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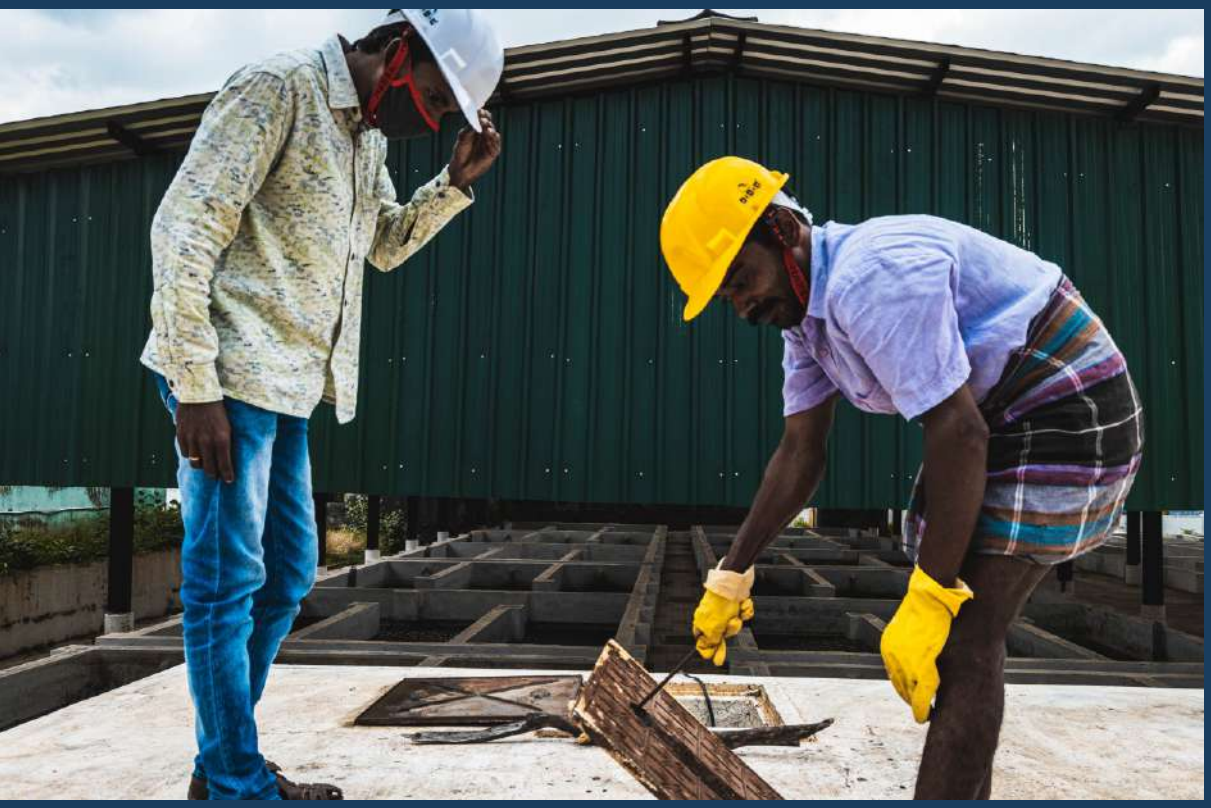
REPORT

DETAILED COMMISSIONING AND OPERATION & MAINTENANCE (O&M) MANUAL FOR FECAL SLUDGE TREATMENT PLANTS IN TAMIL NADU

November 2020



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Detailed Commissioning and Operation & Maintenance (O&M) Manual for Fecal Sludge Treatment Plants in Tamil Nadu

November 2022

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Abbreviations

CT	Collection Tank
FRP	Fibre-reinforced plastic
GI sheets	Galvanised Iron sheets
HPGF/PGF	Horizontal Planted Gravel Filter
ISAF	Integrated Settler and Anaerobic Filter
O&M	Operation & Maintenance
PCB	Pollution Control Board
PP	Polishing Pond
PVC	Polyvinyl chloride
SC	Screen Chamber
SDB	Sludge Dying Beds
SR	Stabilisation Reactor
UPVC	Unplasticised polyvinyl chloride

1 Introduction

1. Introduction

1.1. Background

Fecal sludge management (FSM) is emerging as an economical and sustainable solution to sanitation problems and gaining worldwide acknowledgement.

Fecal Sludge Treatment Plants (FSTPs) play a crucial role in ensuring safe and sustainable sanitation and protecting public health and the environment. The construction of FSTPs should consider several factors, such as site suitability, ease of construction, treatment objectives and capital costs. FSTPs, if constructed as per design, have the potential to be productive and long-lasting. However, once FSTPs are commissioned, the efficient functioning of the plant depends heavily on the operation and maintenance (O&M) protocols followed by the treatment plant operator and maintenance staff. The O&M can be split into two categories:

1. Daily/weekly/monthly operational tasks that are simple to perform and require basic training for the concerned personnel
2. Long-term/periodical O&M (yearly or beyond) that requires the expertise of a specialist and/or engineer

This manual is intended for the operators/caretakers and maintenance personnel to carry out routine, specific and critical tasks. This manual focuses on the operation and maintenance activities at gravity based decentralized Fecal sludge treatment plants to ensure the effective and efficient performance of all fecal sludge treatment infrastructures.

Operational tasks refer to the technical service activities required to run the infrastructure, as well as the correct handling and usage of facilities by the users. **Maintenance** comprises planned or reactive technical activities needed to keep the system working. Maintenance requires skills, tools and spare parts. This document focuses on the maintenance aspect and only highlights specific operational issues which affect the smooth running and maintenance of systems.

This manual has been developed to provide the operator with a better understanding of the 3 W's and 1 H (Where, When, Why, and How) of the operation and maintenance of an infrastructure for its successful functioning. The 3 W's are specifically:

- **What** activities need to be carried out, and the detailed process description?
- **When** to schedule the activities?
- **Where** to conduct the activities (pertaining to the modules)?

1.1.1. Objectives

The manual is to be used as a reference document by the person or entity responsible for operation and maintenance of the treatment infrastructure. It aims to

- Transfer knowledge about the functioning of the different components of fecal sludge treatment/management to operators and users.
- Help the personnel carry out tasks related to the O&M for the upkeep of the treatment infrastructure.
- Ensure compliance of the fecal sludge treatment system with specified standards for the safe reuse or disposal of treatment by-products.
- Save time and cost by minimising system breakdowns.

- Ensure long-term-functionality of all the infrastructure components.

1.1.2. Contents

This manual contains the process description of the O&M to be followed for the smooth functioning of the FSTP, which includes:

a. Brief Introduction of treatment units
b. Regular and periodical O&M activities
c. Safety rules
d. Activity schedules for O&M tasks

1.1.3. Target Users

- Engineers and Operators
- Engineers, planners and other professionals of the Department of Public Health and Education
- Engineers and operators from local government - engineering departments or Urban Local Bodies (ULBs).

1.2. Safety Measures

This section highlights some of the basic dos and don'ts (as shown in Figure 1) of the safety measures to be taken while performing O&M related activities.

a. General Site Safety

- **B**e careful and observant.
- **E**nsure inspection manholes are covered when no O&M activity is being performed.
- **Do not** leave open chambers unattended.

b. Personal Safety Precautions

- Wash your hands and disinfect them after tasks.
- Wear proper clothing (long sleeved shirt, long trousers, shoes and gloves, apron, mask) while carrying out maintenance tasks.
- Always keep a first aid kit, lime or concentration of chlorine solution, hand wash and sanitiser, spare gloves and masks at the treatment plant.
- Avoid contact with wastewater and protect wounds from coming in contact with the sludge or wastewater.
- Ensure cleanliness of protective gear such as clothes, gloves, and boots. Disinfect the PPE after daily use.
- Keep yourself hydrated when working inside the sludge drying bed.
- Do not eat or drink while conducting the O&M tasks. Find a clean space away from the system to eat and drink.
- Do not be barefoot or bare handed while handling sludge and performing the O&M activities

c. Proper Disposal of waste

- Ensure waste such as scum, solid waste, used gloves, masks and paper towels is collected and stored in a safe and dedicated collection facility. The collected waste should be disposed of at regular intervals at a dedicated disposal facility, at least 10 metres away from waterbodies to avoid infiltration into ground/fresh water.
- In case of spillage while discharging the sludge into the FSTP, the operator must clean the spill using a vacuum pump. If this is not possible, then cover it with lime. If both options are not

possible, wash off spill and direct the wash water to a covered drain. Spray chlorine on the spill area.

- Do not wait longer than necessary to dispose of garbage.
- Do not dispose garbage at unofficial dumping locations.
- Do not burn garbage.

Figure 1.1: Safety precautions

Source: CDD Society, 2019

1.3. List of equipment

Figure 1.2: List of equipment

Sl. No	Equipment Name	Image
1.	Bucket	
2.	Trowel	
3.	Gloves	
4.	Mask	
5.	Shoes(Gum boots)	
6.	Wheelbarrow	
7.	Shovel	
8.	Garden Scissors	
9.	Wooden Pole	
10	Fishnet mesh	

Sl. No	Equipment Name	Image
11.	Measuring tape	
12.	Broom	
13.	Mechanised tiller and trailer	
14.	Ladder	
15.	Torch	
16.	Rake	
17.	First Aid kit	
18.	Plastic Sheet	
19.	Pressure Washer	

Source: CDD Society, 2019

2

Overview of Treatment Plant

2. Overview of Treatment Plant

The treatment plant is divided into two parallel decentralised units of 10 cu.m treatment capacity each within the FSTP site to handle 20 KLD of sludge per day. Each unit of the treatment system comprises a screen chamber, a stabilisation reactor and 12 sludge drying beds and a common liquid treatment unit with a total treatment capacity of 20 KLD. Once the first unit is entirely loaded to meet the design capacity of 10 cu. m/day, the next unit should be loaded.

Figure 2.1: Plant Layout - 20 KLD

Source: CDD Society, 2019 & TNUSSP, 2020

The final quality requirement of treatment by-products for its safe disposal or reuse, and the different combinations of treatment modules are chosen based on the influent characteristics of sludge to achieve the desired result. Following are the stages of treatment and technology options adopted for the treatment of fecal sludge.

Table 2.1: Treatment stages and technology	
Treatment stage	**Treatment technology**
Pre-treatment	Screen chamber
Sludge Stabilisation	Anaerobic Sludge Stabilisation Reactor
Sludge dewatering and drying	Sludge drying beds
Liquid treatment	DEWATS-based modules comprising settler integrated with anaerobic filter, horizontal planted gravel filter, and polishing pond
Source: CDD Society, 2019 & TNUSSP, 2020	

2.1. Description of each stage of treatment

2.1.1. Pre-treatment

The de-sludging truck carrying fecal sludge will be directed to a receiving point inside the treatment facility. The fecal sludge will be discharged into the respective screening chamber for pre-treatment. Large solids are trapped in this chamber using a vertical bar screen.

The solids collected on the bar screen and the chamber are removed regularly and dumped at the dedicated collection facility within the treatment facility. Based on the trash volume as well as defined frequency, it is emptied and disposed of at a dedicated disposal facility allocated by the Municipality.

2.1.2. Sludge stabilisation

The liquid sludge (mixture of liquid and solids in slurry form) from the screening chamber is further conveyed to an Anaerobic Sludge Stabilisation Reactor (with three chambers in series) by gravity for further treatment. The main objective of this treatment is homogenisation as well as degradation of organic matter present in the incoming sludge. Apart from reduction in organic concentration, this treatment process helps in increasing the dewatering ability of sludge in the subsequent treatment module.

The stabilisation tank has three chambers – the first chamber acts as a homogenisation reactor, where the existing sludge and new sludge come in contact through controlled mixing. The second chamber, comprising two compartments and the third chamber provides a digestion zone, where the sludge is subjected to anaerobic treatment of organics present in the fecal sludge. The third chamber comprises one tank and is designed for one day retention. The entire volume of sludge from this chamber is pumped into the dewatering and drying unit. This tank also has the provision for conveyance of the supernatant water to liquid treatment facility, if required.

2.1.3. Sludge dewatering and drying

The solids collected/pumped from the third chamber of the stabilisation reactor in the form of slurry is transferred to sludge drying beds using flexible hosepipes. The sludge drying beds are structures with sloped base holding graded filter media. The main functionality of the SDB is dewatering and drying of sludge. The percolate from the sludge drying bed is collected at the bottom through perforated drainage pipe and conveyed for further treatment in a liquid treatment facility. The dried sludge from the surface of the drying beds is removed periodically by manual labour and transferred to the sludge storage house for co-composting.

Composting is the process of treating solid organic waste. It is the controlled biological decomposition of raw organic materials to form compost. The aim of the composting process is to break down organic substances to produce a stable and high-quality compost through biological decomposition. Co-composting is an extensive utilisation technique used when organic waste and dried fecal sludge (DFS) are available. The DFS that is to be treated (which has already undergone treatment in a sludge drying bed) can be combined with organic matter from household waste or vegetation (municipal solid waste – MSW) to optimise the composting process. Moisture levels must be sufficient to ensure decomposition in optimum conditions. The material to be composted can be piled into heaps so little infrastructure is required. This system is based on natural processes, the degradation of organics by microorganisms that destroy the pathogens contained in the FS.

2.1.4. Liquid Treatment

The percolate water from the sludge drying beds (as well as supernatant water from the stabilisation reactor) is subjected to treatment in DEWATS-based treatment modules which consist of a) settler integrated with an anaerobic filter for primary and secondary treatment, b) horizontal planted gravel filter for tertiary treatment, and c) polishing pond for post treatment.

The settler is provided to trap the solids through gravity settling, whereas the anaerobic filter is used for the removal of organic matter present in the percolate water. The horizontal planted gravel filter is used as a tertiary treatment process for filtration and removal of nutrients and ammonia present in the percolate to a maximum extent. Post treatment of percolate water which is mainly disinfection is carried out in the polishing pond by exposing the water to ultraviolet (UV) rays.

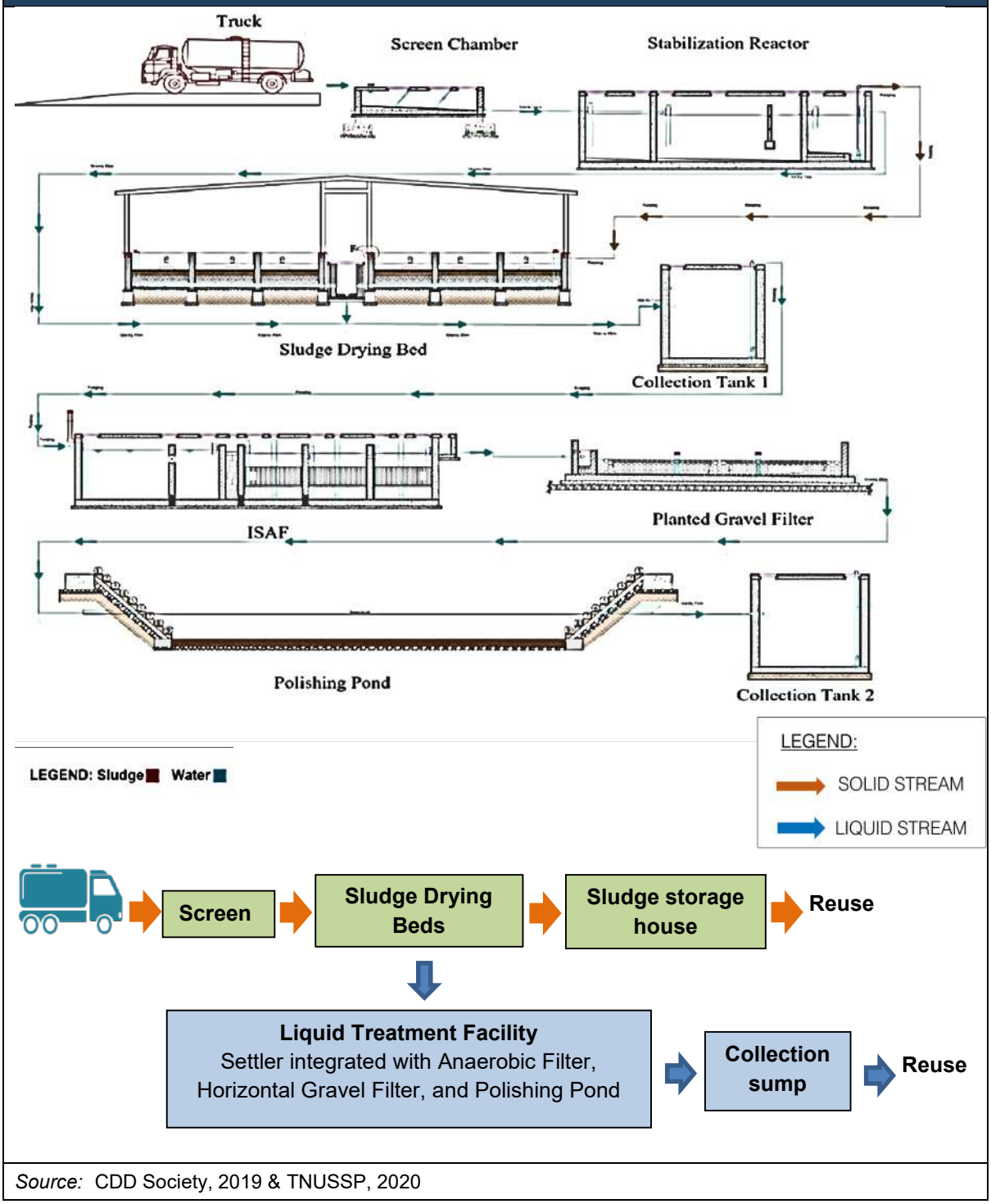
3

Operation and Maintenance Aspects

3. Operation and Maintenance Aspects

The design of the treatment modules adopts a modular approach to optimise the operation. There are two, three and four streams of treatment modules for 20, 30 and 40 KLD treatment capacity respectively, with each stream having a maximum capacity of 10 KLD. Every day the first 10 cu.m of truckloads of sludge shall be put in the first stream and the upcoming loads in the second (for 20 KLD), third (for 30 KLD) and fourth (for 40 KLD) stream respectively.

Figure 3.1: Treatment process flow



Source: CDD Society, 2019 & TNUSSP, 2020

3.1. Tasks to be performed and coordinated before feeding of fecal sludge

The treatment plant is designed to handle only fecal sludge and not chemical or industrial waste. To ensure that the FSTP runs at its full capacity without any impact on the performance of the plant in the long run, it is essential to perform some checks and coordination activities.

3.1.1. Tasks to be performed before feeding of fecal sludge into the screening chamber:

The following activities must be performed by the FSTP operator before the de-sludging operator disposes of the fecal sludge into the screening chamber:

a. Coordinating with the de-sludging operator
b. Collecting fecal sludge source data
c. Collecting fecal sludge sample and testing its pH & EC

Figure 3.2: De-sludging operator at an FSTP	Figure 3.3: Testing for PH & EC
	
Source: CDD Society, 2019 & TNUSSP, 2020	

3.1.2. Truck arrival and sludge disposal

The truck arrives at the FSTP and heads to the respective screening chamber. The truck connects to the inlet of the screening chamber with a pipe and discharges the fecal sludge into the screening chamber. Once the sludge is completely emptied from the truck, the pipe is disconnected and the truck leaves the treatment facility.

No spillage should occur anywhere in the plant. The possibility of spillage can be: a) at the de-sludging point near the screen chamber b) at the sampling point during FS screening or c) any leakages in the truck. In case there is a spillage, the operator must clean the spillusing a vacuum pump or wash it off. The wash water should be directed to a covered drain and chlorine should be sprayed on the spill area.

3.2. Main O&M at the respective treatment module:

3.2.1. Screening chamber

The screening chamber must be cleaned after every discharge of fecal sludge. The solid waste must be removed from the screen manually and disposed of in the trash bin outside the chamber. The solids accumulated in the screens must be collected using the trowel and put in a bucket and disposed of into the trash bin. Spillage should be avoided. To ensure safety, water must be available near the screen chamber for personnel use in case of accidental spillage. Dried screenings from the trash bin must be

removed once in two weeks and safely disposed of along with the Municipal Solid Waste for further processing. During this entire operation, the operator must wear protective equipment such as gloves, mask and ensure no skin contact with the fecal sludge. The sludge will flow from the screening chamber to the stabilisation reactor by gravity. No external action is needed for this step. Manholes should be closed properly and immediately after removal of screenings and/or after the cleaning process is completed.

3.2.2. Stabilisation reactor (SR)

The main task in SR is emptying the third chamber regularly and discharging the sludge into the respective sludge drying/dewatering beds. The sludge is discharged using the submersible pump with the valve arrangement and flexible hose pipe. The valve must be kept open until the flow ceases as the volume of the third chamber corresponds to the volume of sludge desired in one sludge drying bed. The supernatant water from the third chamber flows by gravity to the collection tank 1 for further treatment. The operator should wear appropriate protective equipment and ensure secure installation of the piping to avoid spillage and contamination of the surroundings.

3.2.3. Sludge Drying Bed (SDB)

The sludge is dried for 12 days in the sludge drying bed. While the sludge is drying, the percolate flows into the liquid treatment facility. The dried sludge must be removed manually after 12 days and placed at the foreseen area. As there are a total 12 drying beds in one row/stream, the dried sludge removal cycle will be once in 12 days (may increase if the treatment facility has a weekly off to ensure the daily discharge of sludge from the SR into the sludge drying beds. If the drying period increases to more than 12 days, then sludge accumulation level in the third chamber of the SR must be checked before accepting fresh sludge in the sludge drying bed. As there is a risk of presence of helminths and pathogens, the operator should wear respiratory protection and gloves in addition to the usual protective clothing.

3.2.4. Integrated Settler (IS)

In the IS, the solids moved from the SDB with the percolate will settle and be digested. This module does not require any external operation as the flow works by gravity. The settled solids have to be removed once a year.

3.2.5. Anaerobic filter

This module does not require any external operation as the flow works by gravity. The settled solids must be removed once a year and the filter material should be cleaned once in three to five years or if clogged.

3.2.6. Horizontal Planted Gravel filter

This module does not require any external operation as the flow works by gravity. Dead leaves, debris and other junk fallen on the surface of HPGF must be removed periodically and the filter material should be cleaned once in six years or if clogged.

3.2.7. Polishing Pond

This module needs to be emptied regularly, at least once in three months. The sludge settled at the bottom should be de-sludged when the pond is emptied. Algae or other water plants, if found in excess, must be cleared regularly.

3.2.8. Final Collection Tank

The treated wastewater from the polishing pond passes to the collection tank by overflow and proceeds to a natural pond/drainage. The collection tank must be emptied regularly, at least once in three months. The sludge settled at the bottom must be de-sludged when the tank is emptied. To

ensure regular pumping and avoid backflow of water, it is necessary to check the operation of the pump (in case provided) every day and carry out regular pump maintenance activities.

3.2.9. Data collection

FSTPs are designed to treat only domestic sludge. So utmost care must be taken to avoid receiving any industrial sludge which is harmful to the biological treatment system. One of the methods of verifying the sludge characteristics by understanding its source through analysis and data collection such as source, de-sludging frequency and location. .

3.2.10. Sludge discharge logbook

A daily logbook of the sludge discharge, including load volume, truck number and discharge time gives insight on the feed rate of the sludge into the FSTP and the operation details.

3.2.11. Drying time in SDB

The SDBs are designed to have nearly 12 days of drying time. Data collection on actual drying time under different climate conditions improves operation time and efficiency.

3.2.12. Sludge Analysis

Dried sludge samples should be taken regularly and given to a laboratory for complete chemical and biological analysis to ensure smooth functioning of the FSTP as well as the safety of the product when discharged or reused.

3.2.13. Effluent water analysis

Sampling of effluent should be done regularly and given to a laboratory for complete chemical and biological analysis for the smooth functioning of the FSTP and to ensure the water quality is acceptable for discharge.

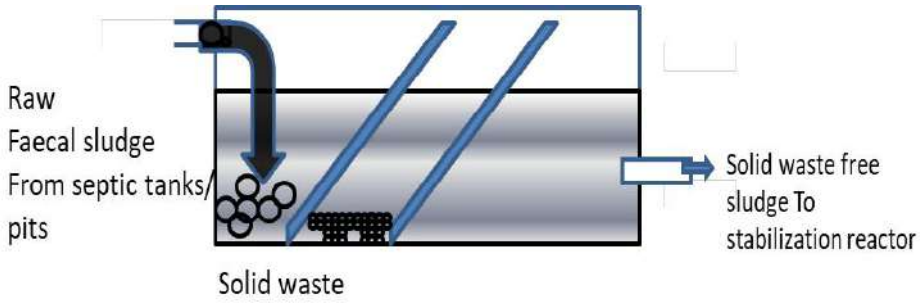
4 Detailed O&M Tasks

4. Detailed O&M Tasks

4.1. Screen Chamber

Screening is typically the first or preliminary step of primary filtration of any wastewater or sludge treatment facility. Screening is imperative to remove municipal waste and large solid objects from the fecal sludge and prevent clogging.

Figure 4.1: Screen chamber



Source: CDD Society, 2019

The screen chamber requires less maintenance, but regular removal of solids from the chamber must be ensured to avoid clogging and overflow.

4.1.1. Operation Tasks

Operation Task 1- Cleaning of Screening Chamber

Figure 4.2: Removal of solids accumulated in the screens and grit deposited at the bottom of the chamber

Source: CDD Society, 2019

Table 4.1: Cleaning of Screen Chamber	
Where	**At Screens**
When	Every day
Why	To avoid clogging and overflow from the chamber
How	• Open the manhole covers of screen chamber. • Collect the solids accumulated at the screens using the trowel and put them in a bucket. Clean the deposited grit using a broom and flush it out with water. Do not spill the solids anywhere outside the chamber. • Clean the bars using water and broom • Cover the manholes
Equipment	• Broom • Trowel • Bucket • Personnel equipment (gloves, mask, shoes)
Precautions	• Operators should follow the safety rules before performing the tasks mentioned in section 2 • The waste collected from operation and maintenance tasks must be disposed of at a municipal solid waste collection facility.
Source: CDD Society, 2019 & TNUSSP, 2020	

4.1.2. Maintenance Tasks

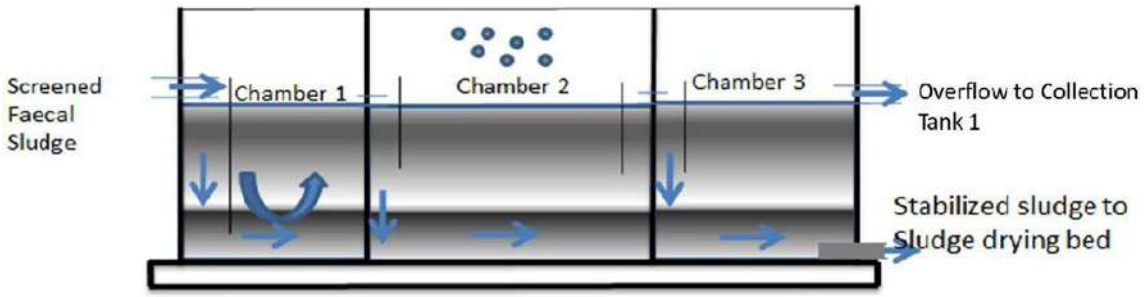
Maintenance Task 1- Repaint/Replacement of screens

Table 4.2: Maintenance of screen	
Where	**Bar screens**
When	After 3-4 years/ whenever necessary
Why	To avoid clogging and overflow from the chamber
How	• Remove the screens • Wash the screen using fresh water • Paint the screens with anticorrosive paint/ replace with new ones as per drawings • Fix the screens back in the same position • Cover the manholes • If screen bars are highly corroded, replace entire bar
Equipment	• Paint brush • Emery sheet • Paint • Water pipe
Precautions	• Operators should follow the safety rules before performing the tasks mentioned in section 2 • Ensure sludge does not enter the screening chamber while cleaning
Source: CDD Society, 2019 & TNUSSP, 2020	

4.2. Stabilisation Reactor (SR)

The liquid sludge (mixture of liquid and solids in slurry form) from the screening chamber is further conveyed to an Anaerobic Sludge Stabilisation Reactor (with three chambers in series) by gravity for further treatment. The main objective of this treatment is homogenisation as well as degradation of organic matter present in the incoming sludge. Apart from reduction in organic concentration, this treatment process also helps in increasing the dewatering ability of sludge in the subsequent treatment module.

Figure 4.3: Stabilisation Reactor



Source: CDD Society, 2019

4.2.1. Operation Tasks

Operation Task 1- Conveying sludge from SR to SDB

Table 4.3 : De-sludging from last chamber to SDB

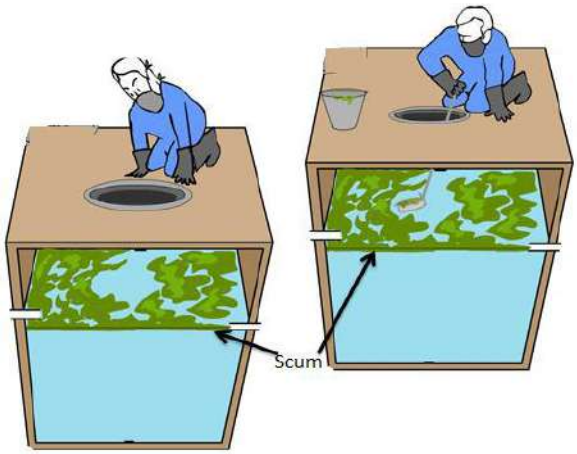
Where	**Stabilisation reactor**
When	Once a day
Why	To discharge the sludge from the third chamber to the SDB
How	• Check and document the level of sludge and supernatant in the last chamber of the stabilisation reactor • Connect the flexible hose pipe from the stabilisation reactor outlet to the respective sludge drying bed inlet pipe using connecting clamps • Open the valve and start the pump • Wait until the flow stops and the chamber is empty • Stop the pump and close the valve • Remove the flexible pipe from the sludge drying bed and disconnect it from the stabilisation reactor outlet without any spillage • Clean the flexible hose pipe • Repeat this procedure every day to fill the respective sludge drying bed
Equipment	• Gum boots • Flexible pipe • Gloves • Mask
Precautions	Operators should follow the safety rules mentioned in section 2 before performing the tasks

Source: CDD Society, 2019 & TNUSSP, 2020

4.2.2. Maintenance Tasks

Maintenance task 1 – Scum removal

Figure 4.4: Scum Removal



Source: CDD Society, 2019

Table 4.4: Removal of accumulated scum in the first chamber of stabilisation reactor	
Where	**Stabilisation reactor**
When	Once in 6 months
Why	● To provide the required retention time for sludge and wastewater ● To avoid clogging of pipes ● To avoid movement of scum into the subsequent chamber or module
How	● Open the manhole cover slab ● Check for the presence of scum and solids inside the chambers ● Use the fishnet sieve and remove the scum from the chamber and collect it in a tray ● Transfer the collected scum in the trash bin ● Place the manhole cover back
Equipment	● Fishnet sieve ● Plastic bowl ● Trash bin
Precautions	Operators should follow the safety rules mentioned in section 2 before performing the tasks
Source: CDD Society, 2019 & TNUSSP, 2020	

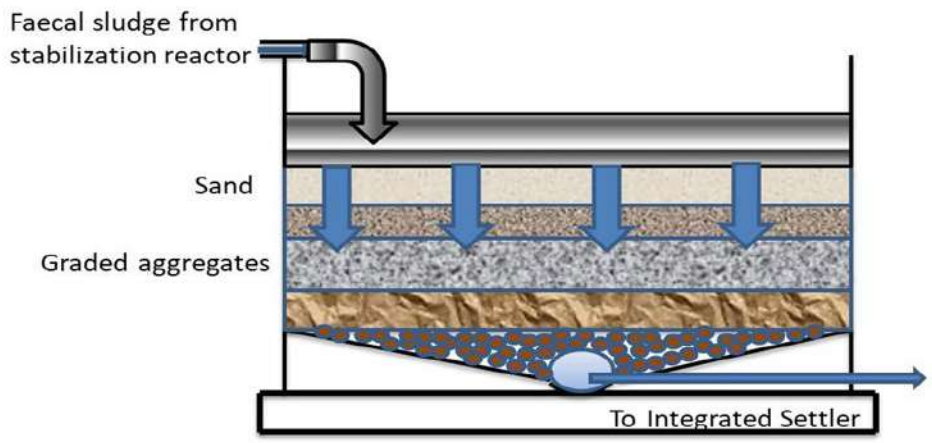
Maintenance task 2 – De-sludging

Table 4.5: De-sludging of stabilisation tank	
Where	**Stabilisation reactor**
When	Once a year
Why	● To provide the required retention time for sludge and wastewater ● To avoid clogging of pipes ● To avoid movement of scum into the subsequent chamber or module ● To ensure the effluent quality meet the design treatment efficiency
How	● Use a sludge cutter pump to empty the sludge from chamber 1 or 2 of the stabilisation tank as per the sludge measurement. The other end of the hose pipe must be connected to an empty Sludge Drying Bed. ● Secure the hose pipe tightly to both the inlet and outlet pipes using the clamps on both the ends. ● Stir the contents in chamber 1 or 2 using the wooden pole provided at site. ● Keep stirring the content with a stirrer during the discharge. ● Fill the sludge to the 25 cm mark in the SDB. ● Stop the sludge flow from the SR by switching off the pump and closing the valve. ● If the pump gets clogged, then stop the pump and restart it. This will help bring back the flow. If this does not work, perform the following steps: ● Take the pump from the SR and check for blockage around the foot valve of the pump. ● If there are blockages, clean it and reinsert inside the SR and perform the steps mentioned above. ● If the flow is not restored after performing the above steps, report it to the Municipality/TP.
Equipment	● Sludge cutter pump ● Flexible hose ● Mask ● Gloves ● Hose pipe clamps ● Wooden pole ● Fresh water or treated water from final collection tank
Precautions	Operators should follow the safety rules mentioned in section 2 before performing the tasks
Source: CDD Society, 2019 & TNUSSP, 2020	

4.3. Unplanted Sludge Drying Bed

Unplanted sludge drying beds are shallow masonry tanks filled with sand inside clay jally and gravel with an under-drain at the bottom to collect leachate. Sludge is discharged onto the surface for dewatering. The drying process in a drying bed is based on percolation of liquid through the sand and gravel to the bottom of the bed, and evaporation of water from the surface of the sludge.

Figure 4.5: Sludge drying bed section



Source: CDD Society, 2019

4.3.1. Operation Tasks

Operation Task 1- Removal of the dried sludge

Figure 4.6: Dry sludge condition before removal from bed & removal of dried sludge

Source: CDD Society, 2019

Table 4.6: Removal of dried sludge from SDB	
Where	**Sludge drying bed**
When	Once sludge in the bed is dried and/or underlying sand layer is visible through the cracks
Why	To remove the dried sludge from bed for next feeding

Table 4.6: Removal of dried sludge from SDB	
How	• Wear gloves and remove the dried sludge by hand, tap it to remove excess sand and collect it in a plastic bowl and transfer it to a wheelbarrow. • Transport the dried solids from the wheelbarrow to the trailer and dispose of the sludge in the sludge storage house within the treatment facility. • Get the wheelbarrow and trailer back to the drying bed. • Repeat the steps until the bed is completely emptied.
Equipment	• Gum boots • Wheelbarrows and trailer • Gloves • Mask • Goggles
Precautions	• Operators should follow the safety rules mentioned in section 2 before performing the tasks. • The operator must be careful not to remove sand with the dried sludge
Source: CDD Society, 2019 & TNUSSP, 2020	

4.3.2. Maintenance Tasks

Note: It is recommended to replace the filter material, however one can also remove the existing filter material, wash and restore it.

Maintenance Task 1- Replacing filter material

Table 4.7: Replacing filter material in unplanted drying bed	
Where	Sludge drying bed
When	Once in 5 years or whenever sludge drying period increases extensively
Why	• To ensure smooth percolate flow • To ensure the design treatment efficiency
How	• Take out all the sludge as mentioned in 4.3.1. • Remove the sand layer from the bed using shovels. • Transport and dispose of the removed sand safely. • The sand used for replacing filter media should be free from silt and clay. Wash and use the filter media if sand is present. • Once the sand is free from silt and clay, place it on drying beds to 150 mm thickness. • Check id the filter material below the sand bed needs cleaning. If needed, remove each layer of the filter material, clean or replace to the required thickness.

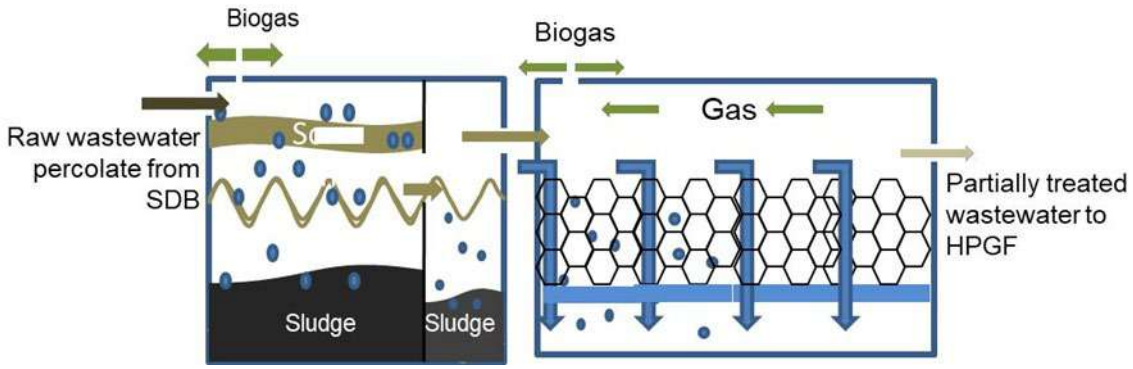
Table 4.7: Replacing filter material in unplanted drying bed	
Equipment	• Shovel • Plastic sheet • Brush • Water
Precautions	Operators should follow the safety rules mentioned in section 2 before performing the tasks
Source: CDD Society, 2019 & TNUSSP, 2020	

4.4. Integrated Settler and Anaerobic Filter

The percolate from the Sludge Drying Bed and supernatant from the third chamber of stabilisation reactor is further subjected to treatment in the Integrated Settler (IS) and Anaerobic Filter (AF). The IS and AF is provided with three parallel streams of two-chambered baffled reactors and three-chambered anaerobic fixed bed filters, respectively. As wastewater flows through the filter, particles are trapped and organic matter is decomposed by the biomass attached to the filter material.

The IS and AF applications are designed and dimensioned in such a way that treated water meets the requirements stipulated in environmental laws and regulations. The IS and AF are based on the principle of low maintenance since the most important parts of the system work without energy inputs and cannot be switched off intentionally.

Figure 4.7: Integrated Settler and Anaerobic Filter



Source: CDD Society, 2019

4.4.1. Operation Tasks

Operational task 1 – Ensure free flow of water

Figure 4.8: Ensuring free wastewater flow

Source: CDD Society, 2019

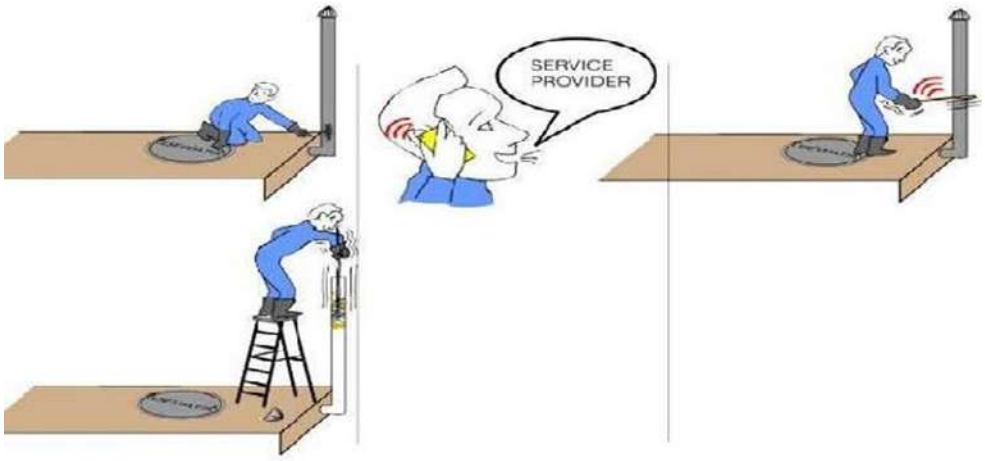
Table 4.8: Ensuring free wastewater flow at IS and AF

Where	Inlet, outlet of IS & AF
When	Once in 15 days
Why	• To identify possible obstructions in the pipes of IS and AF modules. • To allow free flow of wastewater through the entire system (IS and AF modules) • To identify possible damages or leakages
How	• Open all the manhole covers at the inlet and outlet of IS and AF modules. • Check if the wastewater has its usual flow (compare with earlier observations). • If no or slow flow is observed, check for obstructions caused by solid materials, floating materials or depositions. Remove obstruction, if any, using steel wire and remove floating material using a long steel sieve. • Place manhole covers back.
Equipment	• Steel wire • Long steel sieve
Precautions	• Operators should follow the safety rules before performing the tasks mentioned in section 2. • Flush the water only after cleaning and opening the outlet of inspection chamber • Clean short pipes using L-brush and normal brush

Source: CDD Society, 2019 & TNUSSP, 2020

Operational Task 2- Ensuring functionality of the vent pipes

Figure 4.9: Ensuring functionality of vent pipes



Source: CDD Society, 2019

Table 4.9: Ensuring functionality of the vent pipe	
Where	Vent pipe in Stabilisation Tank, Settler and Anaerobic Filter
When	Once a month
Why	• To avoid bad odour around the system
How	• Look for damages in the vent pipe • Check for blockages in the vent pipe by either looking through it, tapping it with a stick and judging if it is free from the emanating sound or through other suitable methods. • Remove any blockages. If you notice any damage, contact the service provider for replacement
Equipment	Normal brush tied to the steel wire/rod
Precautions	The vent pipe cowl must be placed back after clearing the blockages
Source: CDD Society, 2019 & TNUSSP, 2020	

Operational Task 3- Check for the sludge level

Figure 4.10: Process for checking sludge level

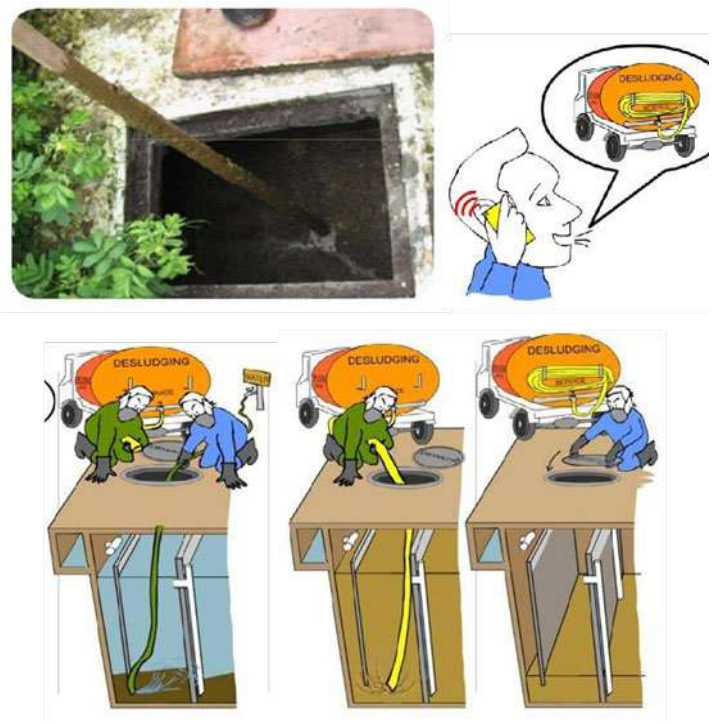
Source: CDD Society, 2019

Table 4.10: Check sludge level	
Where	Chambers of Settler, Anaerobic Filter
When	Once in 6 months
Why	• To provide the required retention time for wastewater • To ensure that sludge deposit is minimal
How	• Open the manhole covers. • Take a clean long stick or a scale. Wrap a white cloth around the stick. • Insert the cloth-wrapped stick vertically and slowly near the inlet and outlet of the chamber till it touches the base of the module. In the AF chamber, insert the stick through the de-sludging pipe and measure the sludge height. • Take the stick out slowly and look at the level of sludge mark on the wrapped cloth. • If the mark of the sludge is higher than 50 cm, carry out de-sludging according to the degree of solidification. • Cover the manhole.
Equipment	• Long stick/scale • White cloth
Precautions	• Operators should follow the safety rules before performing the tasks mentioned in section 2 • Discard the cloth after measuring the sludge
Source: CDD Society, 2019 & TNUSSP, 2020	

4.4.2. Maintenance tasks

Maintenance Task 1 – De-sludging the Settler and Anaerobic Filter

Figure 4.11: De-sludging process of settler and AF



Source: CDD Society, 2019

Table 4.11: De-sludging of anaerobic filter

Where	IS and AF
When	Once in 6 months/ whenever necessary
Why	• To avoid solidification of sludge • To provide required retention time for wastewater flowing through the chamber
How	• Open the manhole cover of the chamber • Measure the sludge level (Refer 4.4.1). • Remove excess (more than 50 cm) sludge from the chambers using the desludging equipment. • Leave around 15 cm of sludge in each chamber to ensure continuous treatment of wastewater. • In AF chamber, remove the excess sludge through the de-sludging pipe • Place the manhole cover back.
Equipment	• De-sludging pump • L-shovel • Straight shovel • Trowel • Personal protective equipment

Table 4.11: De-sludging of anaerobic filter	
	• Hose pipe
Precautions	• Operators should follow the safety rules before performing the tasks mentioned in section 2. • Proper agitation of sludge with the available water will hasten the pumping process. • Pumping should be avoided at the last bit (15 cm from base slab) of the sludge at the bottom as it contains big stones and other solid waste, which will damage the pump. • Access inside the tank is strictly prohibited. Complete de-sludging and aeration should be done if entry is required.
Source: CDD Society, 2019 & TNUSSP, 2020	

Maintenance Task 2- Cleaning filter materials at Anaerobic Filter

Note: It is recommended to replace the filter media, but if one chooses to wash filter media and reuse, the following are the guidelines.

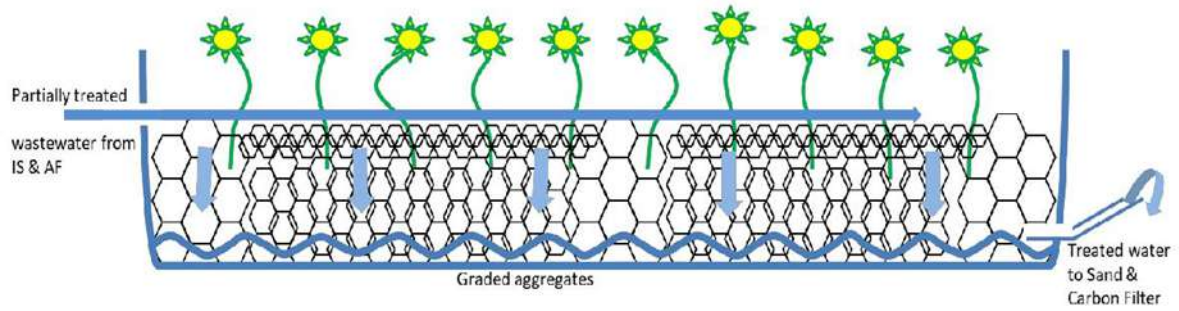
Figure 4.12: De-sludging process of settler and AF

Source: CDD Society, 2019

4.5. Horizontal Planted Gravel Filter (HPGF)

The Horizontal Planted Gravel Filter is a shallow tank filled with graded gravel or pebbles, in which wide-rooted plants are planted. The treatment mechanisms are biological conversion, physical filtration and chemical adsorption. Plants commonly used in HPGF are *Canna indica*, *Typha latifolia*, *Phragmites Karka* and *Cyperus papyrus*. The plant selection is mainly based on their ability to grow on wastewater and have their roots go deep and spread wide. Plants transport oxygen via their roots into the ground.

Figure 4.13: Horizontal Planted Gravel Filter



Source: CDD Society, 2019

4.5.1. Operation tasks

Operation Task 1- Check for swivel pipe

Table 4.12: Checking swivel pipe level in HPGF

Where	Horizontal Planted Gravel Filter Outlet
When	• Once a month or in the following cases: • Flooding in the PGF • Dampness in the filter material • No plant growth • Excess mosquito breeding.
Why	To maintain the desired level of water within the treatment module
How	• Open the manhole cover of the outlet chamber. • Check if the swivel pipe top is at 50 cm from the bottom of the outlet chamber base or 10 cm below the filter media near the outlet. • If the swivel pipe top is not at the desired level, lower or raise it reaches 50 cm from the bottom of the outlet chamber base. • If there is no water flow from the top of the swivel pipe, check for leakage at the swivel pipe joint at the bottom.
Equipment	• Measuring tape • Gloves
Precautions	Operators should follow the safety rules before performing the tasks mentioned in section 2

Source: CDD Society, 2019 & TNUSSP, 2020

4.5.2. Maintenance tasks

Figure 4.14: Trimming of plants in HPGF

Source: CDD Society, 2019

Table 4.13: Weed removal and trimming of plants	
Where	Horizontal Planted Gravel Filter Outlet
When	Once a month or when there is excess growth of plants
Why	• To avoid rotting of dead leaf litter in the HPGF bed. • To avoid clogging of filter material in the HPGF. • To avoid blocking sunlight. • To maintain cleanliness and increase aesthetic value near the treatment module.
How	• Check for presence of dead leaf litter and/or weed inside the HPGF. • Remove it manually or using an appropriate tool. • Trim the plants in the HPGF if they have grown excessively and are blocking the sunlight.
Equipment	• Garden scissors • Gum boots • Sickle
Precautions	• Ensure there are no rodents/snakes/spiders/ants present in the HPGF. • Operators should follow the safety rules before performing the tasks mentioned in section 2
Source: CDD Society, 2019 & TNUSSP, 2020	

4.6. Post Treatment Systems: Polishing Pond

4.6.1. Maintenance Tasks

Maintenance Task 1- Cleaning the polishing pond

Table 4.14: Cleaning the Polishing Pond	
Where	Polishing pond
When	Once a month
Why	• To ensure that collected water stays useable • To avoid odour • To remove the sludge collected at the base
How	• Remove all the weeding and litter manually using the knife, trowel, shovel, and bucket. • Use the pump for de-sludging the sludge at the base and dispose it of in the stabilisation reactor. • Empty the treated water from the polishing pond. • Use a brush to clean the interior walls and floor of the pond.
Equipment	• Long metal shovel • Bucket • Wheelbarrow • Trowel • Shovel • De-sludging pump
Precautions	• Operators should follow the safety rules before performing the tasks mentioned in section 2
Source: CDD Society, 2019 & TNUSSP, 2020	

4.7. General Tasks

4.7.1. Operational tasks

Operation Task 1 – Pump operations

Table 4.15: Pump operations	
Where	Collection tank and Stabilisation reactor
When	Daily/whenever required
Why	• To ensure uninterrupted functioning of the treatment system, solar panels, and the pump • To avoid clogging, smell and backflow problems
How	• Operate the pumps as instructed by the vendor or service provider • Clean and maintain the solar panel as instructed by the service provider
Precautions	• Operators should follow the safety rules before performing the tasks mentioned in section 2 • Follow guidelines provided by vendor
Source: CDD Society, 2019 & TNUSSP, 2020	

4.7.2. Maintenance task

Maintenance task 1 – Checking and replacement of broken pipes

Table 4.16: Checking for pipe damage	
Where	All units
When	Once a month
Why	• To avoid leakages, clogging and odour • To ensure uninterrupted functioning of the treatment system
How	• Check for any damaged/broken pipes. This can be visually identified by leakages or smell. • If there are broken pipes, notify the supervisor or whoever is in charge. • Replace the damaged pipe with a new pipe of same diameter and specifications. • Follow the drawings in fixing important pipes.
Precautions	• Operators should follow the safety rules before performing the tasks mentioned in section 2 • Follow guidelines provided by vendor
Source: CDD Society, 2019 & TNUSSP, 2020	

Maintenance Task 2- Checking and fixing damaged structure

Table 4.17: Assessing structural damage	
Where	All units
When	Once a month
Why	• To ensure uninterrupted functioning of the treatment system
How	• Check for any damaged structure. This can be visually identified by leakages or smell. • If there is damage, notify the supervisor or whoever is in charge. • Redo the damaged portion as per the drawings and specifications
Precautions	• Operators should follow the safety rules before performing the tasks mentioned in section 2 • Follow guidelines provided by vendor
Source: CDD Society, 2019 & TNUSSP, 2020	

5 Safety Requirements

5. Safety Requirements

This section lists the safety requirements and precautions to be taken within the FSTP premises. All the O&M tasks in the FSTP must be performed in a safe and efficient manner with utmost regard for the health and safety of the employees and the public. Safety is an integral part of everyone's duties and responsibilities.

5.1. Personal Safety

1. The plant operator and all labourers should take precautions because many coliform groups, various kinds of pathogen, and egg parasites exist in fecal sludge. The plant operator and all the labourers should strive to maintain good health by doing the following:
    a. Wearing clean uniform, work boots, face mask and gloves.
    b. Washing hands and disinfecting them after work and before having a meal.
    c. Taking a shower if possible after work.
    d. Not entering the offices wearing dirty clothes.
    e. Taking vaccinations against tetanus, leptospirosis fever and deworming medicines as per prescription.
2. Consuming liquor and smoking during working hours, and within the premises are strictly prohibited.
3. Wearing sandals or open toe shoes on premises is discouraged, especially when handling tools or entering the treatment module.
4. Workers must wear rubber boots or leather shoes in areas of possible contact with biological organisms found in fecal sludge.
5. Confined spaces including treatment modules, manholes or any space below the ground level or has inadequate ventilation, may contain harmful gases. Clean the sludge off in such confined spaces and keep the cover slab open for a minimum of one hour to ensure aeration.
6. Workers must not enter a confined space without proper equipment or rescue personnel standing by under any circumstances.
7. Rubber gloves must be long enough to reach well above the wrist, leaving no gap between the glove and coat or shirtsleeve.
8. Safety shoes must be worn when handling tools and equipment.
9. Wearing a gas mask while entering any of the treatment modules) is a must.

5.2. Site precautions

1. Materials and supplies such as pipes should be stored in a neat and orderly manner at the site to prevent them from falling off shelves.
2. Junk parts removed from the treatment module should be disposed of safely.
3. Spare parts used in the operation of the FSTP should be kept in a neat and orderly manner with the item labelled.
4. "No smoking" signs must be strictly adhered to.
5. It is ideal to consider the size and weight of any object before attempting to lift or move it. Do not lift any materials that cannot be handled comfortably; for example dried sludge loads from the sludge drying beds. If necessary, take assistance or wait until assistance is available.
6. When carrying objects near treatment modules, take extra care to avoid falling in the tanks or dropping objects into the tanks.
7. Employees should use task-appropriate tools and only those in good condition.
8. Indoor areas shall have adequate lighting.
9. Fire extinguisher should always be available at the site.

5.3. Medical emergency/ First Aid

In case of a sudden medical emergency, the absence of immediate medical attention could put the patient's health in serious jeopardy or cause debilitating injuries. The following steps must followed while administering first aid

1. Keep the victim lying down.
2. Examine the victim; look for serious bleeding, lack of breathing and poisoning.
3. Keep the victim warm.
4. Send someone to call a physician or ambulance.
5. Remain calm. Do not move the victim unless necessary.
6. Never give an unconscious victim anything to eat or drink.
7. Keep crowd away from the victim.
8. Ensure the victim is comfortable.
9. Do not allow the victim to see his injury.
10. Give artificial respiration if required.

First Aid: The First Aid Toolbox should contain the following items. Unnecessary and out of date items should not be placed in the first aid box.

First Aid Box

1. Triangular bandage
2. Elastic bandage/ wraps
3. Splint
4. Ointment for sprains
5. Eye pads
6. Baking soda
7. Iodine solution bottle
8. Cold pack
9. Packets of sterilised cotton wool
10. Tweezers
11. Scissors
12. ORS sachets
13. Antiseptic and antibiotic treatment application
14. CPR mask
15. Sterilised dressing (gauze pads)
16. Semi-rigid cervical collar
17. Waterproof adhesive tape (various sizes)
18. Hand sanitiser
19. Waterproof plasters
20. Latex gloves
21. Box adhesive bandages (band-aids) (waterproof)
22. Three-layered masks

Emergency Response Procedures

6. Emergency response procedures

Improperly treated fecal sludge carries infection-causing bacteria, viruses, parasites, and toxic chemicals. Human contact with raw or improperly treated sewage can lead to serious health problems. If the FSTP works as designed, then there is a reduced risk to public health or environment. However, during emergencies, there can be increased risks. The purpose of this section is to minimise the potentially damaging effects of spills, valve failure, and leakages in the system. This section details the types and level of emergencies, and the specific responses for each. These are usually out of the ordinary events and not part of the day-to-day operations of the FSTP.

Emergencies that can occur at the FSTP:

- Spillage from the de-sludging truck
- Valve breakdown
- Overflow from any treatment module

6.1. Spillage from Truck

Table 6.1: Spillage from truck	
What may be the cause?	Failure of outlet valve or wrong operation of outlet valve of de-sludging vehicle
How could this happen?	• Damage of the de-sludging vehicle's outlet valve during feeding. • De-sludging vehicle outlet valve stuck in open position during feeding. • Spillage from the hose pipe used for feeding fecal sludge.
Emergency response	• Close the outlet valve. • If the above step does not work, connect the hose pipe of the de-sludging vehicle to the inlet pipe of the SC so that the sludge is bypassed • In case of spillage, clean it using a vacuum pump and cover the area with lime. If this is not possible, wash the spill area direct the water to a covered drain. Finally, spray chlorine on the washed surface.
Source: CDD Society, 2019 & TNUSSP, 2020	

6.2. Valve breakdown

Table 6.2: Valve breakdown	
What may be the cause?	Failure or wrong operation of outlet valve of de-sludging
How could this happen?	• Failure of valve may happen due to solid waste/debris stuck at the valve's opening due to wrong operation. • Damage to the valve may happen if the operator forcefully turns the valves in the wrong direction.

Table 6.2: Valve breakdown	
Emergency response	• If sludge has spilled near the valve, perform the following steps: • Pour soil over the sludge. Leave it for at least two hours. • Collect all the soil mixed with sludge in a plastic bowl using a shovel. • Dispose this sludge in the SDB. • Report the problem to the TMC. • Repair or replace the valve, if necessary.
Source: CDD Society, 2019 & TNUSSP, 2020	

6.3. Overflow from any treatment module

Table 6.3: Overflow from any treatment module	
What may be the cause?	The module outlet or the inlet of the next downstream module is clogged.
How could this happen?	Excessive accumulated scum or sludge and debris blocking the pipes or modules. Crushed or frozen modules or damage in the pipes connecting the various modules or excessive inflow of water into the module due to flooding may also cause overflow.
Emergency response	• Stop the flow into the module immediately. • Clear the blockage in the pipes using the iron bar and pumped water. Insert the iron bar in the outlet pipe of the module and force the pumped water. • Check if any debris is stuck in between the outlet of the module and the inlet of the downstream module. Push the debris to the next module using the iron bar and collect the debris from the inlet of the downstream module. If debris cannot be moved, report it to the TMC immediately. • Check for damage/crushing of pipe. If found, report it to the TMC immediately.
Source: CDD Society, 2019 & TNUSSP, 2020	

6.4. Flooding of SDB

Table 6.4: Flooding of SDB	
What may be the cause?	Due to heavy rain in the treatment plant area
How could this happen?	As SDBs are in the point of lowest elevation they are prone to flooding during rainy season. Rainwater from roof could also flood the SDBs.
Emergency response	• Close the inlet end caps if they are not closed. • Call the ULB de-sludging vehicle to the plant. • Locate the beds filled with water. • Start de-sludging these beds. Help the de-sludging vehicle operator in desludging. • De-sludge only the water over the sludge; try not to suck the sludge.

Table 6.4: Flooding of SDB	
	• Dispose of the wastewater in a nearby farm after approval from the landowner/ farmer. • Clean the surroundings of the SDB by removing all the dry sludge chunks. Use a plastic bowl to collect sludge and dispose it of into the SDB. • Water the affected area. • Report to TMC if the problem persists.
Source: CDD Society, 2019 & TNUSSP, 2020	

6.5. High sludge level in IS & AF chambers

Table 6.5: High sludge level in IS & AF chambers	
What may be the cause?	Due to solids moving in large volume from SDB modules.
How could this happen?	Overloading of SDB or gaps in filter media of SDB enabling more solids to travel along with percolate.
Emergency response	• Perform 6.4 of maintenance task section • Check for gaps in filter media of SDB
Source: CDD Society, 2019 & TNUSSP, 2020	

6.6. Solids moving into HPGF from IS & AF

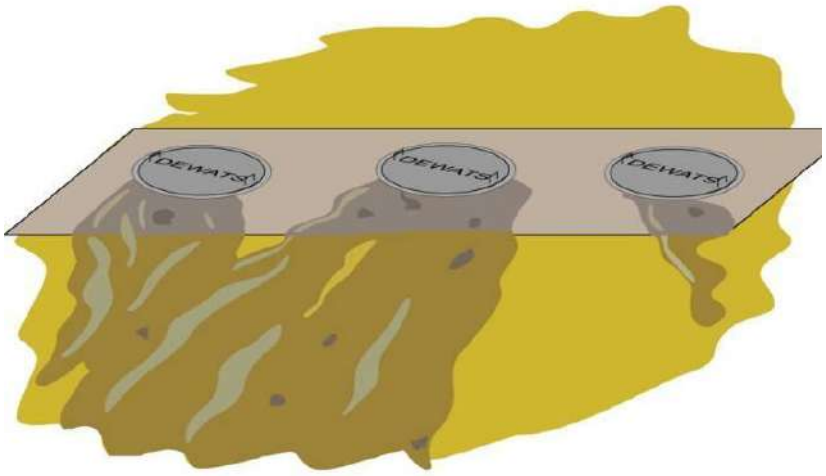
Table 6.6: Solids moving into HPGF from IS & AF	
What may be the cause?	High level of solids in IS chambers or high rate of flow in IS.
How could this happen?	• Due to high inflow rate into IS from SDB solids in the IS chambers may move with the water into the HPGF. • Not de-sludging the IS+AF chambers on time as per maintenance plan
Emergency response	Perform the 4.3.4 of maintenance task.
Source: CDD Society, 2019 & TNUSSP, 2020	

6.7. Emergencies by symptoms of the system

These emergencies are usually the result of inappropriate operation, such as excessive inflow to the system, improper de-sludging, but can also be symptoms of external influences such as earthquakes, tsunami, or heavy rain.

6.7.1. Overflow of wastewater from system

Figure 6.1: Wastewater overflow



Source: CDD Society, 2019

Table 6.7: Overflow of wastewater from system	
What may be the cause?	The outlet of the module is clogged or intrusion of water into the module
How could this happen?	Due to garbage being flushed, excessive accumulated scum or sludge and debris blocking the pipes or modules. Crushed or frozen modules/pipes or excessive inflow of water into the module due to flooding may also be responsible.
Emergency response	Take up maintenance in the module concerned immediately to ensure free wastewater flow. Additionally, check the sludge level in all the systems. De-sludge, If required.
Source: CDD Society, 2019 & TNUSSP, 2020	

6.7.2. No or little wastewater inflow to a module

Table 6.8: No or little wastewater inflow to a module	
What may be the cause?	The module inlet or the previous upstream module is clogged.
How could this happen?	Due to garbage being entering the system, excessive accumulated scum or sludge and debris blocking the pipes or modules. Crushed or frozen modules/pipes may also be responsible.
Emergency response	Check if wastewater is produced at the sources. Check the inlet pipe for obstructions.
Source: CDD Society, 2019 & TNUSSP, 2020	

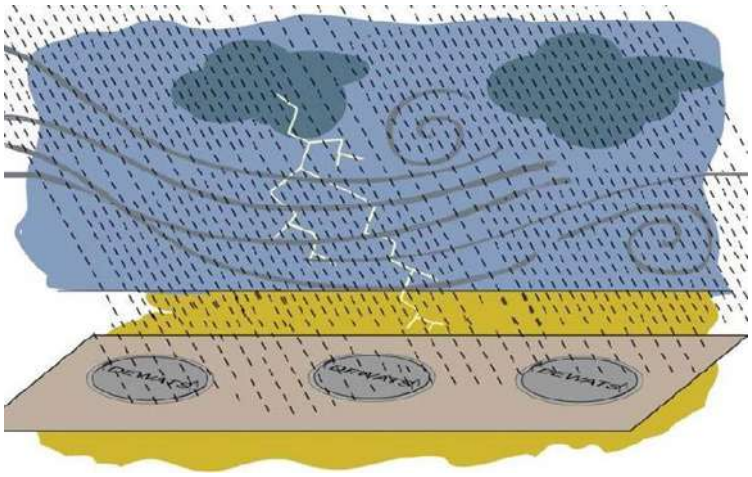
6.7.3. Bad odour emanating from one or more modules

Table 6.9: Bad odour emanating from one or more modules	
What may be the cause?	The vent pipe may be damaged or blocked, releasing biogas and odour. Accumulated scum or garbage may also release a bad smell.
How could this happen?	Due to garbage entering the system or excessive accumulated scum. External influences such as birds, insects or other objects may obstruct the vent pipes.
Emergency response	Perform the task “Ensuring functionality of the vent pipes” at all the modules. Check with the end user if harmful chemicals have been released into the system
Source: CDD Society, 2019 & TNUSSP, 2020	

6.8. Externalities and force majeure

Table 6.10: Externalities and force majeure	
What may be the cause?	Storms and other external influences can damage the pipes and the system itself or clog parts of the system with debris.
How could this happen?	Due to debris carried by stormwater on the FSTP premises. Uncovered treatment modules allow some debris into the module.
Emergency response	Clear debris by performing the following tasks: • Check for litter and dead leaves, weeding in the surroundings. • Ensure the manhole covers are intact and cover the manholes. • Check the sewer system and the physical/ visual appearance of systems for any structural damage and rectify accordingly. If the system cannot be put into an operational mode, contact the service provider.
Source: CDD Society, 2019 & TNUSSP, 2020	

Figure 6.2: Natural emergencies



Source: CDD Society, 2019

7

O&M Checklist

7. O&M Checklist

Name of the Facility: Name of the Operator: Signature: Date: Time:

Table 7.1: Periodical O&M Checklist					
Sl. No	**Tasks**	**Frequency**	**Primary Responsibility**	**Yes/no**	**Observations (if any)**
1	**SCREEN CHAMBER**				
	Cleaning of screens/ removal of solids accumulated in the screens	Daily/When blockage found	Helper		
	Grit removal	Daily/When blockage found	Helper		
	Clean spillage, if any, after every de-sludging truck leaves the facility	Daily/After every de-sludging activity	Helper		
2	**STABILISATION REACTOR**				
	Pumping of sludge from SR to SDB	Daily – Before the start of operations	Operator		
	Check level of sludge and supernatant in all the chamber of the stabilisation reactor	Daily	Operator		
	Cleaning flexible de-sludging pipe	Weekly once/When blockage found	Helper		
3	**SLUDGE DRYING BED**				
	Removal of dried sludge (only when sludge bed is dry and underlying sand is visible)	Once in 2 weeks	Operator		
4	**INTEGRATED SETTLER & ANAEROBIC FILTER**				

Table 7.1: Periodical O&M Checklist					
Sl. No	**Tasks**	**Frequency**	**Primary Responsibility**	**Yes/no**	**Observations (if any)**
	Ensure/observe free flow of water at the outlet	Once in 2 weeks	Operator		
	Cleaning inlet distribution channel	Monthly once	Helper		
	Observing free flow of water at the outlet	Once in 2 weeks			
	Cleaning vent pipes	Once in 3 months			
	Check sludge level in the settler	Once a month (if more than 1 m, then de-sludge)			
	Check sludge level in the anaerobic filter	Once in 6 months (if more than 0.3 m, then de-sludge)			
5	**HORIZONTAL PLANTED GRAVEL FILTER**				
	Weed removal	Daily	Helper		
	Cleaning inlet distribution channel	Monthly once	Helper		
	Checking swivel pipe level: • The water level is above the upper surface of the filter material (coarse aggregates) • Dampness on the surface of the filter material • No plant growth • Mosquito breeding	Monthly once	Operator		
6	**SLUDGE STORAGE SHED**				
	Emptying dried sludge	As and when required	Helper		

Table 7.1: Periodical O&M Checklist					
Sl. No	**Tasks**	**Frequency**	**Primary Responsibility**	**Yes/no**	**Observations (if any)**
7	**SEWER SYSTEMS**				
	Cleaning registers & check for flow	Monthly once			
8	**GENERAL MAINTENANCE/ HOUSEKEEPING**				
	Ensuring manhole covers are not damaged and covering the manholes properly	Daily	Helper		
	Cleaning up litter and dead leaves in the surroundings	Daily	Helper		
	Disposal of unused hoses, extension cords and ropes	Monthly once	Helper		
	Cleaning accumulated scum/garbage	Monthly once	Helper		
	Gardening/watering plants	Daily	Helper/ Gardener		
	Landscaping/sweeping-cleaning facility	Daily	Helper/ Housekeeping		
	Checking sludge level in all systems	Daily			
	Ensuring all lights are in working condition at the site	Daily			Report problem here:
3-6 MONTHLY O&M CHECKLIST					
1	**STABILISATION REACTOR**				
	Scum removal	Once in 3 months	Helper		
	Pumping sludge from the first two chambers	Once in 6 months	Helper		
	Cleaning ‘T’ pipes	Once in 6 months	Helper		

Table 7.1: Periodical O&M Checklist					
Sl. No	**Tasks**	**Frequency**	**Primary Responsibility**	**Yes/no**	**Observations (if any)**
2	**SLUDGE DRYING BED**				
	Periodical re-filling of sand	Once in 6 months/ as and when required	Operator		
	Cleaning perforated drainage pipes	Once in 6 months	Helper		
3	**COLLECTION TANK**				
	Emptying and cleaning of collection tank	Once in 6 months/ as and when required	Helper		
4	**INTEGRATED SETTLER AND ANAEROBIC FILTER**				
	Removal of scum	Once in 3 months	Helper		
	De-sludging the settler and anaerobic filter	Once in 6 months/ as and when required	Helper		
	Cleaning inlet and outlet pipes	Once in 6 months	Helper		
5	**HORIZONTAL PLANTED GRAVEL FILTER**				
	Trimming plants	Once in 3 months/when overgrowth observed	Helper		
	Cleaning perforated drainage pipes	Once in 6 months	Helper		
6	**POLISHING POND**				
	Removal of weeds and excess algae	Once in 3 months	Helper/ Gardener		
	De-sludging	Once in 6 months	Helper		

Table 7.1: Periodical O&M Checklist					
Sl. No	**Tasks**	**Frequency**	**Primary Responsibility**	**Yes/no**	**Observations (if any)**
7	**PUMP AND LEVEL CONTROLLER MAINTENANCE**	Once in a month/as and when required			
	SEWER SYSTEM				
	Cleaning pipes between registers	Once in 6 months	Helper		
YEARLY O&M CHECKLIST					
1	**SCREEN CHAMBER**				
	Maintenance of screens- repaint/replacement of screens	Yearly Once	Operator		
2	**SLUDGE DRYING BED**				
	Washing and replacing filter material	Once in 3 years/ when clogging is observed/drying is slower than 20 days	Operator		
3	**INTEGRATED SETTLER AND ANAEROBIC FILTER**				
	Cleaning/replacing filter media in anaerobic filter	Once in 3 years	Operator		
4	**HORIZONTAL PLANTED GRAVEL FILTER**				
	Cleaning/replacing filter media	Once in 6 years	Operator		
Source: TNUSSP, 2020					

8 Commissioning of FSTP

8. Commissioning of FSTP

The transitional period between a plant's operations and the end of the construction process is known as commissioning. (CII, 2022) The overall objective of the commissioning of the treatment project is to ensure that the components of the treatment plant are complete, operational, and meet the design requirements.

The objectives of commissioning will be achieved through the following tasks:

- Completion of construction confirming that all civil structures, electromechanical components and any other items related to the treatment plant have been checked for correctness and completeness.
- Pre-commissioning to confirm each module and its accessories (if any) is fit.
- Process commissioning by starting up the treatment plant with feed sludge.
- Carryout performance testing of the plant to achieve completion of commissioning.

Overall commissioning will be complete when,

- The functionality of the treatment plant is as per the project design brief.
- The treatment plant demonstrates the capability to meet the performance standards prescribed in the project design brief.
- All the project related documents and O&M guidelines are handed over to the client with required training.

Commissioning of the treatment plant is carried out in different stages as mentioned below:

- Pre-Commissioning of individual components (dry and wet commissioning);
- Process commissioning and performance tests; and
- Commissioning completion and handover

8.1. Pre-Commissioning

The pre-commissioning checks mainly include on-site inspections and tests. *Refer to Annexure 1 for the checklist and reporting*. During this stage, each module of the treatment plant will be systematically inspected for its installation. This mainly includes:

- Checking for correctness and completeness of construction, including a) the finished size and level of each module, b) all the components within the treatment modules and its specification – Annexure 1.
- Hydraulic testing of civil structures and pipes (leakage, flow) – Annexure 2.
- Electrical and mechanical equipment and control equipment, if any, and testing its optimum performance – Annexure 3.

8.2. Process Commissioning

Process Commissioning is the process of introducing sludge/sewage into the treatment plant, establishing the biological treatment, and testing the operation of the overall process.
Process Commissioning includes the following:

- Establishment and stabilisation of the treatment process, which includes sludge stabilisation and dewatering, and drying and percolation treatment;
- The operation of electrical, mechanical and control systems under anticipated operating conditions;
- Operation of all auxiliary/standby equipment;

- Final adjustment of valves, equipment, and control settings;
- Performance testing to establish that the operation of the plant conforms to the specified requirements and the design intent; and
- Final training of operators and demonstration of maintenance activities.

Process Performance Test shall be conducted at the end of process commissioning (45 to 60 days) to demonstrate that the plant meets the output specification in the project design brief. A Process Performance Test Report shall be prepared on the completion of the test, outlining the results of all the testing.

8.3. Commissioning Completion and Handover

Final commissioning completion and handover will occur after the successful completion of the Process Performance Test and all commissioning completion criteria as mentioned in the above sections.

The handover of the treatment plant includes the following documentation and deliverables:

- Document introducing the plant and a process overview
- Construction drawings (preferably as built drawings)
- Operations and maintenance manuals
- Operator training on O&M
- Asset registration sheets
- Reports related to design and construction phases of the project.
- Vendor manual (Equipment O&M manuals) and contacts
- Final commissioning report

8.4. Pre-Commissioning Report

Commissioning check of the treatment plant is one of the key activities that need to be carried out before the plant starts operation. It is the process of ensuring that all components of a treatment plant are constructed/installed and tested according to the operational requirements. The checklist below provides the overall observations of the pre-commissioning checks as well as the understanding of correctness and completeness of each of modules. Refer to Annexure 1 for a detailed checklist for pre-commissioning checks.

Table 8.1: General Pre-commissioning Checklist- Screen Chamber

Sl. No	Parameters/ Description	Pass Yes/ No	Comments/ Correction note	Assigned Person	Date
1	Confirm that the civil structural & screens dimension are as per design				
2	Confirm that quality of finishing is adequate				
3	Confirm that leakage test has been carried out				

Table 8.1: General Pre-commissioning Checklist- Screen Chamber					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
4	Confirm that the Screen is as per design & placed in position & operational conditions				
5	Confirm if plumbing arrangement is in place				
6	Confirm if levels are as per drawing				
7	Confirm if painting work is done				
8	Confirm truck access & ease of disposal into tank				
9	Confirm if manhole cover is placed as per drawing				
Source: TNUSSP, 2020					

Table 8.2: General Pre-commissioning Checklist – Stabilisation Reactor					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
1	Confirm that the civil structural- internal dimension are as per design				
2	Confirm that quality of finishing is adequate				
3	Confirm that leakage test has been carried out				
4	Confirm that sludge is flowing equally in both chambers				
5	Confirm if plumbing arrangement is in place				
6	Confirm if levels are as per drawing				
7	Confirm if painting work is done				

Table 8.2: General Pre-commissioning Checklist – Stabilisation Reactor					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
8	Confirm the sludge flow from the pump				
9	Confirm that vent pipe arrangement is provided				
10	Confirm there is no blockage in the pipe				
11	Confirm that flow rate is as per design				
12	Confirm that hose pipe is available				
13	Confirm manhole cover is placed as per drawing				
Source: TNUSSP, 2020					

Table 8.3: General Pre-commissioning Checklist - Sludge Drying Bed					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
1	Confirm that the civil structural- internal dimension are as per design				
2	Confirm that quality of finishing is adequate				
3	Confirm that leakage test has been carried out				
4	Confirm that vent pipe arrangement is provided				
5	Confirm that there is no blockage in the perforated pipe				
6	Confirm that sludge is spread evenly throughout the bed				
7	Confirm that plumbing arrangement is in place				
8	Calculate the volume of percolated water from the bed				
9	Confirm that sludge height is as per design				
10	Confirm if painting work is done				
Source: TNUSSP, 2020					

Table 8.4: General Pre-commissioning Checklist - Collection Tank 1					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
1	Confirm that the civil structural- internal dimension are as per design				
2	Confirm that quality of finishing is adequate				
3	Confirm that leakage test has been carried out				
4	Confirm that all the percolate is reaching the tank				
5	Confirm that plumbing arrangement is in place				
6	Confirm that pump and valve arrangement are in place				

Table 8.4: General Pre-commissioning Checklist - Collection Tank 1					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
7	Confirm that overflow pipe arrangement is provided				
8	Confirm if painting work is done				
9	Confirm that manhole cover has been placed as per drawing				
Source: TNUSSP, 2020					

Table 8.5: General Pre-commissioning Checklist - ISAF					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
1	Confirm that the civil structural- internal dimension are as per design				
2	Confirm that quality of finishing is adequate				
3	Confirm that leakage test has been carried out				
4	Confirm that plumbing arrangement is in place				
5	Confirm that vent pipe arrangement is provided				
6	Confirm that there is no blockage in the pipe				
7	Confirm that flow rate is as per design				
8	Confirm if painting work is done				
9	Confirm manhole cover has been placed as per drawing				
10	Confirm the orientation of inlet outlet t-pipe as per the construction drawing				
11	Confirm if the cinder is washed & placed				
Source: TNUSSP, 2020					

Table 8.6: General Pre-commissioning Checklist - HPGF					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
1	Confirm that the civil structural- internal dimension are as per design				
2	Confirm that quality of finishing is adequate				
3	Confirm that leakage test has been carried out				
4	Confirm that plumbing arrangement is in place				
5	Confirm distribution of water is equal in the bed				
6	Confirm sampling pipe is provided				
7	Confirm swivel pipe is fixed properly				
8	Confirm if painting work is done				
9	Confirm if the plantation is carried out				
10	Confirm manhole cover has been placed as per drawing				
Source: TNUSSP, 2020					

Table 8.7: General Pre-commissioning Checklist - Polishing Pond & Collection Tank 2					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
I	Polishing Pond				
1	Confirm that the civil structural- internal dimension are as per design				
2	Confirm that quality of finishing is adequate				
3	Confirm that leakage test has been carried out				
4	Calculate the total volume of treated water				
5	Confirm that plumbing arrangement is in place				

Table 8.7: General Pre-commissioning Checklist - Polishing Pond & Collection Tank 2					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
II	Collection Tank 2				
1	Confirm that the civil structural- internal dimension are as per design				
2	Confirm that quality of finishing is adequate				
3	Confirm that leakage test has been carried out				
4	Calculate the total volume of treated water				
5	Confirm that plumbing arrangement is in place				
6	Confirm if painting work is done				
7	Confirm if manhole cover is placed as per drawing				
Source: TNUSSP, 2020					

Table 8.8: General Pre-commissioning Checklist - Additional facilities 1					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
I	Sludge Storage House				
1	Confirm that the civil structural- internal dimension are as per design				
2	Confirm that quality of finishing is adequate				
3	Confirm truck access & ease of disposal of dry sludge				
4	Confirm if painting work is done				
II	Operator Room				
1	Confirm that the civil structural- internal dimension are as per design				

Table 8.8: General Pre-commissioning Checklist - Additional facilities 1					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
2	Confirm that quality of finishing is adequate				
3	Confirm if all the electrical fittings are working				
4	Confirm that toilet facilities are provided				
5	Confirm if painting work is done				
III	Store Room				
1	Confirm that the civil structural- internal dimension are as per design				
2	Confirm that quality of finishing is adequate				
3	Confirm if all the electrical fittings are working				
4	Confirm if painting work is done				
Source: TNUSSP, 2020					

Table 8.9: General Pre-commissioning Checklist - Additional facilities 2					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
1	Confirm if an O&M manual is available				
2	Confirm if all construction debris is removed				
3	Confirm training of Operator on O&M				
4	Confirm if the boundary wall/ gate work is completed				
5	Confirm if water supply provision is made or available				
6	Confirm if first aid box is available				
7	Confirm if treatment plant details are available on the board				

Table 8.9: General Pre-commissioning Checklist - Additional facilities 2					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
8	Confirm if emergency contact details are provided for public information				
9	Confirm if fire safety installation is provided				
10	Confirm electricity connection at site				
11	Confirm working of solar power system				
12	Confirm if control panel board is working				
13	Confirm if all the streetlights are working				
14	Confirm installation of DG				
15	Confirm inter-module plumbing work				
16	Confirm the availability of required PPE and O&M tools				
17	Confirm potable water supply at site				
18	Confirm if landscape work is completed				
Source: TNUSSP, 2020					

Bibliography

1. CII. (2022). Construction Industry Institute. Retrieved from https://www.construction-institute.org/resources/knowledgebase/knowledge-areas/commissioning-startup-handover

Annexures

Annexure 1: Detailed Pre-commissioning Checklists

Table A1.1: Detailed Pre-Commissioning Checklist – Screen Chamber					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
1	Is the inlet pipe fixed on the side wall?				
2	Are the inlet and outlet pipe levels provided as per design?				
3	Are vitreous tiles laid on the inner sides and floor?				
4	Are sufficient openings provided in the coarse and the fine screen?				
5	Is size of coarse and fine screens as per design?				
6	Is screen fabricated with stainless steel material?				
7	Are the coarse and fine screens placed in 60 degree inclination with the base slab, at bottom of the screen towards inlet side and parallel to each other?				
8	Are handles provided for easier removal of the bar screens during O&M?				
9	Is the bottom bar at the screen removed? (to prevent clogging of solid particles at the screen)				
10	Is the slope in the base slab provided as per the design?				
11	Is the module constructed at least 300 mm above ground level?				
12	Is a freeboard of minimum 300 mm provided to all water retaining structures?				
13	Are frames provided for manholes?				
14	Is the module watertight? If no, mention the defects with inferences				

Table A1.1: Detailed Pre-Commissioning Checklist – Screen Chamber					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
	Dimension:				
15	Finished width of the tank				
16	Finished length of the tank				
17	Length between the inlet side wall and coarse screen				
18	Length between the coarse screen and fine screen				
19	Length between the fine screen and outlet sidewall				
20	Depth of the chamber				
	Levels:				
	Benchmark-+100.000m				
1	Inlet level (side)				
2	Base slab level near the inlet				
3	Base slab level near the outlet				
4	Outlet of screen chamber				
5	Bottom level of top slab				
6	Top level of the top slab				
7	Top level of the base slab				
8	Distance b/w SC and SR in metre				
Source: TNUSSP, 2020					

Table A1.2: Detailed Pre-commissioning Checklist - Stabilisation Reactor					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
1	Are 4" pipes used for all pipelines in the Stabilisation Reactor?				
2	Are the inlet and outlet pipe levels provided as per design?				
3	Is the inlet distribution/baffle wall provided in the second chamber as per the design?				

Table A1.2: Detailed Pre-commissioning Checklist - Stabilisation Reactor					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
4	Is an angular cut (45 degree) provided at the bottom of all the vertical inlet pipes?				
5	Is sufficient slope provided at each chamber of the SR as per drawing?				
6	Is proper bedding slope and sump provided at the base of the collection well of the SR (pump sump)?				
7	Are 'T' pipes provided at all the inlets & outlets?				
8	Is the pump provided in the collection well as per specification? Mention capacity of pump				
9	Is the module constructed at least 300 mm above ground level?				
10	Is a freeboard of minimum 300 mm provided to all water retaining structures?				
11	Are frames provided for manholes?				
12	Is the module water tight? If no, mention the defects with inferences				
13	Is a flexible hose connected from the SR outlet to the sludge drying bed?				
14	Is plastering slope provided on the top of the cover slab for rain water run-off				
	Dimension:				
1	Finished width of the tank – First chamber				
2	Finished length of the tank – First chamber				
3	Finished width of the tank – Second chamber				
4	Finished length of the tank – Second chamber				

Table A1.2: Detailed Pre-commissioning Checklist - Stabilisation Reactor					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
5	Dimension of the opening below the partition wall and base slab in the second chamber				
6	Finished width of the tank – Third chamber				
7	Finished length of the tank – Third chamber				
8	Size of the sump at the base of the third chamber				
	Levels:				
1	Inlet of SR				
2	Outlet of CH1				
3	Outlet of CH2				
4	Outlet of CH3 (supernatant O/L)				
5	Base slab concrete level of SR				
6	Difference in levels b/w CH1 I/L and CH1 O/L				
7	Difference in levels b/w CH2 I/L and CH2 O/L				
8	2" dia pipe pump outlet level				
9	Projection above the top slab level				
10	Top level of top slab (including 50-mm plastering at the top for draining of rainwater)				
11	Freeboard at CH1				
12	Freeboard at CH2				
13	Freeboard at CH3				
14	Distance b/w SR and SDB in metre				
Source: TNUSSP, 2020					

Table A1.3: Detailed Pre-Commissioning Checklist - Sludge Drying Beds					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
1	Is sufficient slope provided at the base of the drying bed?				
2	Is a vent/maintenance pipe with a cowl provided at one end of the perforated drainage pipes?				
3	Are manholes provided in the registers for easy access?				
4	Is sufficient level drop provided from Register to Register?				
5	Is sufficient slope provided for the perforated drainage pipe?				
6	Are the filter materials placed in order as per the drawings?				
	a) 40 mm gravel-200 mm thick				
	b) 16-20 mm gravel-150 mm thick				
	c) 6-8 mm gravel-100 mm thick				
	d) 1-2 mm sand-50 mm thick				
7	Is the Porotherm brick/grass paver/terracota jali-100 mm thick, filled with sieved sand 1-2mm placed in all the beds?				
8	Is a splash plate (cuddapah stone slab) laid at the inlet point of the beds?				
9	Are steps provided to access the drying beds if found necessary?				
10	Is the pedestrian platform finished floor level as per specification?				
11	Are the structural steel members of roof structure fabricated as per the drawings?				
12	Is polycarbonate sheet used for roofing alternatively?				
13	Are corrugated sheets provided for roofing?				
14	Are wind stays provided over the roof?				

Table A1.3: Detailed Pre-Commissioning Checklist - Sludge Drying Beds					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
15	Is rainwater gutter provided in the roof?				
16	Is the module constructed at least 300 mm above ground level?				
17	Is a freeboard of minimum 300 mm provided to all water retaining structures?				
18	Are frames provided for manholes?				
19	Is the module watertight? If no, mention the defects with inferences				
20	Is slope at base slab provided as per the drawing?				
21	Is plastering slope provided on top of the cover slab for rainwater discharge?				
22	Is painting done as per specifications?				
23	Total number of drying beds				
	Dimension:				
1	Total (finished) size-B x W of the module including pedestrian platform				
2	Finished width of each bed				
3	Finished length of each bed				
4	Depth of each drying bed				
5	Finished size of inlet distribution chamber				
6	Finished width of pedestrian platform				
7	Finished size and depth of the registers				
i)	R1				
ii)	R2				
iii)	R3				
iv)	R4				

Table A1.3: Detailed Pre-Commissioning Checklist - Sludge Drying Beds					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
v)	R5				
vi)	R6				
vii)	R7				
8	Finished size and depth of the collecting register R7				
9	Distance between each register from R1 to R6				
	Levels:				
1	Inlet level of the SDB at the beginning of the pedestrian platform				
2	Finished floor level of the pedestrian platform at the start point				
3	Finished floor level of the pedestrian platform at the centre				
4	Finished floor level of the pedestrian platform at the end				
	Level details of one bed				
1	Inlet pipe level at the Inlet Distribution Channel				
2	Inlet pipe level to the drying bed				
3	Outlet pipe levels of the Distribution Chamber				
4	L' bottom outlet pipe levels of the Distribution Chamber				
5	Perforated drainage pipe outlet level at the downstream side toward the registers (R1 to R6)				
Source: TNUSSP, 2020					

Table A1.4: Detailed Pre-Commissioning Checklist - Sludge Drying Bed - Register's Levels					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
	Interconnecting Registers				
	Register R1				
1	R1-I/L				
2	R1-O/L				
3	Difference in levels between R1 I/L & O/L				
	Register R2				
4	R2-I/L				
5	R2-O/L				
6	Difference in levels between R2 I/L & O/L				
	Register R3				
7	R3-I/L				
8	R3-O/L				
9	Difference in levels between R3 I/L & O/L				
	Register R4				
10	R4-I/L				
11	R4-O/L				
12	Difference in levels between R4 I/L & O/L				
	Register R5				
13	R5-I/L				
14	R5-O/L				
15	Difference in levels between R5 I/L & O/L				
	Register R6				
16	R6-I/L				
17	R6-O/L				

Table A1.4: Detailed Pre-Commissioning Checklist - Sludge Drying Bed - Register's Levels					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
18	Difference in levels between R6 I/L & O/L				
19	Top level of porotherm brick layer				
20	Distance b/w SDB and CT1 in metre				
Source: TNUSSP, 2020					

Table A1. 5: Detailed Pre-Commissioning Checklist - Collection Tank 1					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
1	Is an overflow pipe provided just above the outlet pipe?				
2	Is pump of the required capacity provided? Mention brand name and its capacity				
3	Are base slab and interior of pipes cleared of construction debris and other waste?				
4	Is the size and position of the manhole as per drawing?				
5	Are the positions and levels of inlet, outlet and distribution pipes as per design?				
6	Is the module watertight? If no, mention the defects with inferences				
7	Is slope at base slab provided as per the drawing?				
8	Is plastering slope provided on top of cover slab for rainwater discharge?				
9	Is painting done as per specifications?				
10	Is the module constructed at least 300 mm above ground level?				

Table A1. 5: Detailed Pre-Commissioning Checklist - Collection Tank 1					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
11	Is a freeboard of minimum 300 mm provided to all water retaining structures?				
12	Are frames provided for manholes?				
	Dimensions:				
1	Finished Length of the Tank				
2	Finished Width of the Tank				
3	Depth of the Tank				
	Levels:				
1	Inlet level				
2	Pump outlet				
3	Top level of top slab (including plastering)				
4	Thickness of top slab (excluding plastering)				
5	Bottom level of top slab				
6	Top level of base slab				
7	Freeboard				
Source: TNUSSP, 2020					

Table A1.6: Detailed Pre-Commissioning Checklist - ISAF					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
1	Are the Inlet and Outlet pipes fixed in position with the specified number and spacing in the settler?				
2	Are openings provided at the partition wall of the settler as per the drawings?				

Table A1.6: Detailed Pre-Commissioning Checklist - ISAF					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
3	Is a vent pipe with cowl provided in the chamber?				
4	Are the baffle pipes at the inlet, partition wall and at the outlet fixed in position with specified number, location and spacing as mentioned in the drawings in the AF?				
5	Are de-sludging pipes provided and placed at the right location?				
6	Is the brickbat layer placed 50 mm below the pipe level?				
7	Is the distribution channel base slab finished smoothly and 50 mm below the AF inlet pipe level?				
8	Are the cinder materials packed in nets and placed on top of the perforated slab?				
9	Is adequate slope provided at the outlet distribution channel as per the drawing?				
10	Is the module constructed at least 300 mm above ground level?				
11	Is a freeboard of minimum 300 mm provided to all water retaining structures?				
12	Are frames provided for manholes?				
13	Is the module water tight? If no, mention the defects with inferences				
14	Is slope at base slab provided as per the drawing?				
15	Is plastering slope provided on top of cover slab for rainwater discharge?				
16	Is painting done as per specifications?				
	Dimension:				
1	Finished size of first chamber in settler				

Table A1.6: Detailed Pre-Commissioning Checklist - ISAF					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
2	Finished size of second chamber in settler				
3	Finished size of inlet distribution channel of AF				
4	Finished size of first chamber in AF				
5	Finished size of second chamber in AF				
6	Finished size of third chamber in AF				
7	Finished size of outlet distribution channel of AF				
	Levels:				
1	Top level of the top slab				
2	Bottom level of the top slab				
3	Inlet pipe level at the inlet chamber				
4	Inlet pipe level at the settler				
5	Minimum freeboard at the settler				
6	Bottom level of partition wall opening at settler				
7	Inlet level of distribution channel chamber (Outlet of Settler)				
8	Outlet level of the distribution channel (inlet to AF)				
9	Base slab level of distribution channel				
10	Outlet of first chamber of AF				
11	Outlet of second chamber of AF				
13	Outlet of third chamber of AF				
14	Outlet of the distribution channel				
15	Bottom level of precast perforated slab				
16	Top level of the base slab				
17	Top level of cinder material				
Source: TNUSSP, 2020					

Table A1.7: Detailed Pre-Commissioning Checklist - Horizontal Planted Gravel Filter					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
1	Are all the inlet and outlet pipes fixed in position as per the drawings?				
2	Are all the inlet pipes to the distribution channel (DC) placed at the same level?				
3	Is the distribution channel base slab finished smoothly and 50 mm below the PGF inlet pipe level?				
4	Is the register placed in the middle of the module near the inlet?				
5	Are the pipelines from the register to the PGF given sufficient slope?				
6	Are the filter materials properly sieved, washed and then laid?				
7	Are the perforated drainage pipes at the outlet placed in position with sufficient perforations?				
8	Is a vent pipe with cowl provided at the end of the perforated drainage pipes?				
9	Are sampling pipes with perforations provided at the filter chamber?				
10	Are cowls provided at the top of the sampling pipes?				
11	Are swivel pipes provided at the outlet register in the required inclination? (20 cm below the filter material, top level on the outlet side)				
12	Is the module constructed at least 300 mm above ground level?				
13	Is a freeboard of minimum 300 mm provided to all water retaining structures?				
14	Are frames provided for manholes?				

Table A1.7: Detailed Pre-Commissioning Checklist - Horizontal Planted Gravel Filter					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
15	Are the specified plants planted in the PGF?				
16	Are the plants planted in the PGF with sufficient spacing?				
17	Is the module water tight? If no, mention the defects with inferences				
18	Is slope at base slab provided as per the drawing?				
19	Is plastering slope provided on top of the cover slab for rainwater discharge?				
20	Is painting done as per specifications?				
	Dimensions:				
1	Size of the inlet distribution chamber R1				
2	Finished width of distribution channel				
3	Finished length of distribution channel (flow direction)				
4	Finished internal dimension of each PGF bed				
5	Outlet chamber size (single PGF)				
6	Outlet chamber size (twin PGF)				
7	Size of the Register R2				
8	Size of the Register R3				
	Levels:				
	Inlet Register R1				
1	Inlet pipe level				
2	Outlet pipe level at the register				
	Inlet Distribution channel				
3	Inlet pipe level to the distribution channel				
4	Finished base slab level				

Table A1.7: Detailed Pre-Commissioning Checklist - Horizontal Planted Gravel Filter					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
	PGF				
5	Outlet pipe level of the distribution channel (Inlet to PGF)				
6	Top level of distribution pipe wall				
7	Top level of base slab near the inlet				
8	Top level of base slab near the outlet				
9	Top level of base at the outlet chamber (swivel pipe chamber)				
10	Outlet pipe level at the outlet chamber				
	Outlet Register R2, R3				
13	Inlet level of R2				
14	Outlet level of R2				
15	Inlet level of R3				
16	Outlet level of R3				
Source: TNUSSP, 2020					

Table A1.8: Detailed Pre-Commissioning Checklist - Polishing Pond					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
1	Are steps provided for the accessibility of the pond?				
2	Is proper stone soling provided at the bottom and the sides of the pond?				
3	Is a clay layer laid at the bottom of the pond?				
4	Is precast RCC slab provided at the sides?				
5	Are all the inlet and outlet pipes fixed in position as per the drawing?				
	Dimensions:				
1	Finished length of the pond				
2	Finished width of the pond				

Table A1.8: Detailed Pre-Commissioning Checklist - Polishing Pond					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
3	Designed depth of wastewater in the pond				
	Levels:				
1	Inlet pipe level				
2	Outlet pipe level				
3	Base slab top level				
Source: TNUSSP, 2020					

Table A1.9: Detailed Pre-Commissioning Checklist - Collection Tank 2					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
1	Is an overflow pipe provided just above the outlet pipe?				
2	Is pump of the required capacity provided? Mention brand name and its capacity				
3	Is base slab and interior of pipes cleared of construction debris and other waste?				
4	Is the size and position of the manhole as per drawing?				
5	Are the positions and levels of inlet, outlet and distribution pipes as per design?				
6	Is the module water tight? If no, mention the defects with inferences				
7	Is slope at base slab provided as per the drawing?				
8	Is plastering slope provided on top of the cover slab for rainwater discharge?				
9	Is painting done as per specifications?				

Table A1.9: Detailed Pre-Commissioning Checklist - Collection Tank 2					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
10	Is the module constructed at least 300mm above ground level?				
11	Is a freeboard of minimum 300 mm is provided to all water retaining structures?				
12	Are frames provided for manholes?				
	Dimensions:				
1	Finished length of the tank				
2	Finished width of the tank				
3	Depth of the tank				
	Levels:				
1	Inlet level				
2	Pump outlet				
3	Top level of top slab (including plastering)				
4	Thickness of top slab (excluding plastering)				
5	Bottom level of top slab				
6	Top level of base slab				
7	Freeboard				
Source: TNUSSP, 2020					

Table A1.10: Detailed Pre-Commissioning Checklist - Additional Facilities (Part 1)					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
I	**Sludge Storage House**				

Table A1.10: Detailed Pre-Commissioning Checklist - Additional Facilities (Part 1)					
II	**Operator Room**				
III	**Store Room**				
Source: TNUSSP, 2020					

Table A1.11: Detailed Pre-Commissioning Checklist - Additional Facilities (Part 2)					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
1	Is a boundary wall constructed as per the master plan?				
2	Is an approach road provided? Mention width of approach road				
3	Is a ramp provided near the screen chamber to facilitate emptying of the septage from the truck?				
4	Is sufficient ramp height provided? Specify height of the ramp				
5	Does the height of the truck outlet match the inlet of the screen chamber?				
6	Is adequate space for vehicle/truck movement within the plants provided?				
7	Is a spillage collection drain provided to carry away the septage that spills from the truck outlet while unloading?				
8	Are stormwater drains provided at site?				
9	Is proper backfilling done and all debris moved out of site?				

Table A1.11: Detailed Pre-Commissioning Checklist - Additional Facilities (Part 2)					
Sl. No	**Parameters/ Description**	**Pass Yes/ No**	**Comments/ Correction note**	**Assigned Person**	**Date**
10	Is solar panel installed? Specify capacity of the panel				
11	Is the solar power generated sufficient for the pump operation?				
12	Is clearance ensured from potential hindrances to treatment and civil structures (e.g. trees/compound walls near SDB or PP)?				
13	Effluent disposal arrangement: availability of drain or other ways?				
Source: TNUSSP, 2020					

Annexure 2: Hydraulic Test

Water tightness and flow test for each module:
After pre-commissioning checks, all the tanks should be tested for smooth water flow and water tightness.

Water tightness (leakage) test:
Procedures for conducting the test are as follows:

a. Empty and clean all the chamber/s.
b. Fill the chamber/s, if there are more than one chamber or row of chambers, then fill alternative tanks (as specified in the drawing) and take all the levels of water with reference to the base slab/top slab.
c. Leave the water for 24 hours and check the levels in each chamber.
d. If the leakage is not found, then pump the water to the other set of empty chambers and take all the levels of water with reference to the base slab or distribution pipes.
e. Once the above-mentioned procedures are complete, then flood all the chambers and check the flow direction and smoothness.

Table A2.1: Hydraulic Test Reporting Format

Sl. No.	Particulars	Water filled in	Water level readings with respect to outlet level / top level of Swivel pipe		
			1st Day	2nd Day	3rd Day
1	**Stabilisation Reactor**	All the chambers up to Outlet level			
		1st Chamber			
		2nd Chamber			
		3rd Chamber			
2	**Settler**	All the chambers up to Outlet level			
3	**Anaerobic Filter**	All the alternate chambers up to Outlet level			
		1st Channel: 1st Chamber			
		2nd Chamber			
		2nd Channel: 1st Chamber			
		2nd Chamber			
		3rd Channel: 1st Chamber			

Table A2.1: Hydraulic Test Reporting Format					
Sl. No.	**Particulars**	**Water filled in**	**Water level readings with respect to outlet level / top level of Swivel pipe**		
			1st Day	**2nd Day**	**3rd Day**
		2nd Chamber			
4	**Sludge drying beds**	Close the outlet pipe with end cap and fill water in SDB up to the top level of swivel pipe			
		1st SDB			
		2nd SDB			
		3rd SDB			
		4th SDB			
5	**Planted Gravel Filter**	Close the outlet pipe with end cap and fill water in PGF up to the top level of swivel pipe			
		1st PGF			
		2nd PGF			
		3rd PGF			
		4th PGF			
6	**Collection Tank**	Up to the Outlet level			
		1st Tank			
		2nd Tank			
Any other (Please specify)					

Hydraulic Test has been carried out successfully without any leakage in the above mentioned FSTP Modules.

Date, Name and Signature

Annexure 3: Electromechanical equipment test

Refer to manufacturer manual and conduct the check for its efficient functioning: If any differences are found in comparison to the specification, contact the supplier/manufacturer.

All the electromechanical equipment and control equipment checked for its functioning and confirmed it is working as per the manufacturer specification.

Date, Name and Signature

Annexure 4: Construction Drawings

Scan to see list of all the drawings.

TN US SP
TAMIL NADU URBAN SANITATION SUPPORT PROGRAMME

Tamil Nadu Urban Sanitation Support Programme (TNUSSP) supports the Government of Tamil Nadu and cities in making improvements along the entire urban sanitation chain.

The TNUSSP is implemented by a consortium of organisations led by the Indian Institute for Human Settlements (IIHS), in association with CDD Society, Gramalaya and Keystone Foundation.

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