be very large. The proposals for improvement of the water supply will therefore have to be tailored to be within the limitations of the funds available for the sector in the town. A comparative benefit/cost of different works should be considered and the most beneficial and cost effective proposals have to be prepared after interaction with the PHED and the local city level authorities. The proposals may follow the following general guide lines:

System Design

1. The Water Supply Systems when being re-organized, should be targeted for the projected population of the city for next 30 years (Year 2041 for RUSDIP). The population projections for the city should be developed adopting all the standard methods, looking into the dynamism and future prospects of the town and keeping in view the projections that may have been developed by the Town Planning Department for the city.
2. The population projections of the city should be further subdivided in projection of population of wards. This will differentiate in the growth according to the present status of the wards e.g. an already crowded ward is likely to not grow or grow slowly, an average developed ward will grow moderately and the wards which are new and sparsely developed so far will grow faster. These projections should be discussed with the local town planning officials, PHED and the city officials. Their opinion on the distribution of population and it's projection should also be considered before finalizing the figures. These figures should then be used for arriving at the distribution zone wise population and water demand projections. No proposals for any individual locality can be considered unless this city exercise is complete and the proposal is in line with the city projection. These projections should be one of the first tasks and should be got approved from the PMC before further designs of distribution networks in the city.
3. The rate of water supply may be adopted as 135 lpcd with addition of 20% losses (this includes losses for transmission system if very long @ 2% (max.) and 3% for treatment plant may be taken where applicable and 15% distribution losses ie. 169 lpcd for production purpose).
4. The rate of supply includes all institutional and small industry demands. However if there is a major bulk consumer, that may be taken separately.
5. The planning horizon for water sources may be 30 years, but the development of the resources can be phased depending upon the economy of the option e.g. if only tube wells are proposed to be developed, we can develop them for about 5 year demand projections and the subsequent additions can be made later, but say if a dam is to be constructed, it will have to be done for longer projections if feasible otherwise. Ground Water Department officials must be consulted for report of sustainability and potentiality of the aquifer.

Capacity of raw water reservoir should be as per periodic availability of raw water from canal on case to case basis. The water to be taken for drinking purposes from source should be got reserved from the Irrigation Department before taking it in to account.

6. The confirmation of the reliability of the water sources proposed is an important aspect and the data should be carefully collected and evaluated. In case of ground water sources, the reports of the hydro geologist conversant with the local areas should be obtained.

7. The transmission system should be designed in accordance to the capacity of the water source. The most economic option of using 1, 2 or 3 pipes can be worked out for major and long period transmission systems. The discount rate is adopted as 10.0 %, the rate of power may be adopted as Rs. 4.75 / unit. No provision for escalation of power rates is made in the evaluation. Usually the period for evaluation should be 15 or 30 years.

8. The possibility of using recycled water for restricted usage should be considered as a part of the water resource development.

9. Opportunities for recharging of water basin should also form a component of resource development.

10. New Pumps should be designed for a 15 year period. However space should be planned for a period of 30 years.

11. All elements of our design should be assumed for working of 22 hours. It should be supported through reliable power supply system.

Network Design

12. The distribution networks are designed for 24 hour operation and that is our aim. However it will require several efforts to achieve this in due course but till then the systems will have to be operated on intermittent basis. The distribution system should be designed for 30 years. It should be designed as a continuous system with peak load factors as per manual of water supply in accordance to the design population of the zone under consideration and not the population of the city.

13. This design then should be checked for intermittent supply for 2015 demand assuming 3 – 2 or 5 – 3 hours intermittent supply in morning & evening. This will have to be achieved by creating suitable sub-zones (installing valves) and operating them sequentially instead of operating the whole zone together as done in design for 30 year requirement. The effort should be to find a way so that we can operate the system for the intermittent supply without additional or with minimum additional investment. This may be achieved by some changes in the size of distribution mains and may require change in ESR capacity and accordingly the transmission line and pumping arrangements should be considered.

14. Minimum number of valves should be proposed in the system and wherever proposed they should have a purpose as valves that are not operated usually get jammed and are of no use when required, also forgotten and lost under ground. Any valve provided has to be operated at least once in a month to keep it operational.

15. The layout of the distribution should be such that we have ready DMA (districts for NRW study) of 3000 connections or less. This means the distribution should be totally separated with one entry of water which can be metered and isolated.

16. Wherever we are intervening in distribution in old covered areas, the designs may be checked for 30 year profile, but it will generally lead to parallel pipes in several lanes. All these parallel pipes are not required immediately and their

investment can be deferred. We should therefore recheck the system for about 2015 demand restricted the new pipes to a minimum so as to meet our pressure requirement and defer the balance investment to a future date. This should be clearly spelt out in the report.

17. The line agencies should be asked for the preliminary identification of the leaking and damaged pipelines and then study should be conducted for re-placement of these lines so as to reduce losses and if necessary, proposals for their upgrade/replacement may also be included. This work should not be carried out in small patches or for regular repair works to be taken up by the line agency. In case lines are to be changed than complete length of that system should be considered for replacement to have a tangible effect on the supply system.
18. While connecting new laid pipe lines with old distribution system it should be properly checked with reference to levels of different systems.
19. When designing the area using existing lines, the condition of the existing lines should also be evaluated and if necessary, necessary proposals for their upgrade/replacement may also be included. We should make an effort to provide a system that on the whole does not loose more then 15% water.
20. A standard drawing of a Valve cap should be adopted as given by PMC. This type of valve cover can be used for valves of non rising spindle type with back seat arrangement. Here the gland can be replaced from top. This is a cheaper option and should be adopted wherever feasible in place of the regular valve chambers which mean a large investment in construction and additional fittings and also increasing number of joints.

Reservoirs

21. ESR capacity should be worked out using mass diagram. However where ever we have the option of changing pumping hours or the consumption pattern by supplying different sub zones at different times we should try and find the most economic option. The capacity of the ESR should be split in two if there is a big difference in the capacity for 15 year and 30 year profile, if the difference is small, it maybe provided for 30 years. In any case we should have space provision for ESR suitable for the 30 year requirement as the distribution has been designed assuming this location.
22. The investigation for the foundation should be got done and enclosed and clear recommendations of the SBC for the type of foundation proposed should be given.
23. The foundation investigation, structural design and construction drawing of the ESR may be submitted in 3 hard copies and one soft copy so that proof checking maybe got done.
24. It is proposed to ensure that no ESR overflows and waste water. Therefore, it is proposed to have either a float on the inlet to the ESR of typical design, a pressure switch with pressure transmitter on the rising main which trips the pump when the predetermined level is reached or to install electrically actuated valves on the inlet with level switches to close and open the valve at predetermined water levels.
25. Very often there are more than one ESR being fed by one pump. It is to be proposed to use pressure switches on the delivery mains set at such a pressure that when all ESR are full and the entry to them is closed, the pressure rises above the stipulated pressure in the delivery main sustain for a minute, this should trip the pump. The pump shall start again after the pressure in the line has been released by opening of the float valve or the electrically actuated valve of any of the tanks it feeds.

26. Wire mesh cage must be provided on staircase from last landing at top to balcony and from balcony to top of container. Locking arrangement at balcony level can also be provided for safety purposes.

27. The levels should generally follow the absolute levels by picking up the reference level from Survey of India Bench Mark or some other established bench mark. In any case, the levels used for the distribution system and the ESR and CWR must have the same reference level for the town. The levels should also be checked with base maps being prepared under RUSDIP.

28. The CWR capacity is also to be accordingly worked out by mass diagrams. It should however be noted that there can be several combinations of the capacity of the CWR, ESR and the Pumping system including the pumping main to meet the demand of the distribution. The most economical combination should be worked out.

29. Provide a small chlorination tank in all ground level reservoirs of diameter not less then 3 times the diameter of the inlet pipe and depth of 2.25 meters. This can also be used for diffusing chlorine in the water under a minimum depth of flow of 2.0 m.

Pipe line

30. It shall be kept in mind that the systems should be reliable and should not waste water. A very judicious approach should be adopted in selection of material of pipes and utmost care should be taken in accepting the supplied materials. We should use only DI or MS pipes for rising mains in all locations. We can consider use of uPVC pipes for low pressure rising mains from tube wells to CWR in alluvium areas.

31. In the distribution networks, we may use only uPVC class 3(with Class-4 UPVC fittings), for sizes available in alluvial areas with min diameter of 110 mm. However for rocky areas and for larger sizes for which uPVC pipe is not available, DI pipes will be used.

32. The field testing of the entire pipeline laid shall be done for pressure of 1.5 times working test pressure as per relevant IS code in general; however in case of DI pipe the field test pressure may be considered as 2 x maximum design pressure (with minimum design pressure as 6.0 Kg/ sq cm).

S.No.	Type of pipe	Working Pressure	Field Test Pressure
1.	uPVC Pipe class 3	6 Kg./sq cm	9 Kg./ sq cm
2.	uPVC Pipe class 4	8 Kg./ sq cm	12 Kg./ sq cm
3.	AC Pipe class 15	7.5 Kg./ sq cm	11.25 Kg./ sq cm
4.	DI Pipe K 9	As per pipe size & up to 45 kg / sq cm	2 x maximum design pressure (with minimum design pressure as 6.0 Kg/ sq cm)
5.	PSCC Pipe	Say WP 8 Kg./ sq cm	12 Kg./ sq cm
6.	MS Pipe	Say WP 8 Kg./ sq cm	12 Kg./ sq cm

33. The thrust blocks should be designed for this test pressure and the factor of safety for the block design maybe restricted to one.

34. We are using different material of pipes CI, DI and uPVC and there are existing AC or MS pipes in the system which all has to be integrated. All such connections

between different type of pipes should be made through universal mechanical joints (jiffy joint).

35. While preparing the estimates, it needs to be ensured that the quantity / weight of the required specials are thoroughly analyzed and listed to the possible extent. The specials should be placed in the following categories:
    - uPVC specials for uPVC pipes
    - CI specials suitable for uPVC pipes
    - D/S CI specials for CI pipes.
    - D/F CI specials for CI pipes
    - D/S DI specials for DI pipes
    - D/F DI specials for DI pipes
    - MS specials
36. The list and quantities may be worked out and their weights calculated and the rates may then be taken in Rs. /Kg. for CI specials for each of above categories for individual class of pipes used (up to 350 mm and above 350 mm separately). The rates for uPVC will however have to be taken for each piece. It would be prudent to add all types of specials in the BOQ with token quantity which may be required although not estimated right now.

Pumping Stations

37. The selection of the centrifugal pumps should be made on basis of the specific speed of the pump as per the duty conditions. The specific speed is calculated as follows:

    $N_S = 3.65NQ^{0.5}/H^{0.75}$

    H Head
    Q Discharge
    N Speed
    N_s Specific speed

38. We should then adopt as follows:

    a. Centrifugal Pumps are utilized for applications with $N_s > 36$

    b. Radial Flow Pumps for N_s up to 100 (approx.)

    c. Mixed Flow Pumps for N_s 100 to 300

    d. Diagonal Flow and Axial Flow Pumps for $N_s > 300$

39. The sizing of suctions and delivery pipes are important. The permissible velocities of flow should be restricted to the following

    a. Suction Header 0.6 to 0.9 m/s
    b. Suction Pipes 1.5 m/s
    c. Delivery Pipes 2.0 m/s

Electrical Installation

40. The Provisions for the Electrical Installations are generally not provided in detail. Complete provisions for the supply of power from the Electricity Authority should be incorporated after discussions and as per approval of the Authority. In general a dedicated system should be preferred where the installation is critical.
41. Suitable provisions for Transmission lines, DP Structures, HV Switch Gear, LV Switch Gear, PF improvement Panel, Local Push Button Stations, Motors (Certified High Efficiency Motors should be asked for up to 15 kW rating), Cables, Lighting and Earthing should be made in the estimates.
42. The individual requirements (size and quantities) of the above items should be made in the estimate and BOQ.

Metering

43. One of the most important inputs for control of the system is installation of bulk water meters at critical locations. In general we should make an effort to have reliable information on the daily production of water, the supply in various zones and important transfers of water from one zone to another. Suitable proposals for bulk metering should be made. Only full bore electromagnetic flow meters with PTFE lining may be proposed. Bulk meters must have sufficient power back up and should be able to transfer and store data on computer automatically so that it is available for analysis. Manual operation for recording such data should not be required.

44. Operational consumer metering is important input for controlling the supply. The existing situation in the system may be evaluated and suitable interventions may be considered in consultation with the PHED.

45. At the places of intervention of RUSDIP, new domestic connection should be provided in front of existing houses in case of new water lines and replacement of existing house connections in case of replacement of water supply lines. RUSDIP should provide for house connection through MDPE pipes up to meter point. PHED should also be encouraged to use MDPE pipes for house connections and replacement of meters, if required.

46. Non functional domestic water meters are to be replaced and it should be ensured that PHED makes 85-90% connections metered.

Replacement of old and inefficient Pumping Machinery

47. It is encouraged to look into the existing installations (pumping machinery & panels) of the water supply system where the installed equipment is not suitable and is resulting in wastage of power and underutilization of resources. The cases can be of very old pump sets, mismatch of the rated duty conditions and the actual duty requirement, mismatch of the motor and pump and the control panel, inadequate suction pipe and delivery pipe sizes, etc... Any investment in setting right these problems is paid back in very short periods (ranging from 6 months to 2-3 years). Such works should be identified and incorporated in the proposals on utmost priority.

48. The details of the proposal should be discussed with the local PHED officials (JEN, AE & EE) in advance as often it has resulted in several variations later on their demand. These proposals as necessary may include the civil works and valves fittings as required. It should however be ensured that it will be possible to do the change without dislocating the services to which such installations are committed. Suitable details for such work program will have to be worked out and stipulated.

Inspection and Testing

49. Categories of inspection and test for various materials/equipments have to be clearly identified and mentioned in the bid document (technical specifications). Inspection category must be classified as follow;

    Category A: The Drawing has to be approved by the Engineer before manufacturing and Testing. The material has to be inspected by the Engineer or by an Inspecting agency approved by the Engineer at the manufacturer's premise before packing and dispatching.

    Category B: The drawings of the Equipment have to be submitted and to be approved by the Engineer prior to manufacture. The material has to be tested by the manufacturer and the manufacturer's test certificates are to be submitted and approved by the Engineer before dispatching of the Equipment.

Category C: The material may be manufactured as per standard and delivered to the site.

General

50. Inventory by the line agency are to be transferred on digital base maps of the town with GIS layers.

51. The standard bidding documents should be understood very clearly and ensure required details (i.e. special conditions of the Contract, Technical specifications, drawings and BOQ items including preamble to BOQ etc.) in the bid document for the particular sub-project, harmony in the documents by the DSC/IPIU /IPMC/ incharge packages in PMU.

52. The estimates should be reflective of the present market prices and should be based on the current SOR to be issued by RUSDIP and the market prices for items not included there.

53. Safety aspects needs to be attended in the design of the system and included in BOQ properly – Excavation in deep trenches, barricading, crossing with sewer lines and manholes, execution and maintenance at heights over the ground.

Design Report Format:

54. The report should consist two parts:
    a. **City status report**
    b. **Sub-project specific report**

55. The **city status report** should contain at least the following chapters:
    (a) Index
    (b) Salient Features of the town – Topography, Hydrology, Aquifer status, reliability of water sources, reservation of water from surface sources etc.
    (c) Introduction – History of water supply schemes with up to date details, ongoing & future plans and their status, previously sanctioned augmentation and re-organization schemes.
    (d) Back ground consisting of **present status** but not limited to in terms of:
        i Water supply – existing supply, sources of supply, quantum of supply from different sources, Number of Tube Wells etc.
        ii Quality of water - Treatment facility and capacity, Available at different type of sources, at supply level.
        iii Storage capacity - capacity of RWR, CWR, SR, Number of head works, location and status of bulk meters.
        iv Pumping Machinery - No. of pumping stations, locations, capacity, power consumption etc.
        v Power supply - At sources and at head works.
        vi Number of Water connections - Metered & un-metered, category wise number of connections.
        vii Financial status - Billing (amount and quantum of supply), revenue realization, expenditure on O&M (with bifurcation of sub-head expenditures).
        viii Coverage - Area, households, population, length of pipe lines with their sizes and material.
        ix Organization status - Manpower details and capacity to handle O&M.
        x Other salient features of present water supply system covering inter departmental issues.
    (e) Analysis of parameters detailed at s. no. 55(d) of present status of water supply - Existing requirements, future requirement with horizon of Year 2021, 2031 and 2041.
    (f) Analysis of deficiency in the town with present requirements and future requirements of Year 2021, 2031 and 2041, measures to mitigate the

deficiencies with improvement in the existing system and augmentation of the existing system.

(g) Analysis of Non Revenue Water and likely measures for bringing NRW level to 20%.

(h) Executive summary for suggestive measures to mitigate deficiencies / long term solutions and list of proposed works in totality.

(i) Phasing of the proposed works in line with allocations under RUSDIP for fulfilling its goal matrix and indicators. Identification of works to be taken up by the concerned line agency. Define role of RUSDIP/ PHED/ others to meet out the deficiencies.

56. The **sub-project specific report** should contain at least the following chapters:

(a) Index

(b) Introduction - Analysis of Priority for RUSDIP

(c) Detail analysis of the sub-project specific requirement and justification.

(d) Sub-project specific present level of indicators and indicators after execution of the project covering:

General:

- ✓ Increase in water supply and its storage capacity
- ✓ Number of new connections
- ✓ reduction in power costs,
- ✓ reduction in wastage of water,
- ✓ Improvement in supply pressures and or quality
- ✓ Corresponding health benefits

Pumping Stations:

- ✓ Number of Pumping Stations proposed to be replaced in the System.
- ✓ Actual & Stipulated Duty of Pumping Sets Q, H, Efficiency for each type of pump.

Water supply Line Network:

- ✓ Map of the proposed and existing system showing type of pipe, diameter, location, valves and fittings. Map should show enough levels and land marks to enable easy orientation in field.
- ✓ Statement of length of pipe lines in various type and diameters.
- ✓ Description of different supply zones and valve operations.

Water Treatment Plants:

- ✓ Capacity / Type of Plant.
- ✓ Input and proposed output quality of water.
- ✓ Estimated requirements of chemicals, power consumption, sludge generation every year.

Bulk Water Meter

- ✓ Type, Size, Capacity, Location of Installation, Objective of Installation

Operation Maintenance Contract:

- ✓ The details of the O & M Contract if it is a part of the contract should be given along with the conditions
- ✓ List the training program to be undertaken to the line agency staff.
- ✓ Guarantees of the equipment if any

(e) **Technical Report containing** - Narrative of the various design aspect, parameters, alternatives and conclusions – highlighting special features; Work Program; Operation and Maintenance; Benefits expected from the investment.

(f) **Bidding document** - Incorporation of Scope of work, special conditions of contract, Technical specifications, Tender & Detailed Construction Drawings, Estimate & Bill of quantities and preamble to BOQ etc. in Standard Bidding document.

(g) **Operation and maintenance -** Expectations from the line agency (personal requirement / cost requirement), Expectations from the contracting firm.

(h) **Execution Methodology -** Sequence of execution, Tentative work plan, interface with other works, Quality Assurance and Quality Control, Safety aspect during execution.

(i) **Time line for completion of sub-project.**

(j) **Likely Impact after the completion of sub-project under RUSDIP** - Supply level, Power saving, Revenue realization, NRW reduction, Man power reduction, No. of beneficiaries/ colonies covered/ houses & %of total city area.

(k) Linkage of existing and proposed work on base maps prepared by RUSDIP (Availability of plans/ details of existing system)

(l) **Sub - project Issues**

i **Status of land** availability / Land acquisition for structures to be constructed,

ii **Interdepartmental issues** with Forest, Railways for crossings of Railway lines and works through railway land, National Highways for road cutting / crossings and Bridges, Availability of Raw water, Power availability from VVNL, BSNL, Pollution Control Board, License from explosive department, Removal of encroachment and their resettlement.

iii **Time line for clearance** from concerned department

iv **Shifting of under ground utilities** (sub-project wise) - Details of concerned department, Mode of shifting, Clearance from line agency, Likely impact of shifting

v **Deposit works** to be executed by other departments for execution of the sub-project.

This circular should be abided by all members of PMU, IPIU, IPMC & DSC.

(Karni Singh Rathore)
Project Director

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Copy to following for information and necessary action:

1. Addl. PD -I & II/ FA/ SE (D-I)/ Dy. PD (T)/ Dy. PD (Adm.)/ SE (WW)/ SE(R&B)/ SE (Mon) / PO (all)/ Sr. AO / All APOs / AAO/ PA to PD PMU, RUIDP, Jaipur.
2. SE PIU, Ajmer, Bikaner, Kota, Jaipur, Jodhpur and Udaipur.
3. Team Leader PMC/ Team Leader CTA Consultant/ IPMC, IPIU, DSC's RUSDIP.
4. ACP, PMU, RUIDP, Jaipur to send by e-mail.

Dy. Project Director (T)