PREVENTIVE MAINTENANCE PLAN

FRAMEWORK FOR GUAM DEPARTMENT OF EDUCATION

GUAM DEPARTMENT OF EDUCATION

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Contents

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List of Acronyms

AC	Air Condition
BMS	Building Maintenance Superintendent
CIP	Capital Improvement Projects
DM	Deferred Maintenance
DOI	Department of Interior
EAMS	Enterprise Asset Management Systems
FM	Facilities Maintenance
FY	Fiscal Year
GDOE	Guam Department of Education
HVAC	Heating, Ventilation, and Air Conditioning
KPI	Key Performance Indicators
O&M	Operation and Maintenance
OIA	Office of Insular Affairs
PM	Preventive Maintenance

Preface

The study team would like to acknowledge the leadership and support provided by the Guam Department of Education Superintendent Fernandez. His support for the ABCs Initiative and willingness to commit his staff's time and knowledge to the development of this report are greatly appreciated.

For his outstanding support and generous provision of time, resources, and knowledge in overseeing all aspects of facility management for GDOE and invaluable contributions to this report, special thanks are given to Randy Romero. The study team would also like to express their deepest gratitude to Jon Quidachay for contributions of fundamental data and time in reviewing the report and guiding its preparation.

The ABCs Team hopes this work will assist GDOE in building a sustainable preventive maintenance program.

Executive Summary

This preventive maintenance plan was created to document critical actions that should be undertaken to ensure that Guam Department of Education facilities, infrastructure and equipment remain viable and to maximize investments made. The plan is comprised of three core components:

1. Job Plans: identification of key preventive maintenance tasks and summary steps for execution by maintenance staff or to inform scopes for contracted work.
2. Work plans: task locations and frequencies, including resource estimation and logistical considerations.
3. Organization and Management Structure Change Recommendations: a review of existing management and staff positions and conditions, and recommendations for adjustments or new positions that would help support proactive facility management.

The first section of this report provides background on what preventive maintenance is, why it is important, and why it makes sense to invest in it. Goals of the program proposed herein are reviewed and discussions of environmental considerations, construction typology and material selections, and inventory age and related concerns are provided.

Core components of the preventive maintenance plan are summarized in Section 2, with additional detail provided in the appendices. Eleven basic tasks and frequencies (e.g., annual, semi-annual, and monthly) are defined along with locations where the work should occur. Annual labor resources required to conduct this work are estimated to total 175,100 labor hours that would be contracted to local service providers (84 person years).

Existing funding and sources for facility management, as well as estimated costs for the preventive maintenance work presented in this report and associated cost controls, are reviewed in Section 3. The overall budget for preventive maintenance is estimated to be about $4M. Cost controls for preventive maintenance tasks and strategies for addressing facility needs with constrained budgets are also reviewed.

Organization and management structure change recommendations are provided in Section 4, along with an overview of current staffing, facility management challenges, and adjustments that could be made to support the move to a knowledgeable and appropriately staffed facility management team, including training and succession planning. A conceptual organizational chart is provided to graphically depict the recommendations made in the report and provide a visual reference for related discussions.

1 Introduction

1.1 Why a Preventive Maintenance Plan?

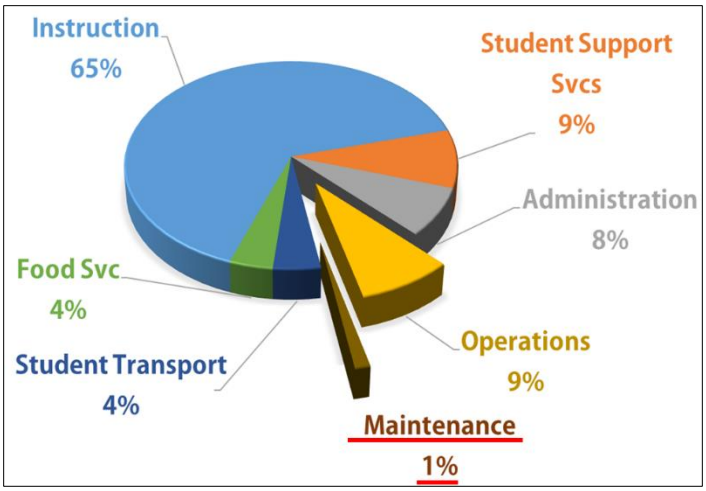
Preventive maintenance is conducted to ensure that facilities are performing as intended, to keep occupants safe, and preserve healthy indoor and outdoor environments while helping to extend facility life. Preventive maintenance tasks include activities such as scheduled visual inspections of roofs and drains, lubrication of machine parts, painting, inspecting plumbing for leaks, and cleaning drains and gutters.

Over time, if facility maintenance staff can conduct this work regularly, preventive maintenance will lead to a reduction in time spent responding to trouble calls (i.e., unanticipated work). Trouble calls, or emergency repairs, result in added costs such as paying a premium when urgently sourcing spare parts and labor. Routine maintenance and monitoring build a facility manager's awareness of facility needs and allow for planning larger maintenance activities (e.g., major repair and replacements). This helps avoid school disturbances that could result from equipment failure and unplanned downtime.

Studies show that reactive maintenance is more costly than preventive maintenance (see Section 1.2). The overall program should be comprehensive, but facility managers should set priorities and allocate resources based on asset value and cost of failure (e.g., fire protection, weatherproofing, air conditioning, indoor environmental quality).

1.2 Industry Standards and Trends

It is common for institutional organizations around the world to have facility management budgets that are not based on empirical data, are chronically underfunded and lack dedicated funding sources. School maintenance budgets are no different, and school districts depend on annual budget allotments that may vary based on other regional needs and public priorities. School facility management operation and maintenance (O&M) budgets must also compete with other major school related costs such as instruction and student support (e.g., staff salaries), student transportation, food services, and administration. Average maintenance budgets are estimated to account for a very small fraction of O&M budgets and about one percent of overall school district budgets (see Figure 1).



What is Preventive Maintenance?

"Preventive maintenance is the routine, regularly scheduled maintenance of a piece of equipment to ensure its continued use and maximize its life expectancy (e.g., by replacing filters, changing oil, and cleaning coils)" (NCES, 2003). This is proven to be more cost effective than the "run it to failure" approach by extending economic life and improving system reliability.

Figure 1– Average maintenance budget as a percentage of overall school district operating budget
(Source: Training and Sustainability Program Framework Report, 2015)

Establishing and executing a preventive maintenance program is challenging. Facility management research shows that it is a critical component of comprehensive maintenance program that will ensure reliability, reduce operating costs, and increase the life expectancy of the equipment (NCES, 2003). Key references related to justifying and guiding development of a preventive maintenance program include:

- The Impact of Underfunding Preventative Maintenance on Total Cost of Ownership (2020)
- Planning Guide for Maintenance of School Facilities (2003)
- Priority Actions for Adequate & Equitable U.S. PK-12 Infrastructure (2015)
- Best Practices for School District Facilities and Maintenance (2015)
- State of our Schools (2016)

Facility management literature emphasizes the need for preventive maintenance in reducing the frequency of trouble calls and overall maintenance costs in the long-term. Furthermore, because a rigorous preventive maintenance program leads to fewer trouble calls or other emergency events, preventive maintenance also tends to reduce school disruptions (e.g., down AC units, or repairs during school hours).

Questions to keep in mind when implementing the program:

- For districts that are instituting preventive maintenance for the first time, has an appropriate system (e.g., AC, lighting, roofing) been identified for piloting before commencing with a full-scale, district-wide program?
- Have manufacturer-supplied user manuals been examined for guidance on preventive maintenance strategies for each targeted piece of equipment?

"To realize the full potential of a comprehensive preventive maintenance system, school staff, the school board, and town planners must incorporate maintenance priorities into all modernization goals, objectives, and budgets. However, it is also fair for stakeholders to expect the maintenance program to yield results—namely: clean, orderly, safe, cost-effective, and instructionally supportive school facilities that enhance the educational experience of all students. But stakeholders also need to demonstrate patience because the only thing that takes more time than implementing changes to a maintenance program is waiting to see the improvements bear fruit." (NCES, 2003)

- Are records of preventive maintenance efforts maintained, and, if so, is it done efficiently and is historical information easily accessible?

In *The Impact of Underfunding Preventative Maintenance on Total Cost of Ownership (2020)*, researchers found that cutting 50 percent of funding from an existing preventive maintenance program is estimated to increase total cost of facility ownership by more than 30 percent, a much higher factor than the cost of preventive maintenance. As an example, a preventive maintenance budget of about $30,000 was analyzed. Cutting this budget in half (i.e., "saving" about $15,000) resulted in about a $50,000 increase to overall ownership costs with a fully funded preventive maintenance program (see figure 2).

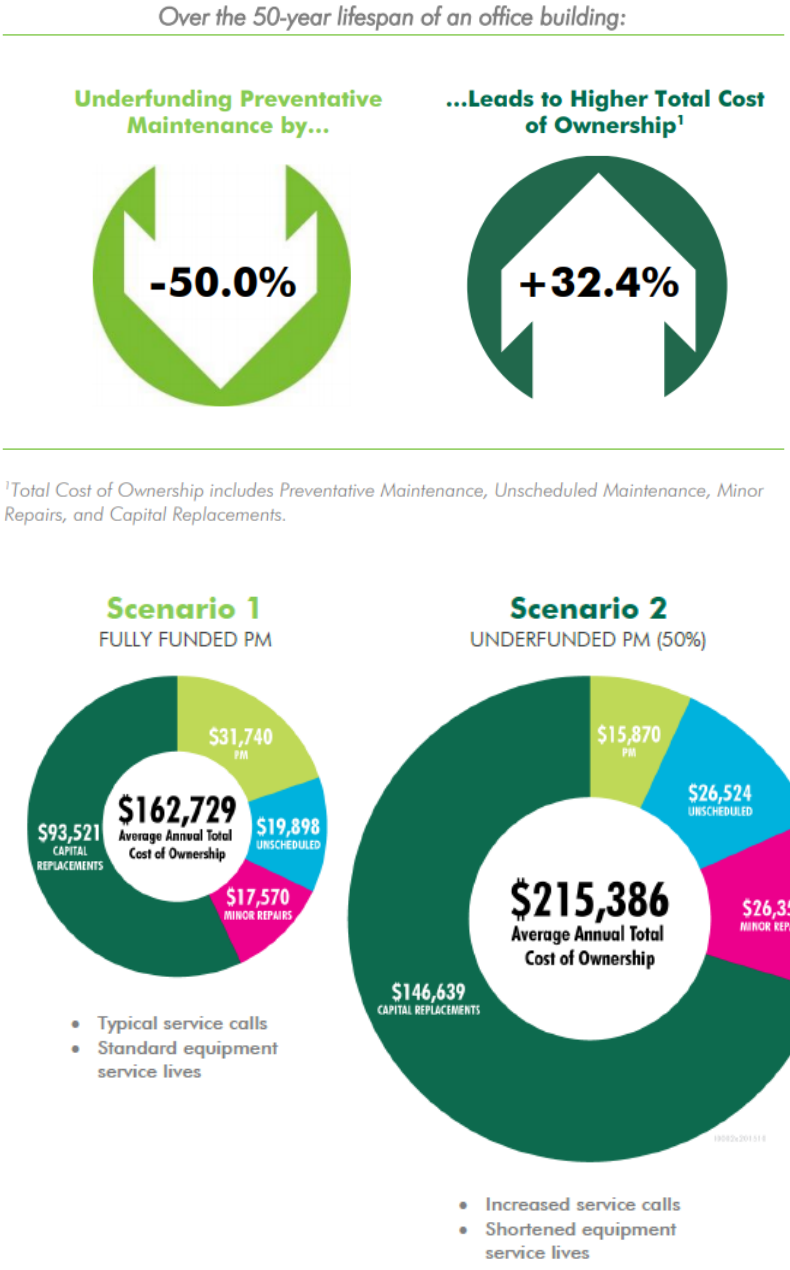
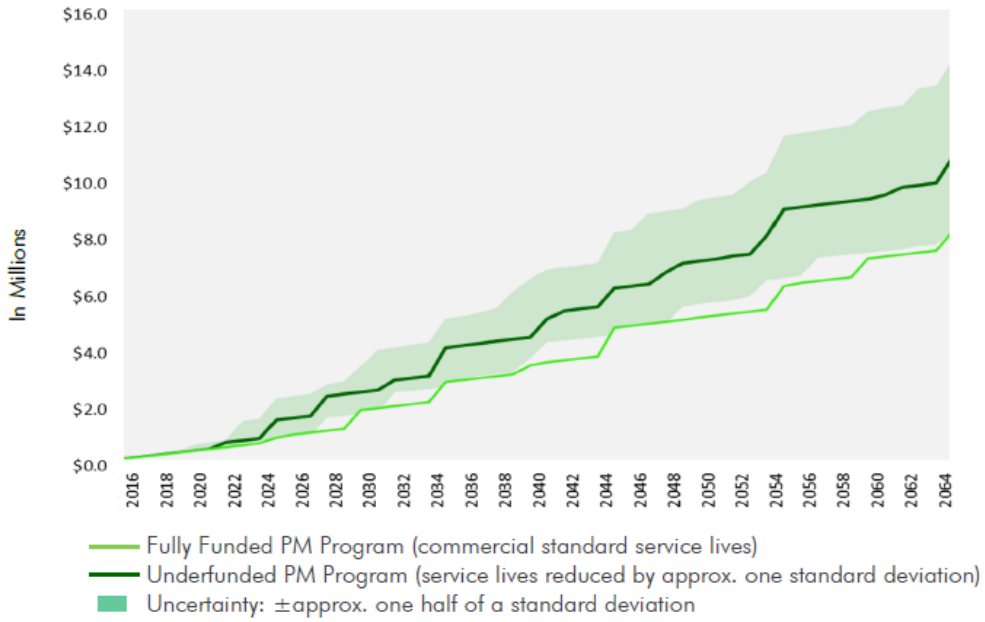


Figure 2 - Effects to total cost of ownership from reducing investments in preventive maintenance (Source: IFMA, 2020)

This finding highlights the value of preventive maintenance over time and is further illustrated in cumulative costs of ownership in Figure 3, which shows higher costs over time and higher probability of failure for facility assets when preventive maintenance is underfunded.



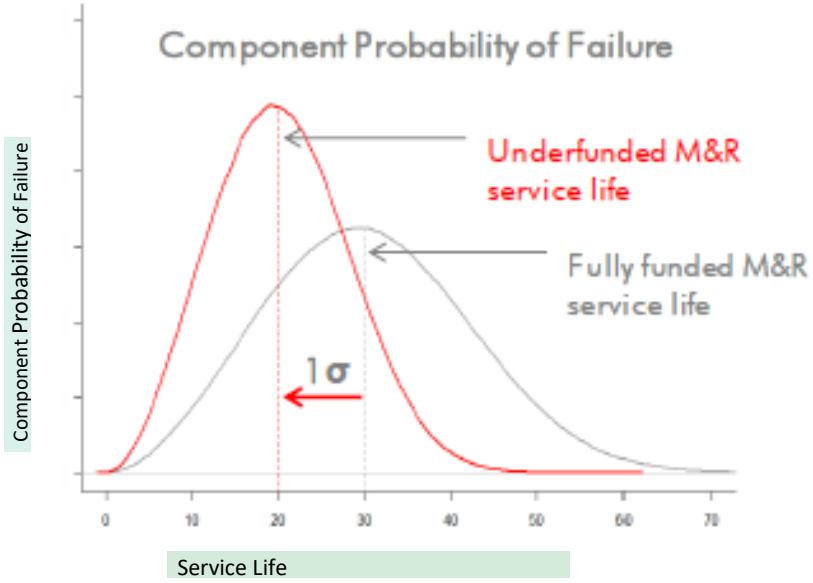


Figure 3 - Higher costs over time and higher probability of failure for facility assets when preventive maintenance is underfunded

(Source: IFMA, 2020; disclaimer: A conclusive mathematical relationship between underfunding PM and the effect on unscheduled maintenance and replacement frequencies is unknown. This case study makes the reasonable assumption that unscheduled maintenance increases and service lives are reduced if equipment is not properly maintained.

These concepts are widely understood by facility managers and are evident in facility conditions. The concept that regularly *conducting* cleaning and maintenance tasks will extend service life, reduce overall costs, and create a more amenable environment for students and teachers serves as the basis for this report and the impetus behind instituting and sustaining and preventive maintenance program.

As noted in a recent article published on FacilitiesNet (2020), in managing condition assessment data, preventive maintenance actions, and planned replacements, it is important to use preventive maintenance to recalibrate anticipated repair and replacement schedules. "There needs to be some mechanism for continually validating the assessments, and they need to be integrated with the operations and maintenance plans." By conducting preventive maintenance, facility managers can keep an accurate accounting of conditions and priorities. An enterprise asset management system (EAMS) can facilitate an integrated approach if appropriate levels of detail are applied to maintenance planning, tasks are executed, respective data is tracked, and facility managers are able to report information effectively to leadership. For tracking performance, attention should be given to establishing the right metrics. "Rather than establishing 200 metrics, focus on key performance indicators."

Key performance indicators (KPIs) should focus on long-term goals, not short-term measures. School facility management is always in flux (e.g., alterations to building or asset inventories, building code changes, programmatic goals and facility needs). Setting a number for achievement (e.g., number of work orders completed per month or in a year, time required to execute tasks) could result in ongoing changes as milestones are reached, or targets abandoned if considered unattainable, and lose legitimacy. Short-term measures can also cause data misinterpretations (e.g., fewer work orders completed compared to last month). Looking at facility management in terms of "finite games" or playing to win and "infinite games" or for the purpose of continuing the play can help. Stacey Barr (2020) notes that "finite games in performance improvement are the projects we implement to make a change in performance. The infinite game of performance matters more: it's continuing the play of continual improvement in the result we ultimately want to excel at, by getting better at winning the right finite games." As examples, focusing on student safety, environmental quality, continuity of student learning, and extent of ability to address all facility maintenance and repair jobs can help tailor KPIs to the administrative needs of school district leadership while accounting for the immediate needs of school facility occupants, staff, and students. This view can help facility managers select meaningful performance analysis measures and identify hidden constraints to improved performance.

Integrating current facility condition data with capital improvement plans and operations and maintenance plans supports long-range performance goals and clarifies budget needs. Reporting this information effectively can be approached in terms of reliability, in addition to overall dollar amounts, e.g., "If I don't spend money and repair this unit, I'm afraid it's going to fail. Then we won't have air conditioning for two weeks." (FacilitiesNet, 2020) Impacts of failed assets or building elements can cause injury, downtime, and prolonged interruptions to school services. Part of conveying facility management needs in relatable terms includes the consequences of deferring needed maintenance and the risks of increased costs of facility ownership that would be projected to result.

1.3 Goals and Objectives

1.3.1 Best practices

When implementing and monitoring a preventive maintenance program, a set of guidelines can help achieve a successful result. The following list is a set of recommended best practices.

Facility Managers

- Should set high standards and promote workplace accountability.
- Ensure that all maintenance staff are adequately trained to perform the duties that they are assigned.
- Implement a practice of job shadowing, or an apprentice/mentor model should be used for building and transferring knowledge and experience.
- Maintain and consider staff morale and their perceptions.

Work Allocation

- Each week, a percentage of person-hours should be allocated for preventive maintenance tasks (vs. trouble calls).
- It is important that all scheduled preventive maintenance tasks are performed as appropriate for each site.
- Tasks should be planned well in advance (e.g., one year) to ensure that resources are available, responsibilities are clear, and personnel have enough time to perform.
- If the work is outsourced, then the in-house team should be trained to properly inspect and verify the adequacy of outsourced services.

Documentation

- A successful program involves documenting the work performed.
- Work orders should be filled out completely and should accurately indicate hours for all completed work.
- Benchmarking, analysis of program effectiveness, and ongoing revisions or modifications of the program can be informed by documented work history and are necessary to identify ways to improve processes to meet tenant expectations and ensure that maintenance staff have confidence in the program.
- Adjustments and corrective action can be pursued as needed based on data analysis.

Program Monitoring Metrics - KPIs

- Key Performance Indicators (KPIs) should be defined to help facility managers evaluate programs in a way that considers the end users (e.g., building occupants such as students, school staff/administrators) as well as human resources (e.g., maintenance and managerial staff).
- Program performance ultimately will be judged by these groups so helping them understand program goals and soliciting input on process and performance will bolster program rollout.

- Example KPIs include completion time for maintenance tasks and percentage of all planned maintenance tasks that are completed.
- Performance metrics should be reevaluated if they fail to align with expected or desired results. Facility managers should consider how they are helping maintenance staff prepare for assigned tasks and if scheduling adjustments are needed (Cowley 2014).

Funds

- Stable, annually recurring appropriations are critical to a successful preventive maintenance program. This also requires a commitment that funds will be spent on maintenance and not be directed to other priorities (e.g., teacher salaries, utilities).

New programs

- Newly initiated preventive maintenance programs may require an increase in maintenance staffing during the transition from reactive or emergency maintenance to preventive maintenance.

1.4 Background

1.4.1 Environment and Climate

Guam Department of Education (GDOE) schools are in a coastal tropical environment. These conditions are hard on facilities because of constant sun, rain, salt, and humidity, frequent high winds, high salt content in the air, and potential for floods and earthquakes. Facility design and construction or renovation needs to account for these detrimental conditions to maximize a facility's useful life. The following is a listing of tropical conditions and how potential impacts to facilities adapted from the Department of Defense's discontinued tropical design guide.

High solar radiation: The ultraviolet spectrum in the tropics is particularly harmful to many commonly used building products. High ultraviolet exposure results in rapid deterioration of most non-metallic roofing materials, paints, sealants, elastomeric coatings, and wood. High solar radiation also causes building materials to develop high material temperatures which require careful detailing of the joints in cladding and structural systems.

High humidity: Relative humidity in the range of 70 percent to 100 percent for most of the year creates ideal conditions for mold and mildew that promote wood decay. It also accelerates rusting of various metals and intensifies galvanic action in many metals. Many paints in high humidity conditions do not perform well. In addition, high humidity conditions require careful detailing of vapor barrier locations in air-conditioned buildings. Common building materials that exhibit hygroscopic properties (e.g., absorbs moisture) such as gypsum, insulation, and particle board can lose their structural and functional properties in humid climates.

Intense rain periods: Facility mangers may need to specify soil treatments in addition to water infiltration control. Consider and avoid structural instability and exacerbation of rust and decay due to

possible water infiltration of buildings. Because tropical areas experience seasonal intense rainfall, producing flood conditions, include provisions for and consideration of ponding and runoff conditions.

Prolonged elevated temperatures: elevated temperatures have adverse effects on building materials such as paints, woods, and many asphalt-based products. These high temperatures combined with high humidity will cause severe deterioration.

Salt-laden air: salt rapidly accelerates wood deterioration, promotes galvanic action between metals, rusting of ferrous metals (including inadequately protected reinforcing steel), and pitting of many aluminum alloys. Salt laden air also adversely effects the application of paints, sealants, elastomeric coatings, and asphalt roofing applications.

The severity of salt-laden environments varies throughout the tropics. The degree of intensity varies with elevation, prevailing on-shore wind, vegetation and rainfall. Although all tropical design must address corrosion protection, installations in known or suspected severe corrosive environments require additional protective enclosures, materials, and coatings.

Air-conditioned buildings: The major design problems affecting plumbing, air conditioning, ventilation, and other mechanical systems in tropical areas include accelerated corrosion of materials due to exposure to salt-spray, condensation, and rain; and condensation on building materials, equipment, ductwork, and piping. These problems lead to subsequent problems of moisture absorption, swelling, mold, and mildew formation.

1.4.2 Building Types and Construction

Structural deficiencies are relatively isolated throughout the public-school facility inventory and not consistently associated with a certain building type. Deferred maintenance associated with structural elements of the buildings observed during Phase 2 condition assessments (2012-2013) was caused primarily by corrosion of steel components, including steel reinforcing within concrete or masonry buildings, and termite damage or rot of wood framed components. Steel corrosion and wood rot is typically due to water infiltration or exposure to humid, salt-laden atmospheric conditions.

The table below provides an overview of structural deterioration based on building type and an indication of frequency of both the building types and the problems associated with each building type:

Table 1 - *Overview of Structural Deterioration Based on Building Type (Source: ABCs Condition Assessment Report; updated with input from the ABCs team structural engineer)*

	Observed very frequently
	Observed commonly
	Observed in isolated instances

Common Structural Concerns by Building Type	**Frequency Observed**
One and Two-Story Low Slope Reinforced Concrete Roofs and Masonry Walls	
Roof water ponding causing leaking, reinforcing corrosion and spalling	
Prefabricated Concrete Gable Roof Slabs and Concrete Walls	
Isolated cracks and spalls, leaks at ridge joint	
One and Two-story Wood Framed Gable Roofs with Masonry Walls	
Termite damage or rot in wood decking and nailers	
Incomplete uplift ties between walls and roof	
Light Framed Metal Walls and Metal Truss Gable Roofs	
Questionable lateral load path from walls to roof diaphragm	
Prefabricated Wood or Steel Framed Roofs with Structural Steel Walls	
Corrosion of steel components at the base of the buildings and lack of tie downs	
Wood Framed Buildings on Slabs or Elevated Piers	
Isolated termite damage or rot	
Missing uplift ties or under-designed for wind uplift or lateral loads	
Slabs cracked or spalled	

To avoid these problems, preventive maintenance should focus on keeping water out of the interior enclosure with well-maintained exterior wall and roof finishes (especially at low sloped roofs and roof ridge joints) and isolation of steel components from the outside environment. This will also eliminate wood decay and most termite activity. Corrosion was also common around the base of first floor perimeter steel framing due to weather exposure at light framed metal walls and may require special attention.

1.4.3 Age and History

Older buildings may require more upkeep and building assets may be close to failure and require monitoring. Larger capital improvement projects may be needed to address deterioration, footprint rightsizing (physical capacity adjustments based on current enrollment), or functional obsolescence (physical layout of old buildings with regard to current educational program objectives), the regular inspection of assets conducted as a part of preventive maintenance can help inform these considerations.

Potential presence of lead-based paint, asbestos containing material, polychlorinated biphenyls and/or air conditioning refrigerants should also be considered during any preventive maintenance actions that could disrupt and release any of these hazardous materials. Ways to encapsulate, work around, or

otherwise not disturb these hazardous materials should be considered in addition to methods for removal and remediation to prevent exposure and potential health and safety risks. Referencing year-built dates and repair work history (e.g., in an Enterprise Asset Management System (EAMS)) can help inform hazardous material considerations.

The GDOE public school system facility inventory includes many buildings with ages exceeding 50 years. However, these schools have had other buildings built on site in the past 25-30 years to accommodate increased student populations and to provide support facilities. No school has any significant history in terms of its physical structure (i.e., architectural significance) per the Guam Historic Preservation Office. (Record of Environmental Consideration for Insular ABC Deferred Maintenance Reduction Program, Various School Locations, Guam; HHF Planners, 2018)

The Guam Historic Preservation Office identified two schools that are considered to have potential for the presence archaeological and historic resources that could be affected by ground disturbing activities: Jose Rios Middle School and Marcial Sablan Elementary School. (Record of Environmental Consideration for Insular ABC Deferred Maintenance Reduction Program, Various School Locations, Guam; HHF Planners, 2018)
Any maintenance activities that include excavations below ground surface at these schools should be coordinated with the Guam Historic Preservation Office.

Ground disturbing activities must also consider the potential presence of unknown underground infrastructure (e.g., power, communications, water, sewer) and appropriate surveying activities (e.g., toning for utility lines) to minimize inadvertent discoveries.

2 Preventive Maintenance Program

2.1 Overview of Components and Resource Needs

The core of an effective preventive maintenance program is the scheduling and assigning of work, which is typically done through a work order system (Alaska Department of Education and Early Development, 1999). Enterprise asset management (EAM) consists of the management and maintenance of assets throughout their lifecycle (Rouse, 2018). EAM Systems (EAMS) focus on the time, resources, and efforts necessary to achieve optimal performance of assets (McKeon & Ramshaw, 2013).

Embedded in the EAMS architecture for the Insular ABCs Initiative is a work order system with which job plans can be applied and used as templates for many different work orders. This capability helps to schedule and plan maintenance work expediently. Job plans are the documentation of repeatable repair processes that list specific maintenance steps for a job. These plans standardize required maintenance actions to promote consistency and thorough completion for each maintenance task. Templated job plans in EAMS can also be modified for unique assets or locations to account for individual needs (e.g., different types of equipment, materials, or conditions).

Current preventive maintenance work for GDOE facilities address the following systems:

- fire protection and fire alarm systems
- air conditioning
- walkway canopies
- generators
- elevators
- grounds work
- custodial services
- cafeteria kitchen equipment

Work is done at various frequencies, such as daily, monthly, quarterly, semi-annually, and annually.

Each task requires various levels of skills to perform them. These certification levels have been broken down into the following 3 categories.

Skill Level

- Skill Level 1: Basic skill range with some formal training.
- Skill Level 2: Advanced skill range with formal training and certification.
- Skill Level 3: Advanced skill range with factory training and certification.
  (Source: Insular ABC's Phase 3 Preventive Maintenance Program Guam; HHF Planners, 2018)

Time

- The average times required to perform the specified tasks are estimated in hours. Manpower estimates were developed based on assumptions of how tasks would be grouped (e.g., provide maintenance to all AC units of a building in one visit) and time needed for mobilization and transportation to respective sites. These estimates were developed in cooperation with host-agency facility managers.

The preventive maintenance tasks, skill levels required to do the work, the frequency with which the tasks should occur, locations of where these tasks should be executed, and estimates of time required to execute the tasks is summarized in Table 2. More details are available in Appendix 2 - Preventive Maintenance Work Plan and Resource Needs.

Table 2 - *Breakdown of GDOE Preventive Maintenance Tasks*

Classification	***System***	***Asset***	***Trade/Skill Level***	***Frequency***	***Total Schools***	***Total Time (Hr/Yr)***
D5037-Q	Fire Protection	Fire Alarm and Fire Suppression Systems	3	Q	35	1,820
D3041-SDL	Mechanical	Air Conditioning (Split Ductless)	3	SA	35	23,376
D3041-SD1	Mechanical	Air Conditioning (Split Ducted)	3	SA	16	2,988
D3041-SD2	Mechanical	Air Conditioning (Split Ducted)	3	SA	16	2,490
D3052	Mechanical	Air Conditioning (Packaged)	3	SA	15	2,640
B1023	Roofing	Walkway Canopies	1	Q	24	2,322
G1010	Grounds	Grounds	1	M	35	4,957
G4092	Electrical	Generators	3	SA	16	2,280
D5017	Custodial	Custodial	1		35	110,777
E1093	Mechanical	Cafeteria Kitchen Equipment (GDOE Operated)	3	M (8/YR)	4	1,764
D1010	Mechanical	Elevators	3	M	8	432
					Total:	175,100

** Frequency categories: annual (A), semi-annual (SA), quarterly (Q), monthly (M)*

The total hours shown in Table 2 were used to estimate the resources required for the proposed preventive maintenance program. See Section 3.2 for more information on resource estimates.

2.2 In-house and Contracted Work

To reduce costs, facility managers evaluate the cost effectiveness of retaining in-house specialists for frequently occurring tasks compared to the benefits of contracting the work. Reactive maintenance, or responding to emergency repairs, often occupies the majority of available staff time, resulting in large workload fluctuations. Adding preventive maintenance activities to staff duties reduces the peaks and valleys in maintenance workload by reducing the amount of maintenance emergencies and creating a more predictable schedule. Preventive maintenance includes periodic servicing and inspections to

ensure proper functioning and keep warranties intact (e.g., roofing, AC units, and fire protection systems).

If the organization is still uncertain whether to outsource, other factors to consider are specialized skills, certifications, tools required, liability, urgency of timing and workload. Highly specialized tasks that do not occur very often (i.e., a small fraction of a typical staff year) should probably be outsourced. Alternatively, some routine maintenance tasks that must occur on a frequent basis might also be better outsourced, as that frees up in house staff to attend to unplanned maintenance activities. Maintenance tasks associated with liability such as servicing expensive equipment or accessing rooftops, may justify outsourcing.

Planned repair and capital renewal are typically contracted because they are long cycle (i.e., once every 5+ years) and require specialized tools or skills. If a surge of maintenance or capital improvements need to be completed before a tight deadline, contract labor may also be better suited to coordinate the multiple tradesmen needed (APPA 2011).

The majority of GDOE's maintenance work is contracted out. Some maintenance work is conducted in-house, but associated efforts are primarily focused on responding to trouble calls. The goal of this preventative maintenance program is to reduce reactive maintenance by conducting preventative maintenance and identifying and correcting developing problems before emergency work is required.

It is critical to note that a successful preventive maintenance program requires stable, annually recurring appropriations and commitment that funds will be spent on maintenance, that no other priorities will compete for operating funds (e.g., teacher salaries, utilities) (Alaska Department of Education and Early Development 1999).

3 Preventive Maintenance Budget

3.1 Existing Funding and Sources

Existing facility funding is provided via the respective annual fiscal year operational budget and legislative appropriations. A breakdown of the annual fiscal year operational budget, shown in millions of dollars (M), for fiscal years (FY) 2015-2020 is shown in Table 3.

Table 3 - *Breakdown of GDOE annual fiscal year operational budgets for FY 2015-2020 (Source: GDOE Budget Office)*

	FY 2015 (M)	FY 2016 (M)	FY 2017 (M)	FY 2018 (M)	FY 2019 (M)	FY 2020 (M)	Six-Year Average (M)
Personnel Services	$3.9	$4.0	$3.6	$3.9	$4.5	$3.6	$3.9
Contractual Services	$3.3	$4.1	$3.8	$4.3	$5.3	$1.9	$3.8
Supplies & Materials	$0.3	$0.2	$0.5	$1.3	$1.9	$0.4	$0.8
Equipment	$0.0	$0.0	$0.0	$0.0	$0.1	$0.03	$0.0
Maintenance Budget	**$7.5**	**$8.3**	**$7.9**	**$9.5**	**$11.9**	**$5.9**	**$8.5**
Capital Outlay	$0.04	$0.0	$0.0	$0.0	$9.8	$0.0	$1.6
Total	**$7.5**	**$8.3**	**$7.9**	**$9.5**	**$21.7**	**$5.9**	**$10.1**

Table 3 shows substantial fluctuation in maintenance funding and capital outlay. Budget fluctuations can present challenges for sustaining an adequate maintenance program. The existing maintenance budget and funding needs are discussed further in Section 3.4.

Costs that are currently being tracked include personnel services (i.e., maintenance staff), contractual services, and supplies and materials. GDOE is adding preventive maintenance to some repair and replacement projects (e.g., fire protection, AC units) and has contracted other preventive maintenance services, both of which are captured under contractual services. Capital outlay should address larger facility improvements (e.g., facility replacement, major renovation or expansion or new facilities) that may be required to address capacity needs or forgone facility deficiencies. Based on data received from GDOE, capital outlays appear to have been very limited over the past six years as noted in Table 3. Other sources of funds for major GDOE facility repair/replacement include Budget Act appropriations (e.g., FY2020 and FY2021 funds for projects) and funding from the Governor's Office (Department of the Interior (DOI) Discretionary Funds in addition to annual DOI Capital Improvement Project (CIP) grants).

3.2 Estimated Needs

The overall budget allotment covers operational costs, capital improvement, deferred maintenance reduction, and preventive maintenance. Given that current deferred maintenance (DM) cost estimates (about $60M; see Section 3.4 for more), it is evident that maintenance and operational needs exceed available funding. Table 4 provides a summary of the preventive maintenance work plan costs that should be accounted for in annual budget appropriations.

Table 4 -*Preventive Maintenance Work Plan Costs Summary*

Classification	***Asset***	***Total Schools***	***Est. Contr. Cost***
D5037-Q	Fire Alarm and Fire Suppression Systems	35	$ 145,244
D3041-SDL	Air Conditioning (Split Ductless)	35	$ 584,400
D3041-SD1	Air Conditioning (Split Ducted)	16	$ 74,700
D3041-SD2	Air Conditioning (Split Ducted)	16	$ 62,250
D3052	Air Conditioning (Packaged)	15	$ 66,000
B1023	Walkway Canopies	24	$ 90,000
G1010	Grounds	35	$ 385,000
G4092	Generators	16	$ 57,000
D5017	Custodial	35	$ 2,373,792
D1010	Elevators	8	$ 86,400
E1093	Cafeteria Kitchen Equipment (GDOE Operated)	4	$ 80,000
		Total:	*$ 4,004,786*

The costs presented in Table 4 were based off actual maintenance contracts executed by GDOE and are related to the labor estimates shown in Table 2 and local labor rates for respective trades.

3.3 Cost Controls

The scopes of work for preventive maintenance tasks need to be clearly defined, particularly for contracted work because oversight and course correction are difficult for the owner to enforce. This includes appropriate maintenance frequencies that should be clearly stated in bid solicitation documents to ensure that the contracts awarded fulfill maintenance needs and maximize the use of budgeted maintenance funds. Inventories of equipment (e.g., AC units) listed in initially awarded multi-year contracts need to be closely monitored throughout the maintenance contract year. Adjustments to inventories need to be made prior to award of contract option years to ensure maintenance tasks are performed in accordance with current contract equipment inventory listings and frequencies. Reduction in inventories should correspondingly reduce required maintenance costs. “Repair by Replacement” of equipment should be carefully evaluated to ensure it is done only when it is determined to be cost effective. Qualified contract managers should oversee these contracts and be diligent in enforcing contract scope, terms, and conditions.

For in-house maintenance work, the appropriate number of personnel should be tasked with performing the work. Balancing labor requirements for preventive maintenance tasks and other work conducted throughout the year and adjusted based on demonstrated trends (e.g., preventive maintenance may reduce trouble calls and emergency work over a few years). Additionally, job plans should specify the necessary skill levels of personnel and accurate material quantities to control labor and materials costs.

3.4 Overall Maintenance Budget Needs, Current Funding, and Deferred Maintenance

As shown in Table 3, GDOE's six-year average maintenance budget was $8.5M (not including capital outlay) and recently dropped to $5.9M. This is grossly inadequate for current needs and does not include funding for the preventive maintenance program items covered in this report. As popularized in "Committing to the Cost of Ownership: Maintenance and Repair of Public Buildings" (National Research Council, 1990), a sustainable steady state maintenance budget should be in the range of two to four percent the current replacement value of an organization's inventory, depending on the age of the facilities and construction materials used. The current replacement value for GDOE maintained schools is $791M (2020 dollars). This means that a sustainable maintenance budget for GDOE should be in the $16M to $32M range, including preventive maintenance but above and beyond DM back log reduction (see following paragraph). This would be two to four times higher than average allocations for the past six years.

Future budget proposals should include the preventive maintenance tasks identified in this report, along with other maintenance needs identified by GDOE. Reliable annual funding is required to provide adequate maintenance to facilities. Furthermore, the deferred maintenance backlog is currently estimated at about $60M. An investment of about $15M per year of direct funding would be required to eliminate all DM within ten years (amount accounts for inflation and accumulating backlog over the ten-year period). As a part of the ABCs Initiative, OIA and the Governor's office have been providing $1M of direct strategic DM reduction funding for the last five years. With supplemental funds provided by the Governor, DM reduction funding totaled about $7M. Other methods to reduce DM should also be considered including:

- Footprint reduction/consolidation or mothballing of underutilized facilities
- Preventative maintenance to extend economic life (to prevent the accrual of additional DM)
- Capital improvement, modernization/building replacement

CIP projects, preventive maintenance, and trouble call repairs can also help to bring down costs. Addressing preventive maintenance and deferred maintenance will reduce overall operating costs in the long-term.

4 Organization and Management Structure

4.1 Current Staffing

Current maintenance staffing is shown in Table 5 and is based on the actual FY 2021 facilities maintenance staffing pattern. For every full-time employee, 2,080 annual labor hours were used to estimate current available manhours. A total of 106,080 labor hours are available for all 51 positions.

Table 5 -*Employment Positions and Associated Manhours*

Position	Position Count	Avail Manhours*
Building Maintenance Superintendent Dist. 1&2	1	2,080
Building Maintenance Supervisor	3	6,240
Carpenter I LDT	1	2,080
Carpenter I	2	4,160
Carpenter I	3	6,240
Carpenter II	7	14,560
Clerk Typist	1	2,080
Electrician II	8	16,640
Facilities Manager	1	2,080
Heavy Equip Operator III	2	4,160
Maintenance Supervisor	1	2,080
Maintenance Worker	2	4,160
Plumber I	1	2,080
Plumber II LDT	1	2,080
Plumber II	4	8,320
Plumbing Supervisor	1	2,080
Program Coordinator II	1	2,080
Refrigeration Mechanic II	2	4,160
Safety Administrator	1	2,080
Trades Helper	5	10,400
Warehouse Supervisor	1	2,080
Welder I	1	2,080
Welder II	1	2,080
Total	51	106,080

* Assumes 2080 hrs per staff member

Position change recommendations, described in Section 4.2, are proposed to build efficiency and capabilities in facility management and maintenance.

4.2 Recommended Management and Maintenance Structure

Based on interviews with facility management staff, observations, and the findings of analyses conducted for this report, the following recommendations are proposed to help build efficiencies in GDOE facility management and sustainability in associated programs and processes. These include

creating a new Deputy Superintendent position to oversee GDOE's existing divisions of Capital Improvement Projects (CIP) and Facilities Maintenance (FM). This new position will provide for direct reporting and accountability to the GDOE Superintendent, effective supervision of the CIP and FM Managers, and direct responsibility for management of the CIP and FM approved annual budgets. This new position will also elevate the importance of the CIP and FM divisions to the level of GDOE's other major divisions and facilitate communications between the Deputy Superintendents of related divisions such as Finance and Administrative Services, and Assessment and Accountability.

Other recommendations, including new, revised, reduced, or adjusted positions, are described below and graphically portrayed in Figure 4.

Office of the Deputy Superintendent for CIP and FM

- Creation of an Administrative Support Section and establishment of an Administrative Officer position. This will provide a dedicated position for all administrative functions to include support to the Deputy Superintendent in the management of the division's annual operations budget.
- Creation of a Work Control Center for EAMS operation and establishment of Program Coordinator III, Data Control Supervisor and Data Control Technician positions to staff it. This will provide for staffing dedicated to the operation of the FM Maximo work order system.

CIP Division

- Establishment of an Engineer III position to replace the current CIP Manager position. This will provide for an engineering position to manage the capital improvements program.
- Create a Planning section and establish a Planner II position. This will provide for a position dedicated to the planning responsibilities in the development of capital improvement projects. These responsibilities include tracking enrollment and school capacities, tracking proposed housing developments for projected enrollment increases in affected school districts, analyses of school utilities consumption data for potential energy conservation projects, planning of school formal condition assessments for adequacy of facilities, and establishment of prioritization protocol for facility investment based on the output of the facility master plan process.
- Create a Construction Quality Control Section and establish a Construction Inspector III position. This will provide a position with the appropriate technical knowledge of construction standards and construction inspection experience in electrical, mechanical, and civil work necessary for the proper observation of construction contract requirements and quality of work.
- Replace current Program Coordinator III positions with two Engineer II positions. This change will enable the hiring of staff that can more effectively develop and manage capital improvement projects. Qualification requirements for these positions will include the necessary technical knowledge, project scoping, cost estimating and project management capabilities in the electrical, mechanical, and civil disciplines.

FM Division

- Reduction of current Building Maintenance Superintendent (BMS) positions. This will provide for a sole BMS to have direct responsibility for the operations of the various trade groups and immediate supervision of the trade group supervisors.
- Elimination of current Building Maintenance Supervisor position. Supervisor positions in the respective trades would better serve the needs of the respective section's personnel in lieu of Building Maintenance Supervisor positions.
- Establishment of two Engineer II positions in Contract Management Section. This change will enable the hiring of staff that can more effectively manage preventive maintenance (PM) and facilities repair contracts. Personnel in these positions will possess the necessary technical knowledge and contract skills for outsourced PM and repair services.
- Establishment of supervisor positions that report directly to the sole BMS (to provide for needed and currently lacking supervisory positions):
    - Carpenter Supervisor (under a new Carpentry Group Section)
    - Electrician Supervisor
    - Refrigeration Mechanic Supervisor

The abovementioned new sections and positions and revised or deleted current positions are illustrated in Figure 4. These proposed changes include removing 30 and adding 2 maintenance positions, for a total of 23 maintenance positions over time as facility maintenance continues to be outsourced. Proposed changes also include restructuring facility management and the creation of new positions to help oversee outsourced contracts and other facility management responsibilities.

Conceptual Org Chart for Discussion Only

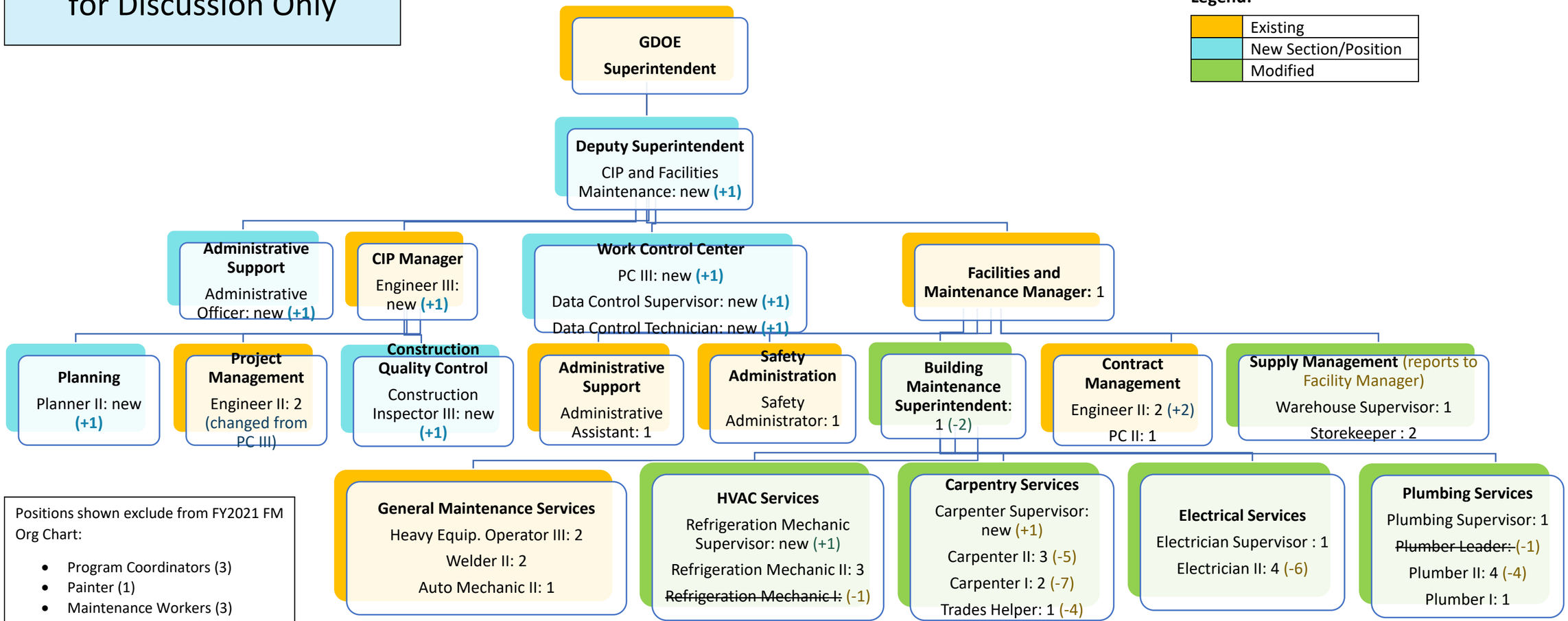


Figure 4 - Conceptual Organization Chart "for discussion"

**The numbers in parentheses indicate a recommended increase or decrease in the current number of positions (filled or vacant).*

4.3 Training, Capacity Building, and Succession Planning

Training is required to support the move to a knowledgeable and appropriately staffed facility management team. Project management training of contract management staff for the development and administration of outsourced contracts is essential. In addition to project management needs, current trades training needs include HVAC, electrical and plumbing systems, and job site safety. The estimated number of GDOE facility management and maintenance personnel requiring training is shown in Table 6.

Table 6: *Estimated number of maintenance personnel requiring training*

Training Area	Number of Trainees
Project Management	4
HVAC Core	1
HVAC 1	2
HVAC 2	3
Electrical Core	1
Electrical 1	2
Electrical 2	3
Field Safety	5
Safety Technology	2
Total	23

Note: Some positions would not require types of training listed in Table 6.

Succession planning is essential for the ascension of qualified trades personnel to their respective trade supervisory positions when vacancies occur (32 of the maintenance staff are reaching retirement age which makes succession planning a critical issue for GDOE). Supervisors can function as mentors that provide over-the-shoulder training to and oversight of other staff for skill building, accountability, and knowledge transfer. Fostering mentorship can help ensure that supervisor positions are filled in a timely manner if staff retire or take on other jobs. Similarly, succession planning for the ascension of trades supervisor to the Building Maintenance Superintendent position over time can help prevent extended vacancies for this critical position, which provides oversight of the various trade's supervisors. Both management and budgeting skills in addition to facilities technical knowledge should be a required qualification and these can be developed through on the job training efforts. Planning for the ascension of the Building Maintenance Superintendent to the Facilities Maintenance Manager position is also possible and would benefit from institutional knowledge gained while serving as a BMS.

The preventive maintenance program, like other operations within the Facility & Maintenance Division, can reduce the risk of losing a substantial amount of institutional memory through staff transitions by using computer-based tools and storing facility documents. EAMS will track all preventive maintenance work history, assist with work planning and scheduling, and can be used to store facility and contract documents. Storing and sharing related information will strengthen and preserve the facility maintenance knowledgebase.

5 Resources

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6 Appendices

A1 - Preventive Maintenance Job Plans

A2 - Preventive Maintenance Work Plan and Resource Needs

A3 - Preventive Maintenance Tasks - School Detail

Appendix 1 - Preventive Maintenance Job Plans

The following is the list of critical preventive maintenance tasks and work steps (i.e., job plans) that are required to ensure functionality, extend useful life, and avoid school disruptions that could be caused by the failure of these assets.

The job plans are divided into categories of work type (e.g., fire alarm, elevator, AC) and provides work details for each associated task. Each category listed here correlates to the work plan tasks itemized in *Appendix 2: Preventive Maintenance Work Plan and Resource Needs Estimation*.

1 D5037 - Fire Alarm and Fire Suppression Systems

(Contracted)

1. Inspect and/or test fire alarm panel (Quarterly)
2. Inspect and/or test primary/secondary power supplies (Quarterly)
3. Inspect and/or test battery sealed lead acid (Annually)
4. Inspect and/or test remote annunciator (Annually)
5. Inspect and/or test audible and visible trouble signals (Annually)
6. Inspect and/or test zone disconnect switches, trouble signal ((Annually)
7. Inspect and/or test ground fault monitoring circuit (Annually)
8. Inspect and/or test manual stations (Semi-Annually)
9. Inspect and/or test heat detectors (Semi-Annually)
10. Inspect and/or test smoke detectors (Annually)
11. Inspect and/or test flame/beam and other detectors (Semi-Annually)
12. Inspect and/or test water flow alarm switches (Semi-Annually)
13. Inspect and/or test tamper switch (Semi-Annually)
14. Inspect and/or test supervisory signal devices (Quarterly)
15. Inspect and/or test audible, bells, horns or others (Annually)
16. Inspect and/or test visual devices (Annually)
17. Inspect and/or test emergency evacuation control panels (Annually)
18. Inspect and/or test speakers/voice alarm (Annually)
19. Inspect and/or test extinguishing system alarm switches (Annually)

2 D1010 - Elevator

Quarterly

- Lubrication - examine all moving parts to determine proper adjustments and lubrication.
- Plumb and alignment - check to make sure the elevator levels at floor height.
- Noise and vibration - listen for any unusual noise or vibrations.
- Obstructions - clear all passageways of any obstructions.
- Verify that the elevator lighting system is operational.
- Overall condition and cleanliness - Check open/close buttons and open/close door functions.

- Piping condition - inspect piping for damage or corrosion.
- Hydraulic power unit: Run through a complete cycle and check for smooth operation.
- Relief valve and Blowdown block: Run cycle and halt between limit switches. Check pressure at the power unit to ensure there is no pressure drop and blowdown block is holding and there is no movement with the car. Check for oil leaks.
- Control Valve: Check for oil leaks. While running through a complete cycle, check for smooth operation and no fluctuations in oil pressure.
- Tank: Check oil level and top up as needed. Depending upon usage, oil may have to be changed if showing signs of breakdown or discoloration. There should be no water in the system. If water is detected, shutdown the system immediately and drain oil and replace in tanks, cylinders, valves, hoses and fittings. Bleed air from the system.
- Flexible hose and fittings assembly: Check hoses and fitting for leaks. Check hoses for distortions, ballooning and cracking. Check fittings for tightness to proper torque. Check fittings for signs of cracking and corrosion. Do not over-torque to avoid damaging fittings.
- Supply line and shutoff valve: Check supply line from control valve to ram for leaks or hose kinks and pinching.
- Hydraulic Cylinder: Check hose connections for leaks and hose deterioration. Cylinder shaft should be a highly polished surface, remove dirt, debris and corrosion.
- Run through a complete cycle and observe that cylinder has full range of motion and no binding.
- Pressure switch. Check operation of pressure switch. Facilitate a failure and observe operation of the blowdown block, car should stop immediately.
- Check operation of low oil pressure cutoff protection.

Biannually

- Condition of wheels and pulleys - Roller guide wheels and assemblies should be adjusted or replaced depending on their condition.
- Check operation of electric devices and wiring connections: motors, switches, generators, etc.
- Cable/pulley/rope tension, alignment and condition - Examine the pit, which is located at the bottom of the hoistway. Check the cable pulley and tensioning devices, counterweight buffers, and limit switches.
- Inspect the condition of the motor and its bearings, brushes, and the machine brake system.
- Chains and cotter pin condition - verify chains and cotter pins are in good working condition.
- Inspect drive sheaves and hoist cables for deterioration. Test the tension of the hoist cables.
- Condition of interlock functions, limit and shutdown switches - Inspect for dust, debris, corrosion, damage, and tightness of connections.
- General safety conditions - Test emergency communication device and emergency stop button.

Annually

- Verify that there are no sharp edges or large gaps throughout the elevator system.
- Examine hoistway equipment located in the elevator shaft (guide rails, corridor doors, and hangers).
- Examine condition of railing system, shaft and bearings.

- Certification - Obtain required certifications by the appropriate and responsible party to testify that the elevator system performs in accordance to rules, regulations, laws, and specifications.

3 Air Conditioning

(Contracted)

3.1 D3041 - Air-Con Type: Split Ductless 9,000 BTU to 36,000 BTU

1. Clean intake side of condenser coils, fans and intake screens.
2. Lubricate shaft and motor bearings, as necessary.
3. Flush condenser coils.
4. Clean air filters.
5. Clean electrical wiring and connections; tighten loose connections.
6. Clean evaporator unit.
7. Vacuum drain lines/piping and drain pans. Ensure drains are not obstructed and free flowing.
8. Check disconnect switch and wiring for fraying of insulation.
9. Check variable speed motors/blower operation.
10. Verify refrigerant lines are properly insulated.
11. Verify fan motors are operating properly and no sign of excessive vibration.
12. Check setting and proper operation of voltage monitor.
13. Check refrigerant pressure _____, add as necessary.
14. Perform operational check.
15. Voltage Reading: L1: _____; L2: _____; L3: _____
16. Ampere Reading: L1: _____; L2: _____; L3: _____
17. Inverter Frequency Reading: _____
18. Thermostat Setting: _____ Set as: 78°F/25.5°C
19. Verify units are properly tied down and secured.
20. Clean area around equipment.

3.2 D3041 - Air-Con Type: 3-Ton to 100-Ton Split Ducted

3.2.1 Split Ducted A/C Preventive Maintenance Components – Air Handling Unit

1. Check controls and unit for proper operation.
2. Check for unusual noise or vibration.
3. Check belts, adjust or replace as necessary.
4. Check condition of evaporator coils, and comb fins if needed to straighten.
5. Check and adjust vibration eliminator.
6. Check screws on bearing collar and pillow block and tighten as needed.
7. Clean evaporator using soft non-metallic bristle brush, vacuum and pressure wash using water as needed.
8. Clean and check blower wheels for cracks and damage.
9. Vacuum drain lines/piping and drain pans ensure drains are not obstructed and free flowing.
10. Check for proper operation and clean dampers, mechanisms and actuators as needed.
11. Check thermo bulb for proper operation.
12. Check discharge room temperature setting and adjust as needed.

13. Perform readings and record discharge and suction pressure.
14. Lubricate shaft and motor bearings.
15. Replace air filters as needed.
16. Inspect exterior piping and valves for leak.
17. Verify refrigerant lines are properly insulated.
18. Verify duct transition in good condition.
19. Check magnetic starter and all fuses.
20. Run unit, check all controls, relays, and switches for proper operation.
21. Check unit housing and casing for rust and apply rust inhibitor as needed.
22. Clean area around equipment.
23. Verify units are tied down and properly secured.

3.2.2 Split Ducted A/C Preventive Maintenance Components – Condensing Unit

1. Check controls and unit for proper operation.
2. Check and adjust vibration eliminator.
3. Check condition of condenser coils, and comb fins if needed to straighten.
4. Pressure wash coils and fans.
5. Clean intake side of condenser coil, fans and intake screen.
6. Lubricate shaft bearings and motor bearings, as necessary.
7. Voltage Reading: Record for each circuit/compressor.
    a. L1: _____; L2: _____; L3: _____
8. Ampere Reading: Record for each circuit/compressor.
    a. L1: _____; L2: _____; L3: _____
9. Check thermostat setting: _____. Set as: 78°F/25.5°C
10. Perform reading and record refrigerant temperature entering and leaving.
11. Clean and inspect fans or blowers.
12. Check for pressure drop across filter drier.
13. Check belts for condition, proper tension, alignment. Adjust as applicable.
14. Inspect piping and valves for leak.
15. Check refrigerant pressure _____ add refrigerant as necessary.
16. Check electrical wiring and connections.
17. Run unit, check all controls, relays, and switches for proper operation.
18. Check unit housing and casing for rust and apply rust inhibitor as needed.
19. Clean area around equipment.
20. Verify units are tied down and properly secured.

3.3 D3052 - Air-Con Type: 3-Ton to 50-Ton Packaged Unit

3.3.1 Packaged Preventive Maintenance Components

1. Check with operating or area personnel for deficiencies.
2. Check tension, condition, and alignment of belts; adjust or replace as necessary.
3. Lubricate shaft and motor bearings.
4. Check condition of evaporator and condenser coils, comb fins if needed to straighten.
5. Check and adjust vibration eliminator.
6. Clean and check blower wheels for cracks and damage.
7. Check screws on bearing collar and blower lock and tighten as needed.

8. Check for proper operation and clean dampers, mechanisms and actuators as needed.
9. Clean evaporator and condenser coils using soft non-metallic bristle brush, vacuum and pressure wash using water as needed.
10. Replace air filters as needed.
11. Clean electrical wiring and connections; tighten loose connections.
12. Clean coils, evaporator drain pan, fans, motors and drain piping as required.
13. Perform operational check of unit, adjust controls and other components as required.
14. Voltage Reading: Record for each circuit/compressor.
    a. L1: _____; L2: _____; L3: _____
15. Check Compressor Amperage Reading: Record for each circuit/compressor.
    a. L1: _____; L2: _____; L3: _____
16. Check for pressure drop across filter drier.
17. Perform readings and record discharge and suction pressure.
18. Perform reading and record refrigerant temperature entering and leaving condenser.
19. Check thermostat setting and record _____. Set at: 78°F/25.5°C
20. During operation of unit, check refrigerant pressure; add refrigerant as necessary.
21. Check setting and proper operation of voltage monitor.
22. Check compressor oil level. Add oil as required.
23. Clean area around unit.
24. Check unit housing and casing for rust.
25. Check thermo bulb for proper operation.
26. Check pressure drop across filter drier and replace as needed.
27. Run unit, check all controls, relays, and switches for proper operation.
28. Verify units are tied down and properly secured.

3.4 Air Conditioning Preventive Maintenance Protocol

3.4.1 Established Protocol

3.4.1.1 Standard Operating Procedure

1. Contractor must adhere to proposed schedule and frequencies in accordance with pre-determined schedule prioritized by GDOE Facilities Maintenance Division (GDOE reserves the right to adjust this schedule as it sees fits to accommodate operations).
2. GDOE has provided a school directory to the contractor for its use if/when needed.
3. GDOE will notify each school via telephone or email at least one (1) week in advance of scheduled maintenance to be conducted at respective schools.
4. Contractor is not required to entertain any work requests made by school personnel and must deal directly with GDOE contract manager (unless it is an extreme emergency).
5. GDOE requests that contractor ensures that all air conditioning temperature settings are at 78°F.

3.4.1.2 Announcements and Notifications

1. Contractor must sign in at the main office upon arrival at the school premise and notify school principal or designee of the planned approach to perform preventive maintenance of air conditioning systems.
2. Contractor personnel must wear company badges and uniforms when on premises.
3. Contractor will present proposed list for the day so that school officials can ensure access to all identified rooms.

4. Special arrangements and accessibility issues must be coordinated between the contractor and school officials.
5. Upon completion of each workday, the contractor must provide a verbal exit report to the school principal or designee to ensure all areas are properly secured at the end of each business day.

3.4.1.3 Warranty Related Issues as Applicable

1. Contractor must determine and immediately inform GDOE Contract Manager of any issues that may be related to warranty.
2. Any warranty related concerns must be supported by a formal field service report and preventive maintenance checklist on a case-by-case basis for further action by GDOE.

3.4.1.4 Call Backs or Re-Work Trouble Calls

1. Contractor is required to respond to any call backs related to the AC units under this contract within each semi-annual pass for up to ninety (90) calendar days from initial preventive maintenance pass.

3.4.1.5 Quality Control Measures

1. GDOE contract manager or designee(s) may conduct random quality control inspections to ensure compliance.
2. GDOE and contractor may request progress meetings at any time to clarify any related issues or concerns.
3. Any issues and concerns related to preventive maintenance must be addressed by the contractor immediately upon notification or not to exceed a maximum response time within two (2) hours upon initial notification.
4. GDOE project manager must review all maintenance records, field service reports, checklists, and related invoices (submitted after completion of each school) as well as track payment status.
5. Both parties are required to make suggested comments and recommendations for improvement following each semi-annual pass.
6. Contractor will be evaluated on a quarterly basis by GDOE contract manager or designee using GDOE contractor evaluation form.

4 B1023 - Walkway Canopies

1. Blow leaves and other debris off canopy roof panels
2. Blow leaves and other debris off roof gutters
3. Inspect and clear downspouts
4. Inspect straps for roof gutters and downspouts and re-secure if necessary
5. Pressure wash splash blocks
6. Provide ground maintenance around splash blocks
7. Blow debris and dirt off column post base plates and wedge anchors

5 G1010 - Grounds

(Contracted)

A. Mowing

1. Mow and leave grass clippings during the dry season (December to May) for added moisture and nutrients, except when clippings are clumping, and excess piles are evident on the ground.
2. Mulch using a mulching attachment on the mower only during the dry season.
3. Mow and remove grass clippings by raking or mower vacuum during the wet season (June to November) to prevent excessive puddling of water.
4. Operate riding equipment and other grounds maintenance equipment with extreme caution when on or near any walkways or when students, staff, and visitors are present. Equipment guards shall remain in place at all times. Guards shall not be compromised during the operation of equipment.

A minimum of two (2) days' notice shall be provided to School Administrative Staff before performing lawn maintenance to allow the school ample time to schedule usage of the school grounds accordingly.

B. Edging

1. Neatly edge all sidewalks, curbs, gutters, driveways, parking lots and buildings to remove overhanging grass.
2. Remove any grass or weeds growing in cracks and joints.
3. Where mowing cannot be done adjacent to buildings, signpost, benches, trees, bushes, and other obstructions, neatly clip the grass by use of trimmers or brush cutters, being careful not to damage cared for obstructions, planters, flowers, tree saplings and signs. Operate trimmers and brush cutters in a safe manner and all protective guards are to be in place. Use blinders when working around parked cars to protect from flying rocks and to ensure no damages are done to any vehicles or property. The Contractor is responsible for any damages due to trimmer or brush cutting activities at no cost to GDOE. Keep all walkways and parking areas free of grass clipping and debris with each mowing

6 G4092 - Generators

(Contracted)

1. Conduct full load test at a minimum of one (1) hour. [3]
2. Perform safety shutdown test operation
3. Inspect/Test automatic transfer switch operations
4. Inspect/Test ATS under load conditions [3]
5. Check oil level, add if needed
6. Change engine lubricating oil, filter, and bypass filter (if fitted) every 500 hours of use [1*2]
7. Check engine for oil leaks [1]
8. Perform oil sampling and testing
9. Record oil pressure – P.S.I R.P.M.
10. Check pre-lube pump (if fitted)
11. Check hydraulic governor oil level (if fitted), replace if needed [1]
12. Check Fuel Levels, inform Owner/Manager if low [2]

13. Inspect fuel condition for operational readiness
14. Check fuel for contaminants and sediments
15. Drain contaminants and sediment from fuel tank [1]
16. Check fuel tank breather
17. Clean out water and sediment trap [1]
18. Change fuel filters[1]
19. Check fuel system pipes and unions for leaks [1]
20. Check operation of engine governor and stop controls
21. Check operation of fuel system priming pump
22. Check fuel/water separator (if fitted), clean or replace as needed [1]
23. Check coolant level and antifreeze content and top up if necessary
24. Check coolant inhibitor
25. Change Coolant/Antifreeze and filter (if equipped), every 500 hours of use [1*2]
26. Check for coolant leaks [1]
27. Check condition of hoses and clips
28. Check condition of fan belts and adjust or renew if required
29. Check water pump and lubricate
30. Check and lubricate fan hubs and idlers
31. Check condition of radiator and radiator cap
32. Clean radiator fins
33. Check condition of radiator ducting and trunking
34. Check operation of block and radiator heaters (if fitted)
35. Check operation of ventilation louvers
36. Record engine cooling system temperatures
37. Change air filter element every 500 hours of use
38. Clean and check air cleaner and piping for damage
39. Check turbocharger operation and condition
40. Check inlet manifold and gaskets
41. Check and tighten turbocharger outlet hose clips
42. Tighten Manifold nuts and cap screws
43. Tighten turbocharger mounting nuts
44. Check for leaks and signs of blowing
45. Check condition of silencer and piping
46. Drain moisture trap in exhaust pipe
47. Check battery electrolyte level and specific gravity, top up if necessary
48. Check condition of charging system
49. Perform battery load test (inform owner if replacement is needed) [2]
50. Record charging rate – amps
51. Check operation of starting system
52. Clean Battery post, terminals and connections
53. Check condition of wire and connectors
54. Check ignition system and wiring
55. Check ignition cap and rotor (if fitted)
56. Check ignition points and condenser

57. Check spark/glow plugs and replace as needed
58. Check bearings and lubricate
59. Check communicators or slip rings
60. Examine brush gear (if fitted)
61. Check alternator to engine alignment
62. Check alternator to engine coupling
63. Check alternator charge operating system
64. Check battery charger operating system
65. Check starter ampere draw
66. Check engine mounting bolts
67. Check engine anti-vibration mountings
68. Check operation of engine governor
69. Check and adjust engine valve clearance, if 500 hours occurred
70. Check and clean engine crankcase, breather
71. Check engine vibration dampers
72. Lubricate all engine linkages
73. Inspect Day Tank operation (if fitted)
74. Keep generator plant room in a clean and tidy condition [1]
75. Check output voltage, adjust as needed
76. Check bearing, lubricate as needed
77. Check winding condition, clean as necessary
78. Check brushes and slip rings (if fitted)
79. Check connections at the breaker, voltage regulator, and windings
80. Check voltage regulator
81. Check all instrument gauge and meter operations, adjust as needed
82. Check over-speed safety shutdown
83. Check circuit breakers
84. Check Electric governor control
85. Check exerciser operation and replace battery as needed
86. Check Voltage output
87. Check Electrical Breakers, Electrical Wires, Electrical Connections

[1]Denotes Hazardous Waste Disposal — All used fluids such as oils, antifreeze/coolant and oil filters will be disposed accordingly as per;

10 GCA- Health and Safety, Div. 2 Environmental Health;
Chapter 47– Water Pollution Control
Chapter 53 – Safe Drinking Water Act
Chapter 76– Storage of Hazardous Materials

Code of Federal Regulations (CFR), Title 40: Protection of Environment;
Part 261– Identification and Listing of Hazardous Waste.
Part 279– Standards for the Management of Used Oil

[2]Denotes	Replacements	A	Fluid replacements and filters will be incorporated into maintenance costs. Oil/Antifreeze/Coolant Changes Shall be dependent on the following factors 1. Upon 500 hours of use 2. Upon detection of contamination 3. Upon oil testing resulting in fluid degradation.
		B	Fuel condition will be maintained. Fuel levels shall not fall below half tank. Contractor shall submit a refueling notice to DOE CIP Office indicating the gallons required and location. GDOE will arrange refueling through a separate contractor.
		C	Parts and Repairs: Contractor shall submit a work order to DOE CIP Office indicating any parts in need of replacement. The work order must be accompanied by an assessment determining the cause of failure, location and cost.

At no time shall any used materials such as oil, antifreeze/coolant, oil filter, parts and contaminated materials be stored within school grounds. All used and contaminated materials shall be disposed properly in accordance with local and federal laws and regulations.

[3]Denotes	Coordination with School Officials and DOE CIP Office	A	School officials and DOE CIP will be notified three (3) days in advanced of generator load tests to ensure entrance into school property. Load tests shall only be conducted after instructional hours, Government Holidays, or weekends.
		B	Full Load test shall include all designated areas (as stipulated on Attachment C.) be fully energized.

1

2

Appendix 2 - Preventive Maintenance Work Plan and Resource Needs

The work plan shown in Table 1 lists the preventive maintenance tasks and associated UNIFORMAT codes presented in Appendix 1. The work plan identifies which tasks are required at which locations, the required frequency, and the total resources required to execute the work.

The estimated contract cost for each maintenance task is shown in the rightmost column. Trade skill levels required to complete the tasks are also shown to assist with contract scoping. Custodial and Cafeteria Kitchen Equipment (GDOE Operated) tasks, based on contracts executed by GDOE, vary from the preventive maintenance focus of Appendix 1 and are not defined therein. These two tasks are included in the work plan for budget estimation purposes.

Table 1 - Hours and cost calculations for preventive maintenance work plan

Asset	*Classification*	*Trade Skill Level*	*Frequency*	*Total Schools/ Units*	*Total Time (Hr/Yr)*	*Est. Contr. Cost*
Fire Alarm System	D5037-Q	3	Q	35	1,820	$ 145,244
Fire Alarm System	D5037-SA		SA	35	incl. above	incl. above
Fire Alarm System	D5037-A		A	35	incl. above	incl. above
Elevator	D1010	2	M	8	432	$ 86,400
Air Conditioning (Split Ductless)	D3041-SDL	3	SA	35	23,376	$ 584,400
Air Conditioning (Split Ducted)	D3041-SD1	3	SA	16	2,988	$ 74,700
Air Conditioning (Split Ducted)	D3041-SD2	3	SA	16	2,490	$ 62,250
Air Conditioning (Packaged)	D3052	3	SA	15	2,640	$ 66,000
Air Conditioning Replacement	D3041	3	SA	35		$ 736,792
Walkway Canopies	B1023	1	Q	24	2,322	$ 90,000
Grounds	G1010	1	M	35	4,957	$ 385,000
Generators	G4092	3	SA	16	2,280	$ 57,000
Custodial	D5017	1		35	110,777	$ 2,373,792
Cafeteria Kitchen Equipment (GDOE Operated)	E1093		M (8/YR)	4	1,764	$ 80,000
		1, 2, or 3	A, SA, Q, M, W, or D	*Total:*	***175,100***	***$ 4,004,786***

Appendix 2 - Preventive Maintenance Work Plan and Resource Needs

1 *Skill Level*
2 Skill Level 1: Basic skill range with some formal training.
3 Skill Level 2: Advanced skill range with formal training and certification.
4 Skill Level 3: Advanced skill range with factory training and certification.

Frequency	
D	Daily
W	Weekly
M	Monthly
Q	Quarterly
SA	Semi-Annually
A	Annually

A3 - Preventive Maintenance Tasks - School Detail

School	Fire Alarm Systems (D5037)	Elevators (D1010)	AC (D3041)	Walkway Canopies* (B1023)	Grounds (G1010)	Generators (G4092)	Custodial (D5017)	Cafeteria Kitchen Equipment (E1093)
Agana Heights Elementary	x		x		x		x	
Agueda Johnston Middle	x		x	x	x		x	
Astumbo Elementary	x		x		x	x	x	
C.L. Taitano Elementary	x		x		x		x	
Capt. Price Elementary	x		x	x	x		x	
Carbullido Elementary	x		x	x	x	x	x	
Chief Brodie Memorial Elementary	x		x	x	x		x	
D.L. Perez Elementary	x		x	x	x		x	x
F.B. Leon Guerrero Middle	x		x	x	x	x	x	
Finegayan Elementary	x	x	x	x	x		x	
George Washington High	x	x	x		x	x	x	
Inarajan Elementary	x		x		x		x	
Inarajan Middle	x	x	x	x	x	x	x	
J.P. Torres Success Academy	x		x		x		x	
J.Q. San Miguel Elementary	x		x	x	x		x	x
Jose Rios Middle	x	x	x	x	x		x	
Juan M. Guerrero Elementary	x		x	x	x	x	x	
L.P. Untalan Middle	x		x	x	x	x	x	
LBJ Elementary	x		x	x	x		x	
M.U. Lujan Elementary	x		x	x	x	x	x	
Machananao Elementary	x		x		x	x	x	
Marcial Sablan Elementary	x		x	x	x		x	
Maria A. Ulloa Elementary	x		x	x	x	x	x	
Merizo Martyrs Memorial Elementary	x		x	x	x	x	x	
Oceanview Middle	x		x	x	x		x	
Okkodo High**								x
Ordot-Chalan Pago Elementary	x		x		x	x	x	x
P.C. Lujan Elementary	x		x	x	x		x	
Simon Sanchez High	x	x	x		x		x	
Southern High	x	x	x	x	x		x	
Talofofo Elementary	x		x	x	x	x	x	
Tamuning Elementary	x	x	x		x		x	
Truman Elementary	x	x	x	x	x	x	x	
Upi Elementary	x		x		x	x	x	
Vicente S.A. Benavente Middle	x		x	x	x		x	
Wettengel Elementary	x		x	x	x	x	x	

Notes:

* No Walkway Canopies PvM currently performed; PM task descriptions and manhours in PvM Plan are proposed tasks and estimated hours.

** Okkodo High is a leased school with cafeteria kitchen equipment operated and maintained by GDOE.