

CEA FRAMEWORK FOR

WATER AUDIT OF THERMAL POWER PLANTS

STANDARD OPERATING PROCEDURE [SoP]

Applicable to sub-critical & super-critical, coal / lignite based Thermal Power Plants



Civil Design Division

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New Delhi-110066

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CEA TEAM

	**Ghanshyam Prasad** **Chairperson &** **Ex-officio Secretary** **to the Government of India** **Central Electricity Authority** **Ministry of Power**	*The management of water in the Thermal Power Plants remains a challenge due to new emerging cross sectoral demands.*
	**Praveen Gupta** **Member (Thermal) &** **Ex-officio Additional Secretary to** **the Government of India** **Central Electricity Authority** **Ministry of Power**	*The initiatives and policy to audit the water use in thermal power plants will significantly enhance India's water security as Thermal Power Plants consume nearly 80% of the Industrial Water Use.*
	**Anuj Kanwal** **Chief Engineer** **Civil Design Division** **Central Electricity Authority** **Ministry of Power**	*By presenting analytical insights through water audit SoPs the whole audit process will be streamlined, promote transparency, and establish standardisation, for all thermal power stations and user agencies.*
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Disclaimer : *This SOP is intended for use by in-house water/energy audit cells of thermal power plants (TPPs) conducting internal/self-audits or empanelled external water auditors engaged by the plant; and plant management and O&M teams responsible for implementing audit recommendations. It should be read together with the plant's environmental clearance conditions, Consent to Establish/Operate (CTE/CTO), and any state- or utility-specific water audit guidelines.*

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SoP 2	Abbreviations	11.26

Abbreviation	**Meaning**
ACF/PSF/MGF	Activated Carbon / Pressure Sand / Multi-Grade Filter
AWRS	Ash Water Recirculation System
AHP	Ash Handling Plant
BIS	Bureau of Indian Standards
CEA	Central Electricity Authority
CEMB	Central Effluent Monitoring Basin
CEMS	Continuous Effluent Monitoring System
CGWA	Central Ground Water Authority
CHP	Coal Handling Plant
COC	Cycles of Concentration
CPCB/SPCB	Central / State Pollution Control Board
CT / OTC	Cooling Tower / Once-Through Cooling
CTE/CTO	Consent to Establish / Consent to Operate
CW	Circulating Water
DM Plant	Demineralisation Plant
ETP/STP	Effluent / Sewage Treatment Plant
FGD	Flue Gas Desulphurisation
FRC	Free Residual Chlorine
FW	Fresh Water
HCSD/LCSD	High/Low Concentration Slurry Disposal
HVAC	Heating Ventilation Air Conditioning
KLD	Kilolitres per Day (1 KLD= 10^{-6} MCM/day)
KLY	Kilolitres per Year

Abbreviation	**Meaning**
MCM	Million Cubic Meter (1 MCM/day = 10^6 KLD = 1000 MLD)
MEE	Multi-Effect Evaporator
MLD	Million Litre per Day (1 MLD = 10^{-3} MCM/day)
MoEF&CC	Ministry of Environment, Forest and Climate Change
MoP	Ministry of Power
NABL	National Accreditation Board for Testing and Calibration Laboratories
NC	Non-Conformance
NFW	Non Fresh Water
NOC	No Objection Certificate
OCEMS	Online Continuous Effluent Monitoring System
PLF	Plant Load Factor
RO/DM/UF	Reverse Osmosis / Demineralisation / Ultrafiltration
RW	Recycled Water
RWH	Rainwater Harvesting
SCADA	Supervisory Control and Data Acquisition
STP	Sewage Treatment Plant
SWC	Specific Water Consumption
TDS	Total Dissolved Solids
TSW	Treated Sewage Water
TPP	Thermal Power Plant
TSS	Total Suspended Solids
WUE	Water User Efficiency
ZLD	Zero Liquid Discharge

SoP 3	Definitions	11.26

Term	Definition
Cooling Tower Effectiveness	The measure of a cooling tower's ability to cool the circulating cooling water, expressed as the ratio of the actual temperature drop achieved across the cooling tower to the maximum theoretically achievable temperature drop, expressed as a percentage.
Cycles of Concentration (CoC)	Ratio of dissolved-solids in the recirculating cooling water to those in the makeup water; a measure of how many times water is reused in the cooling tower before blow-down.
Losses	Loss of water in known processes like evaporation, blow down loss and drift loss as assessed per known formulae. All other losses are Unaccounted water (UW)
Metering Gap	A water inflow, transfer or outflow point where the meter is missing, non-functional or overdue for calibration; it is covered by temporary metering during the audit.
Non-Conformance (NC)	Any exceedance of a norm, permit condition or SOP requirement identified during the audit, recorded in the Non-Conformance Log with root cause, corrective action and target date.
Specific Water Consumption (SWC)	The quantity of fresh water input in a Thermal Power Plant per unit of net electricity generated during a specified period, expressed in m³/MWh. It is a key benchmarking indicator of the plant's water-use performance and efficiency. $$SWC\ (m^3/MWh) = \frac{\text{Total external freshwater input } (\text{m}^3)}{\text{Net electricity generation (MWh)}}$$ It includes all power and nonpower use of the drawn fresh water.
Unaccounted Water (UW)	The difference between total metered/estimated inflow and total metered/estimated outflow/consumption in a water balance.
Water Audit	A systematic approach to identifying, measuring, monitoring and reducing water consumption across an industry/plant; involves preparing a water balance, computing water use, and identifying opportunities for reduction, reuse and recycling.
Water Balance	A quantitative accounting of all water inflows, internal uses and transfers, consumption, reuse/recycling, discharges and other outflows across the defined boundary of a Thermal Power Plant over a specified period. As per SoP 8: Total of all Inflow (F = FW + NFW) = Total of all Outflow (OF) + Consumption (Po + NPo) / losses (evaporation, drift, blowdown etc.) (L) ± Change in Storage (Δ S) + Unaccounted Water

Term	Definition
	F, OF, Po/NPo, L, Δ S are measured so unaccounted water can be assessed.
Zero Liquid Discharge (ZLD)	A treatment configuration in which all wastewater generated within the plant boundary is treated and reused/recycled, with no liquid effluent discharged outside the plant boundary.

SoP 4	CEA Water Audit Framework	11.26

4.1 Scope

This Standard Operating Procedure (SOP) establishes a uniform and systematic methodology for planning, conducting, documenting and reporting a Water Audit at coal/lignite-based Thermal Power Plants (TPPs), irrespective of unit size, technology, cooling system configuration, ash management system or source of water (fresh surface water, ground water, sea water, mine water, harvested rainwater or treated sewage). The Water Audit shall quantify water intake, consumption, losses, recycling, reuse and discharge, identify areas of water wastage and inefficiency, and assess compliance with applicable statutory water-use and environmental requirements. The Annual Water Audit is applicable to all coal- and lignite-based Thermal Power Plants (TPPs) except those TPPs which are located on coast and using sea water for cooling.

4.2 Objectives of the Water Audit

a. Establish a comprehensive and verified water balance for the plant, covering all water inflows, consumption, recycling/reuse, losses and outflows.
b. Determine Specific Water Consumption (SWC, m^3/MWh) and assess water-use efficiency against applicable norms.
c. Identify and quantify water losses, leakages, unmetered/unaccounted flows and inefficient water-use practices or equipment, and identify opportunities for improvement.
d. Maximise water conservation through the Reduce–Reuse–Recycle (3R) approach, including increased recycling and reuse of treated wastewater and utilisation of rainwater and suitable alternate/non-conventional water sources.
e. Evaluate the technical, economic and environmental feasibility of water-conservation measures and prepare a time-bound Water Conservation and Management Plan for implementation and continual improvement.
f. Establish a standardised, transparent and auditable Water Audit reporting framework for submission to plant management and, wherever applicable, to the concerned regulatory/competent authorities.

4.3 Applicability

The Annual Water Audit is applicable to all coal- and lignite-based Thermal Power Plants (TPPs) except those TPPs which are located on coast and using sea water for all purposes.

4.4 Goals of the Water Audit SOP

a. Identify every important water accounting point.
b. Obtain reliable daily data from each point.
c. Maintain the water account throughout the month.
d. Reconcile water received, used, recycled, stored and discharged.
e. Explain material differences and anomalies.
f. Issue and approve a Monthly Water Statement.
g. Close the water account by the seventh day of the following month.

4.5 MoEF&CC – Specific Water Consumption Norms for TPPs

The Environment (Protection) Amendment Rules notified by MoEF&CC on 07.12.2015 (as amended on 28.06.2018) introduced, for the first time, statutory ceilings on specific water consumption (SWC) for coal-based thermal power plants. MoEF & CC has mentioned the ceiling for specific-water-consumption for all TPP's except those located on coast and using sea water for cooling. Water Consumption Limit shall not be applicable for Thermal Power plants using sea water:

Plants with Once-Through Cooling (OTC)	Install cooling towers and achieve SWC ≤ 3.5 m³/MWh within the notified timeline.
Existing cooling-tower (CT) based plants	Reduce/maintain SWC ≤ 3.5 m³/MWh.
New plants installed after 01.01.2017	Achieve SWC ≤ 3.0 m³/MWh (revised from an initial 2.5 m³/MWh) and achieve Zero (Liquid) Waste Water Discharge. Water Consumption Limit shall not be applicable for Thermal Power plants using sea water

4.6 Power Tariff Policy 2016, Ministry of Power

The thermal power plant(s) including the existing plants located within 50 km radius of sewage treatment plant of Municipality/local bodies/similar organization shall in the order of their closeness to the sewage treatment plant, mandatorily use treated sewage water produced by these bodies and the associated cost on this account be allowed as a pass through in the tariff. Such thermal plants may also ensure back-up source of water to meet their requirement in the event of shortage of supply by the sewage treatment plant. The associated cost on this account shall be factored into the fixed cost so as not to disturb the merit order of such thermal plant. The shutdown of the sewage treatment plant will be taken in consultation with the developer of the power plant.

4.7. CEA Advisory (DO letter) dated 2 September 2026 — Annual Water Audits (to be read under section 73 of the Electricity Act)

a. Comprehensive Annual Water Audit covering all water-using systems and processes, establishing actual water consumption;
b. Mapping of all major wastewater streams and identification of avoidable losses;
c. Assessment of recycling and reuse of water;
d. verification of self-reported consumption data by an accredited third party or online portal;
e. Time-bound corrective measures for ensuring compliance with the applicable SWC and effluent discharge norms in case of any exceedance;
f. Regulatory action, as advised by CEA, for repeated non-compliance.

SoP 5	Water Audit Mechanism	11.26

5.1 Plant Water Audit Team

a. Nominate a Plant Water Audit Coordinator and internal support team;
b. Checks the calibration of temporary and permanent flow meters
c. Maintain and calibrate all related instruments and Calibration certificates
d. Maintain Assets Health Report

5.2. Water Auditor

a. The Annual Water Audit shall be carried out by a qualified Water Resources/Civil/Environmental Engineer or by an organization having suitably qualified and experienced professionals.
b. The auditor/agency shall possess relevant experience in water auditing, water balance, water-use assessment and evaluation of water systems, for industry, irrigation or domestic water systems.
c. The Annual Water Audit will be based on the Daily Water Balance basis, averaged for monthly, 6 monthly and yearly basis.
d. The Annual Water Audit, if, carried out through an online portal or any digital system, the system-generated audit report shall be acceptable, subject to availability of system-generated daily, monthly, 6 monthly and yearly audit records.
e. The Water Audit Report shall be reviewed and certified by the designated competent authority/HoP before submission to CEA.
f. In future, if an online portal is developed or notified by CEA, the audit data shall be uploaded on that portal.

5.3. Annual Audit Report Coverage

a. Data Compilation: Daily water balance, averaged for Monthly, 6 Monthly and yearly.
b. Data Computation: Full station balance: intake, transfer, recycle/reuse, discharge; losses quantified, Monthly and Annual Specific Water Consumption (SWC),
c. Site Assessment: Walkdown of systems; metering inventory vs. mandatory points; TSW/STP mapping within 50 km
d. Water Balance and proposed measures to reduce the water consumption. consents, permits, EC conditions, prior audits/DPR
e. Corrective actions: Avoidable losses, metering gaps, status - manual Vs. digitized, Prioritized measures with indicative cost & expected saving — input for future pathways/digitalization

5.4. Audit Calendar

a. Data Collection: Every Day
b. Monthly Assessment: Every month of FY starting from 1 April till 31 March
c. Quarterly Assessment & Review at Plant 30 June, 30 September, 31 December, 31 March
d. Year End Closure FY end 31 March
e. Audit by Inhouse Peer Team or Independent Auditor
f. CEA Submission before 30 June every year

5.5. Audit Compliance

Audit not conducted / submitted on time will be Flagged as CEA Noncompliance record and may affect SWC authenticity with reporting to SPCB, CPCB.

5.6. Verification of the Audit Report by CEA

Random verification of the Water Audit at the Plant shall be carried out by CEA CD Division on case-to-case basis.

5.7. Alignment with other Standards

Plants may embed this water-audit SOP within a formal, certifiable management system to align it with ISO 46001:2019, ISO 9001/14001/50001/ BRSR ESG Format.

SoP 6	Assessment of Known Losses	11.26

Water consumption and losses in thermal power plant operations are interchangeable terms. The water consumed in boiler and Colling tower has to be assessed as Loss. namely, Cooling Tower Evaporation Losses, Cooling Tower other Losses, blow down losses, leakages, auxiliary system etc are inherent part of generation process. Their identification, classification and quantification are essential for understanding water consumption patterns, distinguishing unavoidable losses from avoidable wastage, and identifying opportunities for improving water-use efficiency. Evaporation losses, being largely unrecoverable, shall be appropriately estimated and documented as part of the water audit.

6.1 Evaporation Loss (E)

Source	Nature of loss
Cooling tower	Evaporation, plus drift (windage)
Reservoirs and storage ponds	Evaporation from open water surface
Ash pond / ash dyke	Evaporation from slurry and pond surface
ETP lagoons, CEMB and settling basins	Evaporation from open surface
Wet FGD absorber	Evaporation into the flue gas
Dust suppression and green belt	Evaporation and evapotranspiration of sprinkled water
Steam cycle and miscellaneous	Vents, leaks, soot blowing, sampling

6.2 Cooling-tower evaporation loss

$$E\ (m^3/h) = 0.00085 \times W_c \times (T_1 - T_2)$$

where W_c is the recirculating-water flow (m^3/h), T_1 is the temp of inlet water in Fahrenheit, T_2 is the temp of outlet water in Fahrenheit.

Source: Perry's Chemical Engineers Handbook

6.3 Evaporation form Open water surfaces (reservoir, ash pond, lagoons)

E (m^3/day) = Kp × Ep (mm/day) × A (m^2) ÷ 1000

Where,

Ep is pan evaporation (from an on-site Class-A pan or IMD data for the nearest station),

Kp is the pan coefficient (generally about 0.7) and

A is the water-spread area. Use monthly values to reflect the seasons.

Worked example:

A = 10 ha (100,000 m^2), Ep = 6 mm/day, Kp = 0.7

E = 0.7 × 6 × 100,000 ÷ 1000 = 420 m^3/day.

6.4 Cycle of Concentration (CoC)

"Cycles of concentration" is the ratio of dissolved solids in the recirculating water to dissolved solids in the makeup water. Since chlorides remain soluble on concentration, cycles of concentration are best expressed as the ratio of the chloride contents of the circulating and makeup waters.

$$CoC = \frac{\text{Dissolved solids in the recirculating water}}{\text{Dissolved solids in the makeup water}}$$

OR

$$CoC\ (Conductivity\ Ratios) = \frac{\text{Conductivity of the cooling tower water}}{\text{Conductivity of the makeup water}}$$

Further, CoC may also be estimated from the cooling-water balance as follows:

$$\text{CoC} = \frac{\text{E} + \text{B} + \text{D}}{\text{B} + \text{D}}$$

where ,

E = Evaporation losses,

B = Blowdown losses

D = drift loss.

The above expression is applicable under steady-state operating conditions, assuming that evaporation, blowdown and drift constitute the relevant cooling-water losses.

6.5. Blowdown (B) loss:

a. For Cooling Tower-

$$\textbf{Cooling Tower Blowdown} = \frac{\text{E} - [(\text{CoC} - 1)\ \text{x drift losses}]}{(\text{CoC} - 1)}$$

Where E is the evaporation losses and CoC is the cycle of concentration

b. For Boiler

$$\textbf{Boiler Blowdown Rate} = \left[\frac{\text{TDSfeed}}{\text{TDSmax} - \text{TDSfeed}}\right] \text{x Steam Flow Rate}$$

6.6 Drift loss

D (m^3/h) = Drift fraction × W_c

Drift is entrained water in the tower discharge vapors. Drift loss is a function of the drift eliminator design and is typically less than 0.02 percent of the water supplied to the tower with the new developments in eliminator design.

The TPP shall:

a. Monitor and record CoC for each major recirculating cooling-water system;
b. Record the corresponding make-up and blowdown quantities;
c. Compare the achieved CoC with the plant's design/operating target;

d. Investigate significant deviations or discrepancies; and
e. Optimize CoC based on cooling-water quality, system design, metallurgy and chemical-treatment requirements.

For a perfect equilibrium between water conservation and equipment protection, mass balance and approved water-treatment programme limits shall be used for controlling parameters such as pH, conductivity/TDS, chloride and silica. By mastering the balance between makeup water, evaporation, and blow down, water consumption and energy consumption can be reduced with minimal chemical usage.

6.7 Summary of the losses

Item	Formula	Variables
Evaporation Loss (E)	$E\ (m^3/h) = 0.00085 \times W_c \times (T_1-T_2)$	where W_c is the recirculating-water flow (m^3/h), T_1 is the temp of inlet water in Fahrenheit, T_2 is the temp of outlet water in Fahrenheit.
Blowdown Rate (B)	$\textbf{Cooling Tower Blowdown} = \frac{E - [(CoC - 1)\ x\ \text{drift losses}]}{(CoC - 1)}$ $\textbf{Boiler Blowdown Rate} = \left[\frac{TDSfeed}{TDSmax - TDSfeed}\right] x\ \text{Steam Flow Rate}$	E = Evaporation Rate; CoC = Cycles of Concentration
Cycles of Concentration (CoC)	$= \frac{\text{Conductivity of Cooling Tower}}{\text{Conductivity of Makeup water}}$	Conductivity Measured in µS/cm
Drift Loss (D)	D = Recirculation Rate x Drift Rate(%)	Approximate, Drift Rate depending on eliminator design: 0.001%–0.02%
Makeup Water (M)	M = E + B + D	D = Drift Loss
Percent Reduction in Blowdown	$\text{Reduction } \% = \frac{(CoC_2 - CoC_1)}{(CoC_2 - 1)} x100$	CoC_1:Current Cycles of Concentration; CoC_2:Target Cycles of Concentration

SoP 7	Water Quality Assessment	11.26

7.1 Water Quality Monitoring

Water quality shall be assessed to determine the suitability of water for its intended use, support efficient operation of water-consuming systems, assess the suitability of treated/recycled water for reuse, and verify compliance with applicable statutory requirements.

The sampling Points shall cover

Inflow (F) = Fresh Water (FW) + Non-Fresh Water (NFW):
• FW1: Surface water (river / canal / dam)
• FW2: Ground water (bore wells / tube wells)
• NFW1: Treated water received from an external source (treated sewage / STP water, treated effluent, any other treated water)
• NFW2: Rainwater / storm water harvested
• NFW3: Other external non-fresh input (e.g. mine water, water received from another plant or agency – specify the source)
• RW: Internal recycled / reused water (AWRS recovery, ZLD recovered water, ash dyke / pond return water and other internal recycling streams) – internal flow, not part of F
Process flow:
Power Stream (Po)
• Po11: Cooling tower and condenser cooling, Po12: Make up water, Po13: CT losses, Po14: CT Blow down
• Po21: Boiler/DM plant, Po22: Make up water, Po23: Steam losses, Po24: Boiler blowdown
Non-Power Stream (NPo)
• NPo1: FGD stream,
• NPo2: Ash-water systems
• NPo3: Coal Handling & Dust Suppression
• NPo4: HVAC stream
• NPo5: Fire Fighting Stream
• NPo6: Plant Service Stream
• NPo7: Domestic stream in Plant
• NPo8: Domestic stream to Colony
• NPo9: Gardening Stream
• NPo10: Construction water for new project, if any (separately metered; not for generation)

• NPo11: Any Other stream
Treatment Stream (TS):
TS: ETP inlet / STP inlet / ZLD inlet / DM reject / CT blowdown / Boiler blowdown / Plant drain / Ash decant / Any other stream put to treatment
Out flow (OF):
• OF1: wastewater/effluents / Sludge Stream discharged outside Plant
• OF2: Water supplied / transferred outside the plant
• OF3: Plant drainage system
• OF4: Distributed for Welfare

The parameters to be monitored shall be selected based on the characteristics and intended use of the water stream, plant requirements, applicable design/treatment criteria and statutory standards. Depending on the stream, monitoring may include parameters such as:

- pH and conductivity;
- TDS and TSS;
- Turbidity;
- Chloride, hardness and alkalinity;
- Silica, iron and other relevant dissolved constituents;
- Residual chlorine, where applicable;
- BOD and COD;
- Ammoniacal nitrogen;
- Microbiological parameters, where applicable; and
- Other parameters relevant to the specific water use, treatment process or discharge requirement.

Analysis shall follow the Bureau of Indian Standards (IS 3025) methods or the equivalent APHA methods. Statutory samples and third-party verification samples shall be analysed by an NABL-accredited laboratory or a laboratory recognised under the Environment (Protection) Act.

7.2 Reference Standards

Commonly applicable effluent limits for thermal power plants (verify against current notification and CTO)

Stream	Parameter	Limit
Condenser cooling water (once-through)	pH; temperature rise above intake; free residual chlorine	6.5 – 8.5; not more than 5 °C; 0.5 mg/L
Cooling-tower blow-down	Free residual chlorine; zinc; chromium (total); phosphate	0.5; 1.0; 0.2; 5.0 mg/L
Boiler blow-down	Suspended solids; oil and grease; copper; iron	100; 20; 1.0; 1.0 mg/L
Ash-pond effluent	pH; suspended solids; oil and grease	6.5 – 8.5; 100; 20 mg/L

Potable water supplied to the plant and township shall meet IS 10500 (drinking water specification). Plants committed to Zero Liquid Discharge shall demonstrate that no effluent leaves the plant boundary.

7.3 Evaluation, Non-Conformance and Records

Water-quality results shall be evaluated against the applicable standards, design requirements, operational limits or approved water-quality criteria, as relevant to the respective water stream and intended use. Any exceedance or significant deviation shall be recorded, investigated and addressed through appropriate corrective and preventive actions. Relevant water-quality parameters shall be periodically reviewed and trended to identify abnormal variations or deterioration in water quality, and significant observations shall be brought to the attention of the designated Water Audit Coordinator. Sampling and analysis records, laboratory reports, calibration and maintenance records of monitoring instruments, online analyser records and other relevant monitoring data shall be maintained systematically as part of the Water Audit records.

SoP 8	Water Balance	11.26

8.1 Scope

The Water Audit shall establish a quantitative water balance by identifying and measuring all significant water inflows, internal uses and transfers, recycling/reuse, consumption, losses, storage changes and outflows within the defined plant boundary. The water balance shall be based, as far as practicable, on measured data. The water balance shall account for water used in following major systems but not limited to and as applicable-

Inflow (F) = Fresh Water (FW) + Non-Fresh Water (NFW):
A. Fresh Water Input (FW)
• **FW1** : Surface water (river / canal / dam/ Municipal supply)
• **FW2** : Ground water (bore wells / tube wells)
FW : Total Fresh Water Input = FW1 + FW2 (KLD/MLD)
Fresh water: Only raw water drawn from a surface source (river, canal, dam / reservoir) or from the ground (bore / tube wells) is Fresh Water (FW1, FW2) and only FW is counted in the Specific Water Consumption (SWC).
B. Non-Fresh Water Input (NFW)
• **NFW1**: Treated water received from an external source (treated sewage / STP water, treated effluent, any other treated water).
• **NFW2**: Rainwater / storm water harvested (Though it may be fresh water but kept in NFW2 and not be counted in SWC)
• **NFW3**: Other external non-fresh input (e.g. mine water, water received from another plant or agency – specify the source)
NFW: Total Non-Fresh Water Input = NFW1 + NFW2 + NFW3 (KLD/MLD)
Non-Fresh Water: Treated water of any kind (NFW1), harvested rainwater / storm water (NFW2) and any other external input (NFW3) are Non-Fresh Water. They shall be measured and shown in the water balance. Water recycled or reused more than once inside the plant boundary (RW) is an internal flow; will not be not added to F, FW or NFW.
C. Total Water Input
• **F** : Total Water Input = FW + NFW (KLD/MLD)
• Fresh water as % of total water input = (FW / F) × 100
D. Internal flow (not part of F, FW or NFW)
• **RW** : Internal recycled / reused water – AWRS recovery, ZLD recovered water, ash dyke / pond return water and other internal recycling streams (KLD/MLD)
E. Process flow:
Power Stream (Po)
• Po11: Cooling tower and condenser cooling, • Po12: Make up water, • Po13: CT losses, • Po14: CT Blow down
• Po21: Boiler/DM plant,

• Po22: Make up water, • Po23: Steam losses (zero if not assessable) • Po24: Boiler blowdown
Non-Power Stream (NPo)
• NPo1: FGD stream,
• NPo2: Ash-water systems
• NPo3: Coal Handling & Dust Suppression
• NPo4: HVAC stream
• NPo5: Fire Fighting Stream
• NPo6: Plant Service Stream
• NPo7: Domestic stream in Plant
• NPo8: Domestic stream to Colony
• NPo9: Gardening Stream
• NPo10: Construction water for new project, if any (separately metered; not for generation)
• NPo11: Any Other stream
Treatment Stream (TS):
TS: ETP inlet /STP Inlet /ZLD Inlet /DM Reject/CT Blowdown/Boiler Blowdown/ Plant Drain/Ash Decant/ Any other stream put to treatment
Out flow (OF):
• OF1: wastewater/effluents / Sludge Stream discharged outside Plant
• OF2: Water supplied / transferred outside the plant
• OF3: Plant drainage system
• OF4: Distributed for Welfare
OF: Total Out flow from the system
Losses (L)
• L1: Cooling-tower evaporation, blowdown and drift;
• L2: Evaporation from ash dyke/ponds and reservoirs
• L3: Process and treatment losses
• L4: Leakage and seepage, where quantifiable
• L5: Losses from open channels and exposed systems
• L6: Unknown Losses/any other losses
Changes in storages (Δ S)
• Inventory of Storages in the Plant is to be created in KL/ML/MCM • Δ S: Changes in water stored in tanks, reservoirs, ash ponds/dykes and other significant storage facilities everyday

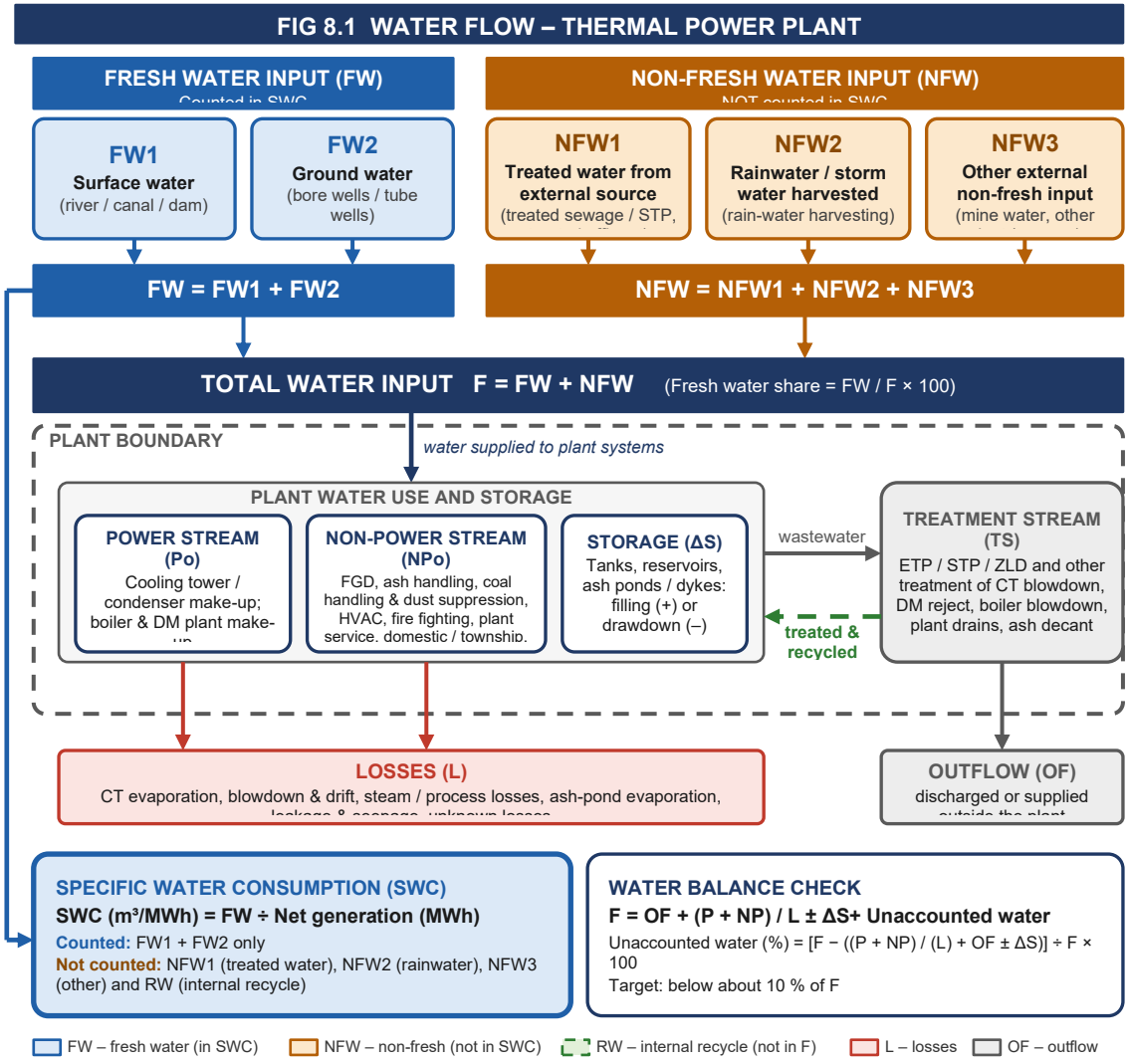
The water balance shall be monitored daily and comprehensively reconciled on a monthly basis, with quarterly, half-yearly and annual reviews based on aggregated data, in accordance with the principle of conservation of mass. Flow rates shall be expressed in KLD or MLD and cumulative volumes in MCM, as appropriate. Where direct measurement is unavailable, daily flows may be estimated using pump discharge rates and actual operating hours, with appropriate unit conversion and documentation of assumptions.

The water balance shall be reconciled in accordance with the principle of conservation of mass.

Total of all Inflow (F = FW + NFW) = Total of all Outflow (OF) + Consumption (Po + NPo) / losses (evaporation, drift, blowdown etc.) (L) ± Change in Storage (Δ S) + Unaccounted Water

With all other as measurable/ assessed quantities, the Unaccounted water can be quantified. Significant unaccounted water shall be investigated to identify possible measurement errors, leakages, unmetered consumption or other losses and the findings shall be reported as part of the Water Audit.

Unaccounted water shall be reconciled to below about 10% of inflow through additional measurement. Recycled and reused water is an internal flow and is not counted again in plant inflow.



8.2 Water Balance Assessment and Preparation of Water Balance Diagram

Water Balance calculations and Water Balance diagrams can be prepared for:

a. Overall TPP;
b. Power Stream
c. Non-Power Stream,
d. Major interconnected water systems

The calculations and diagrams shall clearly show water sources, quantities, major uses, internal transfers, recycling/reuse, losses, Change in storage and discharge points/ discharge/outflow points. The basis of measurement or estimation for each significant water stream shall also be indicated.

8.3 Calculation of SWC

The quantity of fresh water (surface water and ground water only, FW = FW1 + FW2) drawn by a Thermal Power Plant per unit of net electricity generated during a specified period, expressed in m³/MWh. It is a key benchmarking indicator of the plant's water-use performance and efficiency.

$$SWC\ (m^3/MWh) = \frac{\text{Total Fresh Water Input, FW} = \text{FW1} + \text{FW2}\ (\text{m}^3)}{\text{Net electricity generation (MWh)}}$$

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Notes:

1. Mark how each figure was obtained: M- Metered, E- Estimated, or C- Calculated.
2. Use units KL/ML for Daily record and MCM for 6 monthly/Yearly values.
3. Only FW1 and FW2 (surface water and ground water) are counted as fresh water for SWC. NFW1 (treated water), NFW2 (rainwater / storm water), NFW3 (other external inputs) and RW (internal recycled water) are reported but not counted in SWC.
4. Blowdown (if it is treated and reused in the plant, then it should not be counted as losses)
5. Daily average of Monthly E,CoC, M, B, D and relevant water-quality data shall be included in the Annual Water Audit Report (SoP 6 and SoP7) as Annexures.

A. General Plant Information/ permits/consents, design balance, past reports and source details.

S. No	Details	Details
1.	Name of Thermal Power Plant / project proponent	
2.	Installed capacity and units (MW)	
3.	Cooling system type (OTC / CT / hybrid)	
4.	Fuel type and source (coal / lignite)	
5.	Water source(s) and permitted quantity (KLD)	
6.	Employees and township population	
7.	FGD system installed (Y/N; wet / dry / semi-dry)	
8.	ZLD / reuse status (Full / Partial / Nil)	
9.	Water rate (₹/KL) and monthly water bill (₹ lakh)	
10.	Departments connected with water (O&M, CHP, AHP, DM/WTP, CW, township, etc.)	
11.	Location (State / District)	
12.	Technology (sub-/super-critical)	
13.	Ash disposal (wet / HCSD / LCSD / dry)	
14.	Generation (MU) and PLF (%), last 2 FY (PLF average for the year)	
15.	Rainfall (mm); river/lake within 5 km; bore wells / piezometers	
16.	List all Storages in the Plant as S1, S2 etc. in KL or ML or MCM	
17.	Audit type, period and dates	

S. No	Details	Details
18.	SWC rule applicable: 3.5 m³/MWh or 3.0 m³/MWh (basis: Rules / EC / CTO)	
19.	Township water source: same as plant intake / separate	
20.	SWC, monthly average (m³/MWh): incl. township ____ ; excl. township ____	
21.	Water Audit Coordinator and Water Auditor (name, contact)	

B. Water Input, Utilization, Losses, Recycling and Performance

		M/E/C	Actual Yearly daily average (KLD)	Total during the Audit Period (MCM)
Water Input (F = FW + NFW):				
A. Fresh Water Input (FW) – counted in SWC				
FW1	Surface water (river / canal / dam)			
FW2	Ground water (bore wells / tube wells)			
FW	**Total Fresh Water Input (FW = FW1 + FW2) – used for SWC**			
B. Non-Fresh Water Input (NFW) – NOT counted in SWC				
NFW1	Treated water received from an external source (treated sewage / STP water, treated effluent, any other treated water)			
NFW2	Rainwater / storm water harvested (Though it is fresh water but kept in NFW2 so that it may not be counted in SWC)			
NFW3	Other external non-fresh input (e.g. mine water, water received from another plant or agency – specify the source)			
NFW	**Total Non-Fresh Water Input (NFW = NFW1 + NFW2 + NFW3)**			
F	**Total Water Input (F = FW + NFW) (KLD/MLD)**			
	Fresh water as % of total water input = (FW / F) × 100			
RW	Internal recycled / reused water (AWRS recovery, ZLD recovery, ash pond / dyke return, etc.) ; not part of F, FW or NFW			

PF - Process flow (P):				
Power Stream (Po)				
Po11	Cooling tower and condenser cooling			
Po12	CT Make up water			
Po13	CT losses			
Po14	CT Blow down			
Po21	Boiler/DM plant			
Po22	Boiler Make up water			
Po23	Steam losses			
Po24	Boiler blowdown			
Non-Power Stream (NPo)				
NPo1	FGD stream			
NPo2	Ash-water systems			
NPo3	Coal Handling & Dust Suppression			
NPo4	HVAC stream			
NPo5	Fire Fighting Stream			
NPo6	Plant Service Stream			
NPo7	Domestic stream in Plant			
NPo8	Domestic stream to Colony			
NPo9	Gardening Stream			
NPo10	Construction water for new project, if any (separately metered; not for generation)			
NPo11	Any Other stream			
P	Total of all Po and NPo			
Treatment Stream (TS):				
TS1	ETP inlet			
TS2	STP Inlet			
TS3	ZLD Inlet			
TS4	Any other stream put to treatment not included in ETP/STP/ZLD (from DM Reject/CT Blowdown/Boiler Blowdown Plant Drain/Ash Decant etc.)			
TS	Total inlet to all Treatment Schemes			

Out flow - (OF):				
OF1	Wastewater/effluents discharged/Sludge Stream outside Plant			
OF2	Water supplied / transferred outside the plant			
OF3	Plant drainage system			
OF4	Distributed for Welfare			
OF	All out flow from the system			
Losses (L)				
L1	Cooling-tower evaporation, blowdown and drift			
L2	Evaporation from ash dyke/ponds and reservoirs			
L3	Process, Steam loss and treatment losses			
L4	Leakage and seepage, where quantifiable			
L5	Losses from open channels and exposed systems			
L6	Unknown Losses			
Changes in storages (Δ S)				
	Inventory of All Storages S_1, S_2, $S_{3\ etc.}$			
Δ S	Changes (±) in water stored in all storage tanks, reservoirs, ash ponds/dykes and other significant storage facilities. The difference of total inflow and outflow from the storage.			

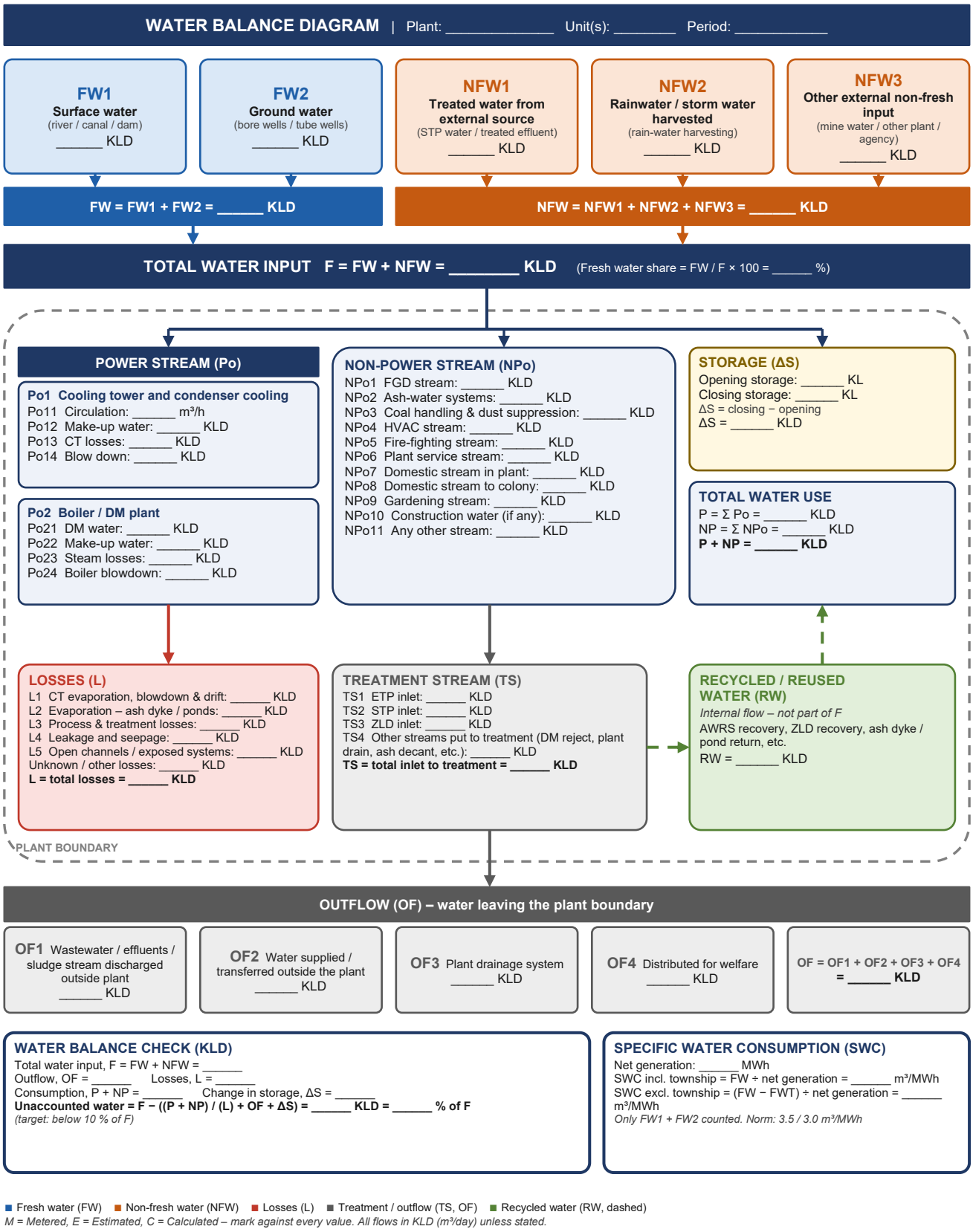
C. Water Balance of Power Plant

(For Water balance check attach the Water Balance Diagram)

	M/E/C	**Yearly daily average (KLD/MLD)**	**Total during the Audit Period (MCM)**
Total water input (F = FW + NFW)			

Fresh water input (FW = FW1 + FW2) – counted in SWC			
Non-fresh water input (NFW = NFW1 + NFW2 + NFW3) – not counted in SWC			
Total water output (OF)			
Total Losses (L)			
Change in water storage, if any (closing Water Storage – opening Water Storage) (Δ S)			
Unaccounted water = F – (Consumption/Losses+ OF + Δ S (KLD)); (Target: <10%)			
Net Power Generation (MWh)			
Specific Water Consumption - **Including township (m³/MWh)** = FW ÷ net generation			
Specific Water Consumption - **Excluding township (m³/MWh)** = (FW − FWT) ÷ net generation; FWT = fresh water supplied to township			
Applicable SWC norm (m³/MWh); compliant Y/N - incl. township / excl. township			
Percentage of fresh water in total water input (FW/F × 100); Percentage of recycled / reused water (RW) Percentage of recycled / reused water			
Wastewater recycled / reused; wastewater discharged outside plant (m³/day)			
Cooling tower CoC (average);			
ZLD status (Full / Partial / Nil)			
Stage with maximum water use and quantity (KLD)			
Minimum / maximum monthly consumption (KLD)			

Figure 9.1: Water balance diagram of the Thermal Power Plant



D. Water Metering Inventory

Sl. No.	Meter location	Meter type	Functional status (working / faulty / not installed)	Last calibration date	Remarks
1	Raw water intake				
2	Cooling tower make-up				
3	DM plant feed				
4	Ash handling water				
5	Township / colony supply (from plant intake)				
6	Potable and service water				
7	Ground water abstractions				
8	FGD make-up				
9	Ash water return (AWRS)				
10	ETP / STP outlet and discharge point				
11	Others (specify)				

E. Unit-wise Audit Analysis

Parameter	M/E/C	**Yearly daily average (KLD/MLD)**	**Total during the Audit Period (MCM)**
Cooling tower Unit			
Cooling system details (type, no. of towers / cells, design range and approach)			
Circulating water flow m³/day			
Makeup water m³/ day			
Blowdown m³/day			
Evaporation and drift loss m³/day			

Cycles of concentration Ratio			
Cooling tower effectiveness %			

Boiler and condensate audit			
Boiler system details (no. of boilers, capacity, pressure)			
Boiler feed water m^3/day			
Boiler blowdown m^3/day			
Condensate recovery %			
Steam losses %			

DM plant audit			
Raw water feed m^3/day			
DM water production			
Reject water			
Recovery efficiency			

Ash handling water audit			
Ash water consumption m^3/day			
Recovered water m^3/day			
Disposal loss m^3/day			

F. Water Quality Analysis (Average Daily for the Audit Report)

Parameter	Unit	Raw water	CW water	DM water
pH	-			
TDS	mg/L			
Conductivity	µS/cm			
Hardness	mg/L as $CaCO_3$			
Others as applicable (chloride, silica, turbidity, Oxidation Potential etc.)				

G. Specific Water Consumption (Monthly, with and without township)

Monthly SWC (financial year, April to March)

Month	(a) Net generation (MWh)	(b) Fresh water input, FW = FW1 + FW2 (m³)	(c) Township water via plant intake (m³)	(d) = (b) - (c) Excl. township (m³)	SWC incl. township (b)/(a)	SWC excl. township (d)/(a)	Remarks
April							
May							
June							
July							
August							
September							
October							
November							
December							
January							
February							
March							
Annual total / SWC							
Monthly average							

Note 1. Where the township / colony draws water from the same source as the plant, report both values: SWC incl. township = (b) ÷ (a); SWC excl. township = [(b) - (c)] ÷ (a).

Note 2. If the township is fed from a separate, independently metered source outside the plant intake, enter 0 in column (c) and do not include it in plant SWC. Water for construction of a new project, if separately metered, is excluded from (b).

H. Domestic water Use

Item	Unit	Value	Remarks
Township water source: same as plant intake / separate independent source	-		
Township population (incl. schools, hospital)	nos.		
Township water drawn through plant intake (metered / estimated)	MCM/year		
Per-capita supply through plant intake	lpcd		

Item	Unit	Value	Remarks
Township water from a separate source (memo item; outside plant boundary, not in plant SWC)	MCM/year		
Water for construction of new project (separately metered; excluded from SWC if agreed with MoEF&CC / SPCB)	m^3/year		

I. Water Use Efficiency (WUE) works done in the plant

Sl. No.	Work	Existing condition (implemented / partial / not implemented)	Details, year of implementation and water saved (KLD)
1	Cooling tower optimization		
2	Leak rectification		
3	DM reject recycle optimization		
4	Electromagnetic flow meters		
5	Blowdown optimization		
6	IoT system		
7	Water management portal		
8	Dry ash handling		
9	Area / Measure (process, utilities, domestic, green belt, washing, dust suppression, recycling, RWH)		

J. Water-saving potential and implementation plan: Initiatives already taken by the plant during reporting period

S.No	Date	Item of work undertaken	Saving (KLD)	% Saving
1				
2				

K. **Conclusion, Recommendations and Sign-off**

	Item	Values
1	Present total water consumption	
2	Water extraction recommended / to be permitted	
3	SWC before audit and after implementation of measures (m^3/MWh): including township / excluding township	
4	Status of previous audit recommendations (implemented / pending)	
5	Fresh / raw water input (FW) and total make-up water (KLD / KLY)	
6	Water recycled / reused (KLD and % of consumption); ZLD status	
7	Unaccounted water in the water balance (KLD and %)	

Signature & Seal of Project Proponent

SoP 10	FAQ	11.26

This section answers the questions most commonly asked by Thermal Power Plants (TPPs) about the water audit. It should be read together with the preceding sections of this SoP. Where the plant's Environmental Clearance (EC) or Consent to Operate (CTO) says something different, the EC/CTO prevails.

A. ABOUT CEA WATER AUDIT FRAME WORK ADVISORY

QA.1. Is the water audit required for sea-water based (coastal, once-through) plants?

The MoEF&CC SWC ceiling does not apply to TPPs using sea water, and such plants are not required to submit the annual audit report to CEA. They should, however, complete the audit steps that remain relevant to them: efficient use of water, corrosion/scaling control, thermal and marine discharge, and effluent compliance. Any fresh water drawn for the DM plant, potable, service or township use should still be metered and accounted for in an internal water balance.

QA.2. Does this SoP apply to gas-based / combined-cycle power plants? What is the SWC or DM-water benchmark for them?

No. This SoP and the CEA advisory of 2 September 2026 cover coal/lignite-based TPPs. No SWC or DM-water benchmark for gas-based or combined-cycle plants is prescribed here. A gas-based plant may voluntarily use the water-balance method and compare its results with its own design values. Any statutory limit for such plants must be taken from the plant's EC/CTO or the applicable MoEF&CC notification.

QA.3. Does the audit apply irrespective of the water source, for example saline borewell water?

Yes. The audit applies irrespective of the source: surface water, ground water, mine water, harvested rainwater or treated sewage. Saline borewell water is a ground-water source. It should be metered, included in the water balance and reported separately with its quality (TDS, chloride). The drawal should also be checked against the permitted quantity. How such water is treated for the SWC ceiling follows the wording of the plant's EC/CTO, which should be confirmed with the SPCB.

QA.4. How do we prepare a closed-loop water balance that reconciles raw water intake with sub-metered consumption?

a. **Boundary:** define it to include all water systems and interconnections (raw water, DM, CW/CT, ash, FGD, ETP/STP/ZLD, township).
b. **Inflows:** quantify every source at the point of entry (river, canal, borewell, rainwater, treated sewage from external sources).
c. **Uses and transfers:** sub-meter each major use and each transfer between units/stages. Cover metering gaps with calibrated temporary meters during the audit.
d. **Losses and outflows:** estimate evaporation, drift, blowdown, seepage, discharge and the change in storage.
e. **Reconcile:** check Σ Inflow = Σ Consumption / Σ Losses + Σ Discharge + Δ Storage. Investigate if unaccounted water exceeds about 10%.

QA.5. Can Water Audit be performed by CGWA Auditor as per CGWA Guidelines?

No. The two frameworks are different. The CGWA Guidelines pertain to GW use.

QA.6 Should the Shutdown period be included in Water Audit?

The Water Balance computes the water use for the operational period of the pumps. During Shut down only Power Stream is not used but the non-Power Stream remain in use.

QA.7 Will the Water Audit help in the reduction of the Water Charges?

Currently, water charges are levied based on allocated quantity of water. However, upon implementation of the Water Audit (WA) framework, this policy is envisaged to transition toward billing based on actual drawal/usage. CEA, in association with TPPs, will take up this matter with the relevant regulatory authorities and state water resource departments for high-performing Thermal Power Plants.

QA.8 Will the best performing Thermal Power Plants be recognised by CEA.

Yes. Every year, a year book on the Water Audit Report for the Thermal Power Plants (TPP) will be released. The Year Book will recognize the best performing TPPs.

QA.9 Is there any list of certified Water Auditors maintained by CEA?

No. The Qualifications of the Water Auditor are given in the SoP 5. The TPP can have a fair and transparent procurement to procure the services of the Water Auditor. In future, if TPPs request CEA, a list of certified water Auditors can be created in CEA.

QA.10 Can we use the In house team to do water Audit?

No. The water Audit has to be through neutral agency or through online portal as described in SoP 5.

B. ABOUT SWC

QB.1. Our plant's SWC is already below the prescribed limit. Is the annual water audit still required?

Yes. Annual water auditing is mandatory for all non-coastal, coal/lignite-based TPPs irrespective of current SWC performance. The audit serves a broader objective: establishing a verified water balance, keeping unaccounted water below 10% of inflow, validating zero liquid discharge (ZLD) / effluent standards, and documenting recycling efforts. Conducting and submitting the annual audit report is necessary to ensure sustained compliance and meet statutory guidelines.

QB.2. What are the SWC norms for existing plants, new plants and plants commissioned after 2024? Is there a capacity-wise benchmark (135 MW, 210 MW, 270 MW, 300 MW, etc.)?

The MoEF&CC ceilings are the same for all unit sizes.

Plant Category / Type	Specific Water Consumption (SWC) Norm	Key Operational Requirement
Existing Cooling Tower-based Plants	≤ 3.5 m³/MWh	Maintain compliance within the prescribed limits.
Once-Through Cooling (OTC) Plants	≤ 3.5 m³/MWh	Mandatory installation of cooling towers within the notified timeline.
New Plants *(Installed after 01.01.2017)*	≤ 3.0 m³/MWh	Mandatory implementation of Zero Liquid Discharge (ZLD).

No separate capacity-wise benchmark is prescribed in this SoP. A plant can additionally compare its audited SWC with its own design value and with its previous audits.

QB.3. Is there a separate or higher SWC allowance for plants with FGD? What if FGD is not installed?

No separate allowance is given in the notified ceilings (3.5 and 3.0 m³/MWh), and none is provided in this SoP. Water used in the FGD system forms part of the plant's total intake and is shown as a separate head in the water balance. A plant without FGD is subject to the same ceiling; its actual SWC will simply be

lower. To keep SWC within the limit, FGD make-up can be reduced by using CT blowdown or treated effluent.

QB.4. Is any relaxation in SWC available for old units (for example 210 MW units with 40 years of life)?

This SoP does not provide any relaxation. The SWC ceilings are statutory limits under the Environment (Protection) Rules and only MoEF&CC can revise or relax them. A plant that cannot meet the limit must record the exceedance in the Non-Conformance Log with root cause, corrective action and target date, and prepare a time-bound plan to comply. If a relaxation is needed, the plant should approach MoEF&CC / the SPCB with the audit findings as supporting evidence.

QB.5. Our plant runs at low load, starts and stops frequently, or has long shutdowns, so SWC is high. How should this be handled?

SWC is calculated on net generation, so water drawn for auxiliary cooling, DM make up and service use during shutdowns, partial load or daily start-stop pushes it up. The SoP gives no exemption from the audit for these cases. The audit should report SWC monthly and annually together with PLF, shutdown days and number of start-ups, so that the reason for the high value is clear and documented.

Measures to limit water use at low load:

a. Isolate idle systems and switch off unneeded cooling-tower cells and CW/ACW pumps.
b. Match CT make-up and blowdown to the actual heat load.
c. Stop non-essential service, dust-suppression and washing uses.
d. Locate and stop leaks, overflows and continuous drains (use sub-meters).
e. Maximise reuse of treated effluent and ash-water return.

QB.6. Is there a plant-wise target for SWC reduction after the audit, and what applies once the prescribed SWC is achieved?

The audit ends with a time-bound Water Conservation and Management Plan, with measures classed as Short (within 6 months), Medium (6–12 months) or Long (12–24 months). The Executive Summary also records whether the total recommended reduction is 20% or more. This SoP does not fix a separate plant-wise SWC target. The statutory ceiling is the minimum requirement. After achieving it, the plant should keep improving, track its SWC against its own previous audit and report the status of earlier recommendations (implemented / pending).

QB.7 How is SWC calculated, and is recycled water deducted from consumption?

SWC (m^3/MWh) = Total Freshwater Intake (m^3) ÷ Net Electricity Generation (MWh) for the audit period. Recycled and reused water (ash-water return, treated ETP/STP water, CT blowdown reuse, condensate) is an internal flow. It is not counted again as inflow and it is not subtracted separately unless the water is from the external source. Its benefit appears automatically as a lower fresh-water intake.

QB.8 Is treated sewage / tertiary treated water from a municipal STP included in SWC? Must we meet 3.5 m^3/MWh when using it?

Treated sewage is reported as a separate input source and SWC is defined on external freshwater intake. The audit should therefore report two figures: SWC based on fresh water, and total water consumption including other sources such as treated sewage. As per the Tariff Policy, 2016, thermal power plants located within a 50 km radius of a municipal sewage treatment plant (STP) are required to use treated sewage for their water requirements, subject to the applicable provisions of the Policy.

QB.9 Should harvested rainwater be included in SWC? How is rainwater used for ground-water recharge accounted for?

Harvested rainwater and storm water used in the plant is an inflow. It must be measured and shown as its own source in the water balance, separate from fresh/raw water. It is not external freshwater intake, so it does not enter the SWC numerator, but it must not be left out, otherwise the balance will not reconcile and any “water positive” claim cannot be verified. Rainwater used only for ground-water recharge does not

enter the plant water system. Report it separately as an estimate: catchment area × rainfall × runoff coefficient.

QB.10. Treated water from our STP is used for horticulture outside the plant and is not taken back. Is it counted as recycling or as a "water credit"?

The recycled/reused percentage covers only water reused within the plant boundary. Treated water sent outside the boundary and not returned should be shown under "Water supplied / transferred outside the plant" in the Executive Summary, not under recycling. The SoP does not provide for any water credit.

QB.11 Are potable water, fire-fighting water and process uses (boiler, cooling tower, ash suppression) included in SWC?

Yes. The water drawn from an external source for plant use counts in the SWC numerator, irrespective of its end use: CT make-up, DM/boiler make-up, ash handling and conditioning, coal handling and dust suppression, FGD, fire and service water, potable water and gardening. Boiler, cooling-tower and ash-suppression water are process uses and are reported as separate heads in the utilisation table. For fire water, only the make-up drawn from the external source is counted, not the stored volume.

QB.12. How should water for the residential township / colony, schools and hospital, or for construction of a new project, be treated? What if the colony is supplied from a different source?

The water-balance boundary includes township, domestic and horticulture use, and the Executive Summary has separate lines for potable/domestic water of plant and township. Water drawn through the plant's intake for the township should therefore be metered and reported separately. Where the township is supplied from the same source as the plant, SWC shall be reported both including and excluding the township: SWC including township = total fresh-water intake ÷ net generation; SWC excluding township = (total fresh-water intake − township water) ÷ net generation. If the township water is not metered, estimate it from population and per-capita demand and mark it as estimated.

If the colony is fed from an independent, separately metered source (for example a dam or municipal supply at another location) that is not part of the plant's intake, it lies outside the plant boundary. Mention it as a note but do not include it in plant SWC. Water used for construction of a new project, not for generation, should likewise be metered separately and shown as its own line. Its exclusion from SWC compliance should be agreed with MoEF&CC / the SPCB and supported by records.

C. MISC. ISSUES

QC.1 What per-capita potable water demand should be assumed? Is 135 litres per head per day applicable for industrial use?

The SoP does not prescribe a per-capita figure. Use measured values wherever meters exist; where a metering gap exists, estimate using the CPHEEO (Central Public Health and Environmental Engineering Organisation) Manual, the National Building Code (NBC) or relevant BIS code.

QC.2. Is there any incentive for plants that achieve an SWC lower than 3.0 or 3.5 m³/MWh?

Water conservation is a national obligation, in line with the National Water Mission objective of improving overall water-use efficiency by 20% across the agricultural, industrial and domestic sectors. Plants are therefore expected to treat compliance as a minimum and to pursue further reduction in water consumption.

A lower SWC also yields direct operational benefits, namely reduced water charges and treatment costs, lower vulnerability to shut down during water shortage, and improved standing with regulators and the local community.

The ceilings of 3.5 m³/MWh (existing plants) and 3.0 m³/MWh (new plants) are mandatory compliance limits and may be amended in coming years as the technology gets evolved.

QC.3 How to implement ZLD? Does gardening / horticulture water fall under ZLD? How is ZLD assessed?

ZLD means that all wastewater generated in the plant is treated and reused/recycled with no liquid effluent discharged outside the plant boundary. To achieve ZLD, high end treatment is done to a super concentrated stream after implementing other waste water treatments. Treated wastewater used for gardening inside the boundary is reuse, and is consistent with ZLD, provided that the quantity is matched to actual need and nothing leaves the boundary as runoff or overflow. Record it as reuse in the audit. For how ZLD compliance is assessed for a particular plant, refer to the EC/CTO conditions and confirm with MoEF&CC / the SPCB.

QC.4 What is the policy on air-cooled condensers (ACC) for thermal power plants?

This SoP neither mandates nor prohibits ACC. Since cooling-tower evaporation is the largest consumptive loss in a TPP, an ACC removes most of this loss and the cooling-tower make-up, and so greatly reduces SWC. The trade-offs are higher capital cost, higher auxiliary power consumption and a heat-rate penalty (particularly in hot weather), and a larger footprint. ACC is therefore a design-stage option, best considered for water-scarce sites after a techno-economic study.

QC.5 What techniques are available to reduce cooling-tower blowdown?

Blowdown falls as cycles of concentration (CoC) rise. So, raising CoC from 3 to 5 roughly halves the blowdown. Practical measures, within OEM and water-treatment limits:

a. Improve make-up water quality and optimise the chemical-treatment programme (pH, scaling/LSI, chloride, silica).
b. Use side-stream filtration and conductivity-controlled automatic blowdown.
c. Maintain drift eliminators and repair condenser tube leaks.
d. Reuse the blowdown in ash handling, FGD, dust suppression or gardening.
e. Where ZLD is required, treat blowdown by RO / evaporator and recover the water.

QC.6 Is there any technology to recover the water evaporated from a natural-draft cooling tower?

In a conventional wet cooling tower, evaporation is a consumptive loss and cannot be practically recovered. The effective approach is to minimise it and to minimize drift loss, keep drift eliminators in good condition (modern designs limit drift to below 0.02% of circulating flow), maintain fill and water distribution, and avoid over-cooling.

QC.7. How can evaporation from reservoirs and ash ponds be reduced?

First estimate it using E (m^3/day) = Kp × Ep × A ÷ 1000, which shows that the loss is directly proportional to the exposed water-spread area. Options to reduce it:

a. Keep the water-spread area small: deeper, compact storage instead of shallow, wide ponds.
b. Hold only the storage that is needed and shorten residence time.
c. Use covered or underground tanks where feasible, and floating covers on smaller ponds.
d. Use high-concentration slurry disposal or dry ash handling and maximise ash-water return to limit pond area.
e. Line ponds and canals to cut seepage, and plant windbreaks around reservoirs.

QC.8. Is there any separate policy for dry bottom ash boilers or dry ash handling?

No separate norm is prescribed. The audit applies irrespective of the ash-handling system.

QC.9 As ISO 14001 Environmental Management System (EMS) auditors, how can we include water audit aspects in our EMS audits?

Water-audit checkpoints can be added to the environmental-aspect and compliance-evaluation review of the EMS audit. For example, verify:

a. that an annual water audit has been done and submitted on time, and the earlier recommendations are being implemented;

b. SWC against the 3.5 / 3.0 m³/MWh ceiling and the water balance with unaccounted water below about 10%;

QC.10. Our plant has an ISO 46001:2019 water-efficiency management system. Will its internal/external audit reports be accepted in place of the water audit? What is the difference between the two?

Not automatically. ISO 46001 is a management-system standard. Its audit checks the system (policy, planning, controls, monitoring and improvement), whereas the water audit under this SoP quantifies the water balance, computes SWC, checks compliance and requires independent verification. ISO 46001 alignment is optional. ISO records such as metering data, baselines and audit findings are useful supporting evidence, but the annual water audit report in the prescribed format is still required for plants covered by this SoP.