Section 7

Special Requirements
7.1 Temporary Treatment Plants

7.1.1 Definition

Temporary treatment plants refer to STP that are built to operate on a temporary basis. The sewage will eventually be diverted to a centralised sewerage system. After then, the temporary treatment plant will be decommissioned.

There are 2 categories of temporary treatment plants:

Category 1
For temporary treatment of sewage during the upgrading of an existing sewerage treatment facility

Category 2
For temporary treatment of sewage during initial stage of a new housing development where it is not feasible to construct a plant of ultimate capacity during initial stage or it is located within the catchment of a centralised sewerage system.

7.1.2 Category 1: Temporary Treatment Plant for Upgrading of Facilities

During the upgrading of an existing treatment plant, the sewage flows into that plant shall be directed to a temporary treatment plant for treatment before discharge. The treatment process of the temporary plant shall be designed and calculated based on: the duration of the project, total existing flow and the compliance requirements. The temporary treatment shall be monitored at regular interval. Approval from the Commission and DOE must be obtained prior any direct discharge of the untreated sewage into the receiving watercourse. The temporary treatment plant shall be located within the compound of the existing site. The temporary treatment plant shall not be built on other site area unless approval is granted by the Commission.

7.1.2.1 Compliance Standards for Category 1 Temporary Treatment Plants

Category 1 temporary treatment plant shall comply with the requirements as stipulated in this Guideline and shall be operated and maintained to the satisfaction of the Commission and the Director General of the Department of Environment (DOE) at all times.

The temporary treatment plant shall be designed to comply with the following minimum effluent requirements:
a) Standard B for STP located downstream of water intake points and non-water catchment zones

b) Standard A for STP located upstream of water intake points

The above levels shall be interpreted as ‘absolute’ pollutant levels. Final effluents will be monitored over the life of the temporary plant. A license to contravene shall be obtained before the construction of any temporary plant and the commencement of any upgrading works.

The temporary plant shall incorporate provisions to minimize adverse impacts such as visual, noise, odour nuisance etc. to the surroundings.

7.1.2.2 Process Requirements for Temporary Treatment Plants

Alternative or innovative designs may be used for temporary plant to meet the general design compliance as stipulated above.

Unit processes within the temporary treatment plant can be designed to absolute standards. For example, a Standard A the effluent level of temporary treatment plant of this category can be designed to 20 mg/l BOD and 50 mg/l SS.

Materials for construction can be of semi-permanent installation such as fiberglass tanks, mild-steel with epoxy coat, etc.

7.1.2.3 Operation of Temporary Treatment Plants

During the upgrading of an existing plant, the project proponent shall appoint a class license to operate and maintain the temporary plant. If the upgrading contractor is a licensed operator, they may be appointed as the operator of the temporary plant.

7.1.3 Category 2: Temporary Plants for New Housing Development

I) Multiple Phases Hosing Development

Temporary plant shall be provided for multiple phases housing development where it is not feasible to construct a plant with ultimate capacity during initial stage.

STP reserves must be located as far as practicable from habitable buildings. The needs of a temporary plant in a multiple phases housing development project depend on phases of development, size of each development phase, location of initial development and duration of the phase lag and entire development plan.
The project proponent will construct a temporary treatment plant in compliance with the following criteria:-

a) Temporary plant will be decommissioned by the developer within time frame agreed between the Commission and the developer.

b) Implementation program for ultimate plant is confirmed in accordance to an approved catchment study.

c) All temporary plant shall remain as private plant and shall be operated and maintained by a licensed operator appointed by the project proponent.

(II) Future Connection to Centralised STP

This applies to a catchment where implementation program to construct a centralised STP is approved but the completion date could not meet the project proponent’s needs. Under such circumstances, the project proponent may be allowed to build a temporary treatment plant.

7.1.3.1 Provision of Land for Temporary Treatment Plants

The owner will be required to allocate land within the housing development for the construction of all temporary works. However, the site of the temporary treatment plant shall not be located on future public amenities land.

The project proponent of the temporary treatment plant will be required to construct the temporary sewer reticulation within the development to convey sewage to the temporary treatment plant. At the same time, the project proponent must also construct the permanent sewer reticulation for the connection to the permanent plants or the centralised sewerage system.

7.1.3.2 Compliance Standards for Temporary Treatment Plants

This category of temporary treatment plant shall comply with the requirements as stipulated in this Guideline. The plant shall also be maintained to the satisfaction of the Commission and the Director General of the Department of Environment (DOE) at all times.

The temporary treatment plant shall be designed and maintained to comply with the following minimum effluent requirements:

a) Standard B for STP located downstream of water intake points and non-water catchment zones.

b) Standard A for STP located upstream of water intake points.
7.1.3.3 Process Requirements for Temporary Treatment Plants

Temporary treatment plants shall be designed to the requirements set out in Sections 3, 4 and 6 of this Volume.

An alternative design may be considered for the temporary treatment plant that will be decommissioned within time frame agreed between the Commission and the developers.

Materials for construction can be of semi-permanent installation such as fiberglass tanks, mild-steel with epoxy coat, etc.

Filter systems may use refurbished filter material that meet the relevant standards. However, other equipment used within the works shall be new. Second-hand equipment is strictly prohibited.

7.1.3.4 Operation of Temporary Treatment Plants

Temporary plant shall remain as private plant. The owner must appoint a licensed operator to operate and maintain the plant.

Temporary treatment plants shall strictly comply to the requirements as stipulated by this Guideline and shall be operated to the satisfaction of the Commission and the Director General of DOE at all times.

Temporary treatment plants shall be designed and constructed so as not to present any nuisance in terms of odour, noise, safety and visual impact to the nearby community.

7.1.3.5 Ancillary Requirement of Temporary Treatment Plants

Temporary treatment plants shall be provided with proper security fencing in compliance with Section 6 of this Volume.

Adequate access roads and drainage shall be provided.

Landscaping of treatment plant shall be provided for better aesthetic value surrounding the plant.
7.2 Treatment Plants Located Within Buildings

7.2.1 Introduction

The installation of treatment facilities within buildings whether occupied or not, including basements of buildings, are not desirable and will not normally approve. Every effort must be made to come up with an alternative site or an arrangement to connect to a public system.

Owners must resolve these issues at an early stage of the planning process. The Commission should be contacted early to establish if an alternative option is feasible.

If approved, such installations will be subjected to stringent service condition requirements for the following criteria:

a) Access
b) Ventilation
c) Electrical requirements for lighting system
d) Noise control
e) Process type
f) Inlet works
g) Pre-treatment
h) Confined space safety
i) Odour Control
j) Discharge systems
k) Flood mitigation measures
l) Operation and maintenance
m) General safety and health
n) Sludge handling
o) Sanitary and plumbing facilities
p) Fire Fighting Equipment

Treatment plants within buildings will be considered as private treatment plants subject to eventual phasing out and replacement by a centralised system.
7.2.2 Specific Guidelines and Requirements

The specific guidelines and requirements for the criteria specified in 7.2.1 are listed below.

I) Access

a) Vehicle access must be provided from the nearest public highway.

b) Parking space for a desludging and service vehicle must be within operating range.

c) Access must be continuously available and unobstructed.

d) Accessible to water and electricity supplies.

e) Sampling point to be available for final effluent.

f) Allowance must be made for installation and removal of equipment.

g) Provision must be made for lifting of heavy equipment.

h) Suitable arrangements must be made for service and repair of equipment.

II) Ventilation

Ventilation design shall be in compliance with the requirements in Section 6 and the specific requirements listed below:

a) Suitable system must be provided to address poisonous, explosive and lack of oxygen conditions.

b) Separate and independent (from the basement) ventilation must be provided for the confined spaces.

c) Ventilation shall be of forced mechanical type.

d) Ventilation must be intrinsically safe with respect to explosive gases such as methane.

e) Ventilation must be designed to deal with the different densities of the various gases.

f) Ventilation fan must be located outside the enclosed space to induce forced air into the plant. Intake locations shall be such that only fresh air from outside the building is drawn into the system and not air recirculated within the building.

g) Ventilation exhaust must be directed outside the building for discharge.
h) Ventilation air exchanges shall be as follows:
i) Intermittent: Minimum of 30 complete air changes per hour
ii) Continuous: Minimum of 12 complete air changes per hour
i) A backup fan must be provided in the event of duty fan failure and must be automatic on entry.
j) A petrol driven generator with an auto restart facility must be provided to continually operate the ventilation system in the event of power failure.

III) Electrical Requirements for Lighting System

a) Only high-intensity, low-voltage discharge lamps to be used for floodlighting of plant area during operation and maintenance.
b) The lighting and electrical equipment must be both vapour and explosion proof.
c) A separate housing must be provided for electrical controls to prevent electrical sparks from coming into contact with flammable and explosive gases.
d) All electrical equipment must be water proof against submersion.
e) Standby generators must be provided to allow the plant to operate independently of the mains supply.

IV) Noise Control

a) Adequate dampening of noise must be provided to meet minimum stipulated requirements by the local Building By-laws, DOE and/or other regulatory bodies. Silencers and acoustic enclosures shall be provided where required to achieve the stipulated noise level reduction.
b) Noise control measures shall be implemented to control the generated noise level to below 65 dB at a distance of 2 m from the boundary of the housed noise source.
c) General noise levels (measured in decibel units) must also be measured 10 m from any point of the plant site within the nearest public space or occupied space or both to an acceptable level stipulated by the regulator.
d) Enclosures used to achieve these noise reductions shall permit ready access to equipment for routine maintenance. Adequate air ventilation shall be provided to allow cooling of the air inside the enclosure to prevent over heating of the equipment/motors.
V) Process Type

The type of treatment process must be limited to systems that are easy to operate and maintain for reasons of:

a) Lower sludge yield and more stable sludge characteristics
b) Lower operational and maintenance requirements

VI) Inlet Works

The design shall incorporate some means of controlling the influent velocity to prevent:

a) Excessive wear due to scouring effects
b) Excessive head loss in the inlet
c) Uncontrolled overflow of raw sewage
d) Release of sewer gases

VII) Pre-treatment

a) The design must include a macerator to
   i) reduce toilet waste and large solids into smaller and finer particles,
   ii) reduce the quantity of screenings
   iii) improve the ease of handling.
b) Screening must be provided at 10 to 12 mm clear spacing to remove fine particles.
c) A combined grit and grease removal system must be provided.

VIII) Confined Space Safety

a) Operators must:
   i) attend a recognised confined spaces training course,
   ii) obtain training certificates, and
   iii) be certified competent to operate in such an environment.
b) Confined space areas within the plant site must be clearly identified before handover for operation.
c) Confined space areas must be demarcated and warning notices placed.
d) Confined space procedures must be established and followed by operatives.
e) The following must be provided:
   i) Rescue sets of breathing apparatus
   ii) Gas detection equipment, preferably electronic, and serviced regularly

f) The design of the treatment plant shall be subject to a Hazard and Operability Review (HAZOP) exercise to identify and reduce the potential risks under the following scenarios:
   i) Electrical failure
   ii) Blockage of inlet and outlet
   iii) Equipment failure including lighting and ventilation
   iv) Blockage of any pipework
   v) Flooding of external discharge point
   vi) Failure of building drainage system

g) The consequences of such failures to operators may include:
   i) Flooding
   ii) Explosion
   iii) Drowning
   iv) Falling into open voids
   v) Asphyxia
   vi) Poison
   vii) Nausea

IX) **Odour Control**

a) Isolate odorous gases from general ventilation exhausts by containing identified odour generating sources with a separate local exhaust system.

b) Containment of the odour sources shall be by installing lightweight and corrosion resistant covers/enclosures designed for practical operation and maintenance works.

c) The local exhaust odorous air shall be conveyed through well designed and balanced ductworks by a centrifugal fan to an effective odour treatment equipment.

d) Odour treatment equipment shall be selected such that odours be reduced to the lowest possible level and in compliance with the EQA.

e) The potential of odour generation, its impact and treatment, shall be considered in all aspects of design.
X) **Discharge Systems**

Most basement plants will lie below the level of the running drain levels. Therefore, it is essential to:

a) Provide an effluent collecting sump prior to pumped discharge.
b) Provide a check valve at the end of the discharge pipe to prevent the backflow from the monsoon drain to the treatment plant.
c) Provide a 100% redundancy of the discharge pumping capacity.

XI) **Flood Mitigation Measures**

a) Provision must be made for the isolation of the treatment plant from flooding by external sources.
b) A sump pump shall be provided.

XII) **Operation and Maintenance Agreements**

a) All treatment plants installed in basements of buildings must be subject to an Operation and Maintenance Agreement. An example of the standard Operation and Maintenance Agreement is given in MSIG Volume 2.
b) All treatment plants located within buildings must be operated by a fully licensed operator and will be subject to periodic checks by the Commission to ensure compliance.

XIII) **Occupational Safety and Health**

a) All treatment plants shall be designed to comply with the Occupational Safety and Health Act, 1994. Properly designed treatment plants will enable the operator to safely handle the treatment plant throughout its design life. A brief summary of the contents of Act 514 is attached in Appendix A.

XIV) **Sludge Handling**

a) An aerated sludge holding tank shall be provided to keep the sludge from going septic.
b) Permanent pipe work with proper coupling and isolation valve should be provided adjacent to the access gate for easy coupling sludge tanker’s hose of hose for during desludging of the sludge holding tank.
c) To provide sludge pump for desludging purpose.
XV) **Sanitary and Plumbing facilities**

a) To provide stand pipe for cleaning purposes. Waste water to be channelled back to the inlet of plant.

XVI) **Fire fighting system**

a) To provide appropriate fire fighting systems in accordance to Fire Department and other statutory requirements.

### 7.3 Fully Enclosed Treatment Plant

#### 7.3.1 Definition

A fully enclosed plant is defined as a treatment plant that is designed such that their treatment unit processes are located within dedicated buildings.

A fully enclosed plant is to be equipped with additional features and requirements to minimize adverse impact to the surrounding environment.

Fully enclosed treatment plant shall comply with the following criteria:

a) Must be located within a dedicated sewage treatment site.

b) Provide with appropriate architectural enclosures building.

c) No unit processes shall be located outside the enclosed buildings/architectural enclosures.

d) Individual treatment unit process may be covered with a permanent structure or housed in an enclosed building.

e) Provide appropriate landscaping to adequately screen the treatment plant from other developments in the vicinity.

Appropriate architecture style, landscaping, architecture surrounding the treatment plant and fencing type must be used.

#### 7.3.2 General Requirements

When approved, fully enclosed treatment plants must comply with the general requirements set out in Section 3, 4 and 5 of this Volume and also specific requirements in this Section 7.3 for the following:

i) Provision of odour control

ii) Noise control and mitigation measures
iii) Minimize visual impact  
iv) Avoid aerosol effects  
v) Enhance safety, health and operability

I) Odour Control

The potential for odour generation, its impact and treatment, shall be considered in all aspects of design.

The range of odorous constituents in such biogenic odours is very wide and they include: hydrogen sulphide, ammonia, thiols and other organic sulfur compounds, amines, indole and skatole, volatile fatty acids and a wide range of organic compounds produced by anaerobic fermentation.

Particular problems can be found at: Inlet works, primary tanks, secondary treatment, sites for transfer, storage and treatment of raw sludges and leakages.

A separate local exhaust system, for containment and exhaust of odorous air to treatment, will isolate such odours from the general ventilation system.

Odour treatment equipment shall be selected such that odour is reduced to the lowest possible level and in compliance with the EQA.

Containment, exhaust and treatment shall be designed as an integrated package.

II) Noise Control

Adequate dampening of noise must be provided to meet minimum stipulated requirements by the local Building By-laws, DOE and/or other regulatory bodies. Silencers and acoustic enclosures shall be provided required to achieve the stipulated noise level reduction.

Noise control measures shall be implemented to control the generated noise level to below 65 dB at a distance of 2 m from the boundary of the housed noise source.

The general noise levels generated shall also be measured 10 m from any point of the plant site within the nearest public space and/or occupied space to an acceptable level stipulated by the appropriate regulators.

Enclosures used to achieve these noise reductions shall permit ready access to equipment for routine maintenance. Adequate air ventilation shall be provided to allow cooling of the air inside the enclosure to prevent over heating of the equipments/motors.
III) Aerosol Effects

Aerosol is defined as a suspension of colloidal particles in gases/atmosphere. Aerosol control measures are important because aerosol affects the human respiratory system.

If uncontrolled, aerosol could present a health hazard to the operator and residents due to the reduced buffer zone around the treatment plant.

Screens, open channels and aeration tanks, where violent and turbulent actions are encountered, may release aerosol. The design of the treatment plant shall take into consideration any unit processes that are likely to emit aerosol and mitigating measures shall be undertaken to counter aerosol release to the atmosphere.

IV) Safety, Health and Operability

The design of a fully enclosed treatment plant shall address safety, health and operability aspects. The guidelines given for treatment plants located within buildings in Section 7.2 shall be followed.

7.3.3 Specific Requirements

I) Covers for Treatment Unit Processes

The purposes of these covers are to contain odour emission at source and to reduce visual impact.

The design requirements for treatment unit processes are outlined below.

a) Covers to contain odour emission shall be provided at all potential sources of odour generation for all unit processes located within the sewage treatment works.

b) Bins used for the storage of screenings and grit collected in the pre-treatment area shall be completely covered to reduce visual impact, odour and to keep vectors away. The designer shall provide further considerations on the size, type and method of emptying the bins.

c) Generally, all unit processes shall be covered or housed within a building enclosure. This shall include all pre-treatment units, aeration tanks, and sludge treatment and handling facilities. The only exception is the secondary clarifier.

d) The bin shall be located on a bunded, paved area adjacent to an access road to the treatment plant.
Special Requirements

e) The cover shall comply with BS EN 124 if subject to loading. It shall also be designed to meet the operating condition of the odour extraction system as well as the location and application appropriation.

f) If the cover is exposed to the environment,
   i) Plastic or fiberglass cover if used, must be manufactured with UV inhibitor and will not warp or deform due to weathering effect.
   ii) Metal covers if used, must have appropriate corrosion resistant coating in accordance to Section 4 of this Volume.
   iii) Where chipping might occurs at the edge of the cover, stainless steel reinforcement frame on all sides of a plastic or FRP cover shall be provided.

g) Coatings for the concrete and steel shall include coal tar, vinyls and epoxies in accordance to Section 4.

h) Covers should be hinged and weigh less than 16 kg to enable lifting unaided. Beyond a cover weight of 16 kg, assisted lifting is required.

i) All unit processes with covers or are housed in a building for odour and visual impact reduction shall be provided with proper air extraction and air scrubbing system. These devices shall be safe to operate and maintain. Odour, noise and visual impact, and aerosol are the major components for consideration in the design of an enclosed wastewater treatment plant. Windows and access hatches that give the operator an extended and uninterrupted view of the treatment process are mandatory for all unit processes that are covered.

j) Covers shall be designed to allow for easy dismantling and easy access for cleaning of the enclosed plant.

k) The materials used for the cover structure depend on the type of cover selected and the characteristics of the odorous environment. In general, the materials shall be selected to provide durability, ease of maintenance, corrosion resistance and be relatively inexpensive. The three most common materials used for containing odours are concrete, aluminum and FRP. The design requirements for each of these are outlined below.

   i) **Concrete**

   Concrete can support the greatest weight but limits the plant maintenance worker’s ability to remove the cover for major repairs. Concrete covers are subject to corrosion and should be treated with a protective coating, such as an epoxy resin.
ii) **Aluminum**

Aluminum covers provide the greatest tensile strength with the thinnest cross-sectional area and can be placed on a light weight frame. The lightweight nature and thin cross-sectional area of aluminum makes it easier to remove and store the covers during maintenance operations.

Aluminum covers are generally less expensive than FRP and concrete, but periodic maintenance in the form of an anodised coating is necessary to help prevent corrosion. The design of an aluminum cover shall consider the incompatibility of aluminum with concrete and other metals. If not, disintegration of the materials occurs and the structural integrity of the system could be jeopardized.

iii) **FRP**

FRP is light weight and generally can be removed by plant operator and stored during maintenance operations. FRP covers also offer resistance to corrosion, but require periodic maintenance with an ultraviolet inhibitor to enhance durability, particularly, if exposed to sunlight on a prolonged basis.

**II) Ventilation system**

Ventilation systems are required to supply fresh air for workers to work in a more comfortable environment and to minimise health and safety concerns.

All covered unit processes must have proper ventilation systems.

a) An exhaust ventilation system shall be provided with air distribution patterns that effectively purge work areas.

b) For waste areas that workers must enter, both blowing and drawing air shall be used to eliminate dead spots.

c) Areas designed for personnel entry must include relief systems to avoid overpressure conditions. Designers must estimate cover system leakage to determine fan capacity.

d) Force air ventilation systems should be inspected and tested periodically to ensure proper air flow and air distribution.

e) Ventilation of enclosed plants can be either intermittent or continuous. However, intermittent ventilation is not recommended because it has a lower degree of safety and more difficult to operate and maintain than continuous ventilation. Continuous ventilation is typically more expensive to operate because of higher electricity costs for running the blowers. Intermittent
ventilation typically requires a higher rate of ventilation. For example, the wet well and grit removal facility requires 12 air exchanges for continuous ventilation versus 30 air exchanges for intermittent ventilation.

f) The requirement in Section 6 shall be refer to for the design of exchange rate. If the work site is classified as a confined space, workers without proper respiratory equipment must not occupy spaces that cannot be ventilated to less than 25% of the permissible exposure limit (PEL) of the contaminant and less than 10% of the lower explosive limit (LEL). For example, hydrogen sulfide which is one of the most common contaminants in enclosed areas exposed to wastewater has a ceiling concentration of 30 mg/m$^3$ (20 ppm).

g) Combustible alarms set at a percentage of the LEL and ventilation failure alarms should be installed in wet wells, screen rooms, or other enclosed areas where a volatile atmosphere could exist. These alarms must have both audible and visual indicators to alert workers that the area is now potentially dangerous as well as alerting those who are about to enter the problem area.

h) Before entering the enclosed plant, where there is potential for a hazardous atmosphere to exist, the operator and/or worker must be able to test for oxygen deficiency, and combustible and toxic gases or vapors.

i) Ventilation systems shall be designed on the basis that the potential odourous gases have been isolated and contained by the local exhaust system for odour control.

j) Ventilation design criteria for work space are as follows:

i) Avoid positioning supply and exhaust registers at equal elevations and on the same enclosure wall. This will prevent short-circuiting the ventilation system and creating dead zones (areas with no apparent ventilation or air motion).

ii) Equip the makeup air supply and exhaust registers with volume dampers to control the airflow rate. Makeup air supply should be less than what is exhausted to create negative air pressure within the enclosure.

iii) A duty and standby ventilation system are mandatory. The standby shall be 100% that of duty.

iv) An external visual indicator, such as green/red light, to be provided outside the enclosed plant to warn of ventilation systems failure.
k) The design of the ventilation system shall take into account the noise aspects. Generally, the design work shall include for sound insulating material, resilient mountings or other appropriate devices to ensure that the plant runs without noise or vibration in its final installed position. Noise level from machinery shall not exceed the level stipulated by the regulators.

III) Odour Control System

a) Isolate odorous gases from general ventilation systems by containment of identified odour generating sources with a separate local exhaust system.

b) Containment of the odour sources shall be by installing lightweight and corrosion resistant covers/enclosures designed for practical operation and maintenance works.

c) Local exhaust rates for containment shall be designed to provide a negative pressure, prevent build up of toxic, corrosive or explosive gases and include provision for process air or air displaced by changes in the level of liquid inside the covered space.

d) The local exhaust odorous air shall be conveyed through well designed and balanced ductworks by a centrifugal fan to effective odour treatment equipment.

e) The overall performance of the odour control system shall comply with the requirements of the Department of Environment (DOE).

f) In situations where specific gases such as hydrogen sulphide and ammonia are significantly present, consideration shall be given for the installation of a pre-scrubber unit upstream of the main odour treatment equipment.

g) Effective odour treatment equipment to be a minimum 90% removal efficient.

h) Consideration must be given to the life span of the odour control system and associated costs in operating and maintaining such a system.

IV) Vent Stack

The vent stack shall at a minimum 5 m above ground level to ensure sufficient dispersion of air. Where the stack is located adjacent to a building, it should be located at least 1 m above the roof line of this building.
V) **Noise Level**

All mechanical equipment that are likely to generate noise such as blowers, compressor and pumps, shall be acoustically isolated to ensure the noise generated are contained and reduced to below the levels stipulated by the regulators.

VI) **Sludge Handling**

a) Due to the compactness of the site, it is not conceivable to have sludge drying beds in an enclosed environment. Instead, an aerated sludge holding tank shall be provided to prevent the sludge from turning septic. Sand drying beds (either covered or otherwise) are not an acceptable form of sludge treatment in an enclosed plant.

b) Permanent pipework with female coupling and isolation valve should be provided adjacent to the access gate for easy coupling of tanker’s hose during desludge of the holding tank.

VII) **Treatment Process Type**

It is preferred that treatment in an enclosed environment employs extended aeration activated sludge because it offers greater process stability and less potential for generating odours. However, other treatment processes warrant further considerations if proven that they have other distinct advantages in an enclosed environment.

VIII) **Siting of Plant**

a) The enclosed plant needs to be located away from driveways to allow for regular maintenance of the screens, grit and grease removal units and wet well of pump stations. If this is not possible, then bollards shall be erected to protect the workers while maintaining the plant.

b) Where plants are located within the premise of a private property, direct vehicle access is to be provided from the public road to the plant via a gate in the perimeter fence.

IX) **Groundwater Conditions**

a) Adequate provision must be made to resist the uplift of the structure due to hydrostatic ground water pressures. The side and bottom walls shall be designed to withstand the anticipated hydrostatic pressures.
b) The top of the plant shall be located at least 150 mm above the finished surface level to prevent the inflow of surface run off into the enclosed plant.

c) Good perimeter drainage is to be provided to ensure that the plant is not flooded.

X) Installation and Removal

Installation and the subsequent removal of all mechanical and electrical equipment need to be taken into account during the design of the cover. The following requirements must be carefully catered for:

a) Adequate space for servicing must be provided in the design of the enclosed plant.

b) If the installation and/or removal of the equipment require the service of a crane or any lifting vehicle, then access must be made available within the treatment plant for these lifting vehicles.

c) An adequate number of access covers and sizes of openings for the removal and installation of the equipment shall be provided.

d) The design of an enclosed plant must allow for the plant to be fully operational during the installation and/or removal of any equipment. Alternatively, provisions for temporary bypass should be accommodated to prevent disruption to the sewage flow while this work is being carried out.

e) In situations where it is not possible to readily install a duty and standby unit, the standby unit can be supplied as a separate item which is kept in store, provided that the faulty unit can be removed and the spare unit can be installed within two hours by general maintenance workers using normal tools.

XI) Mechanical and Electrical Requirements

The wiring, lighting and other electrical or mechanical equipment and appliances that have the potential to generate sparks that may trigger an explosion shall be designed and installed to meet the relevant safety codes to avert the possibility of an explosion.

XII) Building Plan Approval

If a building structure is used to house the enclosed treatment plant, then the design of this building must comply with the requirements stipulated by the relevant Building By-Laws.
7.4 Covered and Buried Treatment Plants

7.4.1 Definition

Covered and buried treatment plants refer to treatment plants with covers that are placed below ground or not more than 1.2 m above ground level. Covers are provided to reduce the odour, noise and visual impact.

This type of plant is only applicable to Class 1 and Class 2 sewage treatment plant with treatment capacity no more than 5000 PE. Special approval by the Commission must be obtained if the plant capacity exceeds 5000 PE. A compromised buffer zone of 10 m minimum from the fence to the nearest building boundary line must be provided for this type of plants. However, the height of the structure is normally limited to 1.2 m above ground.

7.4.2 General

Covered and buried treatment plants have inherent hazard and restriction in operability in their actual operation and maintenance. The requirements in the following sections serve to highlight the minimum improvements that must be made to these plants in addition to those set out in Section 3, 4, 5 and 6 of this Volume.

7.4.3 Specific Requirements for Covered or Buried Plants of 5,000 PE or Less

I) Openings of Covered and Buried Tanks

The design of these tanks must allow for adequate openings so that the operator can carry out routine operation and maintenance works in a safe, efficient and effective manner. These requirements apply to all unit processes that are covered or buried from the inlet works to the effluent chamber. Staggered square openings of roughly 600 mm x 600 mm employed in the past for plants of this nature would not be acceptable. These openings, as a minimum, must be opened top around the periphery of the tank.

II) Access for Routine Operations and Maintenance of the Plant

The designer must take into account the confined space and other related safety issues for entry into such a tank. Provision of proper access into each individual tank is mandatory. Where the depth exceeds 2.5 m, steps with intermediate landings must be included. Other requirements, such as adequate ventilation prior to tank entry, must be considered and provided in the design.
III) Pipework and Aeration System Requirements

Piping for buried plant shall be exposed and accessible for ease of maintenance. PVC pipes are not allowed.

The aeration system (diffuser) must be retrievable from top opening without emptying the tank.

VI) Lighting

Adequate lighting must be provided through adequate opening at the top of these covered or buried tanks to provide a good view of the treatment process such as the air diffusion system, screening, degritting and secondary clarification. This is important for daily plant operations through visual inspection of the individual unit process and routine maintenance of the plant.

V) Hand Railings

Hand railing provisions must be made to prevent falling into open spaces. These hand rails must be provided on the perimeter of the open tanks and further enhanced with kick plates.

VI) Desludging Activities

Adequate access within the proposed treatment plant site is to be made available to allow for desludging tankers to be within the reach of the waste activated sludge storage tanks without undue difficulty of maneuvering the vehicle or damaging the buried tanks or pipe works.

VII) Labeling of Treatment Unit Process

Labeling of each treatment unit is to be provided, from the inlet works to the secondary clarifiers, to avoid confusion with the similar geometry and sizes used for most treatment units.

VIII) Noise Control

Due to the compromised buffer requirements and proximity to adjacent developments, the potential for noise pollution is accentuated. The designer must ensure all noise generating mechanical and electrical equipment within the treatment plant must be contained and treated acoustically to meet compliance to existing noise levels stipulated by the Department of Environment and that set out in Section 4.

IX) Ventilation

Adequate ventilation must be made available to allow for the safe routine operation and scheduled maintenance of the treatment plant. During
design, this ventilation aspect must be considered. The type of ventilation, portable or permanent, must also be determined during design stage.

X)  Odour Control

Odour Control systems to be provided as required in compliance to the EQA.

XI)  Buoyancy Effects

The designer must account for the buoyancy effects in the design of buried or covered tanks. This effect is of concern during high groundwater conditions and emptying of the tank content during desludging works. Furthermore, the designer must ensure that the design of these tanks accounts for the hydrostatic force exerted on the floor from the outside does not exceed the compressive strength of these covered or buried tanks. This is to prevent any breakthrough of the floor and subsequent failure of the tank.

The designer must ensure that the design of these tank at worse case scenario where the tank is fully emptied. This is to prevent any breakthrough of the floor and subsequent failure of the tank.

XII)  Covers

Covers if employed for odour, visual and noise impacts shall be subjected to the following requirements:

a) Lifting may be unaided if the covers are hinged and weigh less than 16 kg.

b) Assisted lifting is required if the covers weigh equal to or above 16 kg.

c) The cover shall comply with BS EN124 loading requirements.

d) If the cover is exposed to the environment,
   i) Plastic or fibreglass cover if used, must be manufactured with UV inhibitor and will not warp or deform due to weathering effect.
   ii) Metal covers if used, must have appropriate corrosion resistant coating in accordance to Section 4 of this Volume.
   iii) Where chipping might occurs at the edge of the cover, stainless steel reinforcement frame on all sides of a plastic or FRP cover shall be provided.

XIII)  Fencing

Adequate fencing must be provided for all plants. Adequate security shall be provided against unauthorised access.
7.5 Guidelines for Homestead Developments

7.5.1 Single Developments up to 30 Units or 150 PE in Total

Individual septic tanks may be allowed for single developments of up to 30 units or 150 PE in total.

Septic tanks will be regarded as temporary treatment plants.

The owner must provide all septic tanks as part of the owner’s infrastructure works.

Septic tanks must be constructed to standard design in compliable with MSIG Volume 5.

7.5.2 Single Developments Over 30 Units in Total With Average Housing Density Greater Than Five Units per Hectare

For single developments over 30 units in total with an average housing density greater than 25 persons per hectare, a sewer reticulation and a communal treatment plant must be provided.

The treatment plant may be classified as permanent.

Sewer reticulation must be appropriately designed to achieve acceptable hydraulic conditions within topographic and routing parameters.

7.5.3 Single Developments Over 30 Units in Total with Average Housing Density Less Than Five Units per Hectare

For single developments over 30 units in total and with an average housing density of less than 25 persons per hectare, a sewer reticulation and a communal treatment plant is preferred.

The treatment plant may be classified as permanent.

Where the terrain of the development is such that if a communal system is constructed it will require the construction of too many intermediate pump stations, then individual treatment facilities may be considered, subject to the following conditions:

i) The individual system must be a system approved by the Commission.

ii) Where the ground conditions permit, soakaway trenches must be used for disposal of the final effluent from the treatment systems.
iii) Developers shall ensure that home owners enter into an agreement with the supplier of the systems or licensed contractors, to carry out operation and maintenance of the system as per design requirements.

iv) Tanks shall be desludged by the Service Licensee as per terms of the agreement signed between the Services Licensee and the Commission.

v) The Commission and DOE may impose stringent conditions, if they believe that such measures are required to ensure that the sewage from the development will not result in an adverse impact on the environment.

All septic tanks shall be designed in accordance with the requirements in MSIG Volume 5.

7.6 Non-Compliance with Standards

7.6.1 Introduction

This section describes the types of incidents, which are outside the control of the operator that may cause a sewage treatment plant to fail its effluent consent. Generally, the more sophisticated the treatment process, the more a process is at risk of failure from one of these incidents. It would be unreasonable to expect the operator of the treatment plants to perform within the effluent quality standards following such incidents. However, the operator must always use his best endeavours to rectify the situation as soon as practicable following such an incident.

The following potential incidents are treated as special cases when meeting absolute compliance with Standard A or Standard B.

7.6.2 Types of Incident’s that Can Cause Treatment Plant Failure

I) Power Interruption

An interruption in the power supply to a treatment plant will cause failure in all mechanical treatment processes.

Some large treatment plants have emergency generators which can be brought on stream to ensure inlet pumping continues.

However, the crude sewage will pass through the plant receiving only rudimentary treatment and will probably fail to comply with Standard A and Standard B.

Furthermore, all existing sewage treatment plants have to be restarted manually once they are tripped through power failure.
On new works, all treatment plants will be fitted with auto-restart facilities for immediate resumption of operation when power is reconnected.

II) Lightning

When buildings or cabinets housing electrical control equipment are struck by lightning, fail safe surge protection equipment trips all mechanical equipment.

This requires all the equipment to be reset and switched on again. On an unmanned plant there will be a delay between the trip-out following the lightning strike and the operators getting to the plant to reset the equipment.

During this period the plant may fail to comply with the relevant standards.

III) Storm and Flood

During periods of very heavy rain, areas of the local sewer network may suffer such ingress of storm water that surcharge of the sewer system will result, causing abnormally large flows to arrive at the STP inlet.

Under these conditions, the treatment plant would receive much higher flows than that designed for and would suffer severe hydraulic overloading.

The effect would be a rapid wash through of sewage and solids causing the works to fail to meet standards.

IV) Major Mechanical Breakdown

In many existing sewage treatment plants, particularly the small ones, insufficient standby equipment has been provided by the developer.

All new plants must be equipped with standby units having an automatic change over system in the event of failure.

Existing plants may be out of action for several days while repairs are carried out to failed equipment. To help alleviate this problem, the operator needs to carry critical spare parts to help speed the repair process.

V) Vandalism, Theft and Criminal Damage

If a treatment plant is subject to this form of interference, then the treatment process is at risk until the necessary repairs are carried out.

Reasonable measures must be taken to deter vandalism.
VI) Deliberate Discharge of Toxic Chemicals

From time to time, irresponsible industrialists may discharge chemical waste to the sewer in contravention of all the relevant legislation.

This may occur as a one-off dumping exercise, or may be the result of a small continuous discharge from a trade process which affects the treatability of the sewage and causes the treatment plant to fail.

VII) Accidental Discharge of Strong Loads or Toxic Substances

From time to time, genuine accidents occur on industrial premises or on the highway that result in abnormal discharges to the sewer. These may take the form of serious fires at industrial premises, the sudden failure of large storage tanks or a major traffic incident involving the transport of liquid products.

Such discharges to the sewer system would almost always result in the sewage treatment plant failing to comply until the effects of the discharge have passed through the system.

VIII) Major Blockages in the Sewer Network System

A blockage in the main sewer network system often causes the sewage to build up behind the blockage and turn septic.

The sudden release of this large volume of septic sewage by the clearance of the blockage, may cause temporary overloading of the treatment plant and lead to a reduction in effluent quality beyond the absolute standard for a short period of time.

IX) Defect

Completed treatment plant to be inspected by competent personal. Visual inspection to be conducted during the final stage of construction. Two type of defect generally detected during inspection:

a) Minor Defect

Non-critical, do not immediately or unduly affect the performance of the plant but nevertheless, require attention to rectify faults within reasonable time frame.

b) Major Defect

Critical or serious and require immediate action to be taken in rectifying faults, impair plant performance, unit processes, or system components.
Consultant’s responsibility to ensure compliance of the design standard and good engineering practice.

7.7 Energy Saving

In selection of treatment process or equipment, the designer should consider the best product which minimized the power consumption for process and major plant equipment without compromising on the quality of treatment discharge.

7.8 Recycle and Reuse

a) To promote/encourage designer to look into potential of energy reuse.

b) To utilize the recycle water (reclaim water) for cleaning and landscaping purposes,

c) To promote and encourage design to identify potential of sludge reuse and/or recycle.