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MACEDONIAN CIVIC EDUCATION CENTER

United States European Command

GUIDELINES MANUAL FOR MAINTENANCE OF SCHOOL BUILDINGS

PART TWO

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This document was prepared by the USAID Youth Ethnic Integration Project team, implemented by Macedonian Civic Education Center (MCEC), in collaboration with the Ministry of Education and Science/Sector for Capital Investments, in coordination with the Office of Defense Cooperation in the US Embassy in Skopje, with the support of the American people through the United States Agency for International Development (USAID). The contents of the document are the responsibility of the authors and do not necessarily reflect the views of the United States Agency for International Development (USAID) or the United States Government.

Title:
GUIDELINES MANUAL FOR MAINTENANCE OF SCHOOL BUILDINGS - PART TWO

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1 INTRODUCTION

Pursuant to Article 55 paragraph 1 of the Law on Organization and Operation of the State Administrative Bodies ("Official Gazette of the Republic of Macedonia" No. 58/00, 44/02, 82/08, 167/10 and 51/11 and "Official Gazette of the Republic of North Macedonia" No.96/19 and 110/19), the Minister of Education and Science adopted

THE SECOND PART OF THE GUIDELINES MANUAL FOR MAINTENANCE OF SCHOOL BUILDINGS

The second part of the Guidelines Manual for Maintenance of School Buildings is developed as part of the USAID Youth Ethnic Integration Project (YEI), implemented by the Macedonian Center for Civic Education (MCEC), in cooperation with the Ministry of Education and Science, key educational institutions, as well as all municipalities/City of Skopje and schools in the Republic of North Macedonia. The funds for the reconstruction of the schools within the project are provided by the European Command of the US Army (EUCOM).

This Manual is a continuation of the first part of the Guidelines Manual for Maintenance of School Buildings, developed under the previous USAID Interethnic Integration in Education Project (IIEP). Both parts of the handbook should be used together, so that schools can start and proceed with the process of developing own procedures and standards for maintaining school facilities.

1. PURPOSE OF THE GUIDELINES MANUAL

The school is not only a place where the educational process takes place, but also an environment where students and teachers spend most of the day. Therefore, the school environment should be clean, safe and comfortable for learning and work.

That is why the second part of the Guidelines Manual for Maintenance of School Buildings offers a number of useful guidelines and recommendations for educational institutions, municipalities and schools, by sharing good practices and experiences regarding 1) school cleaning procedures, 2) operational procedures for planning, preparation and management of disasters (emergencies), and 3) maintenance of solar power systems.

By using this manual, the following goals will be met:

- Maintenance staff and custodians will be able to improve the planning process and their productivity by applying the recommendations for establishing optimal cleaning standards in the school buildings.
- Maintenance staff will learn how to optimally maintain solar power systems, extending their lifespan and avoiding potential hazards because of system problems.
- Leadership and all school staff along with students and parents will learn how to increase school safety by learning about their roles and responsibilities in the event of natural disasters (emergencies), but also how to respond and evacuate safely in such case.

The ultimate purpose of this manual is to support schools and municipalities in their efforts to improve the efficiency and effectiveness of school maintenance, increase safety and provide a clean, sustainable and safe learning and working environment in all schools.

2. STRUCTURE OF THE GUIDELINES MANUAL

This Guidelines Manual is comprised of three separate chapters that address three different areas of schools' work:

- School cleaning and maintenance;
- Disaster (emergency) risk management in schools;
- Maintenance of solar power systems.

Having in place cleaning standards as well as establishing thorough cleaning procedures and activities to be followed by the maintenance staff are the best strategy and practice for improving school hygiene, reducing contamination, preventing infections and providing a healthy learning and working environment. The first chapter of this Guidelines Manual focuses on several important aspects of school cleaning: the cleaning standards in schools, the basic and specialized cleaning procedures for different parts of the school building, use of environmentally friendly cleaning product, appropriate equipment and tools, occupational safety and training, and the process of evaluating the work of the maintenance staff.

The second chapter focuses on creating a safe environment in every school. This continuous process involves developing and implementing strategies to support the safety and security of students not only in the school but also in the community. The purpose of this chapter is to identify the natural disasters that can affect schools and to plan possible responses by identifying the responsibilities and duties of all school staff. Preparing, implementing and continually updating the disaster (emergency) risk management plan will encourage the management, administration, student support services, maintenance staff, teachers, students and parents to respond promptly and calmly without panic in the event of a natural disaster. In addition, all stakeholders should be educated and trained to assume their roles and responsibilities before, during, and after the emergency. With the preparation of a disaster (emergency) risk management plan, the school will send a clear message to parents and the local community that it has established guidelines and procedures for effective disaster (emergency) management.

Solar energy is an unlimited, renewable and environmentally friendly source of energy that can be converted into heat or electricity. These advantages of solar energy can be used in schools for the production of hot water, which can be used for sanitary and heating purposes as well as for production of electricity. Proper maintenance of these systems requires knowledge of the different types of solar energy systems that can be installed in schools, including their main components and the way they work.

The third chapter describes the procedures for identifying the most common system errors, the consequences these errors may have on the system, and possible solutions for removing these errors. By carefully monitoring warnings and safety precautions, school maintenance staff will be able to prevent possible hazards and risks, such as the danger of fire, but also to improve the safety and extend the life of systems that use solar energy.

In addition, the Guidelines Manual provides supplementary materials - tables that will give guidance to schools how to perform regular cleaning, as well as how to prepare protection and rescue plan in case of natural disasters.

3. WHO IS THE GUIDELINES MANUAL INTENDED FOR?

Having in mind that the second part of the Guidelines Manual for Maintenance of School Buildings addresses three different areas of school maintenance, it is intended for different users:

Ministry of Education and Science/Unit for Capital Investments as an institution that should influence at national level the implementation of programs and legislation for better and more efficient school maintenance.

Education sectors/departments in the local government units and municipal education inspectors that control school conditions and may influence the implementation of standards and maintenance procedures.

Leadership and administration in primary and secondary schools, including the principal, secretary, and student support services, should use the guidelines and standards in this manual to improve the quality and consistency of maintenance of solar energy systems, to improve cleaning and hygiene, safety and the quality of the learning environment in schools, while controlling the maintenance costs.

Custodians, as part of the maintenance staff, who are primarily responsible for maintaining hygiene in school facilities, should use the means, methods, and established criteria to meet the cleaning standards. By using this manual, custodians will be better prepared to implement an annual plan for regular and deep cleaning and maintenance, to supervise completion of assigned tasks, and to extend the life of school facilities and equipment.

Technical (maintenance) staff, in particular the groundskeeper and/or the repairmen, should play a key role in identifying possible technical problems in the operation of solar power systems and are an important factor in monitoring safety measures and recommendations and timely elimination of system faults. Their role and responsibilities in the regular maintenance of school buildings and the school grounds are also essential for the normal functioning of the schools.

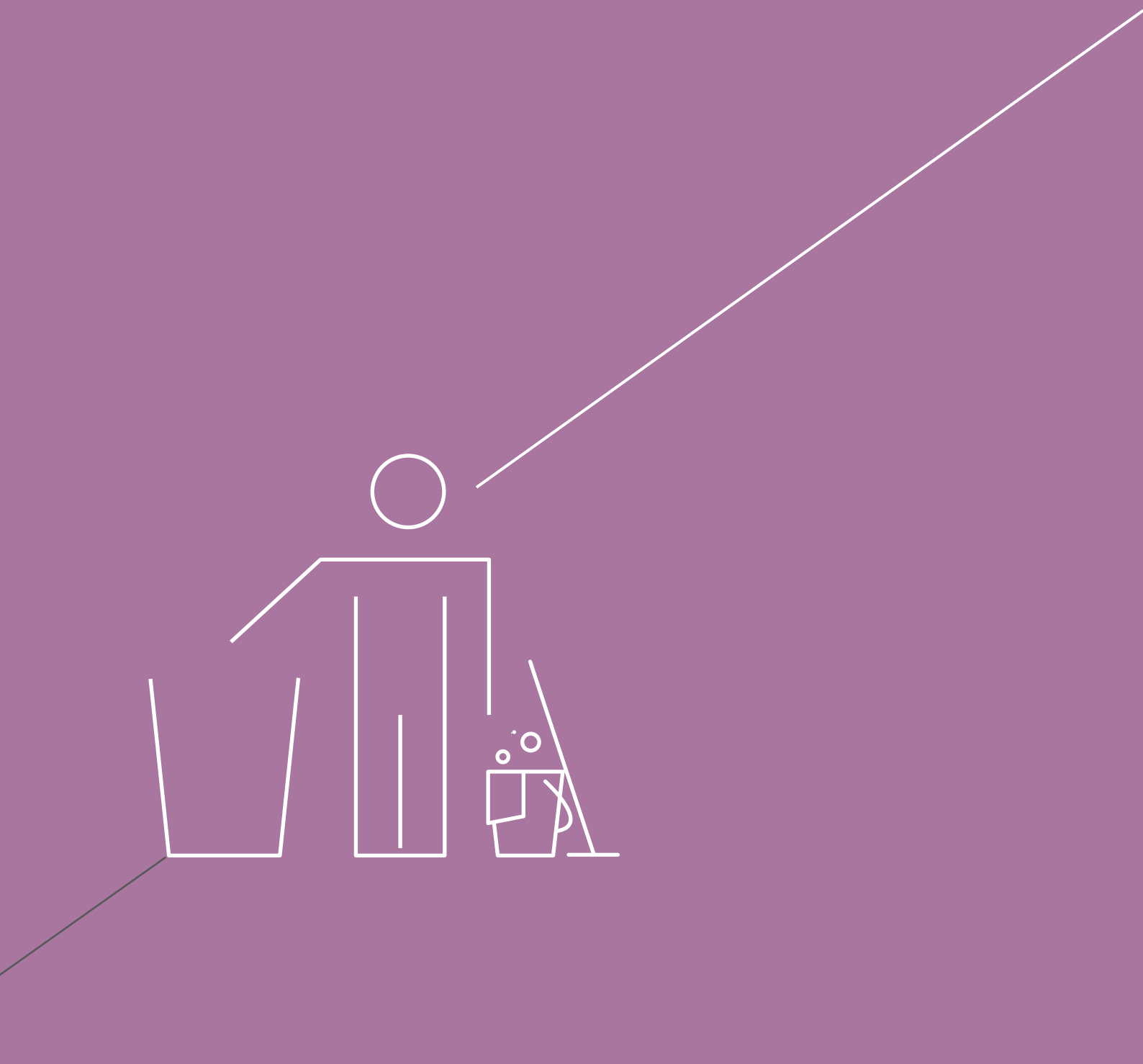
All school staff should help maintain orderliness and hygiene in the school and create a safe learning environment. Teachers can help custodians by teaching students to maintain hygiene, making sure that waste is disposed properly, by showing a personal example of how hygiene is maintained, and by reporting any clutter. In addition, teachers are directly responsible for educating students to maintain safety in schools, how to respond in the event of a natural disaster, how to protect and behave in order to enable rapid and efficient evacuation, without creating panic among students.

Students in terms of school hygiene should accept their responsibility to throw garbage into waste bins, select waste and always wash their hands with soap. On the other hand, they should actively participate in maintaining school safety, remain calm, responsibly apply the protection measures in the event of natural disasters and assist as much as they can, and always report any suspicious activity in the school.

Parents can also contribute for improving school hygiene by involving children in certain cleaning activities at home and developing good personal hygiene habits. Parents' attitude towards school safety also directly affects students' behavior, so they should trust the safety measures taken by the school and encourage their children not to panic in the event of natural disasters, but to monitor always the guidelines and instructions from teachers.

By using the materials, standards and recommendations given in the Guidelines Manual for Maintenance of School Buildings it is expected to:

- improve the learning conditions and environment;
- increase the level of hygiene in schools;
- provide a healthy and safe environment for students, teachers, and all school staff;
- increase the energy efficiency of the facilities;
- reduce costs (heating, electricity, water, etc.);
- increase the lifespan of solar-powered systems installed in schools;
- ensure efficient use of national and municipal resources earmarked for schools.



II SCHOOL CLEANING AND MAINTENANCE

1. IMPORTANCE OF SCHOOL CLEANING

School cleaning and maintenance has impact on student safety and academic performance of students. By promoting high standards of cleanliness, the schools provide conditions for a better teaching and learning environment.

DID YOU KNOW?

Everyday germs are more likely to make you sick than SARS, MRSA, COVID-19 or other "headline" illness. Typically in the winter, as people spend more time indoors and in direct contact with each other, there is a greater likelihood of spreading germs (specifically influenza) through airborne particulates. Custodians should remember to disinfect desks, doorknobs and light switches, particularly from October through March.

Some of the most important benefits of clean schools are:

- **Improved learning environment**

The US study conducted through the Center for Facilities Research at APPA[1] – the association promoting leadership in educational facilities – and co-sponsored by ISSA, the worldwide cleaning industry association, showed that cleanliness is ranked as the fourth most important building element to affect students' personal learning. The top three building elements were noise, air temperature and lighting.

1 https://www.facilitiesnet.com/educationalfacilities/article/Study-Clean-Schools-Promote-Academic-Success--9072

- **Meaningful parental involvement**

When parents encourage their children, and themselves are involved in maintaining the school and school grounds, they contribute to creating a healthy and clean learning environment.

- **More productive teaching**

Teachers are more productive when they interact with children in healthy, clean classrooms.

- **Fewer absences and sick days**

Custodians make sure all areas of the school building are cleaned, sanitized and disinfected year-round. That protects everyone's health, reducing student absences and teacher sick days especially during flu season.

- **A shared sense of healthier school building**

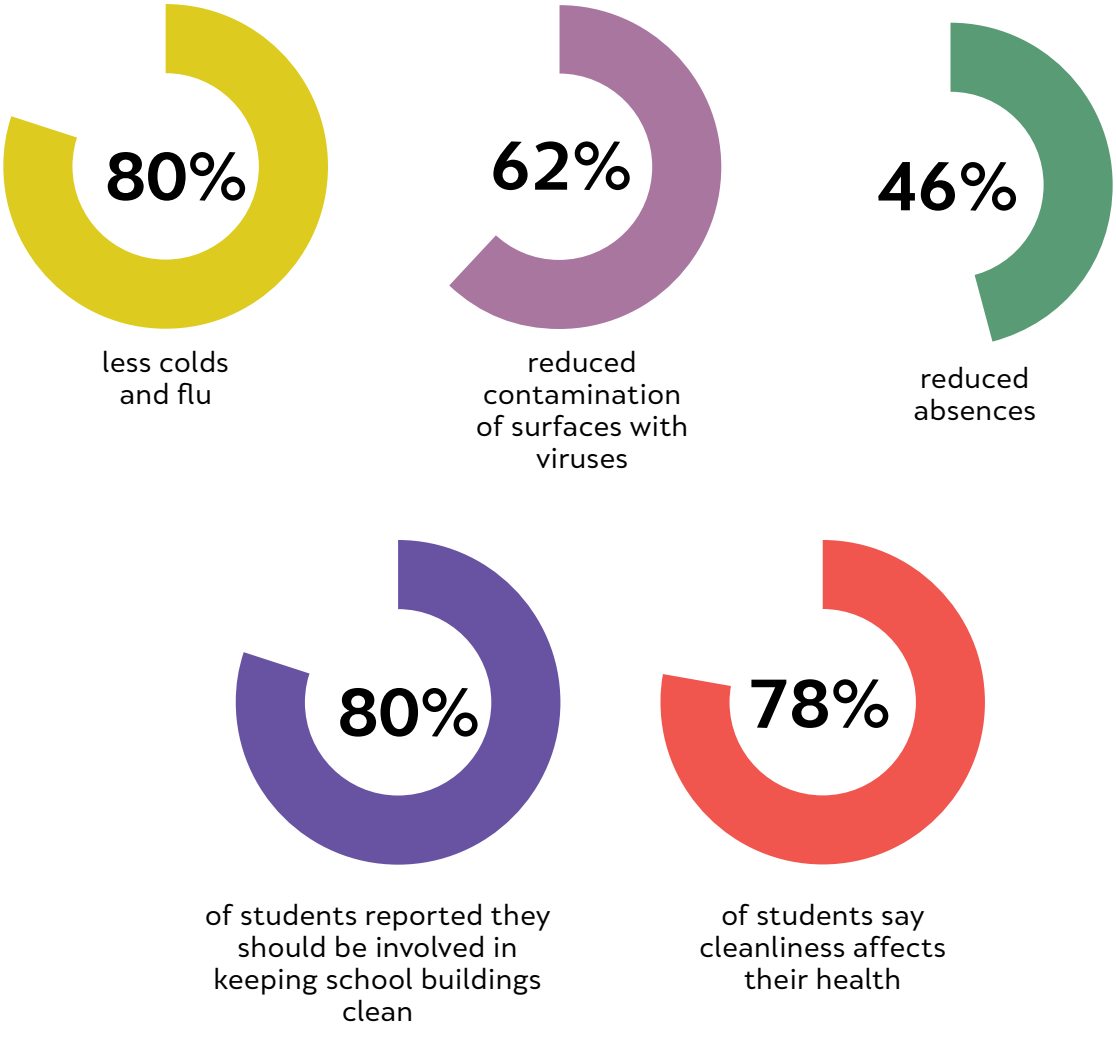
The cleanliness of school surroundings makes a difference in how students feel about their school. Clean classrooms, hallways and sport halls inspire everyone to join and keep the building in top shape. This shared sense of school pride results in a vibrant school that reflects the positive values, such as responsibility, togetherness, cooperation, respect for self, others and environment, are so important to a successful learning experience.

DID YOU KNOW?

Regular attention to cleaning improves overall cleanliness of school building, increases academic performance, reduces school budget for cleaning products, decreases the number of hours to the cleaning schedule and extends life of school building.

In general, schools in our country have cleaning systems, which have no quantifiable standards, have little or no method of measuring effectiveness and performance and are based solely on appearance. School maintenance is not based on actual international research and most custodians use the same tools and processes today that were used 50 years ago.

Findings of the Center for Facilities Research show that about 80 percent of the students reported that lack of cleanliness affected their health, such as allergies and spread of germs, but also that they as students should be involved in keeping campus buildings clean. The other findings are presented below.



School maintenance in general and school cleaning in particular should not be seen as additional cost in the limited school budgets, but as an investment in a healthy learning environment.

DID YOU KNOW?

Clean facilities are not cost, but an investment in a healthy learning environment.

Therefore, in order to support schools and municipalities in their efforts to increase efficiency in maintaining school buildings, this chapter sets out the cleaning standards for each part of the school building, describes the proper use of equipment and cleaning products and addresses the budgetary requirements needed to establish uniform standards for maintaining school hygiene and their implementation in practice.

2. LEGISLATIVE FRAMEWORK

In preparation of this chapter, due regard was given to the existing legislation and guidance including, but not limited, to the following:

- The Law on Primary Education;
- The Law on Secondary Education;
- The Collective Agreement for Primary Education;
- The Collective Agreement for Secondary Education;
- Template for Systematization of Jobs in Primary and Secondary Schools issued by the Ministry of Information Society and Administration.

It is important this manual to be implemented in conjunction with the following accompanying documents:

- Health and Safety Policy;
- School Evacuation Plan;
- First Aid Policy.

Pursuant to the Law on Primary Education[2], Article 80, and the Law on Secondary Education[3], Article 59, the school employees can hold the following positions:

- Administrative workers;

2 Official Gazette of the Republic of North Macedonia No. 161/19

3 Official Gazette of the Republic of Macedonia No. 44/95, 24/96, 34/96, 35/97, 82/99, 29/02, 40/03, 42/03, 67/04, 55/05, 113/05, 35/06, 30/07, 49/07, 81/08, 92/08, 33/10, 116/10, 156/10, 18/11, 42/11, 51/11, 6/12, 100/12, 24/13, 41/14, 116/14, 135/14, 10/15, 98/15, 145/15, 30/16, 127/16, 67/17 and 64/18

- Public service providers in primary/ secondary education;
- Auxiliary technical staff..

The technical staff is further divided into following subgroups, categories and levels of work, as summarized in Table 1.

TABLE 1: Subgroups, categories and levels of work for technical staff

SUBGROUP	CATEGORY A LEVEL A1
Subgroup 1	▶ Custodian ▶ Steam boiler operator ▶ Groundskeeper ▶ Repairman and others
Subgroup 2	▶ Guard and others
Subgroup 3	▶ Driver, and others
Subgroup 4	▶ Dishwasher ▶ Cook and others
Subgroup 5	▶ General worker ▶ Laundry ▶ Care-giver and others

Alternatively, according to the Collective Agreement for Primary Education4, the jobs of technical staff are divided in several groups based on their complexity:

I. LOW COMPLEXITY JOBS, USE OF SIMPLE TOOLS

Subgroup 1:

- Custodian
- Guard

4 Official Gazette of the Republic of Macedonia No. 24/09, 17/09, 84/09, 28/10 and 39/10

Subgroup 2:

- Laundry
- Dishwasher

II. MEDIUM COMPLEXITY JOBS, REQUIRE SOME KNOWLEDGE AND JOB EXPERTISE

- Steam boiler operator

III. COMPLEX JOBS OF WIDER SCOPE, REQUIRE EXPERT KNOWLEDGE

Subgroup 1:

- Groundskeeper
- Cook
- Repairman

Subgroup 2:

- Driver

Based on these legal provisions, each school should prepare a Rulebook on systematization of job positions (template is provided by the Ministry of Information Society and Administration[5] and is available on their website), while the school principal is responsible for adopting the systematization of job positions. Furthermore, the school principal is responsible for selection and hiring of teachers, student support services and other administrative and technical staff in accordance with the law and the acts of the school; for allocation of teachers, student support services and other administrative and technical staff; and for making decisions on termination of employment of teachers, student support services and other administrative and technical staff in accordance with the law and collective agreement. The systematization outlines the specific responsibilities and tasks of the technical staff.

A template[6] of specific responsibilities and duties of school technical staff is provided below.

5 http://www.mio.gov.mk/?q=mk/urneci_sistematizacii

6 The template is prepared based on the best practices of schools in the country

TABLE 2: Template of job description and duties of school technical staff

JOB POSITION:	CUSTODIAN
Job Description:	Maintenance of facilities and equipment
Duties	▶ Performs regular maintenance, cleaning and sanitizing of the working premises, maintains the inventory, cleans the classrooms, entrances, corridors, toilets, sports hall, changing rooms, maintains outer premises around the school building ▶ Reports in timely manner all defects and damages to the Groundskeeper ▶ Performs deep cleaning of the premises (once a month) ▶ Reports and keeps the lost and found items in the school ▶ Responsible for proper handling and maintenance of the inventory, school installations and the building ▶ Helps in organizing school events ▶ In case of absence, other staff members are obliged to substitute for him/her ▶ On-call duty and replacements ▶ Alerts the school management of unauthorized access to school building ▶ Maintains the greenery, flower plants, flower pots, etc.
Reports to:	School Principal

JOB POSITION:	REPAIRMAN
Job Description:	Maintenance of facilities and equipment
Special Requirements:	▶ Crisis Response and Management Certificate ▶ Fire Prevention Certificate
Duties	▶ Takes care of the entire property of the school, maintenance and repair of electrical lighting and power grid, water and sewerage network, central heating and the carpentry in the school building, takes part in painting of the school building ▶ Contacts the repair services for quick removal of the defects that have occurred ▶ Takes care and maintains school furniture ▶ Responsible for power and other tools, fire extinguishers and hydrants in the school ▶ Maintains the school grounds ▶ Maintains the workshop, other premises and helps the custodians in cleaning the school building and sweeping the yard ▶ Performs tasks related to prevention and managing a crisis situation ▶ Substitutes other technical staff members as needed ▶ Distributes the school's mail to all institutions and ensures that the mail is delivered in a legally prescribed manner
Reports to:	School Principal

JOB POSITION:	GROUNDSKEEPER
Job Description:	Maintenance of facilities and equipment
Special Requirements:	▶ Crisis Response and Management Certificate ▶ Fire Prevention Certificate
Duties	▶ Procures all necessary materials (inventory, supplies and disposables) in the school ▶ Receives and provides inventory, supplies and disposables, maintains records, maintains bookkeeping – of fixed assets and small inventory and maintains a register for small inventories and fixed assets ▶ Responsible for recording all invoices regarding the school inventory, supplies and disposables and submitting them for clearance to the accountant ▶ Compiles monthly reports and controls all invoices by checking all incoming and outgoing receipts ▶ Keeps records of all inventory items used by the employees and tracks them down ▶ Prepares schedules and timetable for technical staff and makes substitute plans ▶ Helps in creating school inventory, cooperates with the inventory commission and compiles lists of disposable items ▶ Makes copies of necessary school materials and assists in binding the important school books, records and other materials ▶ Controls the billing system and payment for snacks and hot meals, children's magazines, student travel, photographs, security, etc. ▶ Distributes cleaning products, supervises the school maintenance and cleaning and ensures regular pest control of school premises ▶ In case of a break-in or natural disasters takes urgent measures for prevention of crisis situation ▶ Checks the fire extinguishers ▶ Works on prevention and management of a crisis situation ▶ Takes care for the entire property of the school, maintenance and repair of electrical lighting and power grid, water and sewerage network, central heating and the carpentry in the school building, takes part in painting of the school building ▶ Main point of contact with the repair services ▶ Takes care and maintains school furniture ▶ Responsible for power and other tools, fire extinguishers and hydrants in the school ▶ Maintains the school yard ▶ Maintains the workshop, other premises and helps the custodians in cleaning the school building and sweeping the yard ▶ Performs tasks related to prevention and managing a crisis situation ▶ Substitutes other technical staff members as needed ▶ Distributes the school's mail to all institutions and ensures that the mail is delivered in a legally prescribed manner
Reports to:	School Principal

JOB POSITION:	GUARD
Job Description:	Safety and security
Special Requirements:	▶ Crisis Response and Management Certificate ▶ Fire Prevention Certificate
Duties	▶ Secures school building, inventory and equipment ▶ Maintains the school yard ▶ Reports any damages to the school authorities ▶ In case of a break-in or natural disasters takes urgent measures for prevention of crisis situation ▶ Performs tasks related to prevention and managing of a crisis situation ▶ Takes care of the functionality of the equipment ▶ Performs monthly inspections of the technical equipment and fire extinguishers ▶ Checks the water supply and sewerage system ▶ Checks the electrical installation ▶ Checks and manages the fire extinguishers
Reports to:	School Principal

It is a good practice, the allocation of custodial staffing in each school to be based upon the following criteria:

- Student enrollment;
- Size of common areas;
- Area (in square meters) of the building(s).

An important criterion for determining the number of custodians required to maintain hygiene in a school building is to define the level of cleanliness expected in the school. As mentioned earlier, our schools do not have clearly defined cleaning standards, so it is recommended to take into account international cleaning standards (further explained in section 3. Cleaning standards and Appendix 1: Five Levels of Cleanliness). According to these standards, Level 3 cleaning is the norm for most school facilities to meet the health and hygienic standards. Level 2 cleaning is the uppermost standard, generally reserved for restrooms and food service areas. As a rule, the square meters under a single custodian's care must decrease in order for the level of cleanliness to increase.

Having in mind these criteria, the U.S. Department of Education and the National Center for Education Statistics, gave recommendations that are accepted in many countries throughout the world, that an adequately equipped custodian can clean approximately 1,200 to 2,000 square meters in 8-hour shift, in and outside the school building. Although the figures above are estimates, our research showed they are compatible with the conditions in our schools. Each school should specify the actual number of square meters per shift a custodian can clean, taking into account additional variables, including the type of flooring, wall covers, and number of windows.

2.1. CUSTODIAN RESPONSIBILITIES AND DUTIES

The responsibilities of school custodians are varied. The custodian is responsible for the care of the physical building and its surroundings as well as the comfort of school staff and students. Custodians control many of the health conditions in the school and are partly responsible for the health of staff and students. By promoting high standards of cleanliness, the custodian can provide conditions for a better teaching and learning environment.

The main custodian responsibilities are in the following areas:

- **Building Security and Safety**

The primary responsibility of every custodian is the overall security of the school building. It is vitally important for the custodian to ensure that all exterior and interior doors and windows are locked and all lights are turned off before leaving the building at the end of the school day. In winter, it is their responsibility to remove snow from around normal and emergency exits and on sidewalks along normal walking routes. They should put down ice-melt to reduce slippery surfaces. In case of any other emergency, custodians should act in accordance with the instructions as outlined in the School Emergency and Evacuation Plan. Any defect, damage, theft and/or vandalism of the school property should be promptly reported to the principal (even during the summer months).

- **Area Cleaning**

The important thing in custodial work is thoroughness. Cleaning different school areas involves numerous custodial skills and tasks, so it is important to establish a regular routine and not deviate from it. Following a routine will allow custodians to work more effectively and will reduce chances of omitting a step or missing an important area of cleaning. Cleaning schedules are helpful for this process..

Equipment Care

It is the responsibility of the custodian to ensure that all custodial equipment is in proper working order. Broken or well-worn hand equipment such as wet mops, dust mops, brooms, mop bucket, etc. should be replaced immediately. Do not waste time trying to repair these items when broken.

Chemicals Storage

Custodians are responsible to keep a record of all cleaning products and chemicals the school has in possession. Residential and over-the-counter cleaning products should not be allowed for use in schools, since they are not efficient in cleaning large areas, they are more expensive and have no health certificate. The supplier should train custodians on chemical usage and dilution procedures. The custodians should become familiar with any chemical they are not familiar with.

Facility Repairs

It is the responsibility of the custodian to report for any building/grounds repairs to the groundskeeper and/or school principal. If the custodian is also a repairman, in that case it would be expected from the custodian to make some minor repairs such as changing lamps, minor furniture repair and adjustments, etc.

Protective Clothing and Equipment

Each custodian is responsible to ensure that proper protective clothing and equipment is available for each task to be performed.

Outside Maintenance (school grounds)

In addition to the interiors of school buildings, it is responsibility of each custodian to maintain the schoolyard, such as mowing lawns, maintaining pedestrian paths, parking lots and other amenities. Any necessary watering will be done in cooperation with technical staff if required. They should perform a daily check on playground equipment to see whether it is safe for use at all times and report any excessive damage to the groundskeeper and the principal at once. They should also ensure that all exit doors, sidewalks and stairs are free from snow, ice and obstructions at all times.

REMEMBER

The most important task of custodians is to maintain a healthy learning environment in the school building.

The operational guidelines outlined below are not intended to be all-inclusive, but are only illustrative as far as custodians' duties/tasks to be performed on a daily basis. Certain changes in the schedule and work duties are possible, depending on the school activities.

In the morning:

1. Check the school for break-ins/burglary or vandalism.
2. Check all heating appliances to determine if they are working. Report any unusual noise or vibration to the school groundskeeper at once.
3. Check to ensure that all toilets, urinals, sinks and any other plumbing equipment are functional.
4. Make sure all entrances are cleared of snow removal. Use ice melt when applicable.
5. Open the school for students at the time that has been set by the school principal.

During the school working hours:

1. Check all washrooms/ restrooms for cleanliness and make sure that there are adequate supplies of paper products, garbage bags in waste baskets and hand soap.
2. Clean all entrances and tidy hallways.
3. Remove debris and report hazards on playgrounds, parking area and school grounds to both Principal and Groundskeeper.
4. Check with Principal or Vice Principal for special requests.

At the end of the day:

1. Make sure that all light fixtures are in good work order. Replace all burnt bulbs.
2. Lock all entrances (doors and windows) at the time set by the Principal.

Custodians are expected to work together to keep the entire school building as clean as possible.

Every school is required to have at minimum, two custodians (or groundskeeper and custodian) who will hold the school keys and will be responsible to open and close the building.

Full-time custodian staff members work 40 hours per week, 8 hours per day, but depending on school size, they may work in one/ two/ three shifts.

2.2. CUSTODIAL CLEANING SCHEDULES

In order to meet the cleaning standards at highest level, the custodial team should adopt daily, weekly, monthly and annual cleaning schedules. Cleaning schedules should be systematic and well planned, to include both routine daily cleaning conducted during quiet/slow periods as well as periodic deep cleaning and should include both indoor and outdoor areas.

Having a cleaning schedule will ensure that:

- Daily requirements are completed; these include the daily emptying of rubbish bins and the cleaning of classrooms, washrooms, corridors, and changing rooms.
- Weekly requirements are completed; these include the vacuuming.
- Monthly requirements are completed; these include the deep cleaning of sanitary ware.
- High level cleaning is completed in 2 - 3 month cycles; these include the dusting of venetian blinds, carpets and fabric cleaning, and the deep cleaning of kitchens and equipment.

The cleaning schedule should outline the level of cleaning appropriate to each area of the school, which may include:

- Non-complex but labor intensive cleaning (such as in classrooms and corridors);
- Specialized cleaning of surfaces (such as high-story windows and air conditioning ducts);
- High-level cleaning and dust control (such as in kitchens, gymnasiums and computer rooms);
- The sterilization of surfaces and instruments (such as in science laboratories).

A sample of daily, weekly, monthly and annual or summer holiday cleaning schedules are provided in Appendices 2 to 5.

A custodian work schedule and the tasks to be performed can be simply presented in a table like the one shown below.

TABLE 3: Sample Custodian Work Schedule

SCHOOL:		FREQUENCY				CUSTODIAN ASSIGNED:
SHIFT:						
WORKING HOURS	WORK DUTIES	Daily	Weekly	Monthly	As needed	COMMENTS

Additionally, each school should develop its own maintenance and cleaning plan to bring together the procedures relating to maintenance and cleaning of the school. The plan should apply to everyone working at the school whether a teacher or custodian member staff in order to make sure that correct procedures are followed.

The main objectives of the cleaning plan are to:

- Enhance the appearance of the school, ensuring a healthy and productive learning environment;
- Control bacteria and the spread of infection;
- Reduce the risk of slips, trips and falls;
- Assist in the maintenance of equipment;
- Protect school property including fabrics, fixtures and fittings.

3. CLEANING STANDARDS

Cleaning standards help to not only visually inspect cleanliness, but also to measure the effectiveness and output of cleaning efforts, protect the health of students and school staff.

Cleaning standards should be established in the school's cleaning schedule. This will institute the quality of cleanliness and the requirements for compliance with health and safety regulations.

Appendix 1 outlines APPA: Leadership in Educational Facilities standards used by the custodial services to benchmark and evaluate the cleanliness of school facilities on international level.

The standards have five levels:

LEVEL 1: Cleaning at the highest level. At this standard, surfaces shine and are highly polished with no accumulation of dust, dirt, marks or smudges. This might normally be found in a hospital environment and it is not expected in schools.

LEVEL 2: Uppermost standard for most school cleaning, and is generally reserved for restrooms and food service areas. At this level, all surfaces are bright and clean with little accumulation of dirt, dust, stains or streaks.

LEVEL 3: Base level at which cleaning should be maintained in instructional spaces. Dust, dirt, stains may be observable, but It is acceptable and does not pose any health issues.

LEVEL 4: Low level of cleaning. Areas show significant accumulations of dirt and stains and appear unacceptably unkempt. School custodians should aspire to maintain all cleaned spaces at Level 3 or higher.

LEVEL 5: Lowest level, at which areas are perpetually dirty and grossly unkempt, causing irreversible damage to surfaces and structures

DID YOU KNOW?

Because of the nature of the job itself, custodians should wear gloves, **wash their hands frequently** and avoid touching their hands to their mouth, nose or eyes. Hand sanitizer is not an effective deterrent to cold or flu viruses, but hand washing is.

4. CLEANING PROCEDURES

4.1. BASIC CLEANING PROCEDURES

Good housekeeping requires an understanding of basic custodial skills such as dusting, sweeping, dry and wet mopping, etc. While doing this, custodians use various types of equipment to perform these individual tasks and should know how to use and maintain them properly.

Custodial work and procedures should change as new products and equipment are developed and this should be reflected in school's cleaning plan.

4.2. DUSTING

Dusting is the process of removing particles of dirt from a surface and preventing their redistribution within the area or building. Dust build-up can harden and become thick in corners. Dust will also stain furniture and spread infection. The potential spread of infectious diseases can result from moderate dust accumulation. When dusting, always start at the top and dust down.

MATERIALS REQUIRED:

- **Hand duster or dust cloth.**
- **Damp dust cloth or paper towel.**

PROCEDURE:

1. Upon entering an area, begin at the entrance and work around the perimeter of the room.
2. Dust everything between knee level and eye level as needed.
3. Start with the highest point and work down.
4. Watch for smudges, oily spots, and streaks. These should be removed thoroughly.
5. Never shake out duster or cloth in the building.

CLEAN UP:

- Replace hand duster. If the school has laundry, send soiled hand dusters and cleaning cloths to the laundry for cleaning, otherwise hand wash.

4.3. FLOOR CLEANING

Floor cleaning is one of the first lines of defense against health issues in a school. It is one of the most important skills a custodian has to gain in order to provide a safe, healthy, clean, and comfortable learning environment for students. Floor cleaning in a school setting is different from a home setting. First, there is much more area to be covered in a specific amount of time. Second, there are classrooms, long hallways, common areas and different floor varieties, which make the need for floor cleaning to be flexible and efficient.

4.3.1. DUST MOPPING

Dust mopping helps to remove fine dust and grit, which could grind away floor finish and make floors slippery. Mops are also used to remove fine particles, which a broom and a vacuum will not pick up. Dust mop only dry floors. If the floor is damp, use a broom. The mop enhances the beauty of the floor for a longer period.

DID YOU KNOW?

The dust mop gathers dust and grit unlike a broom, which lifts dust.

For applying dust mop treatment, use the following steps:

- Apply treatment evenly over the mop at least the night before. This allows the mop time to absorb the treatment.
- Roll up the mop and store in plastic.
- In the morning, carefully clean the floor.
- Use a brush for corners of the floor where the mop cannot reach.

When using the cotton head mop, lift and drop it. This gets all the strings into their working position. The mop opens like a parachute when it is dropped. The mop is lopped so it glides over the floor easily. It makes the mop more efficient and will not leave dirt streaks.

MATERIALS REQUIRED:

- **Dust mop of an appropriate size for the area to be mopped. Dust mops come in different sizes and can be made of microfiber or cotton.**
- **Dust mop treatment (optional, not required).**

PROCEDURE:

1. Treat mop with dust mop treatment about 24 hours prior to use.
2. Using one continuous movement, dust the floor area without lifting the mop off the floor.
3. Use the swivel to maneuver mop.
4. Keep the dirt and grit in front of the mop. Collect heavy dirt in a dustpan.

CLEAN UP:

- Release trapped soil by shaking mop inside a plastic bag, by vacuuming or by brushing the mop with a whisk broom or scrub brush. (Releasing the soil extends the life of a disposable mop.)
- Replace dirty mops regularly.

DID YOU KNOW?

Treatment should be used sparingly! Too much treatment can leave streaks and make the floor slippery.

4.3.2. DAMP MOPPING

Cutting-In is a technique for mopping floor edges and corners, an area of least wear that needs the most care. When cutting-in, the mop should be kept parallel to the wall. It helps to:

- Control dirty build-up in corners and along the edges.
- Eliminate splashing walls, which then must be wiped by hand.

MATERIALS REQUIRED:

- **Cotton-string mop-head (clean) and handle.**
- **Mop bucket with wringer and proper cleaning solution.**
- **A putty knife for removing dirt in corners.**

PROCEDURE:

5. Put out the “Wet Floor” signs.
6. Dust mop the floor.
7. Use one bucket with proper cleaning solution.
8. ‘Cut-in’ using a wrung out mop.
9. Mop floor area with wrung out mop using the figure 8 pattern.[7]

CLEAN UP:

- Rinse mop with clear water.
- Hang mop up to dry.
- Rinse and wipe out the wringer.
- Rinse and wipe out bucket.
- Store the bucket upside down.

4.3.3. WET MOPPING

Wet Mopping is a two-steps process. First, the cleaning solution should be put down with a dripping mop. Then the solution should be picked up with a damp (wrung out) mop. Wet mopping is done to remove soil that cannot be removed by damp mopping.

7 For how to clean using the figure 8 pattern, watch this video: https://www.youtube.com/watch?v=ivmBrbO32Qo

MATERIALS REQUIRED:

- **Cotton-string mop-head (clean) and handle.**
- **Mop bucket with ringer and proper cleaning solution.**

PROCEDURE:

1. Put out 'Wet Floor' signs.
2. Sweep the floor.
3. 'Cut-in' with a dripping mop.
4. Apply solution to floor area. Use a dripping mop. Use the figure 8 pattern for efficiency.
5. Pick up solution using a damp (wrung-out) mop - again figure 8 - until floor is no longer wet.
6. If rinsing is required, repeat steps 4 and 5 with rinse solution made up of clear water.

CLEAN UP:

- Rinse mop with clear water.
- Hang mop up to dry.
- Rinse and wipe out wringer.
- Rinse and wipe out bucket.

DID YOU KNOW?

DO NOT over wet the floor!

Over wetting can affect floor finish. Too much solution on floor means too much time to pick it up. Drying time takes too long and the excess solution can loosen floor tiles.

4.3.4. VACUUMING[8]

Proper vacuuming is at the cornerstone of effective school cleaning. Floors contain the largest concentrations of allergens due to heavy foot traffic, and carpeted surfaces, common in school offices and libraries, contain higher levels of allergens than hard-surface floors. Inadequate cleaning may affect up to 20% of the occupants of school buildings who are susceptible to allergies or asthma. This is why, floors should be vacuumed regularly, especially after dusting. Cleaning professionals suggest that they can clean floors faster by removing dry dirt with a vacuum instead of a dry mop before wet mopping.

The ideal maintenance practices for cleaning carpets include:

- Deep cleaning carpeting at least twice per year;
- Replacing carpet according to manufacturer recommendations;
- Thorough weekly vacuuming with high quality HEPA-filter vacuums;
- Properly maintaining cleaning equipment.

MATERIALS REQUIRED:

- **A vacuum cleaner, wand and shoe with 15-meter cord and grounding plug.**
- **HEPA filter.**

PROCEDURE:

For classrooms:

1. Inspect electrical cord for cracks, breaks, or plug damage. DO NOT use machine if any of these conditions exist.
2. Locate wall plug and plug cord into wall plate.
3. Turn on vacuum and start vacuuming the floor down aisle closest to the wall, using smooth fore and aft movements.
4. Keeping vacuum head on the floor move quickly down the aisle vacuuming the aisle and then underneath each desk on one side of the aisle. At the end of the aisle, turn around and head back up the aisle with the wand still on the floor but this time pay attention to desks on the other side of the aisle.
5. Repeat steps 3 and 4 until all aisles have been vacuumed and the desks have been vacuumed underneath.
6. Vacuum under the teacher desks and in the corners and main traffic areas of the classroom.

8 Although vacuuming is part of basic cleaning procedures, not all schools have a vacuum cleaner. Therefore, this section applies to schools that have vacuum cleaners.

7. The average time spent for classroom vacuuming is 4 - 6 minutes per classroom.
8. When vacuuming is complete, turn off vacuum with the switch, walk to wall plate and unplug the extension cord, and begin winding up the extension cord from the vacuum to the wall plug making large loops as you reel in the cord.

DID YOU KNOW?

DO NOT pull the cord out of the wall with the vacuum still on, as this may damage the vacuum electric motor and cord.

DO NOT coil up the cord while it is still plugged into the wall, this will damage the cord.

For hallways and commons areas:

Hallways and large areas require a different technique than classrooms due to the large areas to be vacuumed.

1. Locate wall plug in the hallway and plug in vacuum.
2. Turn the vacuum on and start by swinging vacuum wand and head side-to-side in front of you while walking down the hallway reaching from the wall to the center of the hallway.
3. When you reach the length of the cord, move to the other half of the hallway and return to your starting position.
4. Remove the plug and wind up cord.
5. Go to the next plug; repeat steps 2 and 3 again until the entire hallway is vacuumed.
6. Commons areas must be divided up because of their size. Use wall plugs or other landmarks to divide up the area. Use the same side-to-side technique as hallway vacuuming for commons areas.

CLEAN UP:

- Check the vacuum bag; if the bag is over ¾ full, remove the paper bag and dispose, replace it with a new one.
- Clean the filter and the foam sound muffler weekly. Rinse these items out with water and let them dry over the weekend.
- Empty any traps that may catch heavier objects.
- Coil the cord by rolling it between fingers to prevent twisting.
- Clean vacuum with damp cloth and store properly.

4.4. DRINKING FOUNTAINS

Drinking fountains can become health hazards if not cleaned daily. Water borne chemicals build up quickly and may harbor germs if not removed as part of the daily cleaning procedures.

PROCEDURE:

1. Spray with a disinfectant solution.
2. Wipe clean and dry with a soft cloth.
3. Ensure drain holes are clean and clear of debris.
4. Operate fountain briefly to check for proper function.

4.5. WINDOW CLEANING

Major window cleaning projects are usually part of the school annual (summer) cleaning schedule. However, to keep the appearance of the school up, the custodian must clean certain windows daily in visible areas. The procedure described below should be used in all areas for routine window cleaning.

PROCEDURE:

1. Use Glass Cleaner. For routine cleaning, it is best to have it in a spray container.
2. With a clean cloth wipe off the glass, the edges of the glass and the frames.
3. Instead of a cloth, you can use a manual rubber wiper for annual cleaning.

4.6. COMPUTER CLEANING

School computers are either located in computer labs or in classrooms, but they should be cleaned regularly, as they may contain bacteria. Computer keyboard is usually the most germ-infected item. Cleaning it regularly helps remove any dangerous bacteria and keeps the keyboard working properly.

PROCEDURE:

1. Turn off the computer before cleaning.
2. Use a vacuum to remove dirt, dust and hair from around the computer, on the casing, and on the keyboard.
3. Be careful not to adjust any controls or disconnect any leads.
4. Do not spray any liquid onto or into computer equipment.

4.7. BODILY FLUIDS CLEANUP AND DISPOSAL

Bodily fluids cleanup is the responsibility of the custodian on duty at the time of notification of the incident. All bodily fluid spills should be treated as a priority biohazard cleanup. Bodily fluids include vomit, saliva, mucus, blood, urine, and feces. Custodians should closely follow the procedures listed below to comply with the safety standards. Only special disinfectant agent should be used when cleaning up body fluids of any kind.

MATERIALS REQUIRED:

- **"Wet Floor" signs.**
- **Personal protective equipment (vinyl gloves, long-sleeve shirt, safety glasses or face shield).**
- **Paper towels, disposable rags or cloth towels.**
- **Neutral cleaner in a spray bottle.**
- **Disinfectant in a spray bottle.**
- **Broom and dustpan.**
- **Trash bags.**
- **Mop and bucket with disinfectant.**

PROCEDURE:

1. Put on personal protective equipment.
2. Put out "Wet Floor" signs.
3. Sweep or carefully pick up any solids such as glass, paper or other hard objects and place in a trash bag.
4. For tile floors: damp mop entire area with a cleaner/disinfectant being careful not to spread the fluid or to contaminate a larger area. If on carpet - extract the carpet with your carpet extractor using hot water only. After you have completed extracting the area, spray the extracted area with disinfectant and let it dry.
5. Thoroughly clean and disinfect all the custodial equipment used. Carpet extractor, mop, bucket/wringer, broom and dustpan. Remove your personal protective equipment and discard into the trash bag with the other contaminants and cleaning debris; tie bag closed.
6. Place the trash bag with contaminated objects and cleaning debris inside a second trash bag and tie the bag. Dispose of the double trash bags with contaminants in the garbage dumpster.

NOTE:

Never use a vacuum to clean up this type of contaminated spill, as this may cause airborne contaminants. If a wet mop is used during the cleanup, dispose of the mop head as contaminated waste. Any equipment used during the cleanup process such as dustpans, scrapers, wood block, etc. must be completely cleaned off and disinfected prior to future use.

5. AREA CLEANING

Following right procedures for cleaning different school areas is a good practice for avoiding cross-contamination, that is the process by which bacteria or other microorganisms are unintentionally transferred from one surface or object to another, with harmful effect. While constantly cleaning these surfaces can seem to be an impossible task and very time-consuming, sticking to the procedures and cleaning schedules can make the maintenance of these areas much easier and more efficient.

5.1. ENTRANCE WAYS AND HALLWAYS

School entries and hallways channel students, visitors, and faculty to various rooms and offices from the outside. With them come soils, chemicals, pollutants and moisture that must be removed by the custodian. Dirt brought in on the hands and feet of students, staff and visitors ends up on doors, glass, walls and floors throughout the school. Furthermore, visitors frequently judge the condition of the entire building by the cleanliness of entrances and hallways, so it is important that they receive a good impression of the custodial service.

MATERIALS REQUIRED:

- **“Wet Floor” signs**
- **Window cleaner**
- **Neutral cleaner**
- **Replacement lights**
- **Wiper**
- **Sponges**
- **Floor brush or dust mop**
- **Putty knife**
- **Counter brush**
- **Wet mop**
- **Mop bucket with wringer**
- **Hand duster**
- **Custodial cart**

PROCEDURE:

1. Clean entrance door.
2. Remove rocks or objects that could prevent doors from closing properly. Make sure door hardware is clean and working properly.
3. Dust all areas between eye level and knee level - daily. High pipes and doorjambs can be dusted - weekly.
4. Sweep the inside and outside of entranceway.
5. Put out the “Wet Floor” signs.
6. Damp mop the floor with a neutral cleaner.
7. Use a putty knife to remove gum and dirt deposits.
8. Replace burned out lamps with proper replacement - as required.

Many entries have walk-off mats to remove sand and dirt before it can be tracked further into the school. These built-in mats need to be vacuumed daily. Removable mats should be taken outside and cleaned or vacuumed. Built-in traps should be cleaned daily.

Hallways also require considerable attention to keep them looking clean.

MATERIALS REQUIRED:

- **Same as for entrance cleaning**

PROCEDURE:

1. Put out “Wet Floor” signs.
2. Spot wash walls and lockers with a neutral cleaner.
3. Clean door glass and display cases with window cleaner - as needed.
4. Spray disinfectant on door handles.
5. Dust all horizontal surfaces including locker tops, window casings and doorways - weekly.
6. Replace burned out lamps with appropriate replacements - as required.
7. Clean drinking fountain(s) daily.
8. Dust mop floor with appropriate size dust mop and be sure to sweep or vacuum under furniture placed in the hall. Check the need for carpet spot cleaning or damp mopping.
9. Vacuum as needed – making sure that at least once a week all edges, corners, doorways, behind all doors, and under everything is vacuumed.

5.2. OFFICE CLEANING

MATERIALS REQUIRED:

- **Custodial cart**
- **Hand duster**
- **Window cleaner and paper towels**
- **Furniture polish and rags**
- **Vacuum cleaner**
- **Spray bottle with neutral cleaner**

PROCEDURE:

1. Empty all waste cans.
2. Refill soap and paper towel dispensers, if any.
3. Dust horizontal surfaces - weekly, except desktops. DO NOT move items or papers on desks.
4. Dust or clean countertops – weekly or as needed.
5. Vacuum floors – daily.
6. Clean windows, spot clean daily.
7. Carpet, check for stains and spot clean as needed.

5.3. CLASSROOM CLEANING

MATERIALS REQUIRED:

Tile floor equipment:

- **Dust mop**
- **Counter brush**
- **Dust pan**
- **Damp mop**
- **Mop bucket and wringer with neutral cleaner solution**
- **Putty knife**

Carpeted floor equipment:

- **Vacuum cleaner**
- **Spray bottle with water**
- **Rags for blotting fluid and water**

General cleaning equipment:

- Hand duster
- Window cleaner in spray bottle
- Paper or cloth towels
- Neutral cleaner in spray bottle
- Custodial cart
- Soap dispenser refills and paper towels (for classrooms with sinks)

PROCEDURE:

1. Empty waste cans.
2. Refill soap and paper towels dispensers.
3. Wipe doorknobs.
4. Remove all gum and black marks.
5. Wipe computers, computer screens, keyboards and mouse.
6. Dust cabinet tops, ledges, bookshelves - weekly.
7. Spot clean walls (especially by waste cans).
8. Dust mop floor or vacuum and straighten desks.
9. Spot mop floor or spot clean carpet - as needed.
10. Damp mop the entire floor.
11. Clean classroom door windows daily and classroom windows - as needed.
12. Classroom sink (where installed) cleaned weekly or as needed.
13. Replaced burned out light bulbs – as needed.
14. Vacuum as needed – making sure that at least once a week all edges, corners, doorways, behind all doors, and under everything is vacuumed.

DID YOU KNOW?

Keep lamps clean (dirty lamps can reduce light output by 15 percent).

5.4. RESTROOM CLEANING

Restroom cleaning is a combination of procedures designed to clean and sanitize restrooms and keep them in proper working order. Restroom cleaning includes waste pick-up, servicing of dispensers, dusting, wet mopping, and some special disinfecting procedures designed to maintain proper cleanliness. Clean restrooms are important for several reasons. Students and faculty tend to take better care of restrooms that are clean, well maintained. Nothing gets complaints faster than dirty restrooms or dispensers that are out of order. More importantly, clean restrooms are a safeguard to good health, reduce the possibility of transferring infections to others and will have no offensive odors.

Some restrooms are easier to clean due to wall construction, types of fixtures, floors, etc. The number of people using a restroom will control how often the restroom should be checked and cleaned.

MATERIALS REQUIRED:

- **“Wet floor” signs**
- **Toilet brush and bucket**
- **Sink brush and bucket**
- **Sponges and/or clean rags**
- **Paper supplies – paper towels and toilet paper**
- **Trash can liners**
- **Disinfectant and neutral cleaner in spray bottles**
- **Window cleaner**
- **Window wiper**
- **Broom and dust pan**
- **Wet mop (for restroom cleaning only)**
- **Mop bucket and wringer with disinfectant cleaner solution.**
- **Putty knife**
- **Hand Soap (for dispensers)**
- **Stainless Steel Cleaner**

PROCEDURE:

1. Close off the restroom.
2. Place “Wet Floor” sign at the door.
3. Empty waste bins. Replace liners as needed.
4. Check and fill toilet paper and paper towel dispensers.
5. Check and fill soap dispensers.

6. Clean and disinfect all contact points like door handles, knobs and partitions.
7. Spot clean walls - as needed.
8. Sweep floor with broom, pick up with dustpan.
9. Flush toilets and clean toilet bowl with toilet bowl cleaner.
10. Spray disinfectant cleaner on outside of toilet and toilet seat (unless a squatting toilet, when the disinfectant should be spread on a wider area).
11. Urinals (repeat steps 9 and 10).
12. Clean sinks with sink brush and solution.
13. Spray sinks and countertops with disinfectant cleaner.
14. Spray small amount of glass cleaner on mirrors. Wipe dry with soft cloth.
15. Wipe chrome fixtures with clean cloth to avoid water spotting.
16. Damp mop floor thoroughly using disinfectant.

DID YOU KNOW?

The average daily cleaning time for a restroom with 2 or 3 stalls is approximately 20 minutes, with 4 or 5 stalls is approximately 30 minutes, while for a restroom with 6 stalls or more is approximately 40 min.

5.5. LIBRARY CLEANING

Books are dust magnets, so pulling a book off the library shelf can make dust fly everywhere. A deep clean of the library is the best way to make the place look more presentable and appealing to students. This is why maintaining a cleaning schedule for the library is also important.

MATERIALS REQUIRED:

- **Vacuum Cleaner: A vacuum cleaner is suited to cleaning of materials in the stacks. A piece of cloth should be inserted so that the vacuum will not suck in any loose parts of the binding/paper.**
- **Dust Cloths: One-Wipe treated dust cloths are recommended as preservation safe for cleaning. Do not leave any harmful residues on books.**

PROCEDURE:

1. When cleaning shelves, work from the top shelf down, thus avoiding the reintroduction of dirt to a cleaned shelf.

2. If the tops of the books have a significant layer of dust, some of it can be removed while the books are still on the shelf. Using the vacuum, run the dust tool nozzle over the spines and the tops of the books.
3. Each book should also be removed from the shelves for individual vacuuming/ dusting.
4. Extreme care should be taken when handling any materials that are in fragile condition; for example, the spine is coming loose or the paper is flaking off. A book should never be "scrubbed at" with a dust cloth as the abrasive action of the cloth and the dust will cause damage to the paper and the book covering.
5. The shelves should be dusted before the materials are returned. The shelves themselves should be cleaned rather than just dusted if they are exceptionally dirty or have foreign substances on them; for example, spilled soft drink or coffee. The shelves should be allowed to dry completely before materials are returned to the shelf. Debris should be removed from the stack shelves and discarded; for example, loose sheets of paper, gum wrappers, etc.

5.6. KITCHEN/ LUNCHROOM CLEANING

The need for clean kitchens is obvious, as food for students must be prepared and served under the cleanest conditions possible. In most public schools, there are no kitchens, but in those schools with kitchen or dining areas, it is the responsibility of the custodian to clean up all traces of food from walls, floors, floor mats, under counters, and to carry out the garbage. If this is not done properly left over food will attract rodents, ants, and cockroaches. Additional responsibilities include cleaning the adjoining facilities and inside coolers and freezers (when shut down during the summer break period).

MATERIALS REQUIRED:

- **Hand soap**
- **Neutral cleaner**
- **Trashcan liners**
- **Mop, bucket and wringer with disinfectant solution**
- **Spray bottle of disinfectant**
- **Wet mop (for kitchen use only)**
- **Corn broom**
- **Dust pan**
- **Hand broom/Counter brush**
- **Putty knife**
- **Hand duster**
- **Sponges and/or clean rags**

PROCEDURE:

1. Put out the “Wet Floor” signs.
2. Collect trash and garbage. Carry out to dumpster.
3. Wash garbage cans - if needed with neutral cleaner.
4. Replace burned out lamps with proper replacements - as required.
5. Spot clean walls with neutral cleaner.
6. Sweep floor with broom.
7. Wet mop floor with neutral cleaner solution in mop bucket.
8. Put new garbage can liners in dried garbage cans and return to proper place in the kitchen.

5.7. GYM AND MULTI-PURPOSE ROOMS

Gym cleaning brings together many different custodial skills. The custodian responsible for cleaning the gymnasium must employ good restroom, changing room and entrance cleaning procedures as well. The gymnasium area should be maintained in a manner that provides a clean, safe and well-illuminated environment for students during gym class. Sporting events that take place in gymnasiums attract large numbers of the public who come to watch sporting events and other school programs. The custodian’s work comes under scrutiny during these events and many of those present will judge the school custodial services based on what they see.

MATERIALS REQUIRED:

- **Neutral cleaner in a spray bottle**
- **Window cleaner in a spray bottle**
- **Disinfectant in a spray bottle**
- **Dust mop, frame, and handle (untreated for all gym floors)**
- **Sponges and/or clean rags**
- **Hand broom/Counter brush**
- **Dust pan**
- **Duster with long handle**
- **Wet mop**
- **Mop bucket and wringer with neutral cleaner solution**
- **Putty knife**

PROCEDURE:

1. Walls should be spot cleaned daily with a neutral cleaner. Use graffiti cleaner in accordance with directions on difficult stains on painted surfaces if necessary to remove marks.
2. Floor should be dust mopped daily with the largest dust mop feasible to save time.
3. Remove gum and other dirt deposits with a putty knife. Be careful not to gouge the wood floor finish.
4. Spot mop spills with damp mop and neutral cleaner. DO NOT use more water than necessary when working with wood floors.
5. For drinking fountains, apply disinfectant with spray bottle or sponge. Use a small brush to clean drain holes and tight spots around the fountainhead. Rinse well and dry with a cloth.
6. Seats should be cleaned as soon as possible after use. Debris under seats should be swept or blown out and the floor spot mopped as soon as possible after use. Bleacher seats should be dusted periodically and spot mopped as needed. Check the opening and closing mechanisms for proper operations, broken parts or structural weakness.
7. Dust all horizontal areas. Use a hand duster attached to a long pole to dust high areas such as basketball backboards.
8. Damp mop the gym floor with neutral cleaner at least once weekly.

5.8. GROUNDS CLEANUP

Parents, students and the wider community form opinions about the school and its learning environment, based on the appearance and condition of its grounds. School surroundings can be used for children's active play and sports activities but also as a resource for learning and discovery. However, apart from trash pick up, custodian outdoor duties also include mowing the lawn, raking the leafs, trimming the trees and shrubs, watering flowers and other landscaping duties.

A schedule should be established that includes the daily policing of the grounds to remove litter and other debris, schedules for mowing, landscape care, and sweeping of sidewalks, driveways, and parking lots as necessary.

MATERIALS REQUIRED:

- **Trash can on wheels**
- **Trash picker (grabber on a stick)**
- **Vinyl/rubber gloves**
- **Trash can liners**
- **Push broom**
- **Dust Pan**
- **Lawn mower**
- **Hedge trimmer**
- **Rake**
- **Extension ladder (as needed to get on roof)**

PROCEDURE:

1. Pick up trash and debris daily.
2. Empty outdoor garbage cans and re-line as needed.
3. Clean parking lots and sidewalks as needed.
4. All entrances to be swept daily.
5. Mow the lawn as needed.
6. Rake the leafs as needed.
7. Water the plants and the lawn.

6. CLEANING PRODUCTS, EQUIPMENT AND TOOLS

6.1. CLEANING PRODUCTS

It is not possible to clean properly or safely without a working knowledge of the cleaning products and chemicals that are used. Most cleaners and disinfectants produced today come in a highly concentrated form and are formulated to do a specific job. It is important for the custodian to select the appropriate cleaner for the surface to be cleaned, the type of soil to be removed and/or the area to be disinfected. Even so called general-purpose cleaners are limited in scope and would be ineffective to sanitize a restroom, strip floor finish or wash windows.

Manufacturers of all cleaning products and disinfectants are required to state on their labels the proper directions for product safe usage. Proper dilution ratios and appropriate warnings are also required to be written on the label. It is important that the user read and understand what the instructions on the label mean. For example, a "Danger" label indicates that some additional safeguards and use of specific personal protective equipment may be necessary when handling the product, such as - g oggles, gloves, aprons, respirator, etc. In many instances, special training with the product is warranted. Product labels also provide first-aid recommendations for when incidents or misuse occurs.

Warning labels indicate that when using normal precautions, the product will result in no serious health concerns for the custodian. Listed below are the warning label categories for products usually used by custodians:

CAUTION: Lowest degree of hazard Minor or moderate injury. May irritate skin and eyes. If splashed in eyes or on skin, rinse thoroughly with water for 15 minutes. Call physician. May be irritating when inhaled. If vapors are irritating, relocate to fresh air, preferably outdoors until the irritation has ceased.

WARNING: Intermediate degree of hazard Death or serious injury. Will irritate eyes or skin when in contact with this product. If splashed in eyes or on skin, rinse thoroughly with water for 15 minutes, then call physician. May be harmful or fatal if swallowed. If swallowed; drink two liters of water or milk; or eat bread soaked in milk followed by cooking oil.

DANGER: Highest degree of hazard Imminent hazard. Corrosive; damaging to tissues; or Poison. This product/chemical causes eye and skin damage. Harmful or fatal if swallowed. Do not get in eyes, on skin, or on clothing. Wear goggles and rubber gloves when handling. Avoid contamination of food. Do not reuse empty containers. Rinse empty container thoroughly and discard it.

Some of the most frequently used cleaning products are listed in the table below and the purpose for which they are used in a school setting.

TABLE 4: Most frequently used cleaning products and their usage

PRODUCT	USAGE
Broad spectrum cleaner and disinfectant all-in-one	For restrooms, food prep sinks, locker rooms, etc.
General purpose cleaner	Used on walls, floors, doors, furniture, washable surfaces. Used for damp mopping, auto scrubbing, hand cleaning. (This is not a disinfecting cleaner.)
Heavy-Duty general purpose cleaner and degreaser	All washable surfaces that need a strong cleaner and degreaser: kitchen floors, art rooms, media rooms, etc.
Heavy-Duty restroom cleaner, mild degreaser and descaler	Good for porcelain, ceramic, enamel, stainless steel and aluminum surfaces.
Toilet bowl, urinal cleaner	For both porcelain and stainless steel. Mineral deposit remover.
Glass cleaner	Window glass, Plexiglas, mirrors and wall cleaner.
Vinegar	Neutralizer, window cleaner.
Carpet stain remover	For removal of coffee, betadine, blood, urine, etc.
Odor removal	Kitchens, bathrooms, carpets, pet stains, garbage/ waste cans.

It is not uncommon for a custodian to transfer concentrated chemicals from a large container to a smaller container that can be placed on the custodial cart. Therefore, a solution of chemical is mixed in a spray bottle for ease of application and cleaning. In all cases, it is required to label the new container so others will know what is in it. However, custodians should be aware of the following guidelines:

- Too much concentrate:
  - Can damage the surface being cleaned;
  - Can cause harm to skin and eyes;
  - Can make too many suds;
  - Wastes materials and money.
- Too little concentrate:
  - Does not get the job done. It will have to be done over again which wastes time, energy and materials;
  - Use the correct system for measuring. Then you always know the cost, the strength and the results will be the same;
  - Pre-measured concentrate is easy to control;
  - This system is wasting materials and money.

DID YOU KNOW?

Mixing chemicals is dangerous and can be deadly.

Don't do it!

6.2. CLEANING EQUIPMENT AND TOOLS

Good equipment is essential for an efficient custodial program. The custodial staff is responsible for the proper care and use of custodial equipment and materials. This section provides information on how to maintain the equipment that has been entrusted to custodians. They should always clean and store equipment and supplies after each use. Custodial closets should be kept clean and orderly. Do not allow trash, empty containers, dirty rags, etc. to collect.

The basic duties of the custodial staff includes maintaining assigned closets, storage and caretaking rooms in a clean, safe condition and maintain the cleanliness of these rooms. Closets and storage areas should be maintained like every room in the school. This duty should be accomplished in a safe manner, using the appropriate cleaning supplies and following these guidelines:

- Equipment should be used only for the job it was intended to perform and in accordance with manufacturer specifications;
- Equipment should be properly cleaned and stored after each use;
- Equipment malfunctions or repairs should be reported immediately to the groundskeeper and taken out of service;

- Wet floor signs must be used when mopping, scrubbing or stripping a floor;
- Custodial closets should be closed and locked at all times.

Custodial Closet:

Custodial closets should be located at convenient points throughout the schools to provide a place to keep supplies and equipment within reasonable distance of the work area. Custodians are responsible for keeping the closet neat, clean and free of trash.

Every custodial closet is to be stocked with the equipment and supplies frequently used in the daily cleaning of a custodian's assigned area. The following items are the minimum and not necessarily a complete list needed for specialized areas.

- Fully stocked custodial supply cart;
- Personal protective equipment: Vinyl-type gloves, eye protection, flashlight;
- Two (2) - Mops and one (1) bucket with wringer: Mops labeled for use; one for restrooms and the other for classrooms;
- Two (2) - 15 l. buckets: One marked for toilets; one for sinks;
- One (1) – Handy-mix chemical dispenser;
- Paper products: Toilet paper (one and two-ply), paper towels, assorted size trash bags;
- Hand soap refills – for wall-mounted hand soap dispensers;
- Cleaning chemicals, disinfectant, furniture polish, stainless steel cleaner, spray-on lubricant;
- Pack of disposable vacuum bags;
- Assorted sponges, scrub pads, and clean rags;
- One (1) - Corn broom and dust pan;
- One (1) - Push broom – right size for area to be swept;
- One (1) - Microfiber dust mop;
- "Wet floor" sign.

Procedure:

- Stack or hang equipment or supplies neatly in custodial room;
- Clean all equipment after use and before returning to its place;
- Do not leave cans or bottles open;
- Throw away newspapers, magazines, and other odds and ends that tend to clutter up the closet;
- Leave your custodial closet neat and in order every day when you are through working;

- Wipe shelves and clean closet as required;
- Custodial carts should be stocked at the close of each day.

Color-coded practice:

The color-coded system is used in cleaning to prevent accidentally reusing a cloth or mop that has been used to clean areas such as restrooms. It is a good practice for school custodian staff to devise their own color combinations to meet their specific needs, but also schools can use the industry-standard color-coding system:

- Red for high-risk areas such as toilets and urinals;
- Yellow for low-risk restroom areas including sinks and mirrors;
- Blue for all-purpose cleaning (dusting, window cleaning, wiping desks, etc.) in other areas of a facility;
- Green for food-service areas.

To make transitioning to a color-coded system easier, the following strategies may be helpful:

- Post a color-coding chart in an accessible area such as sign-up charts of cleaning schedules, on the cleaning cart, in custodial closets, or in other areas;
- Have enough quantity of each color to prevent employees from using, for instance, a red cloth if they run out of blue ones;
- In large schools, custodians can also be assigned tasks based on the color systems, so restroom cleaning staff will only get the red colors;
- For color-blind employees, an accommodation can be made by writing on cloths and mops with permanent markers. Several coding systems can be used: “T” for toilets, “S” for sinks and mirrors, and so forth; or “R” for red, “Y” for yellow, and so forth.

The purpose of the following table is to outline which equipment and tools are essential to maintain a clean, safe, and orderly learning environment, how to keep them functional and promote job efficiency.

TABLE 5: Mostly used cleaning equipment/ tools

EQUIPMENT/ TOOL	DESCRIPTION
Custodial Cart 	The custodian cart facilitates the movement of custodians through the school building. It provides storage space for tools such as dust mop, toilet mop, duster, counter brush and dustpan. It also provides space for two buckets with a wringer.
Push Broom 	Push brooms come in various degrees of bristle stiffness to match the different floor surfaces and types of dirt the custodian will encounter. Never leave a push broom sitting on the floor with the weight on the bristles. This will bend the bristles and make the broom less efficient. Always hang the push broom up on hooks when finished.
Corn Broom 	Corn broom is used to sweep up food and trash from under counters and serving islands in kitchen and dining areas. It is used for sweeping the school grounds. As a rule, if the floor is damp, use a corn broom.
Dust Pan 	Used to pick up the overall dust and heavy dirt subsequent to sweeping. Unlike the noisy vacuum cleaners, the dustpan and the brush can be used during class hours as well for an emergency cleaning. Regularly cleaning the dustpan is necessary for maintaining school cleanliness and not spreading the dust and dirt from one are to another.

Dust Mop

The dust mop should get the greatest use of all the tools used in building maintenance. It is important to use the dust mop as often as possible in order to remove the grit, which acts like sand paper under shoes, from the floor.

The mop is used to remove dust, sand and other light soils from resilient (hard) floor surfaces. You can prolong the useful life of the dust mop by brushing out the strands when finished using it. During use, it may be necessary to take the dust mop outdoors and shake lightly to remove dust and dirt held by the mop.

- DO NOT shake a dust mop indoors. This will cause a mess and spread the dirt you have worked hard to pick up.
- DO NOT run dust mops over wet spots on the floor. A wet dust mop will drag on the floor, spread the moisture and dirt around and create more cleanup work.
- DO NOT use dust mops to sweep restrooms and kitchens because these floors are usually wet. More importantly, this is an easy way to spread germs from the restrooms to other parts of the school building.
- DO NOT allow the dust mop head to sit on the floor for prolonged periods. The dust mop treatment could stain the floor.

Mop Bucket and Wringer

The mop bucket and wringer require cleaning after each use. Clean and lubricate the mop bucket casters periodically to reduce caster noise and prolong caster life.

Mop buckets are to be emptied, rinsed and wiped dry after a job is completed. Wringers are also to be rinsed and wiped dry after each use. Lubricate the casters and moving parts regularly.

Wet Mop

The wet mop is one of the most used and abused custodial tools. One reason wet mops are so badly abused is that there are so many different uses for them. Inexperienced or untrained custodians sometimes attempt to use the same wet mop to pick up spills, lay down floor finish and clean rest rooms. This multiple different use of the same wet mop is unsatisfactory. Separate mops should be available for specific cleaning jobs.

Rinse out your wet mop after each use. In all instances, the final rinse should be with cold water to reduce the formation of germs.

- **Mop Heads:** There are two types of mop heads:

  1. **Cotton string mop head:** It is essential that the cotton mop heads be rinsed thoroughly after each use. To whiten a gray mop, soak it in a weak solution of bleach (1/4 cup bleach to 4 liters of water) overnight. Too much bleach will disintegrate the mop head and cause it to be replaced sooner. Rinse thoroughly after bleaching to stop the bleaching action and to keep bleach off your floor surface. Do not store a wet mop head, head down on the floor or sitting in a mop bucket. Store the mop, head up on a designated storage rack.

  2. **Microfiber mop head:** These are considered an essential tool in an infection-control program. They are superior at capturing microbes and other organic matter (dirt, food, liquid, etc.) while requiring less cleaning solution and water.

- **Mop Stick:** Wooden handles should be cleaned regularly with a clean solution of general purpose cleaner. Rough handles may be smoothed with sand paper. Keep metal clamps clean and lightly lubricated.

- **Wash Mops:** It is impossible to do a good job of mopping with a dirty mop. Wet mops should be rinsed out after each use, wrung as dry as possible; then, after shaking the strands apart, hung up in a well ventilated place for drying. Wet mops should not be stored in a damp place because they will mildew and develop an odor that will make them unfit for use.

Antibacterial Microfiber Cloth

All-purpose detergent and a microfiber cloth is considered by experts to be sufficient to reduce the number of germs or pathogenic microbes on most surfaces to an acceptable level for public health. Microfiber cloths and mops are able to capture and remove up to 99% of microbes from nonporous surfaces and objects.

To avoid cross-contamination, different cloths must be used for different areas, in different colors if possible.

A used cleaning cloth, especially if left soaking in dirty solutions, can be reservoirs of microbes that serve as sources of cross-contamination in schools.

- Launder cloths after use and allow them to dry before reuse to help minimize the degree of contamination.
- Replace soiled cloths with clean items each time a bucket of disinfectant is emptied and replaced with fresh, clean solution.

Gloves

The most common types of gloves are made from: Latex, Vinyl or Nitrile and are available in multiple sizes.

Wearing gloves is the first line of defense against chemical burns, nasty illnesses and even dry, cracked skin.

Exposing the skin to chemicals like detergents and solvents (found in all-purpose cleaners) as well as vinegar, ammonia and bleach may cause irritation and burns.

Wearing gloves protects against bacteria, such as salmonella and E. Coli while cleaning.

Vacuum Cleaners

Lost or reduced suction is a routine issue with vacuum cleaners. Large objects picked up by the vacuum cleaner may become lodged in the air passage before it reaches the filter bag. Keep air passages clear by picking up large objects manually before vacuuming rather than hope that they will pass through to the filter bag.

A full filter bag will also restrict airflow. Inspect the filter bag and replace it when it is ¾ full. The vacuum motor filter, which is protecting the motor from dust being discharged from the vacuum, must be cleaned or replaced periodically.

Another cause of lost suction is leaks in the vacuum hose, wand, floor attachment and connections. Inspect these regularly and have them replaced when damaged or broken.

Do not allow vacuum bag to overfill; this greatly reduces power. Check the belt often. Remove threads or hair wrapped around the brush.

An easy way to check if the brush is adjusted properly is to place a penny on the floor by the side of the vacuum, start lowering the brush until the penny vibrates. This is the proper adjustment. Lowering the brush too much can damage the carpet pile and decreases the efficiency of the vacuum.

Ladders

All ladders need to be inspected regularly or prior to each use.

Extension ladders: inspect all of the rungs/steps for security. Extend the ladder full out and check the condition of the safety rope and the extension locks. The locks must be spring-loaded to the locked position when changing the length of the ladder. Check the bottom support feet and be sure the rubber is not missing or damaged and the feet should be adjustable for different ladder angles.

Step ladders: inspect the ladder rungs/steps for security. Ensure the folding mechanism locks in the fully extended position. Make sure the top hinges are functional, that the ladder sections swing open easily and are stable on the ground when locked open.

DO NOT use a step ladder as an extension ladder. Always open the step ladder and lock it open before use.

Wet floor sign

Wet floor signs should always be used when appropriate.

Most of school accidents are caused from wet floors, because of slip and fall incidents. They often result in injuries such as sprains, muscle tears, bruises, back and neck injuries, concussions, and broken bones in the arms that occur when someone instinctively tries to catch him or herself.

Custodial staff should follow guidelines and one of the easiest ways to prevent a slip and fall accident is to use a wet floor sign. The purpose of a wet floor sign is to draw attention to the spill, alert the students and school staff of possible accidents and help them move safely.

6.3. SUPPLY REQUESTS

Custodians are responsible for maintaining the cleaning chemicals, materials and tools and together with the groundskeeper, repairman, guard and/or school secretary should be responsible for timely ordering of cleaning supplies. In order to ensure the most efficient use of school resources the following guidelines should be followed to order supplies:

- Only order those supplies needed to perform assigned job duties, according to the school cleaning plan.
- Order enough supplies to last for a school year or a semester. If the procurement is larger, a better price is more likely to be obtained.
- Supply request forms must be submitted to the designated person for approval (school principal or secretary).

One way to simplify the procurement procedure is to use a standardized template. A template of Supply Request Form is provided in Table 6.

The cleaning materials and supplies necessary for the operational care of school buildings may represent a rather large investment. The proper use and storage of these materials depends a great deal upon the common sense of the custodial staff. This is why, custodial staff should maintain an accurate inventory of necessary cleaning materials and equipment.

TABLE 6: Sample Supply Request Form

School: _____

Building ☐ central ☐ satellite

Product Name	Description	Quantity	Comment:

Check all categories that apply:

Cleaning products
- ☐ All purpose cleaner
- ☐ Glass cleaner
- ☐ Disinfectant
- ☐ Tile cleaner
- ☐ Anti-lime scale
- ☐ Floor cleaner
- ☐ Furniture cleaner

Cleaning equipment
- ☐ Push broom
- ☐ Corn broom
- ☐ Dust pan
- ☐ Mop stick
- ☐ Bucket
- ☐ Bucket with wringer

Disposable material
- ☐ Gloves
- ☐ Cleaning cloth
- ☐ Mop head
- ☐ Mop cloth
- ☐ Sponge
- ☐ Scrub

Hygiene products
- ☐ Toilet paper
- ☐ Hand soap
- ☐ Liquid soap
- ☐ Hand disinfectant
- ☐ Hand towel

Reason for request:	Requested by:	Date:
☐ Used ☐ Broken ☐ Damaged ☐ Beyond its useful life	Approved by:	Date:

7. ENVIRONMENTALLY FRIENDLY CLEANING

Every school should strive and ensure that cleaning services are environmentally friendly. Schools should avoid the use of toxic chemicals in cleaning products and use biodegradable products whenever possible.

Environmentally friendly cleaning products are:

- toxic free;
- biodegradable;
- safe;
- appropriate for school use;
- cost effective.

DID YOU KNOW?

Use green-certified, non-ammoniated glass cleaner

The ammonia in most glass cleaners can damage the surface that you're using it on. Ammonia-free glass cleaner is better for the surface, it is better for you (especially those with allergies), and it is better for breathing. Vinegar and water is a good (and sustainable) alternative and is still considered the best solution for neutralizing and removing salt from most hard surfaces.

Bleach has been used for generations as a disinfectant, and the general opinion during this time has been that it is a safe chemical for this purpose. Bleach was used extensively in schools and other settings due to a number of perceived conveniences such as low up-front cost, ease of purchase, and its ability to be used at different strengths for different purposes. Recent research, however, has identified adverse health effects for users and the environment. This is why, schools should be looking for a safer alternative with a better human-health and environmental profile.

WHAT ARE THE PROBLEMS WITH USING BLEACH AS A DISINFECTANT?

Health problems

- Bleach is suspected of causing asthma, and is known to exacerbate asthma episodes;
- It is irritant to the skin, eyes, and respiratory tract;
- Mixing bleach with ammonia, ammonium compounds, vinegar, or other acids can create toxic gases. **Never mix bleach with another cleaning solution.**

In a school setting

- Bleach degrades metal and other incompatible surfaces;
- It may damage fabrics and floor finishes;
- Bleach is unstable in storage, so it should be purchased monthly;
- A bleach solution must be mixed daily because the germicidal effectiveness of bleach in solution degrades after 24 hours.

DID YOU KNOW?

Bleach IS NOT an effective disinfectant

Besides being very destructive to most surfaces, the area of application must be completely clean before applying the bleach solution. It must then be allowed to sit for a minimum of ten minutes, during which time the surface will be destroyed through pitting or corrosion.

Therefore, when municipalities or schools procure cleaners it is recommended that they be environmentally controlled products. The following should be taken into account in the procurement process:

- Products should be appropriately labeled;
- Products should have safety certificates for use in schools;
- Suppliers should provide all information on controlled products and ensure that they are updated annually;
- Suppliers should provide training to all employees who will use the products.

The certificate for safe use of environmentally controlled products in the school should contain the following information:

- Proper use of a substance;
- Health risks and fire hazards;
- How to use, transport and store the substance;

- Emergency action and first-aid advice;
- Other information, such as waste disposal requirements.

8. SAFETY, PERSONAL PROTECTIVE EQUIPMENT AND TRAINING

Safety in the school is very important. To assist in achieving a safe environment, organization and maintenance of the site, the custodian must be safety conscious at all times. Maintaining supplies and equipment in an orderly condition will always assist in this process. Safety should be a high priority, as it concerns not only the custodial staff, but also all school members and students. Below are several safety guidelines to help achieving this goal.

- Occupational safety measures should be respected at all times;
- Always post a Wet Floor Sign on wet floors;
- Always use the proper personal protective equipment;
- Custodial equipment and cleaning supplies should never be left unattended or in hallways;
- Always keep keys cabinet and custodial rooms locked;
- Chemical cabinets, supplies and boxes need to be at least 1 meter from electrical panels;
- Chemicals should be placed below eye level as per safety compliance guidelines;
- Read labels before using any products to learn about hazards, first aid procedures, and proper handling chemicals;
- Do not mix chemicals together. You can create a toxic gas or hazardous solution;
- Never use a ladder that has been damaged. Report all damaged ladders to the groundskeeper for tagging and disposal as per the safety policy.

Due to the nature of all types of cleaning procedures, there is always a possibility for exposure to bio-hazardous environments or fluids, which may contain: bacteria and viruses. For this reason, it is strongly encouraged that all custodians wear some form of personal protective equipment (PPE), especially gloves. The most common types of gloves are made from latex, vinyl or nitrile and are available in multiple sizes. Other types of personal protective equipment are available when needed for specific tasks; such as - protective eyeglasses or goggles, dust masks, or high visible vest. When working overhead, wear goggles to avoid getting anything in your eyes.

Table 7 summarizes the use of personal protective equipment for cleaning school facilities.

TABLE 7: Most commonly used personal protective equipment for maintenance of school buildings

Activity performed					
	Protective mask	Goggles/ Glasses	Ear Plugs/ Protection	Rubber Gloves	High Visibility Vests
Maintain floors: sweep, mop, strip, wax, scrub	✔	✔		✔	
Remove garbage to outside bins				✔	✔
Maintain carpets: clean/vacuum; spot cleaning	✔	✔	✔	✔	
Clean and disinfect washrooms	✔	✔		✔	
Hazardous spill cleanup (blood/ body fluids, mouse/ bird droppings, chemicals etc.)	✔	✔		✔	

Custodial training is the key to the success of maintaining schools. The emphasis that has been placed on a clean, healthy and safe environment for students, not to mention the requirements for maintenance and repair of facilities, demands a staff that is trained to do the job. Additionally, that training must be ongoing as new hazards to the health environment are found, new products are introduced into the cleaning market and new and better techniques are developed to maintain school facilities.

New school custodian staff, including groundskeeper, repairman and/or guards should be given induction training, which should include all the information needed to safely and effectively begin their duties. This better qualifies custodians to perform assignments in a competent and safe manner.

Basic custodian training should cover the following topics:

- General Cleaning Procedures - the basic fundamentals, equipment, chemicals and methods with specific attention to the daily, weekly, monthly and annual procedures;
- Specific Area Cleaning Procedures - steps and procedures to be used when cleaning offices, classrooms, and corridor areas;
- Gym Floor Care - the chemicals, equipment and work processes necessary to maintain gymnasium floors in the best possible condition;
- Equipment Care and Use – proper use and maintenance for common cleaning equipment;
- Hazardous Substances – proper use of chemicals, particularly those which impose health hazard and hazardous waste handling.

Additionally, all cleaning staff should be trained in the school's health and safety procedures and arrangements, prior to beginning work. Health and safety training should include the following:

- Safe use of equipment and PPE;
- Handling chemicals hazardous to health;
- Fire safety and evacuation arrangements;
- Working at height;
- Emergency procedures;
- First aid.

The training workshops should include a variety of methods to meet the needs of adult learners such as: short lectures, hands-on instructions, videos and short films, illustrative slides and follow up on-the-job training.

In addition to the use of protective clothing and personal protective equipment, maintenance staff must have compulsory accident insurance while performing their duties, such as cleaning panels, roof repairs, contact with electricity and the like. The school may conclude an agreement for individual or collective insurance for all employees who may be insured in the event of an accident that may occur during regular working hours, but also in the event of an accident on the way home from work or work-related travel.

TABLE 8: Collective and individual insurance of technical staff

Type of Insurance	Insured Person Name and Surname	Valid by: (Date)	Comment
Collective Insurance			
Individual Insurance			

9. PLANNING, BUDGETING AND MEASURING PERFORMANCE

Throughout this chapter, it was emphasized that hygiene and cleaning are important part of facilities maintenance so careful consideration should be devoted to developing a plan, a budget and monitoring system to guide decision-making and demonstrate commitment for facilities maintenance.

A key component of an effective and efficient facilities and maintenance policy is a well-designed maintenance and cleaning plan. The plan is an important tool for identifying and communicating needs and priorities and should include short- and long-term objectives, budgets, and timelines. After yearlong work with all primary and secondary schools, municipalities and MoES, we would like to underscore the importance of including all stakeholders – including maintenance and custodial staff, school administrators, parents, and community members, among others – in the facilities planning process.

Based on the best practice model implemented in our schools, the planning process should include the following steps to be comprehensive and efficient:

- Involve stakeholders in the planning process;
- Identify needs (e.g., improving cleanliness and safety, correcting deficiencies, addressing deferred projects, increasing efficiency, decreasing utility bills);
- Establish priorities and targets;
- Collect and use supporting data to inform decision-making;
- Share the plan to gather support from municipality, local community and key stakeholders;
- Allocate funds to pay for planned activities;
- Train staff to implement planned activities;

- Implement the plan;
- Be patient while awaiting cost savings or other results;
- Evaluate the plan systematically;
- Refine efforts based on evaluation findings;
- Review and revise the plan periodically (e.g., every three years).

When budgeting for cleaning, schools should be aware that maintaining clean school is not an expense, but an investment in a healthy learning and working environment.

A template of cleaning budget is provided in Appendix 6. The items in the budget are based on good cleaning practices, but they are not exhaustive and each school should customize its budget based on its needs and identified priorities.

Primary expenditure categories for custodial services are labor, cleaning supplies, equipment, disposable materials and hygiene products.

The schools are advised to procure these products on annual basis, as discounted prices may be obtained for larger quantities. In addition, the bidding of companies through the electronic auctioning system may further reduce the prices.

Although, many factors impact precisely how the budget is allocated to different budget categories (including school size, the number of buildings, the number of enrolled students, and the age of those facilities), based on the calculations and cleaning budgets of schools with good cleaning practices, the average expenditures for cleaning school area covering 1,000 m2 may be summarized as this:

- Cleaning products – 700 denars per month;
- Cleaning equipment – 3,200 denars per year (can be used for many years!);
- Disposable material – 1,350 denars per year;
- Washroom hygiene products – 2,800 denars per month.

Maintaining and cleaning school buildings and grounds effectively requires two vital tasks to be navigated successfully. First, school leadership together with municipal authorities must institute policies that would direct the school's efforts for cleanliness toward desired goals and objectives. Second, the school staff must act on those policies on a daily basis to meet the goals and objectives the school has set. To ensure that custodian staff are doing their part to meet school's goals and objectives, their performance must be evaluated on a regular basis.

To assess custodian staff productivity, the school (through its principal and designated supervisor) must establish performance standards and evaluation criteria. For example, a custodian's performance might be measured by the amount of floor space or number of rooms serviced, the cleanliness of those facilities, and his or her attendance.

Depending on the number and variety of custodial staff hired by the school, the school secretary or groundskeeper may be responsible for the continuous monitoring

of school cleaners' performance and may assess their work. The supervisor should report directly to the school principal, who should respond promptly to any reports or complaints of inadequate cleaning standards.

The supervisor should carry out occasional no-notice inspections to monitor if the work schedule is being followed. Ultimately, the school principal is responsible for ensuring custodial staff meet the expected standards of cleanliness and productivity.

When developing performance standards, the school management must:

- Establish specific goals and action required to meet the goals (e.g. dry mop the classroom floor twice a day);
- Create an evaluation instrument (e.g., a checklist);
- Be as detailed and specific as possible;
- Define the performance scale (e.g., 0 = poor to 5 = excellent);
- Be flexible (i.e., acknowledge extraordinary circumstances when they arise);
- Convey expectations to affected staff people;
- Review the performance standards on a regular basis (e.g., annually).

All appendices detailing the daily, weekly, monthly and annual cleaning schedules, contain a checklist of actions to be performed by the custodian. The custodian is required to sign with initials and verify the hour or the date an action is completed. This helps the supervisors when monitoring custodian work. For learning purposes and better cleanliness, each supervisor should provide detailed comments and assess the performance at a pre-defined scale.

Each evaluation should take into consideration the workload through the work schedules of the custodians. In this way, the school management will get a better picture if human resources are used efficiently.

Self-evaluations can also be useful personnel management tools—i.e., ask the custodial staff member to rate his or her own work and then discuss the outcomes relative to the supervisor's opinion.

III DISASTER (EMERGENCY) RISK MANAGEMENT IN SCHOOLS

1. SCHOOL SAFETY

The main components for maintaining the safety and security of students and school staff are: **prevention** to reduce the risks and dangers in the school environment and **timely planning** of an appropriate response to emergency situations resulting from a natural disaster or other disasters.

To declare a situation or incident as an emergency requires an immediate threat to life, health, property or the environment and is highly likely to escalate and lead to more serious consequences.

School staff need to be aware of and prepared for the various dangers and risks within or outside the school. As an illustration, below are some examples of emergencies:

- Natural disaster: earthquake, flood, landslide, storm, wind;
- School fire or laboratory explosion;
- Intentional act of violence, by a person inside or outside the school, using firearms or cold weapons;
- Accident as a result of infrastructure damage in the school building or yard;
- Accident while students are being transported to or from school or during a field trip in which a student or staff member suffers.

These situations can have different effects on students and staff, such as problems with sleep and concentration, increased fear and anxiety, unwillingness to go to school/work and may affect students' academic achievement.

Although larger-scale natural disasters occur less frequently, regardless of the dimensions of the accident, the pain and suffering that an individual experiences can have devastating effects.

Given the seriousness of these effects on the health and well-being of students and staff, the question arises as to what schools can do to minimize these effects and how to prevent such events from becoming a tragedy.

In most cases, it is difficult to predict the occurrence and development of natural disasters as well as other types of disasters, and to this end, advance planning can help the school to better deal with their consequences.

The process of proper preparation, prevention of risks and dangers, planning of appropriate response and recovery consists of the following stages::

1. Prevention: what can the school do to eliminate any safety risks to people and property;
2. Preparation: planning the action against the worst case scenario;
3. Response: the steps the school will take during an emergency;
4. Recovery: restoring the normal course of instruction after the emergency.

FIGURE 1: preparation and response to an emergency

The school's preparedness at each of these stages will also affect the way the school responds to an emergency: whether it will respond in a calm and disciplined manner or will panic; whether decisive and courageous action will be taken or no action will be taken, which will inevitably lead to endangering people's lives and risking damage to school buildings.

2. PREVENTION AND RISK REDUCTION

School leadership may not always prevent all the risks and dangers that can cause an emergency in the school, but can take actions to reduce the likelihood of certain events occurring and the damage that those events could cause.

To that end, each school should self-organize and establish a Disaster Response and Management Team for emergency planning, preparation and management. The role and responsibility of the Disaster Response and Management Team is to:

- Develop a protection and rescue plan so that it can respond promptly to any emergency situation;
- Implement the plan if an emergency occurs;
- Ensure the sustainability of the plan and its proper updating.

Disaster Response and Management Team should include representatives from all relevant stakeholders, including representatives of:

- Administration (principal or deputy principal);
- Student support services (psychologist);
- Teachers;
- School maintenance staff;
- Security agency (if the school hires such agency);
- Parents' council;
- Student community;
- Competent institutions.

If students with disabilities attend the school, together with their parents they should also be included in the Disaster Response and Management Team in order to provide their recommendations and advice on how best to protect these students.

According to the organizational set-up, the head of this Disaster Response and Management Team should be the school principal. Each school should also appoint a deputy who will chair the Disaster Response and Management Team in the absence of the principal, such as the deputy principal, the school secretary, or representative of the student support services.

Annex 7 at the end of this handbook gives an example of how to complete the tables shown in this chapter to make it easier for schools to prepare a prevention and rescue plan and to be prepared for an emergency response.

Below is an example of how schools can visibly keep the contacts of the members of the Disaster Response and Management Team and regularly update their data. A copy of this contact list should be kept by the school principal, the secretary, and the student support services.

FACT

The contact list should always be updated. The data should be thoroughly checked at the beginning of each school year and regularly updated.

TABLE 9: Members of the Disaster Response and Management Team

No.	Name and Surname (members)	Representative of:	Mobile	Email	Deputy member	Mobile	Email	Comment
1		School - principal						
2		School -administration						
3		School – student support services						
4		School - teachers						
5		School – maintenance staff						
6		Parents' Council						
7		Student Community						

The Disaster Response and Management Team is obliged to organize meetings on a regular basis, at least 4 times a year. Meetings should be organized at the beginning of each semester (preferably in September and January) in order to update the plan and to prepare school evacuation drills based on different scenarios (e.g. earthquake or fire evacuation). In addition, it is recommended that meetings are held several days after each drill in order to summarize the drill activities, evaluate the effectiveness of the evacuation, and evaluate the evacuation plan and its implementation.

Each school should visibily display the emergency phone numbers:

Police 192
Fire services 193
Ambulance 194
Crisis management Centar .195

Below is an example of an action plan in which the various activities of the Disaster Response and Management Team (organizing meetings, evacuation drills, etc.) are listed.

TABLE 10: Plan of activities of the Disaster Response and Management Team

Month / Day	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	Apr.	May	June	July	August
1												
2	Meeting					Drill						
3												
4							Drill					
5												
6			Drill									
7							Meeting					
8												
9												
10			Meeting									
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23					Meeting							
24												
25												
26												
27												
28												
29												
30												
31												

The Disaster Response and Management Team should designate a contact person with the institutions responsible for disaster (emergency) prevention, who will be responsible for coordinating and communicating with these institutions. The contact person will also be responsible for communicating with other schools, that is, working with contact persons from other schools in order to exchange experiences in this area. At the same time, this person will be the liaison between the Disaster Response and Management Team and the school staff and will communicate with them about the challenges and open issues in the area of protection and risk management in the school.

TABLE 11: List of contact persons for communication with other schools

No.	Name and Surname	School/ Institution	Contact Number	Email	Deputy	Contact Number	Email	Comment

Each member of the Disaster Response and Management Team should know its role and responsibilities before an emergency occurs, caused by a natural disaster or other types of accidents.

3. PREPARATION FOR DISASTER MANAGEMENT

Emergency planning and preparation is a long process that requires material, financial and human resources. However, it is necessary for the school to be able to respond quickly and effectively in an emergency.

3.1. EMERGENCY PROTECTION AND RESCUE PLAN

One of the main tasks of the Disaster Response and Management Team in the preparation phase is to develop a protection and rescue plan in case of natural or other disasters. The preparation of the plan avoids inappropriate response, raises the

level of preparedness/readiness of school staff and reduces the likelihood of such events leading to detrimental consequences for the well-being and lives of students and school staff, as well as damage to facilities.

FACT

Before you begin developing a plan, consult your municipality/City of Skopje and the relevant authorities to ensure that your plan is in line with the plan of the local community.

The main goal of the plan is protection, rescue, safe and timely evacuation of students as the most vulnerable category, school staff as well as any other persons who might find themselves in the school.

The development of a protection and rescue plan should include the following steps:

Step 1: **Create a school profile**

Step 2: **Review the previous ones and evaluate the potential hazards and risks**

Step 3: **Map the material and human resources**

Step 4: **Early warning and reporting system**

Step 5: **Organizational setup of the school for disaster management**

Each of these steps is explained in detail, illustrated with appropriate examples and simple tables for gathering and storing the information and data necessary to deal with an emergency.

3.1.1 STEP 1: CREATE A SCHOOL PROFILE

At the beginning of developing the plan, it is recommended to create a profile of the school with all the necessary information that is relevant in case of an emergency. This profile should include the following information:

- General information about the school (contact information and contact persons);
- Human resources (number of students, number of teachers, number of school staff);
- Description of the school and its surroundings (number of buildings, number of classrooms, location, geographical location, area, etc.);
- School map in which critical resources are marked (hydrants, fire extinguishers and other means);
- Evacuation plan, with evacuation routes marked and a gathering place.

The table below provides information that each school should fill out. The table can be supplemented with other information that could be useful and important for the planning process.

TABLE 12: General School Data

School Profile:			
School Name			
Municipality			
Address			
Contact Person			
School's Contact Number			
School's email			
Number of Teachers	M	F	Total:
Number of School Staff (administration, maintenance staff, others)	M	F	Total:
Number of students	M	F	Total:
Preschool			
Grade 1 to 5			
Grade 6 to 9			
Students with disabilities (type of disability and grade)			
Number of classrooms, offices			

Description of the school and its surroundings:

- Location (coordinates);
- Number of facilities, number of entrances;
- Proximity to road network;
- Accessibility;
- Description of the surroundings (other facilities, dangerous sites, etc.);
- Area (m^2).

3.1.2. STEP 2: REVIEW PREVIOUS AND EVALUATE POTENTIAL HAZARDS AND RISKS

The next step in the prevention and rescue plan is to map the risks, dangers and weaknesses that the school has faced in the past and the actions taken to address them. Based on these risks, the Disaster Response and Management Team should assess the risks and dangers that the school may face in the future in order to effectively prevent and deal with any kind of emergency. Since not all schools are exposed to the same risks and dangers, each school should make its own risk assessment. When filling out this table, you will need information and expert assistance from the relevant institutions in this field.

TABLE 13: Risk Assessment

DESCRIPTION OF THE THREE MOST RECENT DISASTERS			
Type of Disaster	Date	Measures Taken	Note

POTENTIAL RISKS						
Risk	Probability			Vulnerability		Preventive measures
Fire						
Earthquake						
Flood						

In addition, each school should regularly conduct a security check of the school and the schoolyard in order to prevent fire, flood and be prepared in case of an earthquake.

TABLE 14: Security Check Of School And School Yard

Activity	Security Check	Resolved Danger	Unresolved Danger	Taken Activities	Note
Type of response	Yes or No	Short answer	Short answer	Detailed answer	Challenges faced
Facility check					
School yard check					

3.1.3. STEP 3: MAPPING OF MATERIAL AND HUMAN RESOURCES

The Disaster Response and Management Team should prepare a list of material and human resources available to the school. Material resources include fire extinguishers, hydrants, first aid kits, protective equipment, etc., while human resources include persons employed in the school who have received training in fire protection, first aid, evacuation and the like.

Accurate mapping of material resources and persons trained to use them will increase the effectiveness of the emergency response. The table below should be placed next to the fire extinguisher/hydrant or other equipment in order to keep an accurate record whether the equipment is functional.

TABLE 15: Ресурси за употреба при итни ситуации / Редовна контрола

Resource	Location	Regular Check	Date of Regular Check	Checked by: (name, surname and signature)
Fire extinguisher (1)	Outside the facility	Every 6 months		
Fire extinguisher (2)	Inside the facility	Every 12 months		
Fire extinguisher (3)				
Hydrant (1)	Outside the facility	Every 6 months		
Hydrant (2)	Inside the facility	Every 12 months		
Ladder				
Gloves				
First Aid Kit				

FIGURE 2: Fire extinguisher: (a) in good working condition, (b) defective, foam leakage and (c) defective, empty fire extinguisher

FIGURE 3: Inspection of fire extinguisher

The school should have a list of all trained staff in order to find suitable replacement for those designated to be part of the initial response teams.

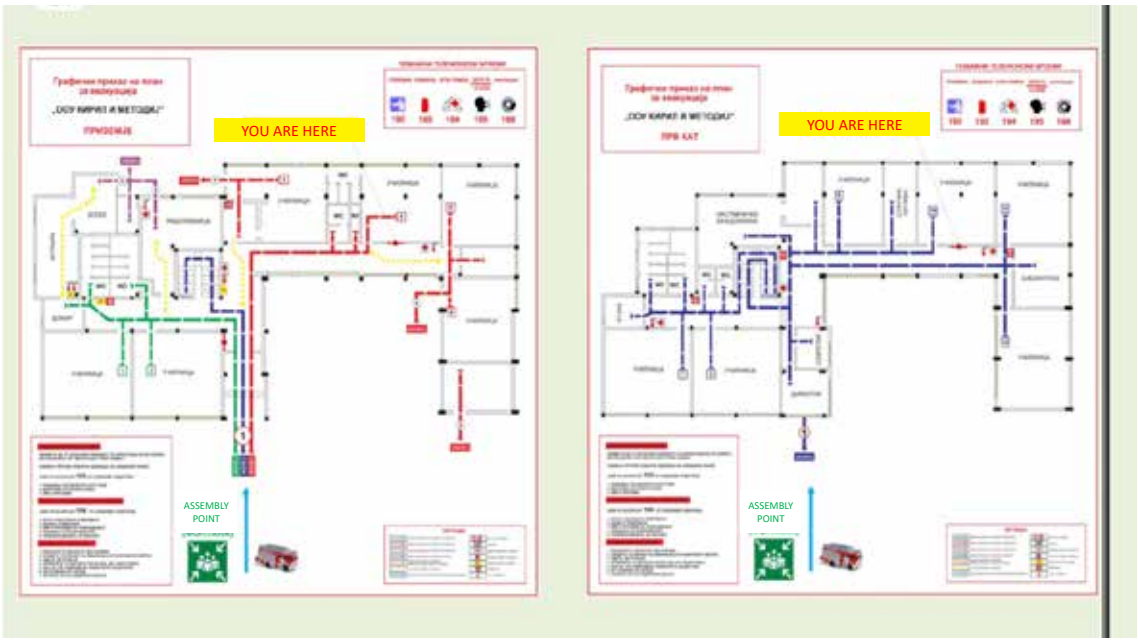
TABLE 16: Overview of trained staff and training attended

Type of Training:	Number of Trained Persons		Total:
	M	F	
Information gathering and communication			
Evacuation			
Firefighting			
Search and Rescue			
First Aid			

No.	Name and Surname	Trained	Contact Number	Email	Comment
1					
2					

The following figure shows an example of a school's evacuation plan, and additionally presents a map of resources, i.e. the location of fire extinguishers, hydrants, first aid supplies.

FIGURE 4: Evacuation plan, with marked evacuation paths, assembly point and map of resources



3.1.4. STEP 4: EARLY WARNING AND REPORTING SYSTEM

Every school should have an emergency early warning and reporting system. The system can be of different types, from the simplest, such as whistle, bell, siren, to the most up-to-date sound system. The plan should specify precisely how the system will be activated, as well as the person responsible for its activation and deactivation.

FIGURE 5: Contemporary early warning system

Regardless of its complexity, the system should be capable of transmitting different signals depending on the nature of the emergency so that everyone in the school can properly recognize it.

TABLE 17: Early warning and reporting systems, location and inspection

System	Location	Inspection	Approved (Name, Surname, Signature)
Fire alarm			
Public announcement system			
Bell			

In the event of an emergency, the first task is to obtain precise information on the incident, and to report it to the school's management and the Disaster Response and Management Team. One of the first steps in planning an emergency communication is to develop mechanisms for alerting students and staff that an incident has occurred and giving instructions for further action to be taken.

For example, when evacuating students it is necessary for the school to decide whether staff will use cell phones or couriers to convey the information.

In case of a natural disaster, the school will be flooded with phone calls from anxious and worried parents. Those who respond to calls should keep records and keep in touch with those who need the most information. Parents should be informed immediately of the type of emergency the school is facing, as well as the steps the school is taking to deal with the emergency and when parents can come and pick up their children.

FACT

Insecurity and uncertainty are the source of rumors, which only increase anxiety! Never bypass the truth and share information that you are sure is accurate and verified.

The school's Communication and Information Team should plan in advance how to communicate with the families, the municipality and the media.

Schools should have an up-to-date list of phone numbers and addresses of all students and parents at all times. There should be a contact for each student to communicate in an emergency. A copy of the list should be kept by several school officials and at the home of the school principal and a representative of student support services, as students and their parents may sometimes need to be contacted outside working hours. The list should be printed, because in an emergency the school will first turn off the power, and then it will be impossible to print the list.

It is best to have the press releases prepared in advance and only to supplement them with details so as not to waste time on compiling them during emergencies. For more on this, see the section on duties of the Communication and Information Team.

3.1.5. STEP 5: ORGANIZATIONAL SETUP OF THE SCHOOL FOR DISASTER MANAGEMENT

How will the school function during an emergency? To answer this question, it is necessary to detail the organizational set-up of the Disaster Response and Management Team and other stakeholders and their roles and tasks before, during and after the emergency within the school. This type of organizational setup where everyone knows their responsibilities is known as the Incident Command System. The figure below shows an example of the organizational setup of a School Incident Command System.

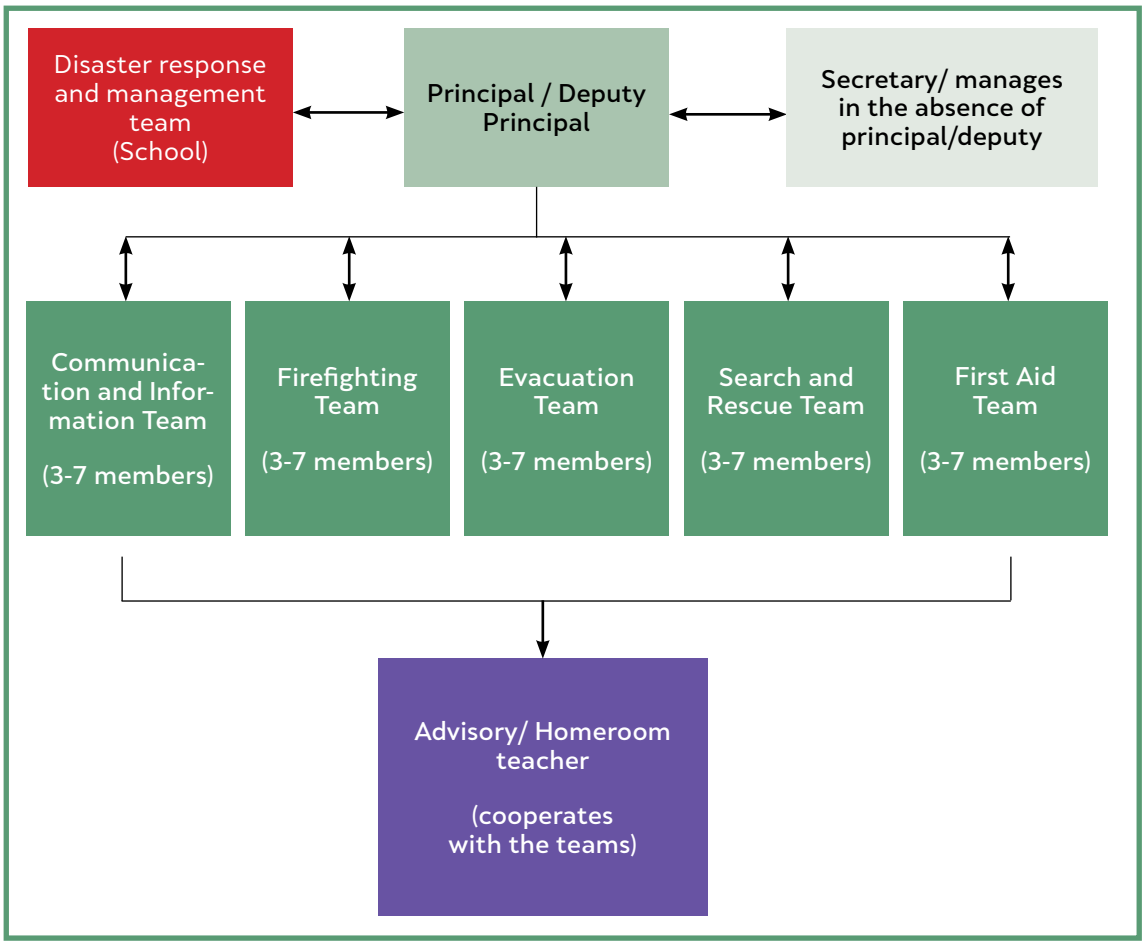
DID YOU KNOW?

"Coordination saves lives" – is the main message of the United Nations Office for the Coordination of Humanitarian Affairs.

The roles and responsibilities of the school can be divided into three levels:

- Managerial responsibility and role of the principal or the designated deputy in his or her absence;
- Individual responsibility of teachers and students;
- Operational responsibility, i.e. responsibility of the operational teams, which are activated depending on the nature of the emergency.

FIGURE 6: An example of the Incident Command System



The number of members in each team depends on the size of the school, but should in no case exceed 7 members, for easier coordination.

The following table shows how team members and their roles can be simply presented.

TABLE 18: Team members and their roles

Name of the Team: (e.g.: Search and Rescue Team)					
No.	Name and Surname	Role	Telephone No.	Email	Comment
1		Tasks to be performed			
2					
3					
4					
5					
6					

When dealing with a particular emergency, in addition to the importance of individual response, schools need to establish initial response teams to perform tasks until the competent authorities arrive for more efficient and effective action.

3.1.6. MANAGERIAL ROLE AND RESPONSIBILITIES OF SCHOOL PRINCIPAL

The school principal as the responsible person manages the process of planning, and has a leadership role in the disaster (emergency) risk management. As mentioned earlier, in the absence of the principal a deputy should be appointed to take over the responsibilities, including dealing with emergency.

Under normal conditions:

- Manage the Disaster Response and Management Team;
- Participate in the development of the plan in collaboration with relevant stakeholders;
- Assess the effectiveness of the plan and update it (once a year or as needed);
- Organize an activity to familiarize all stakeholders with the protection and rescue plan (students, school staff, parents);
- Organize regular exercises in cooperation with the relevant institutions;
- Organize regular training for the school staff and students;
- Appoint the members of the emergency response teams, in coordination with the members of the Disaster Response and Management Team.

During an emergency:

- The principal is responsible for all action taken by the school during an emergency. The following steps should be taken:

1. Alert of an emergency through the early warning and reporting system, by using the appropriate alarm;

2. Announce if the school should be evacuated or everyone should go to safe haven;
3. Coordinate the teams to take the most appropriate measures to deal with an emergency;
4. Confirm the nature of the emergency with the Communication and Information Team;
5. Report the emergency to the relevant emergency services;
6. Inform the parents of the emergency situation in cooperation with the Communication and Information Team;
7. Prepare for handing over the management to the relevant emergency services (the principal is responsible until the arrival of the professional teams);
8. Accurately and timely notify all stakeholders of any changes;
9. Report the emergency to the media.

After the emergency:

- Announce the end of the danger;
- Organize safe reunion of students and parents;
- Make a statement to the media (if needed);
- Re-establish normal classes (as soon as possible);
- Organize a meeting of the Disaster Response and Management Team to evaluate the response to the emergency and update the plan.

3.1.7. INDIVIDUAL RESPONSIBILITY OF TEACHERS AND STUDENTS

At the beginning of the school year, the school principal should make all teachers and students familiar with the activities the school undertakes to deal with emergencies in order to protect their safety.

They should be informed and adequately prepared to respond to emergencies. Informing, providing training and regular drills will help students understand the seriousness of the emergency and react calmly without panic.

TEACH STUDENTS TO BE CAREFUL!

„If you see something report!“

Any student who sees something suspicious should notify the teacher of another member of the school community.

Below are the responsibilities of teachers and the actions they need to take before, during, and after an emergency..

Under normal conditions::

- Become familiar with the emergency plan and safeguarding measures in order to protect and provide help to students;
- Be well acquainted with the evacuation plan and know the evacuation routes from the classroom to the shelter and assembly points;
- Be familiar with the students in the classroom, especially with the needs of students with disabilities.

During an emergency:

Each teacher is primarily responsible for the safety of students during class.

- Recognize the emergency situation and provide appropriate guidance to students;
- Prepare students for evacuation to the assembly point or shelter with the help of the Evacuation Team;
- Check the safety of evacuation routes;
- Issue evacuation guidelines;
- Take the emergency folders, including the attendance list;
- Inform the First Aid Team if a student is injured;
- At the evacuation point, check whether all student from the class are at the assembly point or in the shelter by raising a red or green card or otherwise alert the Initial Response Team/ Evacuation Team whether all students are present or some students are missing;
- Report missing students;
- Take care of students and monitor their discipline at the evacuation place or in the shelter until the emergency ends.

After the emergency:

- Accompany the students to the place of reunion with parents, if different from the original gathering place or shelter;
- After re-establishing normal classes, discuss with students the nature of the emergency, the evacuation, their behavior.

3.1.8. OPERATIONAL RESPONSIBILITY OF THE TEAMS

Depending on the nature of the emergency, the principal decides which teams will be activated as each emergency presents different challenges.

It is recommended the following teams to be established in the school:

- Communication and Information Team;
- Firefighting Team;
- Evacuation Team;
- Search and Rescue Team;
- First Aid Team.

Each of these teams has its own role and responsibilities during normal classes, during the emergency and after the emergency.

It is extremely important for each team to respond quickly, calmly and without panic during an emergency.

COMMUNICATION AND INFORMATION TEAM

Under normal conditions:

- Hold coordination meetings;
- Educate students and teachers on how to report an emergency;
- Personal training;
- Draft a media release.

An example demonstrating how an emergency is reported is provided below. This should be customized depending on the nature of the emergency.

[Report Content]:

1. I want to report a fire (or other kind of emergency / natural disaster).
2. I call from the elementary/high school: _____
3. Address: _____ City / Municipality_____.

Important information:

4. The waiting place of the person who knows where the fire is;
5. Exact location of the fire;
6. Scale of fire;
7. Reporting the number of injured, casualties and reporting on their current situation;
8. Status of the evacuation process;
9. Status of the firefighting action implemented by the team.

During an emergency:

This team should serve as a link between students, teachers, parents and competent authorities for initial response (the table should include type of communication, mobile phone, megaphone, etc.). In carrying out their task, they are at risk and should know that their own safety should always come first and, in the event of danger, they should evacuate immediately. The responsibility of this team is:

- Find out as much information as possible about the situation (e.g. location and size of the fire, whether there are casualties, injured, etc.);
- Notify the school principal (the deputy principal if absent);
- During the evacuation process, monitor the situation and its development (number of evacuated persons and information on casualties) and report regularly to the school principal;
- After the evacuation, establish the exact number of injured and casualties at the assembly place (be especially careful as mistakes are inadmissible in such situations);
- Inform the principal when the evacuation is complete and convey all necessary information.

After the emergency:

- Establish the damage to the school and school yard (oil, electricity, water, telephone line, etc.) along with the school maintenance staff;
- Document the damages (taking photos, minutes, etc.);
- Place “No Entry” sign to protect affected area;
- Identify the lessons learned in order to update the plan.

Figure 7 illustrates how to communicate in an emergency.

FIGURE 7: Overview of Emergency Communication

FIREFIGHTING TEAM

Under normal conditions:

- Hold coordination meetings;
- Organize training for students and teachers on fire protection;
- Organize training for the team members on how to use a fire extinguisher/ hydrant and developing firefighting strategy.

DID YOU KNOW?

In an emergency, if the clothes are on fire, students should know the following rules:

1. **Stop where you are**
2. **Drop to the ground**
3. **Roll over**

During an emergency:

In an event of fire, it is important to know that people should act in pairs in order to protect each other, because if one is in danger, the other member/partner can help.

- Perform fire action using the nearest hydrant, fire extinguisher, water bucket or other resources;
- In case of emergency, conduct a rapid evacuation either through the nearest exit or through a pre-established evacuation route, taking into account that safety is a priority;
- Communicate with the principal (in the absence of the principal with the deputy principal or another person previously designated as deputy) and the Communication and Information Team.

After the emergency:

- Identify the lessons learned.

EVACUATION TEAM

Under normal conditions:

- Hold coordination meetings;
- Regularly check evacuation routes (exits, gathering points, etc.);

- Introduce students and teachers to the evacuation procedure (how to take position during fire, use a handkerchief or piece of clothing to protect against inhalation of smoke, use an evacuation plan, etc.);
- Personal training.

During an emergency:

- In case of fire, report the information quickly and carefully, without creating panic among students;
- If an emergency is declared and the evacuation process is activated, evacuate students to the designated assembly point in accordance with the procedures and the evacuation plans;
- In case the nearest evacuation route is under threat, determine the safest backup evacuation route (it is always necessary to have a backup plan B);
- Successful evacuation requires observation of the following principles: a) horizontal evacuation directions; b) downward direction and c) vertical directions.
- During evacuation, give priority to the younger students (always in prime position);
- Ensure that all students have taken all safeguards (wearing a scarf or part of their clothing to protect against inhalation of smoke, etc.);
- Conduct the evacuation using the "buddy" method to prevent backlash. Each student is responsible for the student sitting with him or her and if there is any lag, fear, panic, anxiety, the teacher is informed as a responsible person;
- If there is a student with disabilities, help with the evacuation of the student or appoint an additional person/teacher who will pay special attention to the student during the evacuation;
- Accompany the students to the assembly point/safe haven;
- Determine the number of present and absent students (by first and last name);
- Determine if anyone is injured (symptoms of suffocation, burns, etc.);
- Communicate with the principal (in the absence of the principal with the deputy principal or another person previously designated as deputy) and the Communication and Information Team.

After the emergency:

- Identify the lessons learned;
- Check the evacuation routes, crossings, signs and warnings.

TABLE 19: List of resources to help during evacuation and their location

Resources	Location	Comment
Loudspeaker		
Whistle		
Light		

SEARCH AND RESCUE TEAM

Under normal conditions:

- Hold coordination meetings;
- Regularly check evacuation routes (exits, gathering points, etc.);
- Introduce students to the self-protection and helping others procedure (taking a position during an earthquake, use a handkerchief or piece of clothing to protect against inhalation of smoke, use an evacuation plan, etc.);
- Personal training.

DID YOU KNOW?

In case of an earthquake, students should know the following simple rules:

1. **Duck** down to the floor
2. **Cover** your head with one arm and crawl underneath a desk for shelter
3. **Hold** on until shaking stops

During an emergency:

- In communication with the Communication and Information Team and the Evacuation Team, confirm who has failed to evacuate;
- In case of a danger, determine how many people may be at risk and try to establish their location (classroom, hallway, toilet, etc.);
- Ensure that all team members are safe and, if their safety is at risk, they are evacuated to a safe place;
- In the event of a successful evacuation, evacuate important equipment and assets if necessary (e.g. school server, computers, etc.);
- Communicate with the principal (in the absence of the principal with the deputy principal or another person previously designated as deputy) and the Communication and Information Team.

After the emergency:

- Identify the lessons learned.

FIRST AID TEAM

Under normal conditions:

- Hold coordination meetings;
- Introduce students to the basic methods of first aid;
- Personal training.

During an emergency:

- Communicate with other teams (Evacuation Team, as well as Search and Rescue Team) to establish if there are injured persons or casualties;
- In case of injuries and casualties, evacuate the injured to a safe place for receiving first aid;
- Once the medical team arrives, provide details of the condition of the injured for further treatment;
- Communicate with the principal (in the absence of the principal with the deputy principal or another person previously designated as deputy) and the Communication and Information Team.

After the emergency:

- Identify the lessons learned.

It is important to know that each team performs tasks and undertakes activities in accordance with the emergency until the relevant initial response services arrive.

3.2. EMERGENCY RESPONSE – OPERATIONAL PROCEDURES

The school should always have an updated number of students, staff and visitors on the campus at all times, which is crucial in an emergency.

For this purpose, every classroom should have an emergency folder, which will be attached near the door of each classroom. The folder should contain a list of the names and surnames of students and teachers from all the classes in that classroom. The teacher is responsible for taking student attendance at the beginning of each class. That way, he always knows how many and which students are absent, which is especially important in an emergency. The folder should also have one red and one green card (sheet). In an emergency, during evacuation or going to the safe haven, by using these cards the teacher can immediately signal whether all students are present (by lifting the green card) or if someone is absent (red card).

FIGURE 8: An example of emergency folder

A school prevention and rescue plan should have an emergency response protocol in place so that every member of the school staff knows how to act.

The protocol should outline the general steps to be taken by the school and should consider two scenarios: an emergency reaction when school is in session, i.e., during the school hours and an emergency response when the school is not in session.

3.2.1. EMERGENCY RESPONSE WHEN SCHOOL IS IN SESSION

If there is a potentially threatening situation when the school is in session, such as an intrusion by an unauthorized person at the school, the following steps should be taken:

- Inform the competent authorities;
- Close and lock all school entrances/exits and school grounds;
- Close and lock all doors and windows in the school;
- Tell students and teachers to stay in classrooms and/or offices until they receive further notice;
- If the school is not safe, school community will be instructed to go to the safe haven;

If evacuation is required follow the appropriate evacuation instructions:

- Contact parents or authorized persons to pick up the students from the designated areas;
- The teachers will hand over the students to the parents or authorized persons following the appropriate procedures.

3.2.2. EMERGENCY RESPONSE WHEN SCHOOL IS OUT OF SESSION

If an emergency occurs early in the morning before school starts or during a non-working day (weekend or holiday) the school should take the following steps:

- Contact parents by phone and inform them not to bring their children to school;
- Inform teachers and other staff by phone;
- Lock the school entrances and doors and the school grounds;
- Do not let anyone to get into school;
- In case a student is in the school without a parent, s/he will be sheltered and the parents will be informed to pick student up.

After the competent authorities assess the seriousness of the situation, the principal decides whether the school will continue with regular classes or will remain closed. The main criterion for such a decision should always be the safety of the students and staff.

When an emergency response is needed, in order to have better coordination, communication and adequate response of all school stakeholders (management, teachers, student support services, maintenance staff, and parents), operational procedures should be established for the following cases:

- Operational evacuation procedures;
- Operational procedures for shelter-in-place;
- Operational procedures for family reunification.

3.2.3. OPERATIONAL EVACUATION PROCEDURES

When the school is faced with an emergency, one of the most important tasks is the quick and safe evacuation of students. During the evacuation, administration staff, teachers and students should be familiar with their duties and responsibilities.

Administration:

- Turn on an alert through the early warning and reporting system as prescribed in the procedure (bell, alarm or other);
- In case of fire close all doors and windows;
- Activate the school's initial response teams;
- Monitor the emergency and give instructions as the situation develops;
- Announce end of danger.

Teachers:

In case of evacuation, teachers should follow these steps:

- Quickly line students up quietly and exit the classroom, taking the emergency folder located next to each classroom door;
- Instruct the students to move one by one, calmly and without panic, to be silent and to refrain from walking near the windows;
- Use the shortest evacuation route to the assembly point;
- When you reach the assembly place, make sure all students are present. Report absent students (those who were previously in school, not those who were absent all day) to the Search and Rescue Team;
- If a student is seriously injured, notify the first aid team;
- Stay with your students during the entire evacuation process;
- Make sure students stay calm until they are notified of the end of danger and instructions are given to return to school or until the procedure of reuniting students with their parents is activated.

DURING THE EVACUATION, STUDENTS AND TEACHERS MUST FOLLOW THESE RULES:

- **Don't run**
- **Don't talk**
- **Don't push**
- **Don't go back**
- **Don't use a mobile phone**

Students:

- Should follow instructions and, if necessary, assist their classmates and teachers.

Evacuation plans should be prominently displayed in every classroom and on the walls of school corridors. In addition, the school map with evacuation routes should also be available to emergency services who will come to assist in dealing with an emergency.

These maps should clearly indicate the assembly points and shelters, as well as the places where the students would be reunited with their parents.

3.2.4. OPERATIONAL PROCEDURES FOR SHELTER-IN-PLACE

Safe havens or shelters are used to provide temporary protection to students and staff until the emergency resolves or assistance arrives. It is recommended that each school have at least two emergency shelters, one on the site and one off-site.

The shelter should provide sufficient space to accommodate all students, staff and additional space for potential school visitors. The space should be appropriately marked with classroom numbers in order to know exactly where to place students from each classroom. The shelter should also have an adequate number of toilets.

The off-site shelter should only be used if the school is declared a danger zone (e.g. a bomb threat). This shelter is used only if absolutely necessary, otherwise students should not leave school. The shelter should be located near the school, at a distance not exceeding several hundred meters, so that students can reach the shelter on foot. They should stay there until their parents come to pick them up.

In the case of going to the shelter, the administration, teachers and students should take the following steps:

Administration:

- Alert of an emergency situation and issue instructions to stay in classrooms or go to safe haven;
- Activate school response teams as needed;
- Monitor and issue instructions as the situation develops;
- Announce end of danger.

Teachers:

- Quickly line students up quietly and exit the classroom, taking the emergency folder located next to each classroom door;
- Instruct the students to move one by one, calmly and without panic, to be silent and to refrain from walking near the windows;
- Use the shortest evacuation route to the safe haven;
- When you reach the safe haven, instruct the students to go to designated area marked by number of classrooms;
- Make sure students sit on the floor and are quiet so they can hear new instructions;
- Make sure all students are present. Report absent students (those who were previously in school, not those who were absent all day) to the Disaster Response and Management Team or Search and Rescue Team;
- If a student is seriously injured, notify the First Aid Team;
- Stay with your students during the entire evacuation process;
- Make sure students are calm until you are notified of the end of danger and instructed to leave the safe haven.

Students:

- Should follow instructions and, if necessary, assist their classmates and teachers.

3.2.5. OPERATIONAL PROCEDURES FOR FAMILY REUNIFICATION

After the emergency is over, each school should have a mechanism in place to reunite students with parents to ensure that only authorized adults can pick students up.

In doing so, the administration, parents, teachers, and students should take the following steps:

Administration and parents:

- Parents should provide contact information about persons authorized to pick up their child (see table below);
- In case of an emergency, the administration ensures that students are handed over only to the authorized persons.

Teachers:

- Introduce parents and students to reunification procedures;
- Confirm the identity of the persons picking up the students;
- Document the whole process by filling out the student pick-up form (see below).

Students:

- Should follow instructions and in no case should they leave the school with people not approved by their parents.

TABLE 20: List of parents (persons authorized to pick-up the students)

No.	Name and Surname	Phone Number	Comment

No.	Student (Name and Surname)	Grade Level	Parent/authorized person	Phone Number
1			1. 2. 3.	
2			1. 2. 3.	
3			1. 2. 3.	
4			1. 2. 3.	
5			1. 2. 3.	

TIP:

The school can share the content of the plan with students, teachers and parents during a school celebration or prepare a special event where through fun activities such as drawing, essay writing, role-play, sports activities, exercises and other activities, everyone will get to know and understand their roles in case of emergency.

When picking up the students, the person needs to confirm their identity.

3.3. EMERGENCY DRILLS

Drills that simulate a particular emergency situation in practice are crucial for preparing students and staff on how to behave and respond to it. They are very useful because in this way the existing procedures may be revised, deficiencies in the Protection and Rescue Plan or evacuation bottlenecks may be identified.

During the school year, it is recommended for the Disaster Response and Management Team to organize two drills requiring response to two different situations, such as an earthquake, fire or flood. The same warning and reporting systems and alarms should be used during drills as in the case of a real emergency.

REPETITION IS THE MOTHER OF KNOWLEDGE

Drills are essential to check that the protection and rescue plan works. Through the drills one can easilly assess the folow of students during an evacuation, check whether the movement is effective and whether the shelter is large enough to accommodate all students and staff.

Preparing students and staff to respond appropriately increases their safety at school as it reduces the likelihood of casualties and injuries. One of the drills should be announced and the other one not in order to ensure an appropriate response regardless of the time of day (during classes or recess) and the location of the students in the school.

Teachers are expected to educate students about the different types of natural disasters and other risks and dangers that can occur at school. Students should be aware of conversations that can lead to injuries, even casualties, such as damage to the facility, power outages, water, telephone and the Internet. Talking about possible emergencies with students reduces fear and anxiety and teaches them to plan and be prepared for an emergency response. Students should also know that if they notice something suspicious they should report it immediately to the nearest teacher.

After the drill, a discussion should be reopened about the purpose of the drill; students should be commended for following the instructions properly, and to be positively disciplined if they did not follow the evacuation instructions and rules.

TABLE 21. Drill Record Form

Date of Drill	Time of Drill	Type of Drill	Weather Conditions	Number of Occupants Evacuated	Total Time For Evacuation	Other Information

MODIFY, ADJUST, INFORM!!

Closely monitor the drill and, if you can, record it to see whether something should be changed. When you make the changes, share the new plan with everyone and point out the changes so that everyone knows the new protocol.

4. EMERGENCY RESPONSE

4.1. RISK ASSESSMENT AND SELECTION OF APPROPRIATE RESPONSE

In the event of an emergency, it is important to intervene immediately. For this purpose, the type of emergency, the size and the location must be first identified in order to choose the appropriate response for it.

Most often, the teachers or school maintenance staff are the ones who notice the emergency. It should be reported immediately to the principal or his/her deputy if the principal is absent, which will need to activate the emergency response protocol.

One of the first decisions to be made is whether evacuation or sheltering in a safe haven is required, as prescribed in the operational plan.

The competent authorities should also be immediately informed of the nature of the emergency so that they can respond promptly.

Many natural disasters can be tracked and predicted, but earthquakes occur without warning.

According to the US Geological Survey, there are 17 earthquakes (magnitude over 7), one devastating earthquake (magnitude over 8) and millions of weak earthquakes annually.

4.2. EMERGENCY RESPONSE

With clearly defined roles and responsibilities, as well as appropriate training, school management can activate appropriate school teams that need to respond immediately and assume their roles and responsibilities.

It is necessary to provide first aid to the injured.

4.3. COMMUNICATION

Following the guidelines given in the previous chapters on prevention and preparedness, the school will be prepared to communicate properly with all stakeholders.

The most important thing to remember is that the principal should immediately send information to all school staff and the local community, primarily the municipality and the parents of the students. The Communication and Information Team will communicate with the principal and operating teams and will transmit accurate, verified and consistent information. The principal is a contact person with the media.

4.4. REUNIFICATION

After safe evacuation or sheltering of students, providing first aid to the injured and minimizing the danger of an emergency, the school should ensure that students are reunited with their parents as soon as possible.

5. RECOVERY

The main objective of the recovery phase is to re-establish normal classes as soon as possible after dealing with an emergency. To this end, it is crucial to provide adequate student support and a safe learning environment in the school.

5.1. MEETING OF THE DISASTER RESPONSE AND MANAGEMENT TEAM

Disaster Response and Management Team should meet as soon as conditions permit to make an initial assessment of the situation and define further steps.

5.2. REGULAR COMMUNICATION WITH STUDENTS, PARENTS AND MEDIA

Regular communication and timely information remain crucial even after the emergency is over. Inform students and parents what kind of support and resources they can receive in the school and/or local community.

To prevent rumors, inform the media about the actions taken to normalize the situation and announce the exact date and time when students should return to school.

5.3. PHYSICAL REPAIRS OF SCHOOL BUILDINGS

The security check of the whole school building and grounds is necessary for faster normalization of classes. Any damage observed should be timely reported in order to be removed as soon as possible.
The groundskeeper or the repairman should lead the Communication and Information Team in the damage assessment procedure. Any damage should be documented with photographs so that the school can receive compensation for the damage from the insurance company. It is therefore necessary for the school building to be insured against fire, flood and other accidents. (Primary schools are obliged to have an adequate damage liability coverage and funds are provided by the founder pursuant to the Article 161 of the Law on Primary Education).

5.4. PSYCHOLOGICAL SUPPORT FOR STUDENTS

Student support services led by the school psychologist should assess the emotional state of students and school staff in order to provide them with the necessary psychological support to deal with the situation.

The school can also organize a group intervention, where students, teachers and other school staff may jointly discuss how they have experienced the disaster, the level of stress, the guilt. One of the most important things is to allow everyone to express their feelings freely, without judgment and censorship.

TALK TO STUDENTS!

After the emergency, the class teacher needs to talk to the students. Here are some tips:

- Listen to your students and let them share their concerns
- Explain to them that they are safe now and that the school is taking additional measures
- Offer additional help by talking alone or with a psychologist

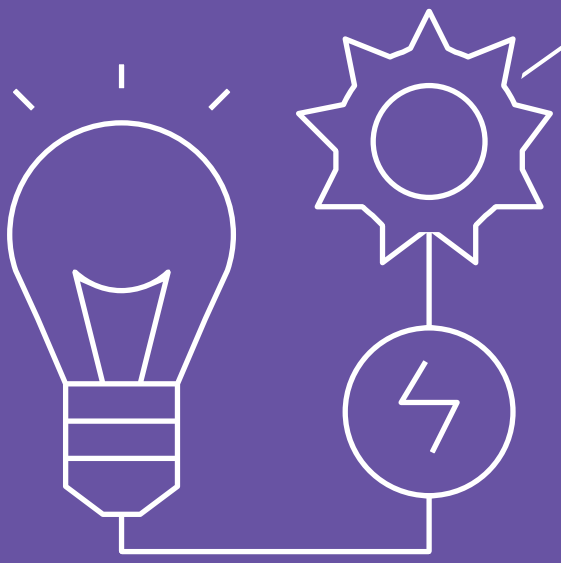
Conversations during homeroom class can help overcome feelings of vulnerability, powerlessness, and the transience of life.

5.5. EVALUATION OF EMERGENCY MANAGEMENT PROCESS

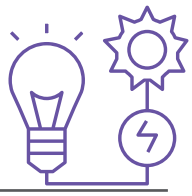
After the emergency, an objective assessment should be made of how the Disaster Response and Management Team, operational teams and the school as a whole have responded and dealt with the emergency. To obtain reliable information it is necessary to conduct interviews or focus groups with representatives of the Disaster Response and Management Team, operating teams, teachers, students and parents to answer the following questions:

- What interventions have been most successful and why?
- What strategies and procedures would you change and why?
- Is it necessary to involve professionals from other fields who could help dealing with the emergency in the future?
- Is additional training needed? In what areas?
- Is additional equipment needed? What kind?
- What additional activities should the school take to be better prepared in the future?

Remember, the recovery phase does not mark the end of the emergency management process. On the contrary, every intervention needs to be carefully evaluated in order to learn new things and improve the process. All lessons learned should become part of the new emergency management plan.



IV MAINTENANCE OF SOLAR POWER SYSTEMS



1. SIGNIFICANCE OF SOLAR ENERGY AS A RENEWABLE ENERGY SOURCE

The sun is the most important source of energy for the entire living world. Unlike the conventional energy sources, such as fossil fuels (oil, coal, gas, biomass), the solar energy is a renewable and clean source of energy and does not lead to environmental pollution with harmful substances. Therefore, the use of solar power systems is constantly increasing. They are used for lighting, water and thermal heating and power generation. These systems are easy to install and their maintenance is quite simple. The only limitation of solar energy is that the intensity of the solar radiation is unstable, cannot be produced during nighttime and the production depends on the season, meteorological conditions and geographical location of the site. Therefore, the location should be carefully analyzed and the available solar energy must be taken into account before a solar power system is designed.

Nowadays, the industry is working intensively on finding out renewable sources of energy for heating the facilities and for producing sanitary hot water (SHW). For this reason, the solar power systems are mainly divided into:

- Systems that use solar energy to produce hot water;
- Systems that use solar energy to generate electricity.

Hot water systems are widely used in public institutions in the Republic of North Macedonia, as well as among private users. However, recently, there is an increased use of systems for electricity generation, especially in public institutions with a particular emphasis on schools.

The sun is a “free” and inexhaustible source of energy that is available in unlimited quantities, without harming the environment. The prerequisites for using solar energy in our country are excellent. The major limiting factors for its relatively poor utilization is the lack of technological knowledge, lack of familiarity of the business sector and the high initial investment costs. The investments are required to procure the necessary devices for transforming the solar energy into useful heating energy and/or electricity.

DID YOU KNOW?

The sun radiates 960 billion kilowatt hours daily onto the Earth's surface. This amount of energy could theoretically meet the world's energy needs for 180 years.

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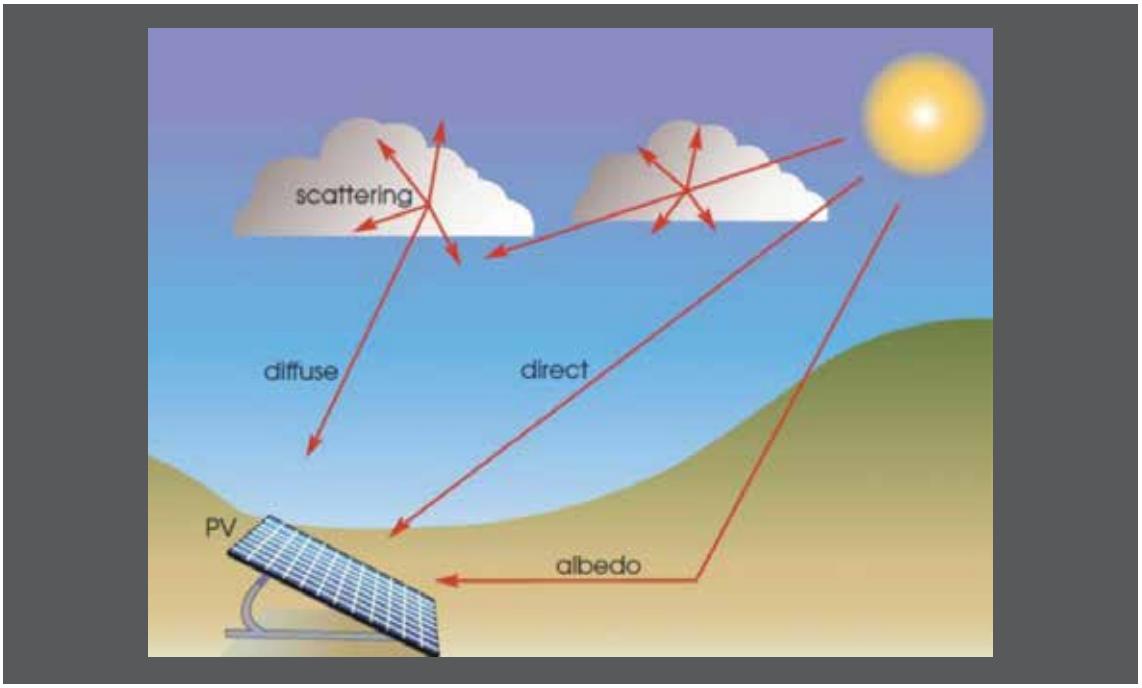
The solar energy can be divided into two components: direct radiation and diffuse radiation. Direct radiation represents the portion of radiation that reaches the surface of the earth directly from the sun. Diffuse radiation is the scattering of sunlight in the atmosphere into molecules and particles of dust and it comes to the surface of the earth from all directions in the sky. In addition, there is reflected radiation (albedo) that measures how much of the solar energy coming to the Earth's surface is reflected without being absorbed.

FIGURE 9. Direct, diffuse and reflected radiation on a photovoltaic (PV) panel



Global radiation is a sum of direct, diffuse and reflected radiation that is taken into account when calculating the required surface area of a collector. For example, for solar collectors with focus on solar radiation, only the direct component has a significant contribution.

DID YOU KNOW?

The first user of the solar technology was the space industry, in the 1950s. Vanguard 1 was the first solar-powered satellite, launched in 1958, generating power through solar cells. This is one of the oldest satellites still orbiting the Earth, racking up more than 10 billion kilometers of travel.

The advantages of using solar thermal energy are:

- Inexhaustible supply of solar energy;
- Solar energy is “free”, although investment in devices is needed to utilize it;
- No harmful emissions of solid particles (due to combustion) and CO_2;
- Can be integrated into existing installation systems;
- Not affected by the increase in energy prices.

To be able to install solar-powered systems, the facility must meet the following requirements:

- To have adequate surface for installation of solar collectors;
- It is recommended the collectors to have south orientation (although slight deviations are allowed);
- To ensure there is no shading of collectors during the day;
- To have an existing system that can be upgraded with solar collectors.

For example, many facilities have a heating boiler, which also operates in the summer to provide a SHW. The operation of the hot water boiler only for producing SHW, makes the system to operate at a lower power than necessary, and thus with reduced efficiency. This can be overcome with the integration of solar collector systems.

DID YOU KNOW?

According to research done in the field of electricity consumption, as much as 50% of consumption goes to heating and cooling. Thermal collectors can also participate in these cooling and heating processes. By getting hot water from the solar panels, which can be used not only for household purposes, but also in the heating system, the electricity consumption can be significantly reduced.

In 80% of the cases where solar power systems are used, solar collectors are used particularly for heating of sanitary water. The reason for this is the continuous consumption of sanitary water throughout the year and the relatively low required temperature. The system is considered to be optimally sized if the annual share of solar energy utilization in relation to the total energy required for the SHW is 55-60% in small solar systems, or 35-45% in medium sized systems. In the case of a higher share of solar energy, the system would be oversized (especially in summer) or disproportionate in terms of the investment costs and energy gain.

During the summer months, solar collectors are usually sufficient to cover entirely the thermal energy needs of the SHW, without additional power from a boiler, electric heater, etc. The temperature of the sanitary water is in the range of 45-60°C. It is important to note that the solar water heater has a higher volume compared to the systems where the heating is with a boiler or electric heater, because the sun has a variable and unpredictable intensity of radiation.

In general, solar thermal collector systems are divided into two types:

- Thermosiphon with circulation of natural working fluids;
- Thermosiphon with forced circulation.

On the other hand, there are also photovoltaic systems, which use solar energy to generate electricity. These systems can also be divided into two types:

- Off-grid independent (stand-alone) solar photovoltaic system, not connected to the power grid due to the terrain or the connection costs;
- Grid-connected photovoltaic system, in which the photovoltaic panels, as a major part of the infrastructure, are connected to the user's internal electrical installation and to the power grid.

Power generation depends on the layout of the panels and the weather conditions. The use of direct sunlight gives maximum effect. However, modern systems can also operate with diffuse light when the weather is cloudy.

DID YOU KNOW?

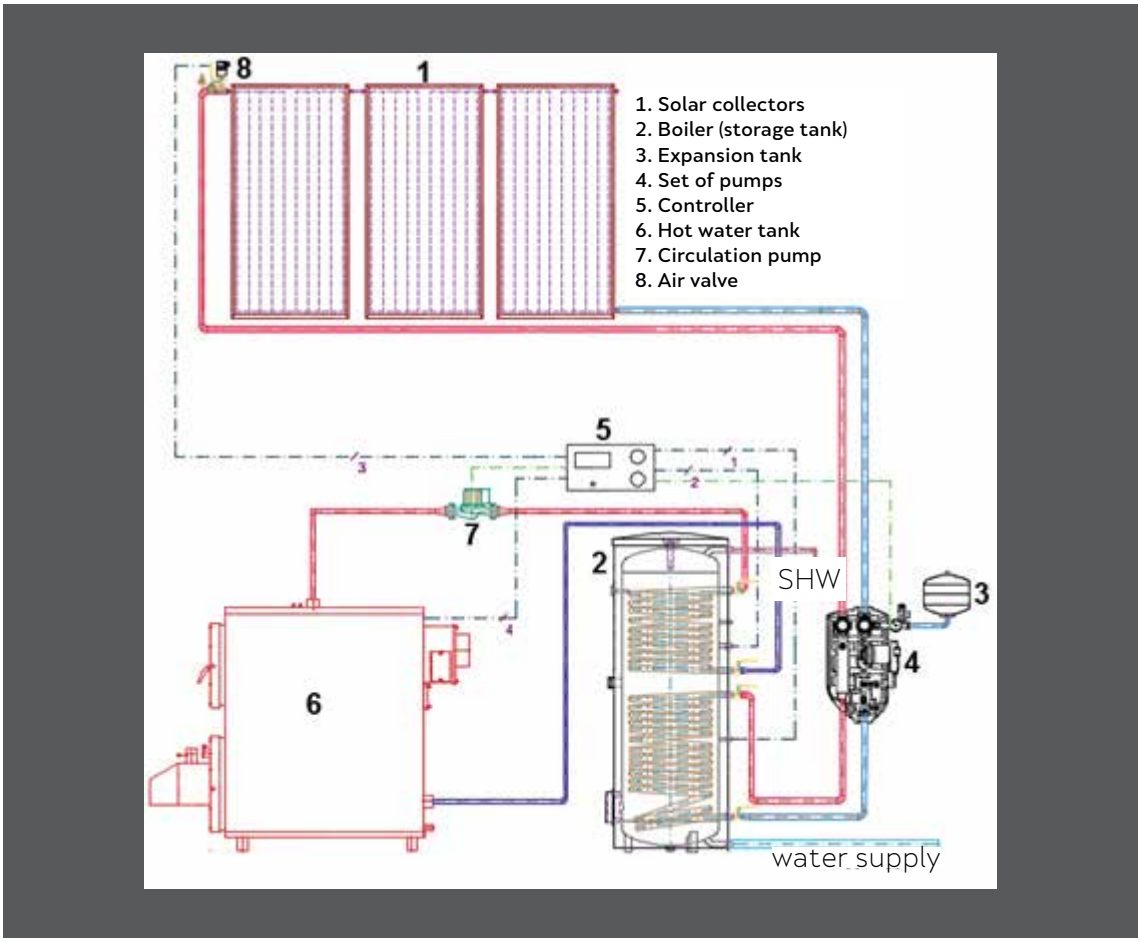
If a photovoltaic system of 1 kW is installed in a given facility, almost one ton of CO_2 will be saved in a year. Taking into account the lifetime of the system, a saving of 25 tons of CO_2 is envisaged. That would be equivalent to planting about 500 trees in an urban area.

2. MAINTENANCE OF SOLAR COLLECTORS' SYSTEMS WITH FORCED CIRCULATION (THERMOSIPHON)

2.1. OPERATION OF AN INDIRECT SYSTEM WITH FORCED CIRCULATION SOLAR COLLECTORS FOR SANITARY HOT WATER

In this type of system, the circulation of the working fluid from the solar collectors to the heat exchanger in the boiler is carried out only with the help of a circulation pump. A mixture of water and ethylene glycol (antifreeze) is commonly used as a working fluid to allow the system to operate at low outside temperatures without the risk of freezing. The schematic diagram below shows a system with the elements for indirect heating of sanitary hot water (SHW) with forced circulation solar collectors.

FIGURE 10. Schematic diagram of indirect system of forced circulation solar collectors



Solar collectors may be comprised of flat plates or vacuum tubes, which does not affect how the system works, but have different operating parameters and performance.

Circulation of the working fluid (water/antifreeze) is carried out with a circulation pump, which is part of the set of pumps indicated by number 4 in Figure 10. Here it should be noted that there are also systems without a set of pumps, but all elements are individually mounted and connected within the system. The working fluid (water/antifreeze) circulates through the solar collectors and is carried in the heat exchanger of the boiler where it transmits heat to the sanitary hot water. The controller marked with number 5 in Figure 10 controls the operation of the circulation pump (no. 4). The controller performs the regulation based on a predefined value for the difference between the temperature of the operating fluid (water/antifreeze) as an output from the solar collectors (temperature probe 3) and the temperature in the boiler (temperature probe 1). At predefined values of temperature difference (e.g. $\Delta T = 5°C$) the controller switches on the circulation pump to operate only when the output temperature from the solar collectors (temperature probe 3) is higher for at least 5°C than the temperature in the boiler as measured by temperature probe 1.

The boiler (storage tank) shown in Figure 10 has two heat exchangers. The solar

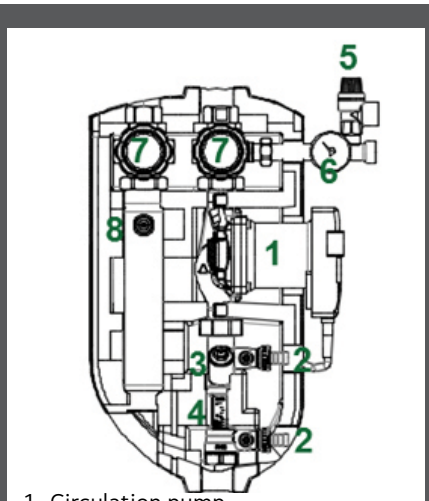
collector system is connected via the pipeline to the second (lower) heat exchanger, while the first (upper) heat exchanger is connected to the hot water tank from which through the working fluid (water/antifreeze) and with the pump (no. 7) the heated working fluid is circulated from the boiler to the heat exchanger for the SHW boiler. The operation of the pump (no. 7) is also controlled by the controller (no. 5), which compares the temperature in the boiler (temperature probe 2) and the temperature in the hot water tank (temperature probe 4). If the temperature difference is higher than the predefined value in the controller, the circulation pump (no. 7) will be tuned on.а разлика на овие температури е повисока од вредноста зададена во контролерот.

2.2. COMPONENTS OF THE INDIRECT SYSTEM WITH FORCED CIRCULATION SOLAR COLLECTORS

Set with circulation pump

The set of pumps marked with number 4, shown in the schematic diagram of Figure 10 is a compact solution, as besides the circulation pump there are several additional regulatory elements connected in one functional unit. These elements are defined in Figure 11. It should be noted that there are systems that do not have a set with circulation pump, that is, the components of this set are individually mounted in the solar collector system.

FIGURE 11. Hydraulic set of solar collectors with circulation pump

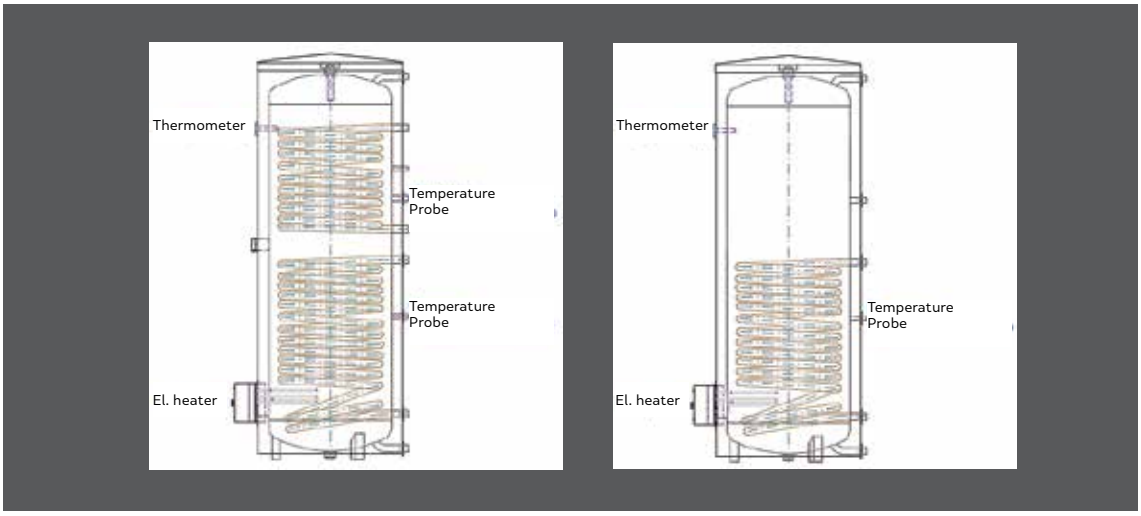


1. Circulation pump
2. Charging/discharging plug
3. Flow regulating valve
4. Flow meter (l/h)
5. Safety valve
6. Manometer
7. Valves
8. Pressure relief valve

Storage tank – boiler

The storage tanks of indirect solar collector systems have integrated at least one heat exchanger, which is connected to the solar collectors through a pipeline network. Depending on the system, the boiler may have one or more heat exchangers. Figure 12 shows boilers with one or two heat exchangers with snake shape tubes. If the boiler has two heat exchangers, usually the lower heat exchanger is connected to the solar collector system (due to the lower temperature than the fluid that is heated by conventional sources such as a hot water boiler, thus having a larger heat exchange surface). A conventional heat source, usually with higher temperature parameters of the heated fluid, is installed on the higher heat exchanger. In addition to heat exchangers, boilers often have space provided for the installation of an electric heater, the operation of which should be regulated by the central controller, in order to optimize the operation of the entire system and to achieve maximum efficiency.

FIGURE 12. Storage tanks (boilers) with one and two heat exchangers



In addition to the heat exchangers, Figure 12 shows the locations where the temperature probes of the controller are mounted. Also shown is the position of the electric heater, which usually has an integrated thermostat. In systems with higher control and process regulation, the controller manages the operation of the electric heater. The electric heater does not have to be mounted as shown, but it can be mounted in a different position or height depending on the manufacturer.

If there is a technical mismatch between the surfaces of the heat exchanger (indirectly also of the boiler's volume) and the surface of the solar collectors, the system can operate with very little efficiency. As an illustration, if the solar collectors are connected to a boiler with an inadequate surface of the heat exchanger or a relatively small exchange surface relative to the collector surface, then the system will operate with low efficiency. If the boiler volume is relatively smaller than the surface area of the solar collectors, there is a high risk of frequent temperature stagnation of the solar collectors (this is explained in more detail below) which further causes absorber damage to the collectors and a change in characteristics of working fluid (antifreeze).

Expansion tank

The expansion tank is installed in closed systems, in which there is a change in working fluid temperatures. The purpose of this device is to absorb the changes in the pressure, which are result of the temperature expansion of the working fluid caused by temperature changes.

There are open and closed expansion tanks. Closed expansion tanks are used in solar collector systems. The closed expansion tank has an elastic (rubber) membrane, which divides the expansion tank into two parts: the first or aquatic part in which the working fluid (water/antifreeze) enters and the second part, which is usually filled with inert gas or nitrogen under pressure.

The choice of expansion tank depends on the total amount of working fluid (water/antifreeze) in the system, the minimum and maximum operating temperature, as well as the operating pressure and the maximum allowable pressure i.e. the pressure of the safety valve.

When the expansion tank is not properly selected, usually when a smaller expansion tank is selected, there is an oscillation in the operating pressure, i.e. it becomes higher. If the maximum pressure is reached, the working fluid may leak through the safety valve.

In addition to the proper selection of the working volume of the expansion tank, it is also necessary to take into account the purpose of its use or the maximum operating temperature to which it will be exposed, as this would affect the choice of material for the elastic membrane. When installing the expansion tank, it should be positioned in such way so there would be no valves in the connection to the solar collectors. If there is a valve, it should be made sure that when the system is put in operation, the valve is open so that the expansion tank can perform its intended function. On the opposite side of the working fluid connection, there is a gas valve on the other side of the membrane, from which the pressure in the expansion tank can be adjusted.

The following figure shows the installation of an expansion tank in solar collector systems (red cylindrical shape).

FIGURE 13. Mounted expansion tank

Controller

The controller is a device that regulates the operation of the solar collector system and plays a significant role in the overall efficiency of the system. There are controllers with a range

of functions depending on the complexity of the system. For indirect systems with forced circulation, the basic controller should have at least two input parameters, i.e. two temperature sensors and one output control signal (for the circulation pump). Due to the complexity of the range of functions available in today's controllers, the manufacturer's manual should be studied in detail to maximize system performance while identifying and removing potential system irregularities in a timely manner. Figure 14 shows two controllers:

- Integrated into the hydraulic set with a circulation pump;
- Independently set controller.

FIGURE 14. Controllers in solar collector systems

Setting up and connecting the sensors

Proper installation of sensors is the primary precondition for functioning of the entire solar collector system. Other important factors affecting the functionality of the system are the location of the sensor, which should have good thermal contact at the measuring point (firmly positioned, and a paste to improve the thermal conductivity between the measuring point and the sensor):

- The temperature sensor on the collector should be fixed directly to the absorber (in this type of setting, it is usually pre-set by the manufacturer) or mounted on the collector's exit tube - the highest temperature. However, care should be taken to set the sensor right on the horizontal part of the collector's exit tube, in order to accurately measure the temperature;
- The temperature sensor in the storage tank should be set at a height (in the middle of the heat exchanger) where the solar collectors are connected (shown in Figure 12: temperature probe location). The temperature probe can be installed by inserting it in the factory-designated location - small diameter pipe with a dead end penetrating into the boiler and having contact with the

SHW - or it can be placed under the insulation, in direct contact with the steel part of the boiler. If the length of the temperature probe is shorter than the controller to the installation site, then it is necessary to extend the cable with a minimum cross-sectional area of 0.75 mm^2. The cross-section of the cable depends on the length that is required for extension and can be found in the manufacturer's documentation. The cables of the probes should not be together with the main power cables (in a tube or cable channel), as electromagnetic fields can affect the accuracy of the measured results. In addition, the power supply of the controller needs to have a high voltage protection (lightning protection plug).

2.3. PREPARATION OF THE SOLAR COLLECTOR SYSTEM PRIOR TO COMMISSIONING

The procedure for preparation of the solar collector system is carried out upon initial commissioning of the system and in cases where the system has not been in operation for a number of reasons.

2.3.1. CLEANING THE INSTALLATION WITH WATER/ANTIFREEZE UNDER PRESSURE

This stage of cleaning or washing the interior of the installation is carried out by re-circulating water/antifreeze under certain pressure and is applied in the following cases:

- Upon initial or basic commissioning of the system;
- After interruption of system operation (service etc.) where the working fluid (water/antifreeze) is discharged from the installation;
- If there is air in the installation that cannot be released through the existing exhaust vents.

Cleaning removes impurities and debris in the system, created by the materials themselves and the operation of the system, such as lime scale residues, which further affects transfer of heat, fluid circulation through the system, etc. This process allows for minimal air intake into the system. Cleaning of installation should not be done when there is intense sunlight outside or at low outside temperatures as there is a risk of evaporation or freezing of water/antifreeze. Figure 15 shows a functional diagram of the system cleaning procedure.

FIGURE 15. Overview of the procedure for cleaning the solar collector system

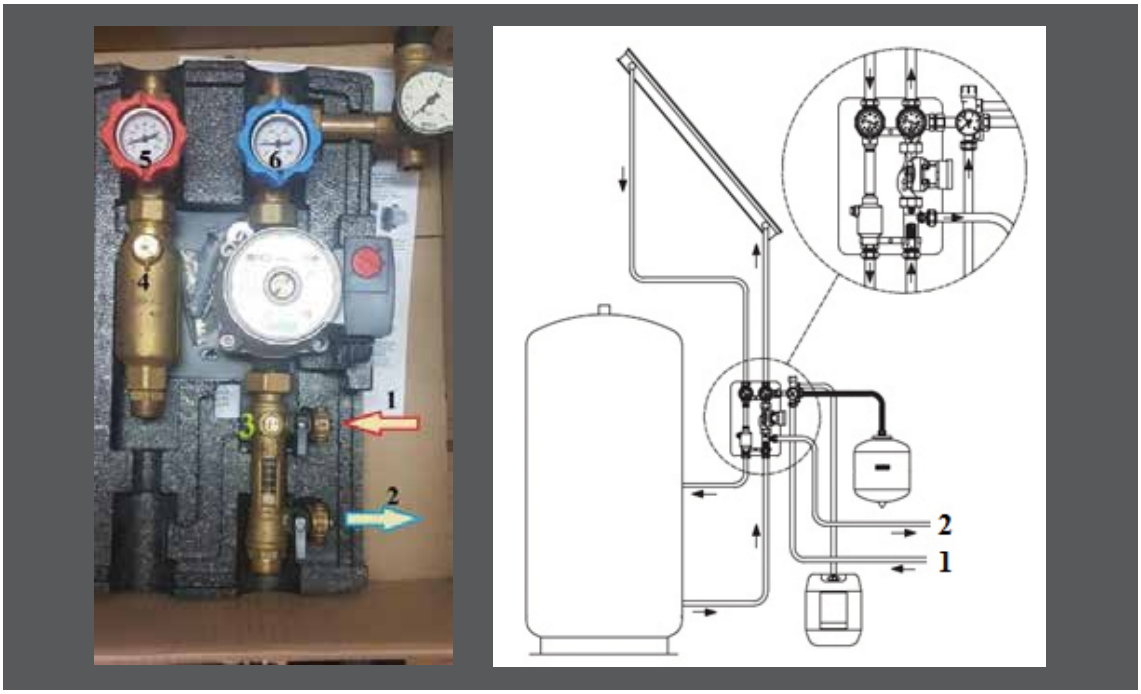


Figure 15. In order to clean the entire installation of the solar collector system, it is necessary to have an additional/external pump that will circulate the working fluid antifreeze or to connect a hose directly from the water supply system, if the system remains filled with water. The external pump is connected through a hose to the valves 1, 2, 5, 6 that should be open, while the valve 3 should be closed, according to the markings shown on the hydraulic set with the set of pumps in Figure 16. The antifreeze, which goes through the installation of the entire system, flows back into the tank through valve 2. The valve 4 partially releases air from the system. This process of re-circulation of antifreeze before filling up the system usually takes about 10 minutes, but it depends on the size of the installation. One of the indicators that cleaning is complete is when the antifreeze returns to the tank without any visible impurities and there is a continuous flow indicating that there is no air in the system. Care should be taken not to apply high pressures during cleaning as this may cause damage to the devices. It is recommended during this process, the expansion tank to be hydraulically insulated from the system in order to protect it from possible damage.

The layout of the elements in the hydraulic set with a group of pumps depends on the manufacturer. The system may not have a hydraulic set as the one shown in Figure 15, but the elements may be individually mounted in the installation. It is important to have a set of valves with the following layout: valves 1, 2, 3 shown in Figure 16, which will allow one-way antifreeze recirculation throughout the installation. The figure shows the valve position when the system is in operation, while in the process of cleaning/ releasing air from the installation, the valves should be in the following position:

- Valve 2 – open for supply of antifreeze;
- Valve 3 - open for leakage/return of antifreeze to the tank;
- Valve 1 - closed.

FIGURE 16. Combination of valves ensuring the cleaning process

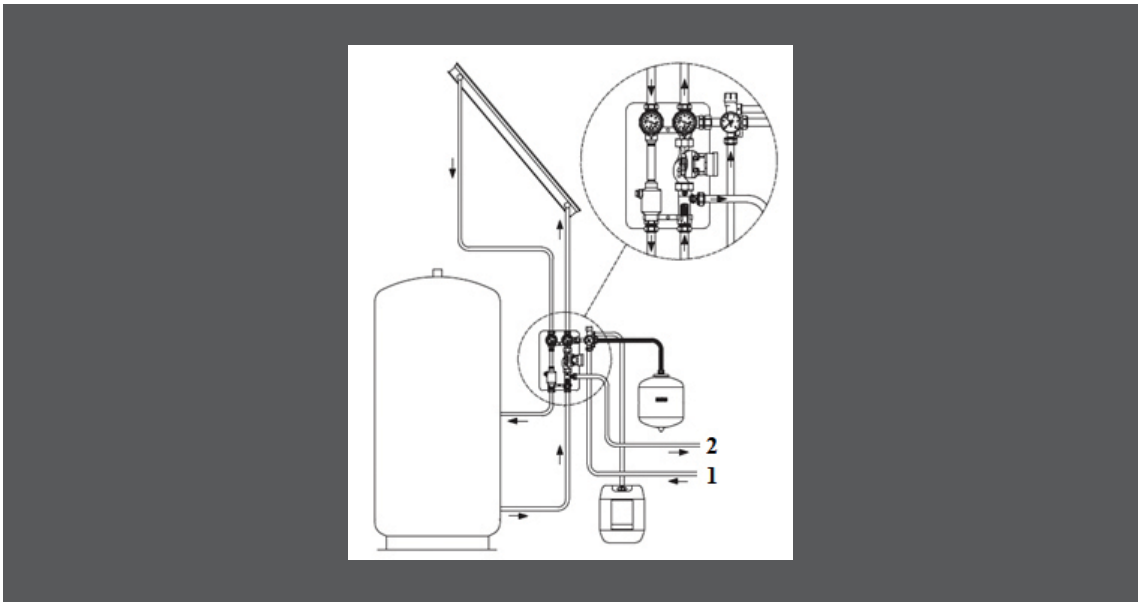
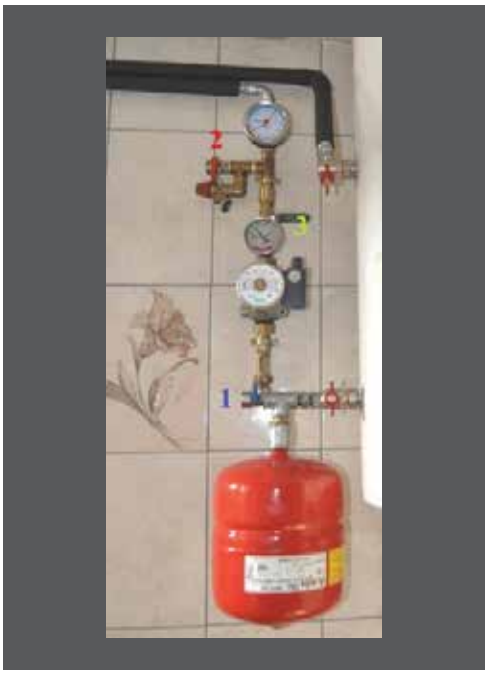


Figure 17 shows an example of an installation where there is no hydraulic set with a circulating pump but with individually mounted elements.

FIGURE 17. System with individually mounted elements and method for filling up the system



The system shown in Figure 17 during cleaning and filling up is operated as follows: the valve 3 is closed, the valve 1 is opened and an external pump is connected through a flexible hose for filling up the system (water/antifreeze). The valve 2, which is also open, is fitted with a hose through which the antifreeze is fed back into the tank from which it receives the working fluid with the external pump. All other valves are open.

The direction of antifreeze re-circulation during the cleaning of the installation must be in accordance with the direction of the circulation pump of the system, and this means

in accordance with the direction of the non-return valve (if such valve exists in the system).

During circulation of antifreeze/water, the pressure must be kept constant in order to prevent air from entering the installation. Once it is determined that there is no more dirt and the flow from the hose is continuous (no air present) the valve 2 can be closed (Figure 15) and the valve 3 can be opened and the installation will be filled with antifreeze (water) under the operating pressure. It is recommended that the operating pressure of the installation during the standstill at the highest point (at the exit point of the collector) be at least 0.5 bar above atmospheric pressure in order to prevent ambient air from entering the installation. The operating pressure can be defined as the sum of the static pressure and the additional pressure of 0.5 bar. Static pressure is defined depending on the height difference between the highest and lowest point in the system. If for example the height difference between the highest point (collectors) and the lowest point (boiler) is 7 meters, then the system is recommended to be filled at a pressure of 1.2 bar (7m x 0.1 bar/m) + 0.5 bar = 1.2 bar). It is recommended to put it at a higher pressure (e.g. 1.4 - 1.5 bar) given that during operation of the system air will be released which should be taken out of the system and this reduces the working pressure.

2.3.2. CHECKING FOR SYSTEM LEAKS AND RELEASING OF AIR

Checking for leaks in the system is done after the system is cleaned. Once it has been determined there are no impurities in the system, valve 2 is closed (shown in Figure 15) and valve 3 is opened. The check for potential leaks is best done at higher pressure and the limiting factor is the pressure of the safety valve (usually 6 bar). When the system is pressurized, the air in the installation is released through the appropriate devices such as: the device marked as 4 in Figure 15 (schematically shown in Figure 17), by the pump screw and the device mounted on the collector (highest point) - automatic pot, also shown in Figure 18.

FIGURE 18. Methods for releasing air from the system

Figure 18 also shows releasing air from the pump, by unscrewing the pump screw, if there is trapped air, it will immediately start to come out with small water/working fluid leaks. The same process is also used in cases where the pump rotor is stuck for some reason, so checking and starting actuation is initiated. The presence of air in the circulation pump disables the water/antifreeze circulation, which can damage the pump and at the same time overheat the collectors (stagnation), damage them and change the properties of the antifreeze.

After the initial air release from the system, it is necessary to add up to the starting pressure (test pressure-limited by the safety valve value) and the system can be checked for potential leaks (visually and manually to locate potentially humid places). During the day, when there is solar radiation, the water heats up (temperature expansion), causing changes in pressure and therefore the display of the pressure gauge cannot be considered reliable for detecting any leaks. This means that the pressure gauge can only be checked/compared at night when there is no solar radiation. If the pressure gauge on the first day shows a decrease in pressure, this may be due to the release of air through the automatic pot(s) mounted on the collector.

Once no leaks are shown, the pressure value can be adjusted by lowering, by releasing the excess water/antifreeze and by opening the valves 1 and 2 as shown in Figure 15. Be careful when filling up the antifreeze system about the value of the declared antifreeze freezing temperature.

2.3.3. SETTING UP THE PUMP – FLOW IN THE SYSTEM

Once the system is filled with the working fluid (water/antifreeze) and the air is released from the system, the flow in the system needs to be adjusted. To set up the flow in the system there must be a device for measuring/indicating the flow (flowmeter) as shown in Figure 19.

FIGURE 19. Flowmeter in solar collectors

The measurement unit of a device is usually expressed in l/min. On the device itself (marked with the arrow in Figure 19) there is a valve that regulates the flow, i.e. it sets the maximum flow in case the pump has its own regulation. In most cases, the flow in small systems is foreseen to be either with high flow of 40 l/m^{2}h. If the system has reservoirs that allow temperature stratification then a specific flow of 20 l/m^{2}h is foreseen. For example, if the system operates at a high flow rate and has a total of 10m^2 of solar collectors parallel connected, the total flow rate should be 400 l/h or the flowmeter and regulator should be set at 6.7 l/min. Most often (although it depends on the system and performance) by adjusting the above stated flow values, in high flow systems, the temperature difference between the supply and return pipe is within the range of 10-15°C, while in the case of low flow the temperature difference is between 30-50°C.

If there is no flowmeter installed in the system, then the flow through the system cannot be inspected and in that case, the flow should be adjusted in relation to the temperature difference of the working fluid (antifreeze/water) in and out of the heat exchanger. However, this kind of regulation is imprecise and appropriate experience is needed.

2.3.4. SETTING UP THE PARAMETERS IN THE CONTROLLER

There are a number of manufacturers of controllers on the market that have integrated a range of functions. The basic function of the controller to be set is the temperature difference between the temperature in the boiler and the output temperature of the solar collector as well as the temperature in the conventional heat source (boiler, heat pump, etc.) and the temperature of the boiler. The controller regulates the work of the circulation pump depending on the value of the predefined temperature differences. Most often the temperature difference for turning on the pump is 5-10°C (difference between temperatures 1 and 3 - involves pump 4 and difference between temperatures 4 and 2 involves pump 7, as shown in Figure 11), while switching off is usually set to 2°C. For facilities in which there is a discontinuity in the use of sanitary hot water, especially at times when the solar radiation is more intense, it is recommended the controller to have the function of protecting the system from overheating. The function for protection of collectors/system from overheating in the event when no sanitary hot water is used is usually defined as “Holiday” mode. The controller turns on the circulation pump when there is no solar radiation (in the evening) to allow to cool the water in the boiler through the solar collectors, thus allowing for subsequent circulation of the working fluid into the system, accumulation of heat in the boiler and protection of the collectors from entering a phase of temperature stagnation when high temperatures of the working fluid occur, which may negatively affect all devices.

2.4. PROCEDURES FOR MAINTENANCE OF SOLAR COLLECTOR SYSTEMS

Solar collector systems generally do not require daily (frequent) maintenance, i.e. there is a need for general periodic inspection of certain parameters, which are often easily detectable as the main indicator is the temperature of the sanitary hot water.

Generally, periodic maintenance consists of:

- Check the operating pressure by reading the pressure gauge. This is done at times when there is a reduced intensity of solar radiation, as a major indicator of possible leaks in the system or damage/leaks due to freezing of the installation;
- Check the condition of the boiler-protective magnesium anode;
- Insulation check etc.

2.4.1. VISUAL CHECK OF THE SYSTEM ELEMENTS

This type of system maintenance, allows for visual checks for any changes to the system of:

Collectors:

- Check the glass for dirt, as this reduces collector's efficiency;
- Check the condition of the joints for any leaks;
- Check for potential damage to the glass,
- Check for insulation damage to pipes,
- Check the condition/contact of the temperature probes at the installation site (improperly fastened probes i.e. loose contact would result into improper reading).

Installation and boiler:

- Insulation status check;
- Leak check;
- Cleaning of filters (dirt collectors);
- Check the condition/contact of the temperature probes at the installation site (if they are properly mounted).

2.4.2. CHECKING THE SYSTEM FOR POTENTIAL FREEZING

Checking the system for potential freezing involves checking the thermo-physical properties of the antifreeze. Changes in the antifreeze properties can occur when exposed to high temperatures, which happens during intense sunlight, and for some reason the pump does not operate, i.e. there is no circulation in the system and the heat stays in the collectors. Freezing of the working fluid in the solar collector system can result into damages to the pipes exposed to external influence, usually the pipes in the collectors. Figure 20 shows an example of freezing resulting into damage to the solar collector's pipes.

FIGURE 20. Damaged pipes of the collector due to freezing of the working fluid

A hydrometer or refractometer is required to check the characteristics of the working fluid/ antifreeze. To this end, the system receives a certain amount of the antifreeze/water mixture, with the devices either directly reading the lowest freezing temperature or the specific density of the mixture. If the specific density is read then the freezing temperature should be read from the density-concentration diagram. It is recommended to check the characteristics of the working fluid with regard to the freezing temperature before winter, as antifreeze degradation occurs when exposed to high temperatures - periods of temperature stagnation in summer.

2.4.3. MONITORING THE OPERATING PARAMETERS AND DETERMINING THE FUNCTIONALITY OF THE DEVICES

Pressure, temperatures and setting the controller are the main parameters that need to be checked more frequently. The pressure changes during the operation of the system, depending on the temperature of the working fluid. After entirely discharging the air from the system (after venting) the pressure changes should not be greater than 0.3 bar (if the expansion tank is appropriately dimensioned, in other cases there may be large oscillations in the pressure values).

Most often the temperature difference between the pipes in the heat exchanger should be around 20°C. Other values would mean that the system has air or impurities that reduce circulation. However, at low flow rates of 20 l/h m^2, larger temperature differences may occur and care should be taken not to be lower than 5°C as there is a risk of deposition of lime scale on the surface of the heat exchanger. The adjustment of the controller and its functions must be tested. If there is an option in the controller's

functions to record the operation time of the circulating pump and the heat received by the collectors, then data analysis can determine if there are any irregularities.

It is necessary to monitor and check the magnesium anode status indicator (if present in the boiler) and replace it when necessary.

2.5. INSTALLATION ERRORS, CONSEQUENCES AND TROUBLESHOOTING

The following table shows the potential errors that may occur when installing the system, its possible consequences and troubleshooting.

TABLE 22: Overview of possible installation errors, consequences and troubleshooting

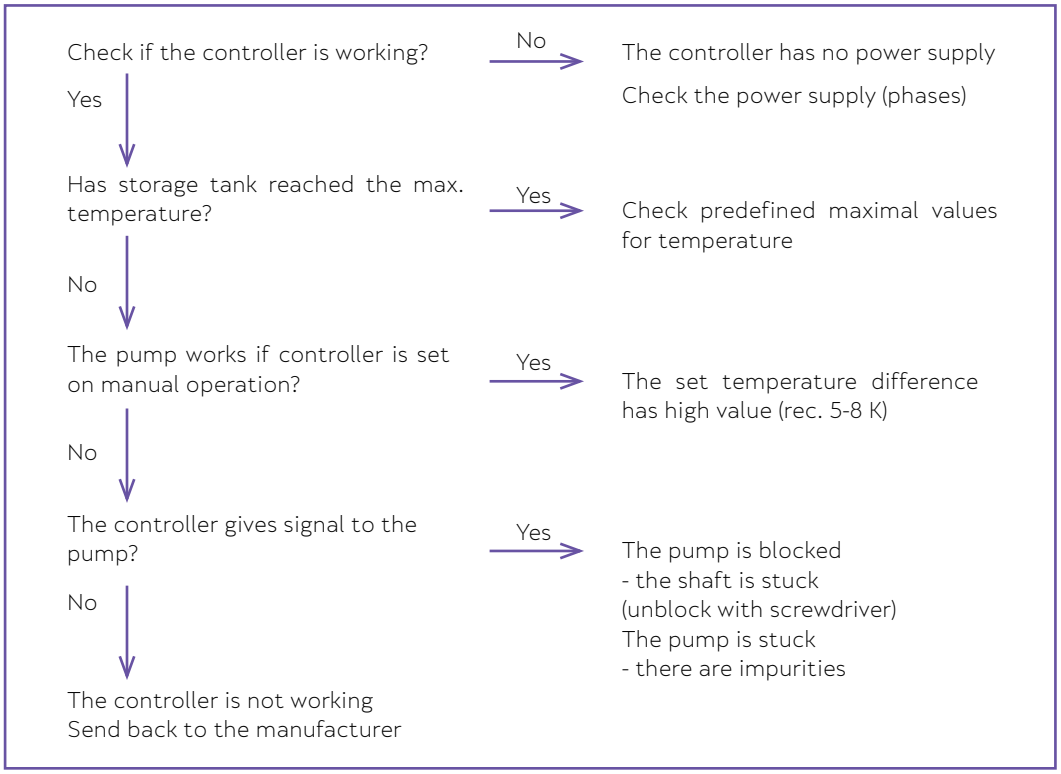
Item	Possible installation errors	Consequence	Troubleshooting
Collector	The collector is in the shade	Reduced energy efficiency (low energy input)	If shading is unavoidable, increase the surface area
	The temperature probes of the collector are in the shade	The controller responds with a delay compared to real-time	The last collector, seen from the direction of flow, should be taken out of shade отокот, да не биде во сенка
	Using different materials (copper over aluminum roof)	Danger of corrosion	Consider the electrochemical potential

Item	Possible installation errors	Consequence	Troubleshooting
Hydraulic installation-system	Improper connection of supply and return pipe in the circulation	Insufficient heat/ input, damage to the pump due to overheating	Proper connection of the supply and return pipe
	Inappropriate expansion tank installed	Damage to membrane, leaks, safety valve response	Installation of expansion tank resistant to antifreeze, temperature, pressure
	The expansion tank connected at the bottom	Accumulation of air, steam, changes in pressure, damage to the membrane	Connecting the expansion tank from the top
	Inappropriate ventilation device (automatic pan), temperature variability	Overheating the system, damaging the elements of the air pans	Using appropriate ventilation devices, up to 150°C
	Inadequate material of pipe network in terms of durability of operating modes-temperature, pressure and antifreeze characteristics	Leaks, loss of antifreeze	Using appropriate materials for operating modes
	Missing non-return valve in installation	Heat loss/cooling of the boiler due to natural circulation	Installation of a temperature-stable non-return valve in the inlet installation
	There is no device to discharge air from the system	There is a danger of complete disruption to the circulation	Setting up a vent system
Storage tank (boiler)	Error connecting heat exchanger pipes to collectors	Low heat transfer in boiler, high return temperature in collectors - low efficiency	Connection accordingly to the layout of the connectors and the direction of fluid circulation
	Inappropriate - too high / low setting of temperature probes, poor pipe contact or lack of temperature probe	Poor system regulation	Placing the temperature sensors in the middle of the exchanger; checking that the contact in the branch for the temperature sensor is good
	Wrong recirculation pipe connection	Water mixing in the boiler - temperature stratification	Connecting recirculation tube in the middle of the boiler

Item	Possible installation errors	Consequence	Troubleshooting
Insulation	Lack of insulation/ insufficient thickness of insulating material	Heat losses	Full insulation in accordance with the recommendations
	Application of mineral wool without protection to surfaces exposed to external influences	Moisture absorption, freezing and increasing heat transfer, insulation damage	Application of protective coating and high temperature resistant insulation (avoiding mineral wool without protection for outdoor use)
	Lack of protective coating of insulation of steel, aluminum	Damage to insulation from birds	Installation of protective steel or aluminum material
Control	High value set for temperature difference	Less heat consumption	Temperature difference is recommended to be within the range (5-7°C)
	Maximum boiler temperature set at >60°C	Potential danger of lime scale deposition in heat exchangers	Recommended temperature in the boiler (s) to be around 60°C
	The temperature sensors of the solar collectors and the boiler were switched while connecting them in the controller	The pump is switched on only when the temperature in the boiler is higher than the collector temperature	Connect the temperature sensors to the appropriate location in the controller
Check before commissioning	When testing the pressure system the water remains in the absorber and pipes (freeze at 4°C)	Damage to the absorber and installation pipes	Testing the system with working fluid (antifreeze) or pressurized air
	Antifreeze concentration (propylene/water) is above 50%	Reduction in heat transfer, increased energy consumption of pumps	Use of antifreeze with maximum concentration of 40%
	The system is recharged during intense sunlight	Steam generation in the system, inability to charge	The system is best charged when there is no solar radiation
	Insufficient air removal from the system, ventilation device not set at the highest point	Oscillation of pressure in the system, heat transfer cannot be achieved	Professional, complete air removal
	Low pressure in the system	Reduced heat transfer due to interruption in circulation	Static height +0.5 bar
Maintenance	The working fluid has not been checked for freezing temperature	Cracking of pipes in collector and system	Periodic checking of freezing temperature
	The pH of the working fluid has not been checked	Possible pipe corrosion and erosion	Checking the pH

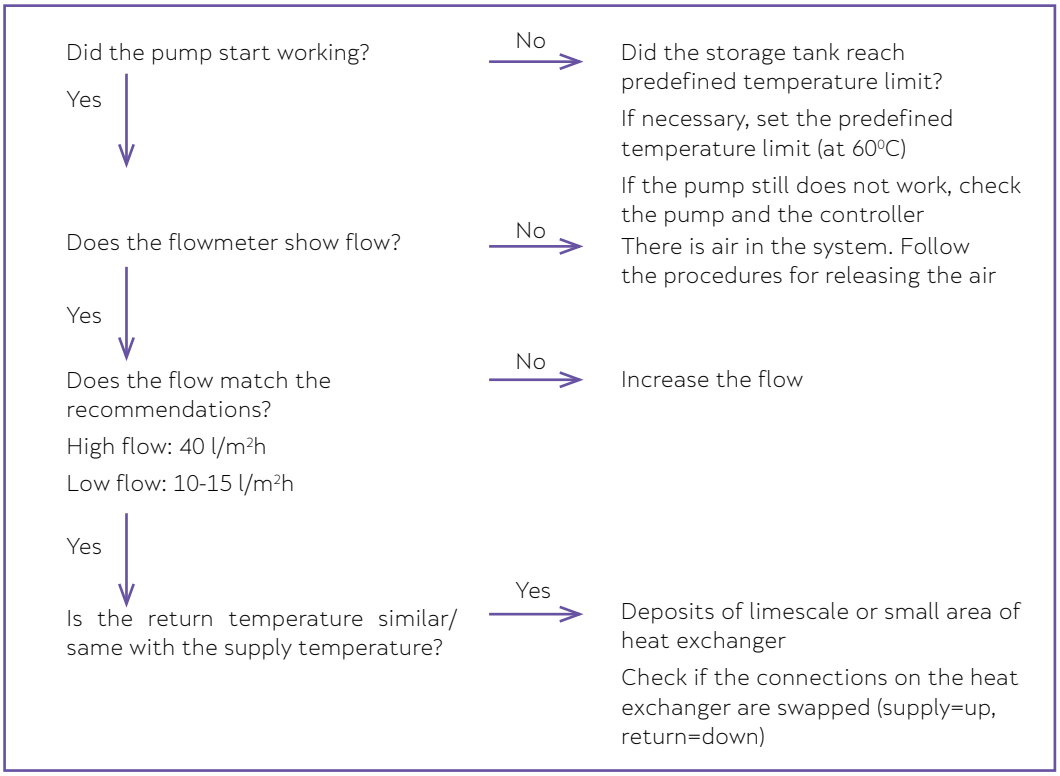
2.5.1. PROCEDURES FOR DETERMINING THE ERRORS AND TROUBLESHOOTING

Procedures for Determining the Errors and Troubleshooting

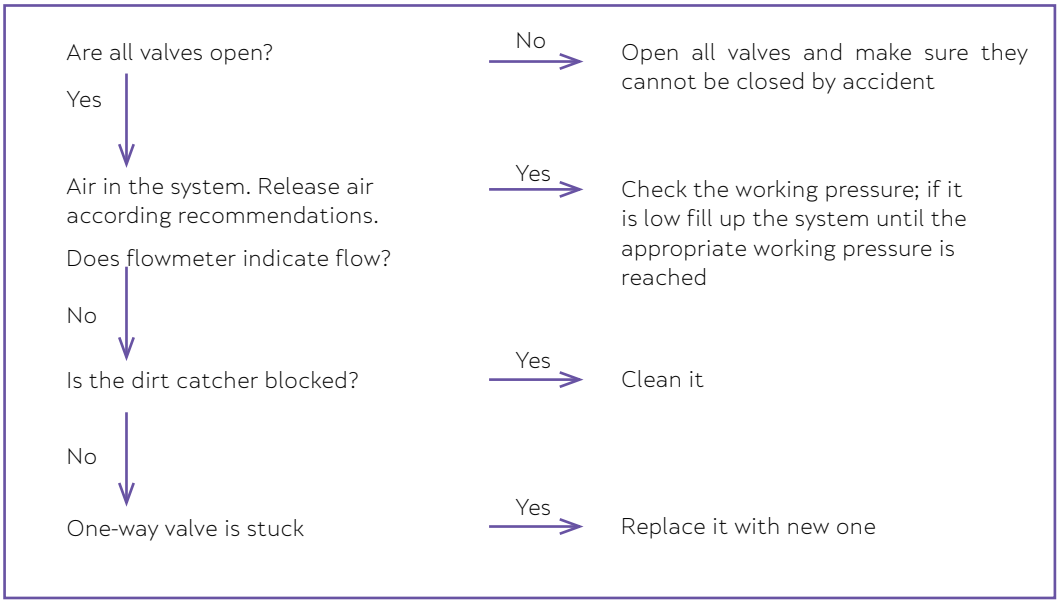


High temperature difference between collectors and storage tank (boiler)

The recommendation for the temperature difference between the supply and return pipe of the heat exchanger for systems with high flow should be about 10K while for a low flow around 30K. However, this should always be checked in the project documentation of the system.



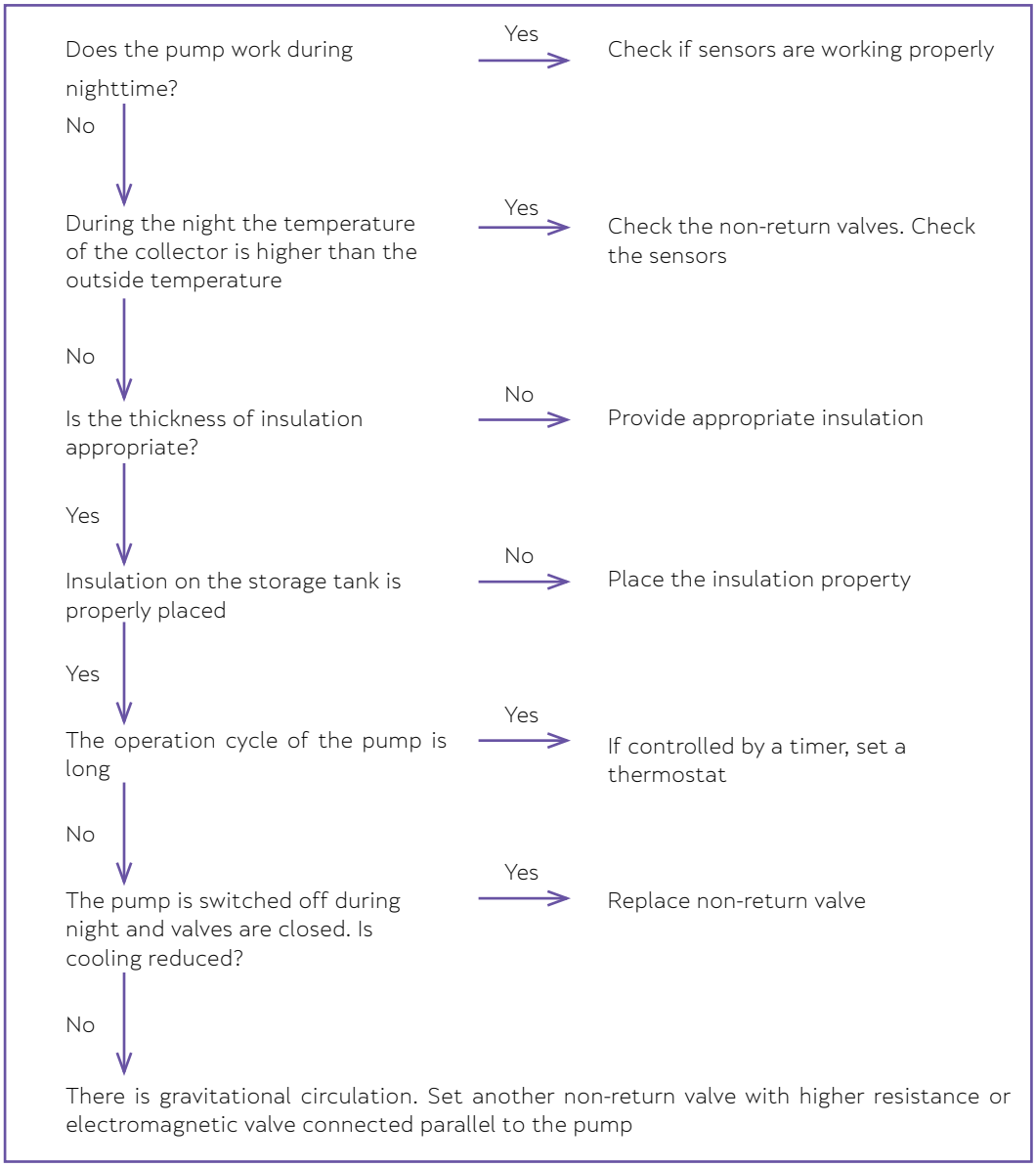
The pump works but the flowmeter does not indicate any flow



It is recommended to follow the procedure for releasing the air from the system because vapor may occur during periods of intense solar radiation. Therefore, this process should be done either early in the morning or in the afternoon. These steps should be followed:

1. Open all valves;
2. Increase the pressure in the system with an external filling pump;
3. Periodically release the circulation pump with short pulses at maximum capacity;
4. If necessary, unscrew the screw from the pump to release air;
5. Close all valves after the air release procedure has been completed.

- **Storage tank (boiler) cools overnight, without consumption of sanitary hot water**



3. MAINTENANCE OF SOLAR COLLECTORS' SYSTEMS WITH NATURAL CIRCULATION (THERMOSIPHON)

Thermosiphon systems use gravitational circulation, which occurs as a result of the difference in the working fluid densities or the temperature difference. The working fluid is heated in the collector, goes up to the top of the tank, transmits heat through the heat exchanger to the cooling water, and then goes back to the lower part of the collector. Sanitary hot water is taken either directly from the tank, or indirectly through a heat exchanger in the tank. The main benefit of a thermosiphon system is that it works without a pump and a controller. This makes the systems simple, robust and highly efficient. A well-designed thermal system is highly efficient, which ultimately depends on the climatic conditions in which it is installed.

The disadvantage of these types of systems is that the tank must be located above or beside the collector. In most thermal systems, the tank is mounted on a collector and both are located on the roof. This solar thermal system is commonly used in areas with moderate climates. The principle can also be used in colder climates, with the tank placed indoors (for example, just under the roof).

A typical single-family system for sanitary hot water has an area of about 2-5 m^2 of collector area and a reservoir of 100-200 liters.

In these systems, the working fluid circulation is natural due to the difference in the working fluid density, there are no moving elements, i.e. no circulating pump, and the transmission is indirect via a heat exchanger. The circulation occurs as a result of the difference in the densities of the working fluid which is heated by the solar radiation in the solar collector, moves to the heat exchanger (which is in the storage tank-boiler), transfers heat and returns to the collector. The working fluid should always have a low freezing temperature. Figure 21 shows a thermosiphon system with flat plate collector. The storage tank (boiler) is always mounted above the solar collector in order to facilitate the circulation of the working fluid.

FIGURE 21. Thermosiphon system with flat plate collector

It is typical for these systems that the cold supply water (from the pipeline) and the sanitary hot water are connected to the reservoir located in the external environment. Pipes for cold (supply) water and sanitary hot water should be well insulated, as there is a high risk of freezing in winter. Therefore, it is necessary to check the insulation of the pipes before winter. If in the winter the outside temperature is extremely low for several days and there is no solar radiation (cloudy weather) there is a danger of the water freezing in the pipes (both the water supply pipe and the pipe for sanitary hot water, if it is not used). The boiler is usually well protected or insulated with polyurethane foam.

Filling up the system with a working fluid/antifreeze is usually at atmospheric pressure, i.e. through one of the openings (usually there are two openings at the heat exchanger). The filling up is performed until it is visually determined that the heat exchanger is full and there are no more bubbles (air) at the site. It is recommended to check the working fluid/antifreeze properties periodically (every few years), i.e. to check the freezing temperature.

The following table gives an overview of the potential failures, causes and troubleshooting.

TABLE 23: Overview of possible failures, potential causes and troubleshooting

Failure	Potential Cause	Troubleshooting
No water flows from the hot water tap	There is no pressure in the water supply network or the inlet valve is closed	Open the appropriate valve
	The water in the inlet pipe or boiler is frozen	Defrost the pipe (and/or boiler) and check for damages
Cold water flows from the hot water tap	The boiler is still not heated	Wait for the water to heat
	No working fluid - insufficiently charged system (heat exchanger)	Add working fluid
In spite of the intense solar radiation lukewarm water comes out from the hot water tap	The boiler has lime scale	Remove the lime scale
	Insufficient working fluid-antifreeze in the exchanger	Refill with antifreeze (check also safety valve)
	Fault in mixing valve (if present in system)	Set at a temperature of about 60°C
Boiling water (steam) comes out of the hot water tap	Intense solar radiation and low consumption of hot water	Install a mixing valve or use the hot water appropriately during periods of intense sunlight
The safety valve is open	High pressure in heat exchanger due to intense heating of working fluid - low consumption of sanitary hot water	If no hot water is used, discharge the boiler and cover the solar collector (s) to prevent overheating.
	High pressure in the heat exchanger - the boiler is idle	

3.1. VACUUM PIPE THERMOSIPHON SYSTEM (DIRECT CIRCULATION-OPEN SYSTEM)

This system also operates on the principle of natural circulation i.e. as a result of the difference in the densities of water which is heated in the solar collector and circulates towards the storage tank (boiler) and the cold water returns back to the collector. The characteristic of these systems is that the water supplied from the pipeline circulates directly through the boiler and vacuum tubes. Figure 22 shows an open vacuum tube system (vacuum tubes penetrate in the boiler where as previously mentioned sanitary water circulates directly and is heated through the tubes.

FIGURE22. Vacuum tube system with direct heating of sanitary water

The water in the boiler and vacuum tubes is not pressurized, but the controller regulates the tank-filling valve and the information in the controller is obtained through regulator/probe. The boiler usually has an electric heater. Since the system is not under pressure, the circulation of sanitary hot water to the consumers is natural, i.e. the pressure at the point of use/tap depends on the height/static difference in relation to the boiler. If the pressure is not sufficient, a pump is usually installed to increase the water pressure to the point of use. Figure 23 shows an installation with a controller regulating system operation, a pressure boosting pump in the installation using heated water and a mixing valve (in the bottom part of the image) for regulating the temperature of the sanitary hot water (boiler shown in the image is additionally fitted with a conventional electric heater independent of the solar system).

FIGURE23. Elements of internal installation of vacuum collector system with direct heating of sanitary hot water

Maintenance of these systems is the same as in the previously described thermosiphon systems. There is only one difference - if the system does not have a leakage pressure of the sanitary hot water it is necessary to check the condition of the sensor (indicator) and the valve that regulates the filling of water in the boiler and the operation of the pressure boosting pump.

4. SECURITY CHECKS AND WARNINGS

Solar systems for power generation are safe when used properly. However, there are potential hazards associated with some of the components of the systems.

TABLE 25: Symbols warning of a possible danger

Symbol	Meaning	Explanation
	Significant safety hazard	Failure to follow the procedure will result in serious injury to the operator.
	General security alert	Failure to follow the procedure may result in serious injury to the operator.
	Electric shock safety alert	Failure to follow the procedure may result in injuries.
	Safety at work	Mandatory wearing of personal protective equipment (appropriate protective goggles and protective clothing) during maintenance.

Some of these systems can be hazardous and can cause fire or even death if, for example, uninsulated wires/pipelines are touched. Generally, these systems are safe if maintained in good working order.

The following precautions should be taken to reduce the hazards and increase safety when performing system maintenance activities:

Batteries

- No maintenance work should be carried out on systems and equipment if a strong sulfuric acid odor occurs near the batteries;
- Smoking or starting fire near systems is prohibited;
- Safety glasses must be worn when performing all activities;
- Acid resistant gloves and apron must be used when maintaining batteries;
- Clean water must be available near the batteries to allow washing of the site in case of acid leakage (especially if it comes in contact with skin);
- Sodium bicarbonate should also be available and mixed with water to wash the area where the acid leaked;
- The handles of each tool to be used must be adequately protected with insulation to avoid unwanted short circuits.;

Photovoltaic modules

- The owner of these systems should NEVER do any maintenance of these systems except for simple cleaning;
- There is a danger of falling when performing activities on the roof of an object. NEVER climb onto the roof of the building unless there is a safety net or if you have the proper safety equipment to protect you from falling.

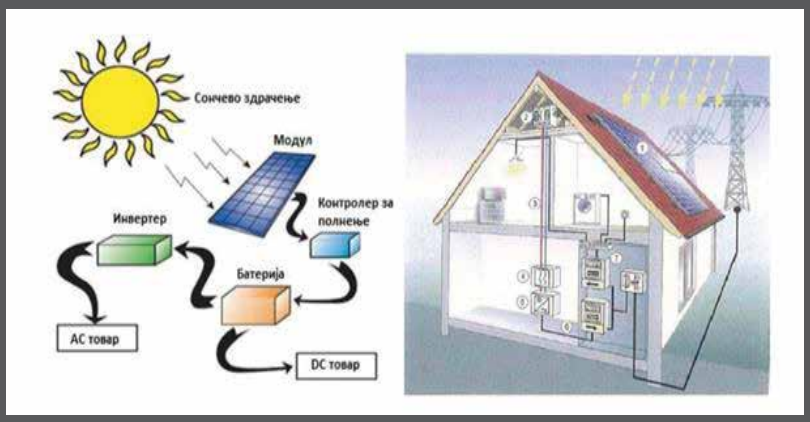
5. INDEPENDENT (STAND-ALONE) SOLAR PHOTOVOLTAIC SYSTEMS

Photovoltaic systems for solar power generation can be operated as stand-alone (independent) or connected to the electricity grid.

Independent systems in addition to photovoltaic panels also use additional equipment:

- Batteries;
- Balance of system (including: inverter, regulators, battery charger, wiring and ducts;
- Generator.

Figure 24. Typical photovoltaic system



a) stand-alone b) grid-connected

Prior to any maintenance of the equipment, the system shutdown procedure must be followed in accordance with the manufacturer's specification.

5.1. MAINTENANCE OF POWER GENERATING EQUIPMENT

Power generating equipment includes photovoltaic systems, generators and controllers. Photovoltaic systems consist of a series of solar collectors and generally do not require maintenance. However, occasional maintenance and inspection will ensure maximum performance of all photovoltaic panels in the system.

If the panels are roof-mounted and there is a risk that the operator may fall during maintenance, protective equipment MUST be used, such as a belt or scaffolding.

The most common maintenance activity for photovoltaic panels is to clean the glass in order to remove accumulated dirt/dust. In most cases, cleaning the panels is only necessary during long dry periods, when there is no rain to clean them naturally. To remove dirt/dust from the panels, they simply need to be rinsed with water. If the modules have a larger amount of soil deposited on the panels, wash the panels with lukewarm water and sponge. Washing your panels is similar to washing your windows with the exception that you CANNOT use chemicals. Panels should be cleaned when the weather is not too hot, and this is usually early in the morning.

After the panels are cleaned, a visual inspection should be carried out to check for cracks or discoloration of the panel. If visible damage is noted, indicate their location so that these defects can be monitored in the future and see if they affect the system performance and efficiency.

When inspecting the solar panels, the bearing structure should also be checked. In doing so, it is necessary to pay attention to the following:

- Threaded connections - if there is any corrosion;
- Construction safety check - whether it is firmly in place.

The gasoline, diesel or LPG generator requires regular checks on the fuel and oil levels in the system. The quantities of these two fluids should be refilled as required. Additionally, regular maintenance including full replacement of oil and filters is required at intervals specified by the manufacturer.

It is recommended that all generators have a voltmeter installed at the outlet to monitor the voltage. If the generator produces higher or lower voltages than the usual 220V or if the unit operates at higher or lower speed than recommended, the generator may cause damage to some of the grid-connected devices or may damage the battery charger. The system also needs to have a working hour meter in order to know when system maintenance is required.

If you suspect the generator is not working properly, call an authorized service technician.

Generators produce high voltage. Do not open the parts of the generator that will allow access to the electronics of the generator.

5.2. MAINTENANCE OF SYSTEM OF BATTERIES

The battery system usually consists of individual 2-volt cells interconnected in series, and sometimes in parallel in order to provide adequate voltage and power accumulation. Sometimes, 12- or 6-volt monobloc cells are used instead of 2-volt cells. These systems should use batteries specially designed for this purpose, with the appropriate capability for charging and discharging specific to such systems. Traditional car and truck batteries are not suitable.

Most commonly used are one of these two types of batteries:

- Batteries where the electrolyte level must be checked regularly; and
- Batteries that do not have access to the electrolyte, i.e. they are sealed with a built-in control valve.

The batteries should be stored in a location in accordance with the manufacturer's recommendations. The system of batteries should be housed in a cabinet or compartment containing only the batteries, accessible only to an authorized person. They must be adequately shielded in a separate room to avoid the possibility of sparks in their vicinity. The battery system should have a natural or forced ventilation capability to avoid the accumulation of explosive gases. The space where the battery system is housed should be clean, dry and lockable to restrict access to it.

Good access to the battery contacts and the electrolyte recharge holes should be provided. Generally, batteries are mounted on a construction so that they are not placed on the floor and to provide full access to them. Shelves or other equipment should not be placed above the batteries as items may fall on the batteries and cause a short circuit or spark. Additionally, battery gases can cause corrosion to that equipment. Accumulation of objects in close proximity to batteries should be avoided in order to have constant and easy access to them.

Exposure to the battery system at extreme temperatures should be kept to a minimum as this may reduce performance and service life. The battery system should be positioned so that each cell is exposed to the same temperature.

Keep in mind that batteries are energy-saving devices that under specific conditions can release all energy at once with explosive effects. The battery system should only be accessible to people who know and understand its operation and are responsible for maintaining it. The access of unauthorized persons must be disabled, in particular the access of children to the system. Restricted access will be the first, and often the best, way for safety maintenance. Appropriate danger signs should be displayed in a prominent place. Signs should warn of the possibility of an explosion and inform everyone that it is forbidden to start a fire or smoke near the battery system.

The following equipment should be permanently available and ready for use near the battery system:

- Bucket of clean water - for acid washing;
- Safety goggles or protective mask- for face and eye protection;
- Rubber gloves - for hands protection;
- Bottle of water for eye washing - in case of spraying acid near the eyes;
- Full protective clothing or apron - to protect the body from acid splashes;
- Baking soda - to neutralize the acid.

Generally, battery maintenance focuses on proper recharging modes, proper electrolyte volume, neat contacts and overall battery safety. As part of regular maintenance, a detailed visual inspection is required. The check should include:

- Whether the batteries are clean;
- Electrolyte level (not required for sealed batteries);
- Battery contact status;
- Signs of electrolyte leakage - stains on the floor or expired electrolyte in the trays under the batteries (if any);
- Condition of battery case;
- Batteries' voltage level.

For a maximum battery life, it is best to ensure that they are constantly charged to the maximum and that they are not allowed to drain below the minimum recommended level. Check the manufacturer's recommendations for the minimum recommended battery level.

It is advisable to check the battery voltage daily at the same time. That way you will get a proper picture of the battery condition. Based on this review, decisions on how to use energy should be made. For example, a decision may be made to delay some activity that consumes a lot of energy or recharges the batteries with a generator. Once you are familiar with the performance of your system, these checks may be less common.

5.2.1. VOLTAGE CHECK

The table below shows the usual voltages that indicate whether the system is in good condition or not. The table is valid only when the system is idle (neither being filled nor emptied). This table should only be used as an indicator. Always, consult the manufacturer for precise values. The table is intended for batteries that charge the electrolyte level and operate at 25°C. At higher or lower temperatures, an appropriate value correction should be made using the temperature correction factor given in the operating instructions. For systems with sealed batteries, only the values given in the manufacturer's specification should be checked.

TABLE 25: Overview of system's voltage for proper maintenance

Nominal voltage	Bad condition	Additional charging required	Good condition	Alert*
2V	<1.9	1.9 – 2.0	2 – 2.2	>2.4
12V	<11.4	11.4 – 12	12 – 13.2	>14.4
24V	<22.8	22.8 – 24	24 – 26.4	>28.8
48V	<45.6	45.6 – 48	48 – 52.8	>57.6

* Note: For some batteries, a short-term load of 2.6V for each 2V cell is allowed.

6. GRID-CONNECTED PHOTOVOLTAIC SYSTEMS

This section provides an overview of the maintenance activities of solar photovoltaic systems connected to the grid. A typical grid-connected photovoltaic system consists of:

- Photovoltaic system;
- Inverter;
- Balance of system (including: gauges, switches, wiring and ducts).

6.1. MAINTENANCE OF THE ENERGY GENERATION GEAR

The solar photovoltaic system is made up of solar collectors placed side by side. Although it is considered that these systems do not require any maintenance, occasional maintenance activities will provide maximum performance.

FIGURE 25. Photovoltaic system mounted on a roof of a facility

The most common maintenance activity for photovoltaic panels is to clean the glass in order to remove accumulated dirt/dust. In most cases, cleaning the panels is only necessary during long dry periods, when there is no rain to clean them naturally. To remove dirt/dust from the panels, they simply need to be rinsed with water. If the modules have a larger amount of dirt deposited on the panels, wash the panels with lukewarm water and sponge. Washing the panels is similar to washing the windows with the exception that chemicals CANNOT be used. Panels should be cleaned when they are not too hot, and this is usually early in the morning.

If the panels are roof-mounted and there is a risk that the operator might fall during maintenance, protective equipment MUST be used (e.g. belt or scaffolding ropes).

After the panels are cleaned, a visual inspection should be carried out to check for cracks or discoloration of the panel. If any visible damage is noted, indicate their location, so that these defects can be monitored in future and determine if they affect the system performance and efficiency.

FIGURE 26. Maintenance of roof-mounted solar panels

When inspecting the solar panels, the bearing structure should also be checked. Two main things to pay attention to are: threaded connections - whether there is corrosion and construction safety check - whether it is firmly mounted.

6.2. MAINTENANCE OF ADDITIONAL EQUIPMENT

Inverters generally require very little maintenance, but when performing system maintenance activities it is advisable to take the following actions:

- Keep the inverter clean and minimize the possibility of dust getting into the equipment. Clean with a dry cloth when needed;
- Ensure that the device is not attacked by pests;
- Check that the inverter works properly by looking at the appropriate LED indicators, gauge or other displays depending on the model.

The **balance of system** generally requires very little maintenance, but when performing system maintenance activities it is advisable to take the following actions:

- Check that all cables and connectors are mechanically secured;
- Check that all switches are functioning properly;
- Verify that the gauges are working properly.

Typically, grid-connected systems use connecting cables between the panels in the solar system and these cables are hidden behind the solar panels. Hence, the only cables that can be checked are the following:

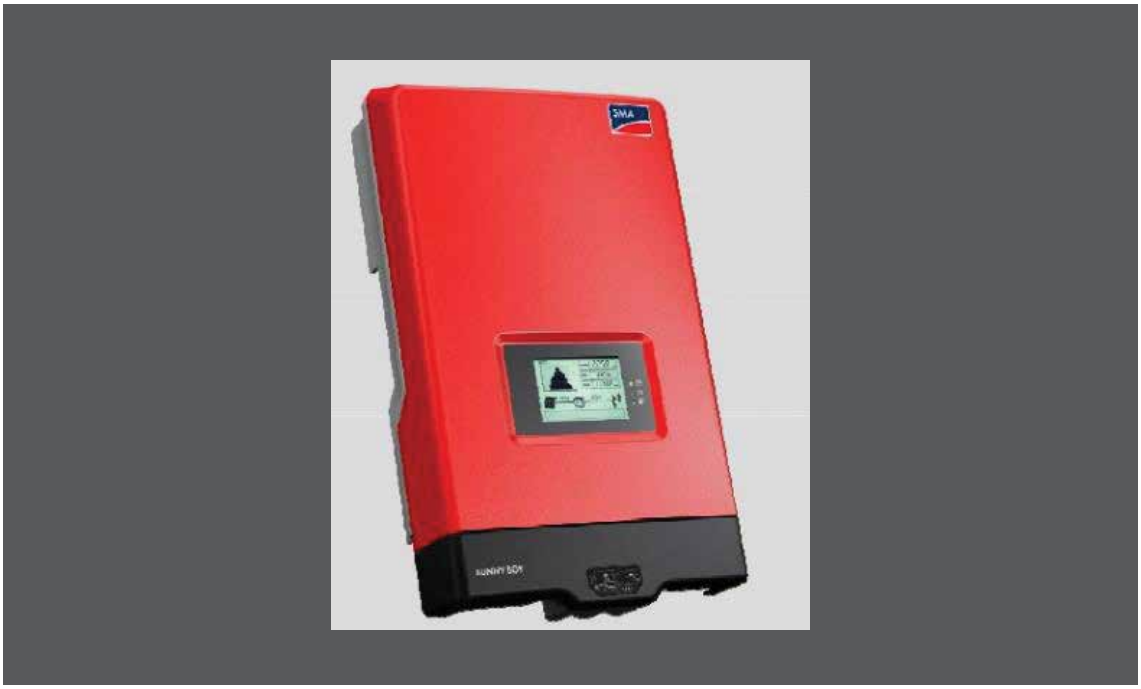
- Cables leading from the panels to the inverter;
- Cables from the inverter to the control board.

When the photovoltaic system connected to the grid is operating properly, there are no moving parts, which can indicate whether the system is operating. During the day, when the sun shines, the modules work quietly and produce electricity that is either immediately used or transmitted to the grid. Hence, one may be in doubt whether the system is working at all. It is recommended for such system to have at least one gauge that records the amount of energy generated by the panels or the amount of energy transmitted to the grid.

If there is only a gauge for the generated energy then you can read it in the morning and again in the evening. The difference in reading determines the daily amount of energy generated.

If the system only measures the amount transmitted to the grid, but your facility consumes the energy, then the gauge will not record large differences. In such a case, disconnect all electricity consumers from your facility and note if the gauge shows any difference.

FIGURE 27. Inverter with display for reading the amount of power generated



Some systems include gauges that record the amount of energy generated at a given moment, while some systems offer continuous monitoring and recording of the generated energy.

TABLE 26: Overview of possible photovoltaic system failures, causes and troubleshooting

Failure	Possible causes	Troubleshooting
Provide appropriate insulation	Photovoltaic panels have accumulated dirt/dust	Photovoltaic glass needs cleaning to remove dirt/ dust.
	Battery malfunction	Call service and maintenance
The display on the inverter does not work	Power outage to inverter	Make sure that all connectors are plugged in properly. Make sure you have electricity throughout the facility.
	Device malfunction	Call service and maintenance
	The device has entered a “security mode” of operation	Call service and maintenance

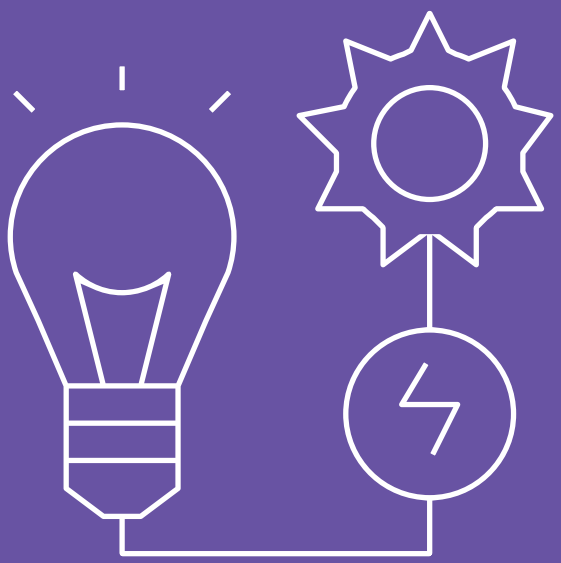
THESE GUIDELINES SHALL ENTER INTO FORCE THE FOLLOWING DAY AS OF THE DAY OF ITS ADOPTION.

No. 08-5084/1

15.05.2020 Skopje

Minister of Education and Science

Arbër Ademi



V ANNEX

APPENDIX 1: FIVE LEVELS OF CLEANLINESS[9]

LEVEL 1

Floors and base moldings shine and/or are bright and clean; colors are fresh. There is no buildup in corners or along walls. All vertical and horizontal surfaces have a freshly cleaned or polished appearance and have no accumulation of dust, dirt, marks, streaks, smudges, or fingerprints. Washroom and shower tile and fixtures gleam and are odor-free. Supplies are adequate. Trash containers and pencil sharpeners are empty, clean, and odor-free.

LEVEL 2

Floors and base moldings shine and/or are bright and clean with no buildup in corners or along walls, but there can be up to two days' worth of dirt, dust, stains, or streaks. All vertical and horizontal surfaces have a freshly cleaned or polished appearance and have no accumulation of dust, dirt, marks, streaks, smudges, or fingerprints. Washroom and shower tile and fixtures gleam and are odor-free. Supplies are adequate. Trash containers and pencil sharpeners are empty, clean, and odor-free.

LEVEL 3

Floors are swept clean, but upon close observation dust, dirt, and stains, as well as a buildup of dirt, dust, and/or floor finish in corners and along walls, can be seen. There are dull spots and/or matted carpet in walking lanes, and streaks and splashes on base molding. All vertical and horizontal surfaces have obvious dust, dirt, marks, smudges, and fingerprints. Lamps all work and all fixtures are clean. Trash containers and pencil sharpeners are empty, clean, and odor-free.

9 Source: APPA: Leadership in Educational Facilities, formerly the Association of Physical Plant Administrators. www.appa.org.rg.

LEVEL 4

Floors are swept clean, but are dull. Colors are dingy, and there is an obvious buildup of dust, dirt, and/or floor finish in corners and along walls. Molding is dull, contains streaks, and splashes. All vertical and horizontal surfaces have conspicuous dust, dirt, smudges, fingerprints, and marks that will be difficult to remove. Less than 5% of lamps are burned out, and fixtures are dingy. Trash containers and pencil sharpeners have old trash and shavings. They are stained and marked. Trash cans smell sour.

LEVEL 5

Floors and carpets are dirty and have visible wear and/or pitting. Colors are faded and dingy, and there is a conspicuous buildup of dirt, dust, and/or floor finish in corners and along walls. Base molding is dirty, stained, and streaked. Gum, stains, dirt, dust balls, and trash are broadcast. All vertical and horizontal surfaces have major accumulations of dust, dirt, smudges, and fingerprints, as well as damage. It is evident that no maintenance or cleaning is done on these surfaces. More than 5% of lamps are burned out, and fixtures are dirty with dust balls and flies. Trash containers and pencil sharpeners overflow. They are stained and marked. Trash containers smell sour.

APPENDIX 2: DAILY CLEANING SCHEDULE

Location	Description	Action	Initials of Responsible Person/ Hour completed	Supervisor's comment:
Entrances, hallways and corridors	These areas are generally the first areas seen by anybody visiting the school including students and staff members. They offer a first impression of the school.	• Sweep the entrance and remove anything that may block the entrance doors		
		• Vacuum		
		• Damp Mop		
		• Remove chewing gum		
		• Clean entrance door glass		
		• Clean access ramp		
		• Disinfect the door knobs		
		• Dust all visible cabinets		
		• Replace burned out light bulbs		
Classrooms and laboratories	In addition to cleaning and sanitizing, it is the cleaner's responsibility to check for burned out light bulbs on a daily basis. Laboratories can pose hazards and care should be taken in situations where specialist equipment is present.	• Air classrooms		
		• Empty bins		
		• Clean whiteboards and/or chalkboards		
		• Vacuum high traffic areas		
		• Spot clean soiled areas of carpet		
		• Dry mop floors		
		• Wet mop floors		
		• Clean glass in doors and partitions		
		• Disinfect the door knobs		

Location	Description	Action	Initials of Responsible Person/ Hour completed	Supervisor's comment:
Offices, library and media center	In addition to cleaning and sanitizing, it is the cleaner's responsibility to check for burned out light bulbs on a daily basis.	• Air offices		
		• Empty bins		
		• Clean white boards and/or chalkboards		
		• Vacuum high traffic areas		
		• Spot clean soiled areas of carpet		
		• Dry mop floors		
		• Wet mop floors		
		• Clean glass in doors and partitions		
		• Disinfect the door knobs		
Lavatories, changing rooms	These are high traffic areas and require regular disinfecting.	• Empty bins		
		• Thoroughly clean and disinfect toilets and urinals		
		• Thoroughly clean and disinfect changing rooms		
		• Restock dispensers		
		• Clean mirrors		
		• Clean sinks		
		• Polish stainless steel and chrome surfaces		
		• Spot wash walls, lockers and partitions		
		• Dry mop floors		
		• Wet mop floors with disinfectant		
		• Disinfect the door knobs		
Food preparation and lunch areas	These are high traffic areas where food is prepared and/or eaten and, as such, require regular disinfecting.	• Disinfect table tops		
		• Empty bins		
		• Sweep floors		
		• Wet mop floors		
		• Vacuum carpets and mats		
		• Disinfect drinking fountains		

Location	Description	Action	Initials of Responsible Person/ Hour completed	Supervisor's comment:
Sports hall	In addition to cleaning and sanitizing, it is the cleaner's responsibility to check for burned out light bulbs on a daily basis.	• Empty bins		
		• Dry mop and spot clean floors using recommended solution		
		• Clean glass in doors and partitions		
		• Vacuum high traffic carpeted areas		
		• Dry mop and wet mop tiled floors		
		• Spot clean walls and remove any graffiti		

APPENDIX 3: WEEKLY CLEANING SCHEDULE

Location	Action	Initials of Responsible Person/ Date completed	Supervisor's comment:
Entrances, hallways and corridors	• Dust tops of lockers/cabinets		
	• Clean glass partitions, display cases and interior door glass		
	• Spot-clean finger marks from surfaces		
	• Dust furniture		
	• Polish floors in non-carpeted areas		
Classrooms and laboratories	• Dust furniture surfaces		
	• Damp clean desk and table tops		
	• Vacuum all carpeted areas		
	• Clean door surfaces		
Offices, library and media center	• Dust furniture surfaces		
	• Damp clean desk and table tops		
	• Vacuum all carpeted areas		
	• Clean door surfaces		
Lavatories, changing rooms	• Dust walls and ceiling vents		
	• Clean doors and wall tiles		
	• Check drains and clean if necessary		
Food preparation and lunch areas	• Clean glass partitions, display cases and interior door glass		
	• Spot clean walls		
	• Dust furniture and fire extinguishers		
	• Polish floors in non-carpeted areas		
Sports hall	• Clean door surfaces		
	• Clean and polish brass or chrome		
	• Remove scuff marks from floors		

APPENDIX 4: MONTHLY CLEANING SCHEDULE

Location	Action	Initials of Responsible Person/ Date completed	Supervisor's comment:
Entrances, hallways and corridors	• Dust vents, lights, pipes, window blinds, door frames		
	• High dust areas above 1.5 meters		
Classrooms and laboratories	• Polish floors in non-carpeted areas		
	• Dust vents, lights, pipes, window blinds, door frames		
	• High dust areas above 1.5 meters		
	• Vacuum upholstered furniture		
Offices, library and media center	• Dust vents, lights, pipes, window blinds, door frames		
	• High dust areas above 1.5 meters		
Lavatories and changing rooms	• Descale fixtures		
	• Scrub floors		
Food preparation and lunch areas	Fortnightly • Dust vents, lights, pipes, window blinds and door frames		
	Fortnightly • High dust areas above five feet		
	• Thoroughly clean furniture		
Sports hall	• Dust vents, lights, pipes, window blinds, door frames		
	• High dust areas above 1.5 meters		

APPENDIX 5: ANNUAL (SUMMER HOLIDAY) CLEANING SCHEDULE

Make sure that you coordinate with school staff to clear all books and desks before school year ends..

Location	Action	Initials of Responsible Person/ Date completed	Supervisor's comment:
Entrances, hallways and corridors	• Refinish any floor surface as needed		
	• Dust all surfaces such as counters high areas and clean light fixtures		
	• Clean all indoor and outdoor window/glass		
	• Clean and wash all lights covers		
Classrooms and laboratories	• Wash all the walls		
	• Clean and wash all lights covers		
	• Sweep and wash floors		
	• Wash the inside and outside of all desks, remove tape, remove gum, clean legs replace any worn/damaged felts		
	• Wash all chairs – top surface, back surface, under surface and legs and replace any worn/damaged felts		
	• Clean all indoor and outdoor window/glass		
	• Clean all white boards as well around edges		
	• Wash garbage cans		
Offices, library and media center	• Dust all surfaces such as counters high areas and clean light fixtures		
	• Clean all indoor and outdoor window/glass		
	• Clean and wash all lights covers		
	• Clean any surface chairs as needed		

Location	Action	Initials of Responsible Person/ Date completed	Supervisor's comment:
Lavatories and changing rooms	• Clean all indoor and outdoor window/glass		
	• Detailed clean all bathrooms		
	• Wash garbage cans		
	• Clean and wash all lights covers		
Food preparation and lunch areas	• Dust all surfaces such as counters high areas and clean light fixtures		
	• Move any fridge and stove and clean behind them and apply floor finish.		
	• Clean all indoor and outdoor window/glass		
	• Wash garbage cans		
	• Clean any surface chairs as needed		
Sports hall	• Reseal floor using manufacturer's recommended products		
	• Clean and wash all lights covers		

APPENDIX 6: TEMPLATE FOR CLEANING BUDGET

Product	Regular unit price	Discounted unit price	Quantity (year)	Annual budget MKD	Discounted annual budget MKD
Cleaning products					
All purpose cleaner					
Anti-Lime scale cleaner					
Drain cleaner					
Disinfectant - solution					
Disinfectant - concentrate					
Quick spray disinfectant					
Laminate floor cleaner					
Tile cleaner					
Toilet cleaner					
Furniture cleaner					
Glass cleaner					
Dish washing liquid					
Air freshener					
Cleaning equipment					
Corn Broom					
Plastic Broom					
Spider net cleaner					
Toilet brush					
Mop (stick)					
Dust Bin					
Dust Pan					
Bucket with wringer 15l					

Product	Regular unit price	Discounted unit price	Quantity (year)	Annual budget MKD	Discounted annual budget MKD
Disposable material					
Rubber gloves					
Nitrile gloves					
Microfiber clean rag					
Mop cotton head					
Mop microfiber cloth					
Scrub					
Zinc coated scouring pad					
Sponge					
Clean rag					
Washroom hygiene products					
Toilet Paper					
Hand towels					
Hand soap					
Hand disinfectant					
Hand liquid soap refill					
			TOTAL:		

APPENDIX 7: SAMPLE TABLES FOR DISASTER (EMERGENCY) RISK MANAGEMENT

NOPTE: Indicate the national legislation pursuant to which the plan is developed..

INTRODUCTION

Table – Members of the Disaster Response and Management Team

No.	Name and Surname (members)	Representative of:	Mobile	Email	Deputy member	Mobile	Email	Comment
1	Member 1	School Principal	xxx-xxx		Deputy member 1	xxx-xxx		
2	Member 2	School Administration	xxx-xxx		Deputy member 2	xxx-xxx		
3	Member 3	School staff	xxx-xxx		Deputy member 3	xxx-xxx		
4	Member 4	Maintenance staff	xxx-xxx		Deputy member 4	xxx-xxx		
5	Member 5	Parents' Council	xxx-xxx		Deputy member 5	xxx-xxx		
6	Member 6	Student Community	xxx-xxx		Deputy member 6	xxx-xxx		

RESPONSIBILITIES: Develop the plan, implement it and organize meetings, drills and other activities in support of it.

RECOMMENDATION: The contact list should always be updated with the latest data.

Table – Plan of activities/meetings/drills of the Disaster Response and Management Team

Month / Day	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	Apr.	May
1									
2	T					T			D
3									
4									
5									
6			D						
7								T	
8									
9									
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26									
27									
28									
29									
30									
31									

Agenda:

M - Meeting, **D** - Drill, **T** - Training – indicate the type of training.

Table – List of contact persons for communication with competent institutions

No.	Name and Surname	School/ Institution	Contact Number	Email	Deputy	Contact Number	Email	Comment
1	Petko Petkovski	School A	xxx-xxx		Goran Goranovski	xxx-xxx		
2	Ivan Ivanovski	School B	xxx-xxx		Borjan Borjanovski	xxx-xxx		
3	Zoran Zoranovski	Institution A	xxx-xxx		Jovana Jovanovska	xxx-xxx		
4	Murat Murati	Institution B	xxx-xxx		Rustem Rustemi	xxx-xxx		

RESPONSIBILITIES/DUTIES: Contact with other schools and institutions responsible for disaster prevention to coordinate and communicate, and exchange experiences in their field of work.

Table - General School Data

School Profile:			
School Name	School _____		
Municipality	Municipality _____		
Address	Street _____ No. _____		
Contact Person	Petko Petkovski		
School's Contact Number	xxx-xxx		
School's email	email@xxx.xx		
Number of Teachers	M	F	Total:
	25	25	50
Number of School Staff (administration, maintenance staff, others)	M	F	Total:
	15	15	30
Number of students	M	F	Total:
	250	251	501
Preschools	84	83	167
Grade 1 to 5	83	84	167
Grade 6 to 9	83	84	167
Students with disabilities (type of disability and grade)	2	2	4 *indicate the grade
Number of classrooms	20		
Number of cabinets	5		
Location /description of school and surroundings/coordinates			
Property List No. (to be attached)			
The school is located in the municipality/village/town of _____, located in an urban/rural area surrounded by _____. The facility is built in _____ year, according to _____ norms and criteria. The main building is in the form of _____ and is made of the following material _____, the roof construction is of _____. There are _____ entrances, _____ major and minor. Number of exits _____, location/description. The total area of the school is _____ m^2. The total area of the classrooms is _____ m^2, of the cabinets _____ m^2 and of the sport hall _____ m^2. Traffic infrastructure exists and connects the school with _____, through the following streets. Sewer network exists/does not exist. There is / is no septic tank. (provide more details as needed)			

Table – Overview of trained staff

No.	Staff	Number of Trained Persons		Total:
		M	F	
1	Information gathering and communication	10	10	20
2	Evacuation	12	12	24
3	Firefighting	11	11	22
4	Search and Rescue	10	10	20
5	First Aid	14	14	28

*Attach a list of trained persons that can serve as a replacement of persons designated to be in the initial response teams

No.	Name and Surname	Trained in	Contact No.	Email	Comment
1	Aleksandra Aleksova	First Aid	xxx-xxx	email@xxx.xx	
2	Hasan Hasani	Firefighting	xxx-xxx	email@xxx.xx	

Table – Risk Assessment

*The three most recent disasters affecting the school.

Type of Disaster	Year	Note
Fire	1982	
Flood	1972	
Earthquake	1963	

*Short history of the three most recent disasters.

*Potential risks:

Risk	Probability			Ранливост		Preventive measures
	High	Medium	Small	People	Resources	
Fire		x		x	x	Taken
Earthquake		x		x	x	
Flood			x	x	x	

* Each school should make its own assessment, as not all schools are exposed to the same risks and dangers. At the same time, the above risks should be explained in detail, including the measures taken.

Table - Security Check of School and School Yard

Activity	Security Check	Resolved Danger	Unresolved Danger	Taken Activities	Note
Type of response	Yes or No	Short answer	Short answer	Detailed answer	Challenges faced
School yard check	YES	Cleaned canals	Dry branches need to be cut.	School staff appointed.	Clogging of canals when a larger wave of water and waste comes.

* This type of activity should be undertaken regularly to protect against fire, earthquake or flood (it is compulsory to provide detailed clarification).

Table - Resources for emergency use

Resource	Location	Comment
Fire extinguisher (1)	1st / 2 minutes from the Principal's office	Type of fire extinguisher
Fire extinguisher (2)	1st r / 5 minutes from the Principal's office	Type of fire extinguisher
Fire extinguisher (3)	2nd / 3 minutes from classroom No. 11	Type of fire extinguisher
Hydrant (1)	2nd / 5 minutes from classroom No. 12	
Hydrant (2)	2nd / 5 minutes from classroom No. 15	
Ladder	1st / 5 minutes from classroom No. 2	
Gloves	1st / 5 minutes from classroom No. 2	
First Aid Kit	1st / 5 minutes from classroom No. 2	

* Indicate any resources that may serve as an emergency aid.

Table - Regular Check

RECOMMENDATION: To be positioned near the appliance in a visible location.

Resource	Regular Check	Approved by (signature)	Comment
Fire extinguisher (1)	Date xxxx		
	Date xxxx		
Fire extinguisher (2)	Date xxxx		
	Date xxxx		
Fire extinguisher (3)	Date xxxx		
	Date xxxx		
Hydrant (1)	Date xxxx		
	Date xxxx		
Hydrant (2)	Date xxxx		
	Date xxxx		

* Fire extinguishers installed outside the facility are inspected every 6 months, while fire extinguishers installed inside the facility are inspected once a year.

* Hydrants follow the same principle (or if needed more often).

Table – List of Early warning and reporting systems and prescribed activation procedures

System	Location	Comment
Fire alarm	1st / next to classroom No. X	
Public announcement system	Principal Office	
Bell	Teachers' Office	

NOTE: Instructions for use.

Table - Regular Inspection

RECOMMENDATION: To be positioned in a visible location next to the appliance.

System	Regular Inspection	Approved (Signature)	Comment
Fire alarm	Date xxxx		
	Date xxxx		
Public announcement system	Date xxxx		
	Date xxxx		
Bell	Date xxxx		
	Date xxxx		

Table - Operational Teams

Name of the Team: (e.g.: Search and Rescue Team)					
No.	Name and Surname	Role	Telephone No.	Email	Comment
1	Member 1	- Search for people who failed to evacuate on time.	xxx-xxx	email@xxx.xx	
2	Member 2		xxx-xxx	email@xxx.xx	
3	Member 3		xxx-xxx	email@xxx.xx	
4	Member 4		xxx-xxx	email@xxx.xx	
5	Member 5		xxx-xxx	email@xxx.xx	
6	Member 6		xxx-xxx	email@xxx.xx	

Under normal conditions:

- Hold coordination meetings;
- Regularly check evacuation routes (exits, gathering points, etc.);
- Introduce students to the self-protection and helping others (taking a position during an earthquake, use a handkerchief or piece of clothing to protect against inhalation of smoke, use an evacuation plan, etc.);
- Personal training.

During an emergency:

- In communication with the Communication and Information Team and the Evacuation Team, confirm who has failed to evacuate;
- In case of a danger, determine how many people may be at risk and try to establish their location (classroom, hallway, toilet, etc.);
- Ensure that all team members are safe and, if their safety is at risk, they are evacuated to a safe place;
- In the event of a successful evacuation, evacuate important equipment and assets if necessary (e.g. school server, computers, etc.);
- Communicate with the principal (in the absence of the principal with the deputy principal or another person previously designated as deputy) and the Communication and Information Team.

After the emergency:

- Identify the lessons learned.

NOTE:

*Tables should be filled out in the same way for the other teams.

Table - Contact List /School Staff

No.	Name and Surname	Position	Telephone Number	Comment
		Principal	xxx-xxx	
		Deputy	xxx-xxx	
		Team Leader	xxx-xxx	
		Member of the Disaster Response and Management Team	xxx-xxx	

Table - Contact List of Institutions

Institution	Telephone Number	Comment
Police	192	
Fire Services	193	
Ambulance	194	
Crisis Management Centre	195	

Table - Contact List of Parents/ Guardians

No.	Name and Surname	Telephone Number	Comment
1	Parent 1	xxx-xxx	
2	Parent 2	xxx-xxx	
3	Parent 3	xxx-xxx	
4			
5			
6			
7			
8			

NOTE:

*To be used for communicating with parents in an emergency to reduce/prevent panic.

OPERATIONAL PROCEDURES/PLANS:

(1) Evacuation:

Operational Evacuation Procedures:		
Activities/Measures	**Responsible Person**	**Comment**
• Turn on an alert through the early warning and reporting system as prescribed in the procedure (bell, alarm or other); • In case of fire close all doors and windows; • Activate the school's initial response teams; • Monitor the emergency and give instructions as the situation develops; • Announce end of danger.	• Administration (it is recommended to list the name of the member and deputy members)	Each member of the administration should be familiar with the measures to be undertaken.
• Emphasize to the students the evacuation principles (do not speak, do not run, do not push and do not go back); • Close windows and doors; • Take an emergency backpack (if any); • Check the safety of the evacuation route; • Direct students to a safe haven as set out in the plan; • When it is safe to go back, bring back the group of students to the classroom; • In case of being a member of one of the initial response teams, after evacuating students safely, entrust students to another teacher for supervision.	• Teachers	
• Follow instructions and, if necessary, assist classmates and teachers	• Students	

(2) Shelter-in-place:

Operational procedures for shelter-in-place:		
Activities/Measures	**Responsible Person**	**Comment**
• Alert of an emergency situation and issue instructions to stay in classrooms or go to safe haven; • Activate school response teams as needed; • Monitor and issue instructions as the situation develops; • Announce end of danger.	• Administration (it is recommended to list the name of the member and deputy members)	• Each member of the administration should be familiar with the measures to be undertaken.
• Close windows and doors; • Do not use a mobile phone; • Involve students in recreational games and activities (to reduce stress); • Provide sanitary conditions (toilet, hygiene, etc.); • Allow students to help each other.	• Teachers	
• Remain at the designated place and follow instructions; • If necessary, assist classmates and teachers.	• Students	

(3) Reunification with parents:

Operational procedures for reunification with parents:		
Activities/Measures	Responsible Person	Comment
• Parents provide contact information on persons authorized to pick up their child (see table below); • In case of an emergency, the administration ensures that students are handed over only to the authorized persons.	• Administration • Parents	• Each member of the administration should be familiar with the procedures, including parents and students.
• Introduce parents and students to reunification procedures; • Confirm the identity of the persons picking up the students; • Document the process.	• Teachers	
• Follow instructions and in no case should leave the school with people not approved by the parents.	• Students	

Table - List of persons (parents authorized to pick-up the students)

No.	Student (Name and Surname)	Grade Level	Parent/authorized person	Comment
1			1. 2. 3.	
2			1. 2. 3.	
3			1. 2. 3.	
4			1. 2. 3.	

NOTE:

* When picking-up a student, the person needs to confirm their identity.

* Depending on the circumstances, additional procedures/plans may be put in place.

Table – Insurance of School Building

RECOMMENDATION: The school building should have fire, flood and theft insurance

Fire insurance	Types of Insurance	Insured Facilities	Valid until (Date)	Вредност
Name of facility, location	Fire insurance	☐ School building ☐ Sports hall ☐ Satellite school		
	Flood insurance	☐ School building ☐ Sports hall ☐ Satellite school		
	Theft insurance (e.g. computers)	☐ School building ☐ Sports hall ☐ Satellite school		
	Glass insurance	☐ School building ☐ Sports hall ☐ Satellite school		
	Additional risk insurance (depending on the location of the facility)	☐ School building ☐ Sports hall ☐ Satellite school		

The Guidelines Manual for Maintenance of School Buildings – Part two can be downloaded from the following web sites:

www.mcgo.org.mk

www.mon.gov.mk