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Escalators and Elevators Maintenance Plans

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Table of Contents

1.0 PURPOSE

Successful maintenance planning of escalators and elevators relies on conducting maintenance at the right time to the right level such that the performance may be optimized, and equipment life may be maximized.

The purpose of this document is to provide guidance in developing and improving maintenance plans for escalator and elevator systems within the facilities. These are minimum requirements for maintenance, inspection, and repair of the systems which the Entities and/or Facilities Management Companies (FMCs) shall modify, specific to the Entity's needs. Furthermore, this document seeks to improve and enhance the Entities' overall understanding of escalator and elevator maintenance, convey best practice and guidance on the incorporation of international standards and regulations in conjunction with the Kingdom of Saudi Arabia's (KSA) established codes and decrees.

Providing supporting examples of maintenance scheduling frequencies and advise on Planned Maintenance (PM) tasks, this document is intended to:

- Impart knowledge that enables the Entities and/or FMCs a base structure from which they can develop a set of documents and procedures
- Enable the management, senior management and engineers to have a clear understanding of the minimum maintenance requirements, along with Entity, client, FMC, staff roles, and responsibilities
- Identify the base analytical information that shall be recorded by engineers and technicians to ensure that discrepancies are pre-emptively identified and rectified through the maintenance management processes applied
- Guide the Entity and FMC service providers on how to develop the elevator and escalator maintenance management plans/manual
- Provide a structured flow and reliable reference points within the document that can be related back to the relevant sections
- Give examples and guidance on how to formulate a bespoke set of documentation, developed against a What, Why, How, Who and When structure that includes the Shall, Should, Consider and Advise philosophy

The intention is to provide adequate reference and methodology for Entities, facilities managers/service providers during the creation of their own documents and processes and as an aid for engaging with external parties for the delivery of service.

References have been provided within the document to direct users to the Entity-specific requirements of any decree or regulation as a point of reference. Where only a summary is provided within the guidelines, the actual reference shall always be the standard that must be employed.

2.0 SCOPE

The scope of this document is to guide those responsible for ensuring the maintenance of escalators and elevators is carried out in a consistent and reliable manner, focusing on planned activities and the reduction of costly and disruptive reactive maintenance. The Entities, FMCs, and/or their specialist service providers shall take steps to enhance the current practice of developing a maintenance plan for efficient facilities operations.

The information contained herein covers key elements of maintenance planning for escalators and elevators within the facilities, that shall be incorporated as a minimum into the finalized facility maintenance plan including, but not limited to:

- Key roles and responsibilities
- Details about the escalator and elevator systems, subsystems, and equipment
- Equipment PM scheduling requirements
- Health and safety of stakeholders and the environment

The maintenance management document (operating manual) has a structured flow of elements that will enable the Entity to develop the bespoke maintenance plans for the facility.

This document will address the following criteria of a maintenance management plan:

- **What** needs to be included – Formulated tasks against adopted standard
- **Why** it should be incorporated – Standards, regulations, law, good practice, and efficiencies
- **How** to build the document – Structure, process, guidance, and flow
- **Who:** Roles and Responsibilities – For 'what' elements, competence level requirements, and management inputs
- **When:** Scheduled frequency – Required scheduled periods, PM intervals, and incorporated content. This is dependent on adopted standards, or best practice where these standards do not exist

Incorporated diagrams and/or flow charts are for guidance and shall not be classed as all-inclusive but as elements that can be further developed as required. These shall be in-line with the finalized document ensuring structured flow and reliable reference points that can be related back to relevant sections of documentation.

Entities and FMCs shall be aware that the variants of facilities that the document covers may not include all of the equipment highlighted within this document, as a standard. Therefore, care around developing the bespoke maintenance plan is paramount.

Notwithstanding the recommendations presented in this document, the final responsibilities for developing the final maintenances management plans/tasks as will be applied to the escalators and elevators shall remain with the Entity, FMC, and/or Maintenance Engineer (ME).

Due to the large number of escalator and elevator brands in service, it is not always possible to safely describe every maintenance procedure in detail. Some of these systems will need to be assessed on a case by case basis locally built upon the Original Equipment Manufacturer (OEM) recommendations. It is the FMC's responsibility to ensure that these plans are expanded to comply with the facility's adopted standard outline requirement.

The finalized scheduling and task documents disseminated, as working documents shall be reviewed on a regular basis thereafter to ensure all information and process content are updated, relevant, and correspond with the Asset List for maintainable plant and equipment within the facility.

The guidelines within the document are designed to cover the following sectors within Entities as the elevators and escalators are common types of equipment that may be found within these sectors. These guidelines are not designed to be specific; and the OEM, installing contractor or specialist maintainer shall be consulted. Where further clarifications or guidance of a specialist nature is required, then the Entity shall engage with a specialist consultancy for independent advice. The following sectors have been considered in the formulation of these plans:

- Healthcare
- Schools and universities
- Offices
- Municipal
- Housing
- Parks and recreation

Note: For the facilities bespoke document, other standards shall be considered and the most effective and/or stringent scheduling/planned maintenance elements shall be adopted as far as possible. Some parts of the maintenance plan may require scheduling to be calculated in run-hours rather than calendar based activities.

3.0 DEFINITIONS

Term	Definition
Elevators	
Elevators	A cabin, that vertically transfers people and goods within a dedicated shaft connecting the floors of a building
Airborne Noise	Noise transmitted through the air. Cars/cabins, cables, control panel, doors, guide shoes, and other vibrating components can produce noise which needs to be kept to a minimum, especially in hospitals
Alarm Bell/Sounder	A bell/sounder which is used to attract attention and help. Normally located on the inside of the car/cabin, car/cabin roof, and placed in the shaft of the elevator, or landings. It shall also be connected to the BMS and auto dialer
Alarm Button	A button to trigger the alarm sounder. When used with a remote control, the button will also trigger the voice connection. Normally operable on the inside of the car/cabin, car/cabin roof, and placed in the shaft of the elevator, or landings with a pushbutton
Alarm Delay Time	The time it takes between the depression of the alarm button and the alarm signal activation of the alarm sounder
Balancing Weight	A counterweight mass that assists in saving energy by balancing all or part of the car's mass, the sling of the car and the load (e.g., weight of the goods, services, passengers)
Bed Plate	A steel or cast-iron rigid platform on which a machine is placed
Brake	An electro-mechanical device used to prevent the elevator from moving when the car/cabin is in a state of rest and there is no power applied to the hoist. It also brings the car/cabin to a halt on direct drive elevator systems as power is drained from the hoist mechanism
Buffers	The buffer is a system at the bottom of the elevator which is designed to protect people by reducing the deceleration rate of the car/cabin in the event of an incident. Buffers will assist in absorbing the car's/cabin's kinetic energy on rapid descent
Cabin/Car	This is the main part of elevator which is designed for the shipment of goods and services, or the passage of personnel
Car/Cabin Over Speed Protection	A safety system which stops the car's/cabin's uncontrolled movement within the elevator shaft
Counterweight	A weight which is part of the hoist system, that ensures stability between the friction sheave and the suspension ropes. To balance the car's weight and a proportion of the car's load normally taken as 50 per cent of the rated design load
Doors	Elevator doors are designed for entry and exit. There are two styles of elevator doors: • **Manual doors:** These doors are opened with the aid of a person wishing to reach the elevator • **Automatic doors:** Automatic doors are the type of doors that are opened automatically, as opposed to being operated by a door operator
Drip Pan	These are oil catchment trays normally located at the bottom of the elevator guide rails, to catch excess lubricant, and prevent it from covering the elevator pit
Drive Mode	A predefined mode of operation in which the elevator operates for a given situation. For example, modes may include normal drive, control drive, and setup drive
Drive Unit	Drive unit is the component that includes an elevator-driving motor, gearbox (if not direct drive), and rope sheave
Electric Motor	The electric motor is used for the elevator traction system and assists with moving the car/cabin between floors
Elevator Rails	These assist the alignment of car/cabin within the elevator shaft, to enable a smooth ride between floors
Elevator Shaft	The elevator cabin/car moves in this space between floors
Goods Elevator	An elevator equipped to carry e.g., goods, forklift trucks

Term	Definition
Hoisting Function	Equipment required to move the car/cabin and counterweight in the elevator shaft. A given combination of equipment required for a range of loads, rated velocities, acceleration, and heights of travel
Landing	The floor space in front of the entrance to the elevator
Landing Door	A door where an elevator shaft opens. Used to provide safe access to the car/cabin over the elevator shaft
Machine Room	A space that houses the elevator electrification, control system, and some parts (all) of the elevator mechanical gear
Maintenance Access Panel	Part of the elevator control system including the emergency car/cabin levelling, and switches, fuses, and an electronic brake release lever user interface
Parking	A function of a single elevator or group of elevators. With this function, when a car/cabin receives a signal it is programmed to always return to a pre-selected landing after the completion of all landing or car calls
Pit	A portion of the elevator shaft which extends from the lowest landing sill level to the shaft floor of the elevator
Raft (Gear)	A steel or cast-iron rigid platform on which a machine is placed
Ropes	Close tolerance high tensile steel wound helical wires, to form cables, known as “ropes” in the elevator profession
Safety Device	For safety reasons this is a mechanical device that is affixed to the car/cabin. During accent or descent, if the elevator approaches a maximum design velocity or speed, the safety device will reduce and normalize the excess velocity/speed to ensure a safe and secure ride
Safety Gear	A mechanical protection system fixed to the chassis of the car/cabin and also to the counterweight frame in certain cases. The system acts to stop and hold an over-speed car/cabin or counterweight by using clamping jaws which close around the guide rails; triggered by the over-speed governor system
Speed Governors	The speed regulating system of elevators is known as the speed governor. If the elevator exceeds the speed limit, then the speed governor counteracts the excess speed. Normally it is affixed to the bottom of the car/cabin and is also known as the cord of the governor
Sheaves	Pulleys used for carrying multiple elevator ropes
Sill	Opening area, bottom section over which landing and car/cabin doors span
Suspension Rope	The ropes suspending the elevator car/cabin and counterweight. Not the same as hoisting rope
Threshold	Concrete structure upon which the landing is situated
Traction Test	A safety test to ensure that there is correct amount of friction between the suspension ropes and the traction sheave
Escalators	
Escalators	A device that acts as a moving walkway between two distinct levels using steps as the means of transportation
Brakes	Brakes stop the escalator when the usual mechanism is triggered. The emergency stop buttons will also stop the escalator. The escalator will stop when the safety devices are activated or when power is lost
Balustrade	Balustrades are the sides of an escalator which extends over the steps. This includes skirt frames, inner panels, skirt panels, handrails and floors
Controller	Controllers include a circuit breaker, local disconnect, motor starter, control relays, fault indicator, and all other functions of an escalator controller. The motor starter restricts the motor's starting current and prevents the motor from e.g., overload, phase reversals input control. The controller also provides an emergency stop to disconnect the power supply to the driving machine motor and apply brakes at controlled speed to avoid the escalator breaking sharply. Controllers include a fault signaling feature in the controller's front panel that visually signals and detects the actuation of safety devices triggering the shutdown of the escalator. Controllers have fire alarm interfaces, as well as seismic sensors. The emergency stop is triggered in case of any such incident
Drip Pans	Drip pans are provided for the escalators to collect oil, grease from step linkages, rainwater and loose debris that may get deposited into escalator truss. Drip pans are sloped in such a way that the liquids collected drain towards the lower truss

Term	Definition
	section and eventually redirected to the industrial drain collection point for environmental disposal.
Gears and Motors	At the top of the escalator is an electric motor (normally an AC induction motor) located inside the truss. Escalators have four gears; there are actually two drive gears at the top on either side, and two return gears at the bottom on either side. These four gears are driven by the electric motor The gears are linked by step chains looping around them and running down on both sides of the escalator. The chains are attached to each step and thus help to move the steps up or down the escalator
Handrails & Handrail Drive Systems	The handrails are used by travelers for balance and safety. The handrail is basically a long rubber ring, a moving handhold provided for escalator passengers, passing over the top of the balustrade and newels. Handrails get their movement from the same mechanism that drives the steps i.e., the main escalator runs directly through the gearbox and drive shaft or drive chains so that the handrails and steps work at the same speed in each direction. A handrail guard is also fitted over the outside of handrail at a point where the handrail enters or leaves the balustrade. It is designed to keep a person's fingers out of the handrail opening
Landing Plates (Top and Bottom Floor Plates)	The landing platform houses the curved portions of the tracks, gears and motors. The floor plate is the point of entry for going onto escalator steps. A comb plate is used between steps and floor plate; the comb plate has cleats which match the step cleats. Landing plates are designed to be supported by the truss head and cover the entire landing area within the truss outline
Moving Walkway	A device similar to an escalator but retaining a flat surface for transporting passengers along a horizontal or shallow inclined surface
Over Speed Governor	Over speed governor cuts off the power supply to the motor and brings the escalator to rest when the speed varies more than the (specified) set percentage of the rated speed
Safety Devices	Depending on the operational disruption of the electrical circuit, safety devices are interlocked to disconnect the motor's electrical power supply and apply brakes to safely and firmly stop the escalator in the direction of travel. It also prevents escalator in-service use, before the safety danger/failure is fixed. Several types of safety devices are used in escalators e.g., emergency stop buttons, overload warning system, speed governor, broken drive chain device, skirt obstruction device, handrail speed control device, missing step device, broken chain step device
Steps	Steps are of horizontal tread formation; the step treads are of cleat type to assure secure foothold and comfortable tread surface. Visual demarcation is usually provided on the front and rear edges of each step to indicate the edges. There are four wheels below each step of the escalator; two on either side of each. The two wheels closest to the top of the step connect the steps with the two chains that are looping around the gears. The horizontal placement at the top and bottom of that chain allows the steps to flatten out, in turn For stability, the two wheels which are closest to the bottom of the step roll along a rail within the truss. Alignment is aided by the groves within each step
Step Chains	They pull the steps to the top, from the bottom platform, in an endless loop
Trusses	The escalator mechanism is enclosed in a structure called a truss, under its steps. These are designed to accommodate the width of the escalator and have enough strengths to keep the tracks and moving parts balanced, maintain steps and running gear safely. It also retains the step mechanism inside truss guides, if the track systems fail
Tracks	The track system built into the truss is designed to hold the steps and running gear at the maximum operating speed and under severe load requirements, while maintaining operation. Relative position of stepping wheel track (front wheels of steps) and trailer wheel track (back wheels of steps) induces staircase formation as the steps travel out of comb plate, and also enables steps to lay flat at the top and bottom of the escalator

Term	Definition
Abbreviations	
ACOP	Approved Code of Practice
AHJ	Authority Having Jurisdiction
ATS	Automatic Transfer Switch
BMS	Building Management System
BREEAM	Building Research Establishment's Environmental Assessment Method
BS	British Standard
C&E	Cause and Effect
CAFM	Computer Aided Facility Management
CB	Capacitor Bank
CDM	Construction Design and Management
CIBSE	Chartered Institution of Building Services Engineers
CMMS	Computerised Maintenance Management System
CMT	Crises Management Team
COSHH	Control of Substances Hazardous to Health Regulations
DB	Distribution Board
DOC	Department Operations Center
DSP	Distribution Service Provider (Electrical Generation Entity)
EAWR	Electricity at Work Regulations
ELV	Extra Low Voltage (Classified as below 50V)
EPDS	Emergency Power Distribution System
ERT	Emergency Response Team
ESF	Emergency Support Function
ESG	Emergency Standby Generator
ESG	Electrical Safety Group
FM	Facilities Manager
FDM	Facilities Departmental Managers
FMC	Facilities Management Company (Facilities Operations)
FOC	Facilities Operating Client (Client/Building Owner)
FOM	Facilities Operations Management (Client/Building Owner Representative)
HBN	Health Building Note
HC	Healthcare
HF	Harmonic Filter
HSaWA	Health and Safety at Work Act
HSE	Health and Safety Executive
HSG	Health and Safety Guidance
HSSE	Health, Safety, Security, and Environment
HTM	Health Technical Memorandum
HVAC	Heating, Ventilation, and Air Conditioning
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IET	Institute of Engineering & Technology
IOSH	Institution of Occupational Safety and Health
KPI	Key Performance Indicator
LAL	Load Acceptance Level
LOTO	Lock Out Tag Out
LSS	Life Safety System
LMR	Lift Motor Room
LV	Low Voltage (Classified as being above 50V and below 600V)
LVDB	Low Voltage Distribution Board
MCC	Motor Control Center
MDB	Main Distribution Boards
MEWP	Mobile Equipment Work Platform (Scissor/Boom Lift)
MCC	Motor Control Center
MDB	Main Distribution Boards
MFCP	Main Fire Control Panel

Term	Definition
MS	Method Statement
MSDS	Materials Safety Data Sheet
MV	Medium Voltage (Classified as being above 600V and below 13.8kV)
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NMA & FM	National Manual of Assets and Facilities Management
NSF	National Standards Foundation
OE	Operations Engineer
O&M	Operations and Maintenance
OEM	Original Equipment Manufacturer
OSHA	Occupational Safety and Health Administration
PAVA	Public Address and Voice Alarm
PDS	Product Data Sheet
PPE	Personal Protective Equipment
PM	Planned Maintenance
PTW	Permit to Work
PUWER	Provision and Use of Work Equipment Regulations
QHSE	Quality, Health, Safety and Environment
RA	Risk Assessment
RAMS	Risk Assessment & Method Statement
RPM	Revolutions Per Minute
SASO	Saudi Standards, Metrology and Quality Organization
SBC	Saudi Building Code
SEC	Saudi Electrical Company
SLA	Service Level Agreement
SMDB	Sub-Main Distribution Board
SOP	Scope of Process/Standard Operating Procedure
T&C	Test and Commissioning
UPS	Uninterruptable Power Supplies
VFD	Variable Frequency Drive
WHSR	Workplace Health and Safety Regulations

Table 1: Definitions

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- Provision and Use of Work Equipment Regulations (PUWER), 1998
- Saudi Aramco Suppliers Safety Management System
- Saudi Standards, Metrology and Quality Organization (SASO) SASO-ISO-TR-11071-1: 2010; Comparison of worldwide lift safety standards – Part 1: Electric lifts (elevators)
- Serco Maintenance Schedules and Practices
- Workplace (Health, Safety and Welfare) Regulations (WHSR), 1992

Note: A number of references above refer to the term ‘lifts’ within their title. This is to be understood as referring to ‘elevators’ used throughout the text of this document.

5.0 RESPONSIBILITIES

Role	Description
Entity	Governmental Entity having jurisdiction over specific sector facilities
Entity Representative/Facilities Operating Client (FOC)	Entity representative having overall management of the facility
Duty Holder	The building owner (who owns the elevators) or a facilities manager responsible for the safe operation of the elevators is the Duty holder, and as such responsible for the elevators used in work activities within the building and for regular thorough examination of those elevators
Senior Facilities Operating Client Management	Group or committee of section department managers representing the FOC.
Facilities Operations Management (FOM)	Discipline certified managers and engineers appointed by FOC to oversee FMC activities
Facilities Management Company	The FMC is an appointed client representative who in collaboration with the client, controls the operational engineering departments and who is responsible and accountable for the qualified persons and competent persons, as well as engineering system site, their ongoing design development, operations, maintenance, and ensuring control and monitoring of those systems
Designated Responsible Person (RP)	The Requirement for this person is dependent on the facility SOP process The RP is employed directly by the Entity/FOC and is responsible for appointing the Authorizing Engineer (AE) of the engineering systems and the staff who operate those systems, and is overall responsible for the Operations and Management (O&M) of those systems They have a responsibility for ensuring that the FMC have complied the maintenance plan using the relevant regulations pertaining to those engineering systems and the staff involved The Responsible/Designated Person shall ensure that the systems are kept up to date with the latest relevant regulations. They may also be required as liaison between the FMC and the FOC
Elevator/ Escalator Authorizing Engineer (AE)	Requirement for this person is dependent on the facility SOP process independent or internal; he shall have the relevant experience and be a chartered engineer The AE shall be appointed by the RP to take responsibility for the effective management of the safety guidance, they shall carry out regular audits, which shall be provided to the RP The AE is also responsible for ensuring that FOC is kept up to date and that in turn the FOC updates into the AE any known anomalies that may pose a safety risk to the facility staff and/or members of the public that may be visiting the facility
Competent Person (CP)	A person with the necessary training, and who has been appointed by an AE (or by an authorizing body within the entity), after conformation of competence, knowledge, skill, and experience. The CP can execute the required actions within a Permit to Work (PTW) and/or other directional documents as may be assigned to him
Elevator Steward	In KSA this would normally be carried out under the CP(s) on site for simple daily checks
Elevator Warden/Elevator Release Warden	In the KSA this would normally be carried out by CP(s) on site, who are also trained in fire evacuation/elevator release training

Table 2: Roles and Responsibilities

5.1 Roles and Responsibilities for Schedules & PM Task Implementation

Figure 1 provided here illustrations the responsibilities and flow process for the formulation of maintenance plans and activities. The diagram highlights the organizations' responsibilities in the formulation of a maintenance strategy that will assist the Entity in achieving corporate goals in enhancing the facility operations with the following benefits:

- Ensuring that the vertical transport equipment is safe to use
- Instruction of CPs
- Ensuring that vertical transport equipment has regular statutory inspections in accordance with a scheme drawn up by a CP or FOM team
- Reducing breakdowns of plant and equipment through a robust maintenance process
- Early identification of faults or degraded equipment to allow contingency planning
- Efficient utilization of manpower to undertake planned maintenance activities, rather than reactive or corrective tasks
- Planning of spare parts and consumables to be available for maintenance activity
- Reduction in warehouse stock and obsolescence
- Accurate reporting to senior management and stakeholders. Especially if used in conjunction with CMMS systems
- Better utilization of utilities (e.g., power, water) through an efficient use of plant
- Ensuring records are kept up to date, of inspections, maintenance and improvements.

Further detail on the formulation of strategic plans can be found within the NMA & FM – Volume 6, Chapter 4: Financial Planning.

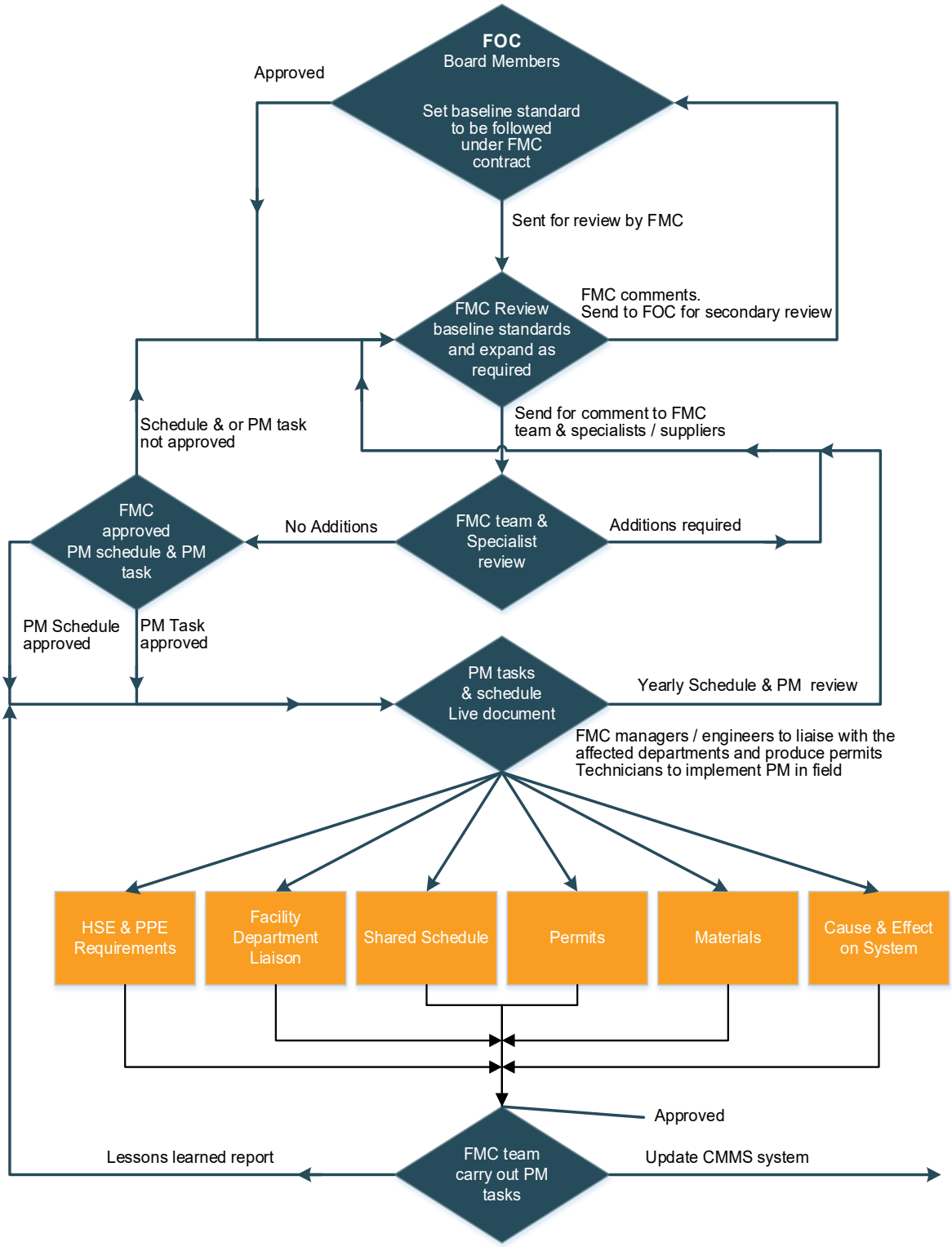

Figure 1: Roles & Responsibilities for Schedules & PM task implementation

6.0 PROCESS

6.1 Systems Overview

All elevators and escalators shall be maintained to guarantee safety and performance at levels consistent with the OEM maintenance requirements. This is to safeguard all users and goods transported by escalators and elevators, and all personnel involved in the maintenance or inspection. EN13015 provides “Rules for Maintenance Instructions” for all new equipment.

Escalators and elevators shall be deemed as specialist equipment, requiring high levels of training and certification for maintenance staff. Entities shall not generally employ specialist staff directly, due to safety concerns, for lone working. It must also ensure that the facility has the back up of spares and consumables from a recognized distributor or manufacturer. As such these activities would generally be subcontracted to an independent contractor who may be one of the following:

- Elevator manufacturing company
- Installing contractor
- Specialist vertical transport maintenance company

The escalators and elevators are to be maintained in accordance with the OEM recommendations, international and local regulations, standards, and best practice within the region. Maintenance sheets are to be provided by the contractor for various activities that are to be undertaken. The Maintenance Contractor will be required to demonstrate how they will comply and adopt best practice and safety for maintaining these systems to site staff.

A planned maintenance service is required for all the escalators and elevators. This shall be by way of scheduled visits. All normal consumable items required for planned maintenance activities and critical spare parts (minor or major) for the normal operation of the systems are to be included.

The Maintenance Contractor shall provide a full breakdown of resources against all planned maintenance activities. This shall indicate the number of staff and their respective discipline and qualifications. The FMC will monitor and manage the planned maintenance activities by way of the Computer Aided Facility Management (CAFM) system. Once the planned maintenance schedules provided by the Maintenance Contractor are approved, the schedules, task sheets and Work Order (WO) information shall be managed by the CAFM system. It shall be noted that escalator and elevator maintenance companies may utilize their own, or the manufacturers system for the recording and scheduling of maintenance and system checks for elevator and escalator installations. The contractor shall provide copies of maintenance modules completed to the Entity management, for the input into the Entity installed CMMS system, unless a dedicated link between the systems is established.

The maintenance agreement will provide for the appropriate number of visits required to suit a particular installation, the needs of the client, and the age of the equipment. However, where there is a high usage or if a continuation of service is particularly required, the frequency of visits may need to be increased to once a month, for major activities/checks (or more often in some cases). The frequency of maintenance visits is a key factor in the continued operation of escalators and elevators and shall be agreed between the client and contractor, including access times for routine and major maintenance. This shall be reviewed periodically following feedback from facility users and through traffic analysis.

Maintenance of escalators and elevators is a mandatory exercise to comply with statutory requirements and ensure continued operation and longevity of equipment. Planned maintenance is the preferred method of undertaking maintenance to suit the requirements of vertical transportation within a facility, as unplanned downtime of equipment can have a significant impact to the facility function. Additionally, call out and ad-hoc maintenance is to be avoided as this can increase maintenance costs significantly. Regular site visits are imperative to:

- Ensure the machinery continues to function safely
- Minimize the time that equipment might otherwise be out-of-service
- Ensure accessibility of trained personnel capable of responding quickly in the event of a breakdown
- Extend the life and performance of the installation.

Regular maintenance of the escalators and elevators shall be carried out, to ensure, in particular, the safety and reliability of installation. The Entity shall consider the ability of escalators and elevators to be maintained without causing injury or damage to staff, patients, students, visitors or other users of the equipment.

EN13015 sets out the minimum standards for maintenance instructions that are to be in place for the maintenance of newly installed equipment. However, maintenance is a dynamic process that must be continued throughout the life cycle of the equipment.
It is important to apply the principles of EN13015 to existing elevators and escalators installations throughout their working life to ensure that hazards are identified, and actions are taken to fulfill essential safety requirements. Utilizing the guidance of the above reference can assist in identifying issues at an early stage before they become costly issues causing potential reputational damage to an Entity. Risk Assessments and Method Statements (RAMS) shall be reviewed periodically and the recommendations of inspecting engineers be completed within prescribed timescales.

6.1.1 Healthcare

Entity senior management shall consider the requirements of the healthcare facility and ensue that attendances of specialist staff are available, that meet with the Entity requirements and goals, in particular, for transfer of patients and avoidance of impact to patient welfare. It shall therefore be a prime consideration that FOM teams remain at site 365/24/7 to be called out in the event of an elevator breakdown, so the trapped patients and staff can be quickly released.

6.1.2 Schools and Universities

FOM team are normally kept on site, to be called out in the event of an elevator breakdown, so the trapped students and staff can be quickly released.

6.1.3 Offices

FOM team will be available at short notice, to be called out in the event of an elevator breakdown, so any trapped staff can be quickly released.

6.1.4 Municipal

FOM team will be available at short notice, to be called out in the event of an elevator breakdown, so any trapped staff can be quickly released.

6.1.5 Housing

FOM team will be available, to be called out in the event of an elevator breakdown, so any trapped tenants can be quickly released.

6.1.6 Parks and Recreation

FOM team will be available, to be called out in the event of an elevator breakdown, so any trapped visitors and staff can be quickly released.

6.2 Written Scheme of Examinations and Thorough Examinations

The written scheme shall identify the parts of vertical transportation equipment components, that must be thoroughly examined, it may cover similar items, which are subject to the same operating conditions, e.g., all the vertical transportation accessories in an Entity which were installed at similar times, and subjected to similar amounts of use.

The scheme may often have a periodicity which is different from the usual 'periodic' examination intervals (i.e., 6 or 12 months). A longer period shall only be based on a rigorous assessment of the risks. The scheme can be drawn up by the owner, user, manufacturer or some other independent person, as long as they have the necessary competence and qualifications.

The written scheme shall be reviewed regularly (i.e. 6-12 months), during each thorough examination and (immediately) after any event that may alter the risks associated with the vertical transportation equipment. Maintenance and operational staff must inform the CP of any incidents that may affect the risks associated with use of the equipment.

A thorough examination of vertical transportation equipment within the Entity shall be undertaken under following circumstances and intervals:

- Before using the vertical transportation for the first time, unless the equipment has an EC Declaration of Conformity of less than one year and was not fabricated or assembled on site. If the vertical transportation equipment was fabricated or assembled on site, it must be examined by a CP (normally a qualified and competent insurance inspector) to establish that the fabrication or assembly was correct and safe, e.g., a platform elevator installed in a building
- After fabrication or assembly, and before use at each location for equipment that requires assembly or installation before use, e.g., tower cranes
- if the equipment is exposed to conditions causing deterioration that is likely to result in dangerous situations, e.g., outdoor elevators subject to the weather elements adjacent to the sea, a thorough examination can be carried out at regular intervals (either at least every 6 months or 12 months depending on whether the vertical transportation equipment is for vertical transportation of people or goods only), or in accordance with an examination scheme drawn up by a qualified and competent person

6.3 Third Party Inspection

All elevators must be verified by third party professional body to ensure that it is safe before first use and periodically once it is in service to ensure it remains safe to use. The authorized third party body must have valid accreditation for testing and inspecting the elevators. The inspection bodies shall be approved by local authorities to perform this activity.

The inspection of elevators and escalators is the responsibility of the Entity to ensure that the equipment meets with statutory requirements. In addition, it will assist in identifying current condition and maintenance practices to ensure they are effective and compliant. The maintenance contractor shall be in attendance during inspection visits to provide access and act as safety person within shafts for inspectors, control rooms, and lift motor rooms and also to rectify any observations at the time, if possible, by the inspector.

The contractor must conclude third party inspections of all elevators through a recognized inspection organization. These inspections are required to be carried out as per the prevailing laws in KSA. Generally, for passenger equipment it shall be at a frequency not exceeding six (6) monthly. For goods only services, it shall be no greater than annually. Entities shall consult with their insurance broker and civil defense services within their region, or particular sector of operation.

The third-party authorized inspection body shall act according to relevant international standards including but not limited to, BS EN 81-20, BS EN 81-50, BS 5655-11: 2005, and BS 5655-12: 2005.

The inspection body must have a management system which includes the following, but not limited to: Proper documentation of its policies, procedures and activities from the receipt of an inspection request

through contract analysis, planning for inspection, inspection, reporting of results, and the issuance of the final report/certificate in compliance with ISO/IEC 17020's documentation requirements (specifications for the application of different types of inspecting bodies).

6.4 Escalator and Elevator System Components and Sub Systems

6.4.1 Elevator System Components

- Control/Motor room
- Controls
- Winding gear
- Counterweight
- Car
- Control/Operating Panel (COP)
- Over speed governor
- Pit
- Hydraulics
- Oil storage
- Security
- Ventilation
- Safety systems
- Shaft platform

6.4.2 Elevator Sub Systems

- Distribution board
- Motor control board
- Auto changeover switch
- UPS (VVVT)
- Duplex/Quadruplex/Multiplex (multi car controllers)
- Motor
- Hand winder
- Motor brake
- Gearbox
- Hydraulic telescopic piston cylinder
- Oil pumps
- Oil tank
- Oil intercooler
- Oil non-return valve
- Call buttons
- Car
- Car doors
- Car door edge detection
- Car roller guides
- Car guide rails
- Car overload detection
- Car brakes
- Sheaves
- Hoist way
- Hoist rope
- Suspension rope
- Counterweight
- Counterweight roller guides
- Counterweight guide rails
- Governor
- Governor rope

- Governor centrifugal switch
- Landing/Floor doors
- Landing/Floor thresholds
- Landing/Floor beam detection system
- Door gear
- Sills
- Automatic oilers
- Oil pans
- Buffers
- Pit ladder
- Lighting
- CCTV
- Security interlocks
- Intercom
- Fire and evacuation controls
- Pit sump pump
- Public Address and Voice Alarm (PAVA) Systems
- Ventilation grills
- Smoke extraction
- Shaft Platform

6.4.3 Escalator System Components

- Distribution board
- Controls
- Lighting
- Drive system
- Steps
- Landings
- Handrails
- Safety systems

6.4.4 Escalator Sub Systems

- Distribution board
- Motor control board
- Motor
- Motor shaft brake (electromagnetic)
- Motor shaft brake (mechanical)
- Gearbox
- Drive chain
- Steps
- Landing
- Handrail
- Emergency stop
- Over speed governor
- Overload detection device
- Drive chain breakage detection
- Broken step detection device
- Missing step detection device
- Skirt obstruction detection device
- Comb/step impact device

6.5 Equipment PM Tasks Frequencies and Requirements

As a minimum, the maintenance contractor is expected to carry out the following planned maintenance tasks during his monthly, quarterly, semi-annual and annual maintenance visits. These tasks are to be undertaken following the installers O&M manual, standards, regulations, and best industrial practice. The contractor shall advise on any additional or modified maintenance tasks, if it can be demonstrated that it has advantages over current methods and also comply with all relevant elevator regulations and standards followed in KSA.

6.5.1 Daily

These shall be carried out as a PM task controlled via the Computer Maintenance Management System (CMMS), or as a monitoring function only. This will however be dependent on the adopted and FOC SOPs. Daily checks and monitoring are key for any entity to ensure that services and plant are available for the designed function. Ideally a check shall be undertaken at start of the working day and periodically throughout the shift or working cycle. Simple log sheets can be used to record parameters and demonstrate the areas and equipment, that have been visited.

The systems, areas, and equipment that shall be monitored on a daily basis within a facility and as good practice are, but not limited to:

- Escalator LV MDBs
- Emergency lighting (cars and motor rooms)
- Other critical system monitoring control panels.

In addition, the inspection of elevator cars shall be undertaken:

- Cleaning internally
- Removal of dust and detritus within door runners
- Ensuring indicators are functioning
- Call points in operation and undamaged
- Maintenance panels closed and secure
- Emergency call in operation (particularly to site based security)
- Lighting check
- Escalator belts intact and not overheating
- No buildup of material adjacent moving parts
- Labels clear, unobscured and in place.

Entities shall compile a list of checks to be undertaken daily and instruct attending staff how to undertake and record the results. Any defects shall be notified to the maintenance contractor/engineer for rectification.

6.5.2 Weekly

Weekly tasks carried out as a PM task are controlled via the CMMS, or as a monitoring function only. Findings shall, however, be recorded in the maintenance log to assist with the historical data for the facility. This allows for senior management to make fact based decisions upon the strategy for PM and current and future financial decisions.

The systems, areas, and equipment that shall be monitored on a weekly basis, as an addition to the daily tasks within a facility as good practice are:

- Elevator/Escalator emergency plant/controls
- Lighting
- Life safety systems for fire detection and suppression (further information is contained within NMA & FM – Volume 6, Chapter 12)
- Lift motor room checks (e.g., HVAC operation, lighting, security, no storage of materials)
- Operation of dedicated FFL using key switch

- Elevator emergency functions in event of fire (C&E checks)
- Check ride quality of elevator and escalators and report any defects concerns
- Escalator brushes are intact and provide protection against materials such as long clothing, abayas becoming trapped in run by clearances

6.5.3 Monthly

Monthly maintenance tasks are generally classed as “intrusive maintenance’ and may involve partial shutdown of systems. Therefore, they shall be included as part of the maintenance plan in the CMMS, or within a paper or software based system. However, the roles and responsibilities, required competencies, site specific SOPs, C&E and Risk Management, need to be taken into consideration when formulating these PM tasks. In particular, stakeholder engagement shall be part of the process so that the users and persons affected may be consulted or informed prior to the activity.

Mandatory regulatory and/or adopted standards compliances along with any NFPA, SASO references must be taken into consideration. This shall be part of a ‘Criticality Assessment’ undertaken at the inception of the maintenance plan to identify those items of plant that have a significant effect upon operations, or attributable to a compliance/statutory requirement. The OEM service manuals shall be included within the PM task procedures, to ensure equipment is correctly serviced in order to reduce potential outages and give increased reliability and lifecycle.

When formulating the schedule and/or PM task in-line with these considerations, it shall be noted that seasonal variances will need to be incorporated, reference document NMA & FM – Volume 5, Chapter 2: Seasonal Operations Planning provides further guidance.

Consideration shall be given to planning major maintenance scheduling during off peak periods when traffic is reduced. In particular, public holiday periods and non-term times (Schools and universities). Each sector shall review and provide these opportunities in advance to the contractor to allow for logistics to be arranged in readiness.

The maintenance management team shall be aware of and liaise with discipline managers to ensure that multi shutdowns for specific plant and/or equipment are minimized. The co-ordination of PM tasks, engineering staff resource sharing, and work permits will enable the FMC to obtain staff efficiencies and reduce, so far as possible, disruption to the facility departments.

It is also the FMC’s responsibility to track/log, update records, review, and ensure that licensing, certification, staff competencies, training, and PM compliance to standard and/or regulations are continually reviewed, updated, relevant to the latest editions/version, and remain compliant.

Within any maintenance environment, particularly within a facility, where high levels of safety are required for staff, students, patients, and users; the equipment and tools required for maintenance shall also be maintained for their use, and where applicable be tested and meet with calibration or compliance requirements. Personal Protective Equipment (PPE), must be in good condition and any deficiencies or damaged items must be replaced.

It is a good practice to include within the RAMS these checks to ensure that these are recorded, and formal inspection takes place. Additionally, recording results of inspections within the CMMS allows for historical data to be tracked, and consumable or perishable stock to be ordered and delivered in good time, avoiding delays or postponement of activities. These tasks shall be scheduled one to two weeks prior to the validity end date, or further in advance for longer lead items, to enable continuity and efficiency of use.

Scheduling of PM tasks is the owner’s responsibility, following the guidance of the lift consultant or installing contractor, to ensure that all standard/regulatory and/or compliance activities are covered for the facilities vertical transport assets and recorded within the facilities database.

The systems, areas, and equipment that shall be monitored on a monthly basis, and as an addition to the weekly tasks within a facility and as good practice are:

6.5.3.1 Elevators

Elevator Car

- No unusual noises when the elevator or doors are operated
- The “Door Open” button, and the door obstruction systems for reversing the doors operate correctly
- Any glass section or panels in the car or the doors are undamaged and secure
- Handrails and side protection (goods lifts) are secure
- The elevator machine room keys, door release keys and other system keys are secured, and only accessible by authorized personnel
- There are no hazards within the elevator car/cabin, particularly flooring, sharp edges, which could become a slip/trip or laceration hazard
- All safety notices are in position
- The elevator car levels are within specifications, and the correct proximity to the landing floor level
- Hand winding equipment and instruction are in position
- Check the machine room temperature is satisfactory
- Gear Box: All lubricant levels shall be maintained to the recommended level by the elevator manufacturer
- Test the main safety circuit to ensure it is fully operational
- The door operator shall be checked and modified electrically and mechanically to ensure smooth and efficient door operation with all associated equipment, e.g. electronic safety detectors, security edges.
- Checking of the 2-way contact unit (if fitted), car telephone (if fitted), voice alert system (if fitted), and alarm sounder/bell(s)
- The emergency lighting shall be tested and left in operation for 1 hour during every site visit and once every year in operation for a 3-hour duration test
- Test the quality of the ride and observe conditions for starting and stopping, and change as required
- Hydraulic Tank Unit: The valve block, pipe work, hoses, and all associated equipment shall be adjusted as required to maintain elevator performance and check for any oil leaks and corrosion.
- Manual testing of the lowering valve and hand pump shall be checked
- Hydraulic Ram (Jack): The hydraulic ram shall be inspected for any excessive leakages and any scoring/marking of the machined face of the piston.
- Empty ram oil spill containers

Controller

- Check all electrical connections for tightness, all electrical switches shall be cleaned and checked for operation
- Check the ventilation fans functioning, and grills are clean
- All indicator lamps, car main lighting, emergency lighting, and ventilation fans shall be checked for operation and lamps replaced as required. All lighting diffusers and fans shall be cleaned
- Check the fuse devices for correct rating
- Check all parts clean from dust and lint
- Check the relay condition contacts to ensure correct operation
- Ensure the cabinet doors are locked shut after inspection

Landing Fixtures and Equipment

- Check the operation of all fixtures
- Check the operation of fire service switch and any other service switches
- Check the landing door tracks
- Check the doors will close due to gravity or spring forces
- Check the door correct engagement and contact wipe
- Check the door excessive play in bottom shoes
- Check the condition of any coupling devices and air cords
- Check the bolts and fixings are tight

- Check the condition of the panels
- Check the correct settings of up thrust devices
- All landing pushes, fire man's switches, indicator lamps are to be checked and tested for operation and replaced when required
- Check the security of the tracks and the sills

Car Entrance and Operator

- Clean car door track of all debris
- Check the door coupling system protection and adjustment, as necessary
- Check the door shoes for excessive movement
- Check the power and signal cables for signs of damage
- Test that the door locking system is working properly
- Check the clearances between the door panels and returns
- Check the door closing speed and force
- Check the operation of the door open button and other reversal devices

Hydraulic pump unit, piston and cylinders

- Check oil level using the dipstick in the tank
- Check the system for oil leaks by observing the valve block
- Check the condition of the piston for signs of abrasion

Cleaning

- The car top must be kept clean of oil, lint, and rubbish to minimize the risk of fire
- The pit floor and its equipment must be kept clean, dry and free of rubbish, lint and oil
- The machine room, machine, control cabinet and other equipment must be free of lint, dust and oil

6.5.3.2 Escalators

The checklist shall include, but not be limited to, the systems mentioned below (NFPA references are guidance only and not an exhaustive standard list to be applied).

- Oil in Machine: Check the oil levels for the chains, carry out oiling of chains
- Inspect handrails for damage, pinching hazards, proper traction, high operating temperature, and speed
- Adjust or repair as required. For handrail chain, adjust the elongation 2 weeks after initial operation and then once every month
- Upper and lower machine room, clean from dust, lint, debris and oil
- Remove pit covers/landing plates and inspect clean, maintain, and lubricate as necessary, all machine parts including but not limited to:
    - Step chains and rollers
    - Step rollers
    - Top and bottom pit areas
    - Machine brake
    - Automatic chain oilers
- Test emergency stop buttons and startup key switches for proper operation
- Inspect step skirts for wear of skirting and low-friction coatings, step treads, balustrades, decking, landing plates, protrusions or gaps. Adjust or repair as required

6.5.4 Quarterly

Quarterly PM task procedures usually involve extended downtime of plant during maintenance activities. The tasks involved in maintenance of scheduled frequency of monthly and greater will generally take additional time to complete. There may also be a requirement to isolate the equipment from service, which may also require switching operations to take place, involving more than one member of staff.

It is of prime importance that the following is undertaken prior to this activity:

- Stakeholder engagement
- Consumables, spare parts availability
- Competent personnel to undertake the task
- PTW
- Isolation facility and associated Lock Out Tag Out (LOTO) equipment
- Segregation and barriers available to prevent intrusion into the work area

The above list is not exhaustive and local requirements may require further considerations. These shall be included within the Maintenance Instruction guide / Task Instruction sheet.

To understand the additional requirements and how they shall be scheduled in with the Monthly PM tasks or as a separate action, a cross referencing and review exercise shall be undertaken by the FMC team and the approval process undertaken (see Figure 1).

When the quarterly additions have been established, are in-line with compliance, standards and regulation, and approved as per the process, the CMMS managing party need to understand how to input information into the system. This may be the current condition as an assessment for future planning. Or where deficiencies may exist will require a maintenance task to be created for follow up action. Parameters for input logging need to be set and understood, and 'what' associations with other tasks that need to be made, must also be defined.

It is important, during the further development of PM tasks and input into the adopted CMMS system, to establish what output reports the FMC and/or client/entity will require from the information, and how they could be gathered and reported. Guidance shall be sought from the software developer or included manuals, where additional bespoke reports may be required

6.5.4.1 Elevators

Guide Rails, Ropes and Terminal Hitches

- Check the security of all fixings
- Remove the rails fluff and dust
- Lubricate the sliding shoes
- Check the main ropes for signs of splintering or corrosion
- Check and adjust lengths to maintain correct elevator running
- Check the security of all terminations
- Check the rope tensions are equal

Hoist Way Switches

- Check and clean the switches, arms, and rollers for free movement
- Check all terminal switches for their functionality
- Check the running clearance of inductors, vanes, probes, and magnets

Car Frame Equipment

- Clean off lint and dust.
- Ensure security of all fixings
- Check for unnecessary clearance on shoes of the sliding type
- Check the unusual noise, heat, and vibration
- Check and test that the safety gear linkage is working freely
- Test the state of car/cabin steadier equipment and adjust as necessary
- Check the trailing flexes for correct hand and signs of damage
- Check that all sheave grooves are in good condition and there are no signs of swarf on floor, or buildup of material adjacent to moving parts

- The gearbox oil shall be checked for viscosity and condition. If required, replace if degradation is evident. Also check crown wheel for any marks or wear

Counterweight

- Check the security of the weights
- Check the sliding shoes for excessive wear or play
- Check the roller shoe for correct float and lubrication
- Check security of sheaves, frame, comp ropes, chain and guiding devices
- Ensure the free operation of any safety gear linkage
- Test the safety gear equipment to ensure proper engagement

Pit Equipment

- Check the free movement of the governor tension devices
- Check the security of buffer
- Check the correct hangs of the compensating chains
- Empty trip trays and ensure all equipment is clean
- Check there are no signs of swarf on floor, or buildup of material adjacent to moving parts

Traction Machine and Brake

- Check for any unusual noise, heat, vibration
- Check all bolts and fixings are secure and have intact split pins fitted where designed
- Check security of the traction sheave
- Check the sheave for wear and damage
- Check the operation for signs and rope slippage
- Check all electrical connections are undamaged and are secure, tighten where necessary
- Inspect brake for free operation and minimum lift
- Check the machine brake release
- The brake drum and coil casting shall be thoroughly cleaned, adjusted, and checked for minimum lift
- The brake linings shall be checked for wear and free from oil and grease, if worn or contaminated, linings shall be replaced immediately
- The brake rivets shall be checked for security. Make all necessary adjustment
- Correct floor levels must be maintained at all times within the equipment design
- Check brake for correct mechanical action and lubricate pivots as necessary to manufacturer's recommendations

Over speed Governor

- The over speed governor shall be cleaned, and seals checked for integrity
- The pulley and bearings shall be checked for wear and correct lubrication
- The Centrifugal switch and mechanism shall be checked and ensured operational as designed

Test Drive

- Check the operation, noise, ride comfort, and stopping accuracy

6.5.4.2 Escalators

Check all protection fittings including, but not limited to:

- Skirt switches
- Comb-plate switches
- Handrail inlet devices

- Missing step devices
- Carriage tension devices
- Inspect and maintain handrail speed and handrail chain tension
- Inspect, clean and maintain handrail newels and rollers
- Test, repair and modify the mechanism of the handrail drive e.g., drive sheaves, drive newels, drive belts, drive chains
- Inspect and maintain proper side-of-step skirt clearance
- Inspect and maintain comb-plates
- Apply friction reducing agent to skirt panels where required
- Check and maintain treads and risers on stairs
- Remove at least one step and inspect the interior truss space in detail, including step tracks and all other machinery, clean, and maintain as needed
- Inspect demarcation lights
- Check for required caution signs
- Check the actuating mechanism for broken chain detection and maintain chain tension
- Test step obstruction device
- Inspect governor speed, carry out governor speed test and check centrifugal switch and mechanism
- Inspect machinery space stop switch
- Inspect anti-reversal mechanism
- Test brakes
- Check and ensure clearances are maintained between adjacent steps
- Clean inside face of handrail. Wax handrail guide if required. Replace handrail as required

6.5.5 Bi-Annual

Biannual PM Task procedures may be standalone tasks or may include the quarterly PM task procedures formulated with additional requirements. It must be noted that six monthly (biannual) PM task procedures will often require manufacturer recommended or standard mandated equipment and/or consumable part replacements.

For escalators it is generally a requirement to undertake an inspection of the steps for condition, wear, and signs of any cracking. This will be undertaken by the third party inspection and recorded in the final report. It is therefore advisable that spare steps be available so that downtime is reduced, and any defects identified can be rectified quickly, at the time of inspection.

Where scheduled maintenance will have a significant impact upon the operation of the facility, the scheduled periods may need to be scheduled in advance or deferred to meet with term requirements of the facility. These changes must be agreed with any third party support where delaying maintenance could have financial implications upon warranty or contractual comprehensive agreements, or impact patient welfare or safety. Senior management of the facility must have the approval of the Ministry to make these decisions at a local level.

Reporting for biannual activities shall follow the same process for recording and reporting functions, as the above recommendations for monthly maintenance activity.

Car and Landing Entrances

- All top tracks including rollers and pivots shall be lubricated to manufacturer’s specification.

Elevator Shaft, Counterweight, and Pit

- The electrical interlock switch shall be checked, the compensating weights for its lock-off operation, and the cleaning of the internal contact parts.

6.5.6 Annual

These procedures may be standalone tasks or be inclusive of the biannual procedures formulated with additional requirements. Some of these tasks may need high level FOC management approval well in advance (depending on the C&E on the building operations), to enable availability of adequate resources.

The same considerations shall be undertaken for annual activities, described above, for biannual as this may require the manufacturer or his agent to complete the activity. The maintenance team shall record all activities and retain copies of service documentation on site for future reference or compliance. Where possible, the service record shall be recorded within the CMMS as a signed copy by both the service technician (OEM/agent) and approved technician or operation engineer at site, upon handover.

There may also be a requirement for Post Maintenance Testing (PMT) to take place, and be demonstrated to site staff, on completion. The procedure for recording and witnessing those activities can be found in the associated document within NMA & FM – Volume 6 Chapter 27.

6.5.6.1 Elevators

Controller

- All overloads and safety equipment, both inside and outside the control panel, shall be checked and changed as required; with an inspection periodicity e.g., annually
- All circuit breakers shall be operated and recalibrated (and replaced if necessary) as required and must be compliant with manufacturers design requirements.
- All trip times shall be confirmed to the client in writing and elevator logbooks to be updated accordingly
- The machine must be fitted with a label showing test date and all trip times
- Phase failure devices must also to be tested each year, and replaced where necessary (generally these are ‘fail safe’ devices)

Car Overload Devices

- All car overload system switches are to be tested annually using load weights
- Recalibration of the load settings (if required) to the manufacturer's specification shall also be performed
- Before delivery to site, the storage of the test weights shall be negotiated with the customer during the test period

Elevator Shaft, Counterweight, and Pit

- All limit switches shall be internally inspected, contacts checked and cleaned, and pivots lubricated
- The counterweight shall be tested for integrity, and the wear shall be checked on the shoes and suspension pulleys (where fitted)
- Roller shoes and lubricated bearings shall be tested for adjustment. To test the bottom clearance and shorten the ropes where necessary

Hydraulic Ram (Jack)

- The wear and condition of the bearings shall be checked on the ram head. All bolts shall be tested, and positions marked for protection. Any marks of failure shall be inspected (i.e. visual, dye pen or x-ray)
- Inspect condition of main seals

6.5.6.2 Escalator

- Emergency stop button: Check operating condition of stop button
- Oil in Machine: Check the oil levels (use a gauge)
- Chains: Carryout oiling on chain
- Handrail Chain: Adjust the elongation 2 weeks after initial operation and then once every month
- Upper and Lower Machine Room: Remove dust, lint and debris to prevent fire
- Governor: Check the operating condition of switch lever. Check the gap between the magnetic detector and the blade
- Check the gap between micro switch and the lever
- Driving Machine: Replace oil 3 months after initial operation and then once a year
- Upper Terminal Gear Bearings: Grease after 3 months from initial operation and then once a year
- Remove dirt and debris deposits from step band
- Check the track for loose fastenings, and tighten where necessary
- Check operation of controller. Clean and adjust as required
- Check step coast when braking empty unit
- Lubricate step flanges
- Clean thoroughly the internal truss and pit areas, including stairs, tracks, trusses, and inner sides of the machine, of all dust, lint, dirt and debris
- Over the entire length of the escalator, the oil pans shall be inspected and cleaned where necessary
- Grease handrail sheave bearings at reversing lower and upper stations
- Grease step chain sprockets. Change oil in gearbox. Lubricate motor bearings
- Inspect, track, repair or replace broken step frames according to industry and manufacturer requirements
- Number all steps, and maintain a clear record of all steps as and when checked, restored, or replaced, and update logbook accordingly

6.5.7 Biennial

These procedures shall normally include the annual procedures and replace the annual PM task; however, they may also be a separate standalone PM task. This is due to the biennial tasks being in general more internally intrusive to the equipment, and may require extended shutdown and parts replacement. The FOC and FMC must access the C&E on the building operations, staff, and pupils, and schedule appropriately. An example of a biennial task is of transformer maintenance requiring a full shutdown and isolation at MV and LV level. This may require standby systems to be brought into service for extended periods to allow maintenance activities to be performed. It is therefore of paramount importance that these systems be maintained prior to the biennial activity in order to allow maintenance to proceed without interruption.

High level FOC management and faculty department approval well in advance (depending on the C&E on the facility operations), shall be gained to ensure adequate resources will be available, and that the departmental stakeholder engagement process has been followed.

6.5.8 Quinquennial

It is recommended through the references highlighted above that a thorough examination be undertaken at periods either set by the Entity, or at least one every five (5) years to ensure that the equipment meets with the safety requirements and any defects that require attention are addressed. This inspection is more intrusive in nature and will require equipment to remain out of service for the inspection. Entity management shall plan in advance for these tests and include within their budgets.

The documents provided are not an exhaustive set of plans, but only serve as an example. Much analysis of the facilities adopted standards and asset PM requirement will need to be compiled to deliver a final maintenance plan. However, the attached will guide the FMC on how to gather and record data, enabling them to deliver a maintenance plan schedule and a compliant, comprehensive set of lifecycles, PM tasks etc. documents.

7.0 ATTACHMENTS

1. EOM-ZM0-PL-000197 Maintenance Checklist for Elevators
2. EOM-ZM0-PL-000198 Maintenance Checklist for Escalators and Moving Walkways
3. EOM-ZM0-PL-000199 Elevators Safety Checklist
4. EOM-ZM0-PL-000200 Elevators Maintenance Tasks Checklist

Attachment 1 – EOM-ZM0-PL-000197 Maintenance Checklist for Elevators

Building NAME:	Reference No.	REV-00A

No.	Maintenance Checklist Electric Elevators		CHECKED SATISFACTORY		
			N/A	YES	NO
	Elevators				
1	**General**	Check all components are clean and are free from contamination/corrosion	☐	☐	☐
2	Pit Areas	Check for excess oil/grease upon guides or base Ensure pit area is clear, of dirt, debris, oil and drains are clear Pit lighting operational	☐	☐	☐
3	Buffers	Check condition	☐	☐	☐
		Check oil level	☐	☐	☐
		Ensure lubrication in operation	☐	☐	☐
		Check operation of proximity/limit switch	☐	☐	☐
		Check security of fixings	☐	☐	☐
4	Brake	Check operation of braking system	☐	☐	☐
		Check for undue wear or defect	☐	☐	☐
		Ensure operating correctly	☐	☐	☐
5	Drive motor	Check bearings for signs of wear (vibration/noise)	☐	☐	☐
		Ensure lubrication in place	☐	☐	☐
		Check condition of commutator or excessive brush debris	☐	☐	☐
6	Gearbox	Check for excessive vibration/noise	☐	☐	☐
		Ensure lubrication in place	☐	☐	☐
7	Sheave	Check condition of sheave and ropes alignment. Uneven wear may indicate incorrect rope tension	☐	☐	☐
8	Overspeed Governor/Pulley	operational and fee to move	☐	☐	☐
		Check operation of limit switch and mechanism	☐	☐	☐
		Check operation of overspeed / tension pulley	☐	☐	☐
9	Controller	Check security of cabinet cooling fans unobstructed	☐	☐	☐
10	Diverter Pulley	Check grooves for excessive wear	☐	☐	☐
		Check bearings for signs of wear (vibration/noise)	☐	☐	☐
		Ensure all guards in place	☐	☐	☐
		Ensure lubrication in place	☐	☐	☐
11	Counterweight/Guides/Shoes	Ensure lubrication of guides	☐	☐	☐
		Check run by clearances	☐	☐	☐
		Check guides/rollers and shoes for excessive wear	☐	☐	☐
		Check security of all fixings	☐	☐	☐
12	Electrical	Check electrical wiring and connections secure and attached	☐	☐	☐

		Carry out thermographic survey to check for overheating terminals/cables	☐	☐	☐
13	Elevator Car	Check emergency lighting operational	☐	☐	☐
		Check auto dialer function	☐	☐	☐
		Check all panels are secure	☐	☐	☐
		Check maintenance panel is locked	☐	☐	☐
14	Safety Equipment Overspeed Protection Devices	Check all parts free to operate and not obstructed	☐	☐	☐
		Ensure lubrication in place	☐	☐	☐
		Check security of all fixings	☐	☐	☐
		Check operation of limit switch and mechanism	☐	☐	☐
15	Suspension Ropes	Check for signs of damage, fraying of cores	☐	☐	☐
		Check for elongation	☐	☐	☐
		Check tension	☐	☐	☐
		Check for lubrication (if applicable to installation)	☐	☐	☐
16	Suspension Rope Fixing and Anchorages	Check for signs of wear or damage	☐	☐	☐
		Check security of all fixings	☐	☐	☐
17	Landing Apertures	Check operation of landing locks	☐	☐	☐
		Check door operation (juddering, sticking, alignment)	☐	☐	☐
		Check door guides free from debris, lint and detritus	☐	☐	☐
		Check door gaps	☐	☐	☐
		Check emergency unlocking devices	☐	☐	☐
		Check lubrication of moving items	☐	☐	☐
		Remove build up of grease, dirt and lint on rollers	☐	☐	☐
18	Car Door	Check contacts for close	☐	☐	☐
		Check door running	☐	☐	☐
		Check door guides free from debris detritus	☐	☐	☐
		Check door gaps	☐	☐	☐
		Check lubrication of moving items	☐	☐	☐
		Check passenger door protection device	☐	☐	☐
19	Floor Levelling	Ensure car levels to within prescribed limits	☐	☐	☐
20	Level Limit Switch	Check Operation	☐	☐	☐
21	Motor Time Limiter Device	Check Operation	☐	☐	☐
22	Safety Devices	Check Operation	☐	☐	☐
		Check correct rating of fuse protection	☐	☐	☐
23	Landing Indicators and Calls	Check operation of landing lights	☐	☐	☐
		Check audible signal operation	☐	☐	☐
		Check buttons operational and illuminated	☐	☐	☐
24	Shaft Lighting	Check shaft lighting operational	☐	☐	☐

No.	Reviewer's Comments		Resolution

Attachment 2 – EOM-ZM0-PL-000198 Maintenance Checklist for Escalators and Moving Walkways

Building Name:	Reference No.	REV-00A

No.	Maintenance Checklist		CHECKED SATISFACTORY		
			N/A	YES	NO
	Escalators and Moving Walkways				
1	General	Check all components are clean and are free from contamination/corrosion	☐	☐	☐
2	Controller	Check security of cabinet cooling fans unobstructed	☐	☐	☐
3	Gearbox	Check for excessive vibration/noise	☐	☐	☐
		Check oil level	☐	☐	☐
		Ensure lubrication in operation	☐	☐	☐
4	Drive Motor	Check bearings for signs of wear (vibration/noise)	☐	☐	☐
		Ensure lubrication in place	☐	☐	☐
5	Brake	Check operation of braking system	☐	☐	☐
		Check for undue wear or defects	☐	☐	☐
		Ensure operating correctly	☐	☐	☐
6	Auxiliary Brake device	Check braking system operation	☐	☐	☐
		Check for excessive wear	☐	☐	☐
7	Intermediate Gear Box	Check for undue wear or defects	☐	☐	☐
		Check for excessive vibration/noise	☐	☐	☐
8	Main Drive Chain	Check for excessive wear	☐	☐	☐
		Ensure lubrication in operation	☐	☐	☐
9	Step / Pallet Chain	Check tension	☐	☐	☐
		Check for excessive wear	☐	☐	☐
		Ensure lubrication in operation	☐	☐	☐
10	Conveyor / Belt	Check for excessive wear	☐	☐	☐
		Check tension	☐	☐	☐
11	Drive Belt	Check for excessive wear	☐	☐	☐
		Check tension	☐	☐	☐
12	Clearances	Check skirting and step side clearances	☐	☐	☐
13	Comb Plates	Check Operation and clearances	☐	☐	☐
		Check for broken comb elements	☐	☐	☐
14	Handrails	Check operation and free from noise/vibration	☐	☐	☐
15	Track System	Check for excessive wear	☐	☐	☐
16	Safety Devices	Check Functional	☐	☐	☐

17	Deflector Devices	Check Functional	☐	☐	☐
18	Lighting	Check Functional	☐	☐	☐
19	Display	Check Functional	☐	☐	☐
20	Signs/Pictograms	Check Functional	☐	☐	☐
21	Balustrade	Check Functional	☐	☐	☐
		Check Functional	☐	☐	☐
		Check condition of panels/glazing unbroken	☐	☐	☐
		Check security of all fixings	☐	☐	☐
22	Protection Barriers	Check in place and secure to prevent trolleys/pushchairs etc. from entry (where fitted)	☐	☐	☐

No.	Reviewer's Comments		Resolution
Originator's Name/Signature and Date:			Checker's Name/Signature and Date:

Attachment 3 – EOM-ZM0-PL-000199 Elevators Safety Checklist

74 Point Elevators Safety Checklist

No	Hazard	EN81-80 Clause	No	Hazard	EN81-80 Clause
1	Presence of harmful materials	5.1.4	40	Car without doors	5.8.3
2	No or limited accessibility for disabled persons	5.2.1	41	Unsafe locking of car roof trap door	5.8.4
3	Drive system with poor stopping/levelling accuracy	5.2.2	42	Insufficient strength of car roof	5.8.5
4	No or inadequate vandal resistance	5.3	43	No or inadequate balustrade on car roof (voids)	5.8.6
5	No or inadequate control functions in case of fire	5.4	44	Insufficient ventilation in car	5.8.7
6	Well enclosures with perforate walls	5.5.1.1	45	Inadequate lighting in car	5.8.8.1
7	Partially enclosed well with too low an enclosure	5.5.1.2	46	No or inadequate emergency lighting in car	5.8.8.2
8	Inadequate locking devices on access doors to well and pit	5.5.2	47	No or inadequate protection means on sheaves, pulleys and sprockets against injury	5.9.1
9	Inadequate vertical surface below landing door sills	5.5.3	48	No or inadequate protection against rope/chains leaving the sheaves, pulleys or sprockets	5.9.1
10	Counterweight/balancing weight without safety gear in case of accessible spaces below well	5.5.4	49	No or inadequate protection on sheaves, pulleys or sprockets against introduction of objects	5.9.1
11	No or inadequate partition of counterweight/balancing weight travel path at the lowest terminal	5.5.5	50	No or inadequate safety gear and/or overspeed governor on electric elevators	5.9.2
12	No or inadequate pit screen for several elevators in the same well	5.5.6.1	51	No or inadequate slack rope switch for governor rope	5.9.3
13	No or inadequate partition for several elevators in the same well	5.5.6.2	52	No protection means against ascending car overspeed	5.9.4
14	Insufficient safety spaces in headroom and pit	5.5.7	53	Inadequate lift machine design for preventing uncontrolled up or down movement of the car whilst the doors are open	5.9.4 5.12.1
15	Unsafe pit access	5.5.8	54	No or inadequate protection against free fall, Overspeed and creeping on hydraulic elevators	5.9.5
16	No or inadequate isolation devices in the pit or in the pulley room	5.5.9	55	Unsuitable guidance system for counterweight or balancing weight	5.10.1
17	No or inadequate lighting of the well	5.5.10	56	No or inadequate buffers	5.10.2
18	No alarm system in pit and on car roof	5.5.11	57	No or inadequate final limit switches	5.10.3
19	No or unsafe means of access to machine and pulley room	5.6.1	58	Large gap between car and wall facing the car entrance	5.11.1
20	Slippery floor in machine or pulley room	5.6.2	59	Excessive distance between car door and landing door	5.11.2

No	Hazard	EN81-80 Clause	No	Hazard	EN81-80 Clause
21	Insufficient clearances in machine room	5.6.3	60	No or inadequate emergency operation instruction manual for rescue of entrapped passengers	5.12.2
22	No or inadequate protection on different levels in machine room	5.6.4	61	No hydraulic shut-off valve	5.12.3
23	Inadequate lighting in machine or pulley room	5.6.5	62	No independent starting/stopping machine contactors	5.12.4
24	Inadequate means of handling equipment	5.6.6	63	No or inadequate slack rope/chain device	5.12.5
25	Perforate landing doors and car doors	5.7.1	64	No run-time limiter	5.12.6
26	Inadequate design of landing door fixings	5.7.2	65	No or inadequate low-pressure device	5.12.7
27	Inappropriate glass in doors	5.7.3	66	Insufficient protection against electric shock and/or marking of electrical equipment	5.13.1
28	No or inadequate protection against dragging of fingers on sliding car or landing doors with glass	5.7.4	67	No or inadequate protection of lift machine electrical overload/temperature	5.13.2
29	No or inadequate lighting on landing	5.7.5	68	No lockable main switch	5.13.3
30	No or inadequate protective devices on power operated doors	5.7.6	69	No protection against phase reversal	5.14.1
31	Unsafe locking device of landing door	5.7.7	70	No or inadequate inspection control station and stopping device on car roof	5.14.2
32	Unlocking of landing door without a special tool	5.7.8.1	71	No or inadequate alarm device	5.14.3
33	Well enclosure with perforate walls near door locks	5.7.8.2	72	No or inadequate communication system between machine room and car (travel height ≥ 30m)	5.14.4
34	No automatic closing device on sliding doors	5.7.9	73	No or inadequate load or overload control on car	5.14.5
35	Inadequate link between panels of landing doors	5.7.10	74	Missing notices, markings and operating instructions	5.15
36	Inadequate fire resistance of landing doors	5.7.11			
37	Car door moving with open landing door	5.7.12			
38	Large car area in relation to rated load	5.8.1			
39	Inadequate length of car apron	5.8.2			

Attachment 4 – EOM-ZM0-PL-000200 Elevators Maintenance Tasks Checklists

The following are basic checks which shall be made as part of a schedule for maintenance visits. Not all checks would be needed on every visit and frequency of checks shall be assessed depending on the equipment, its condition, usage, and other aspects. Other checks might be relevant on different types of elevators whereas some of these listed might not be applicable. The schedule of checks shall include all the manufacturer's checks and might be modified according to the equipment, from the first inspection/survey and from later experience with the equipment.

Pit

Step	Maintenance task	Method and Standard
1	Check the pit condition from the bottom floor landing	1 Call elevator to bottom landing 2 Check that the elevator car is empty 3 Make a car call upwards 4 Wait until car is out from landing level but not in next landing 5 Stop elevator by using emergency key 6 Open the landing door slightly, max 100mm 7 Check the pit condition: • No water • No additional fire load in the pit • If needed, remove dirt with brush and dustpan or applicable mean. If local environment requires, use vacuum cleaner. This would require additional safety measures to ensure maintenance staff safety is maintained at all times • No food or medical waste

Car

Step	Maintenance task	Method and Standard
2	Check the car lighting	Check visually the car lighting. Clean the lighting fixtures, if dirty If broken bulbs/fluorescent tubes/halogens replace all at the same time
3	Check the car interior	Check visually that mirror is intact and there are no sharp objects inside the elevator car. Manually check that handrails and car panels are fixed properly
4	Check signs in the car (elevator identification, load plate information etc.)	The signs must be at the correct positions, sign texts correct and readable
5	Check operation of remote/local alarm system and telephone/ intercom connection (if applicable)	Press the voice connection button in the car, wait for the connection. Perform test and verify operations of the voice connection
6	Check operation of the stop button in the car (if applicable)	Press first a car call button then press stop button. Verify that the car call is cancelled when the stop button is pressed
7	Test function of the safety sill and contact and door lintel contact (swing door)	Press a car call button and check that the call is cancelled, or the elevator does not move when the safety sill or safety device of the door lintel operates

Step	Maintenance task	Method and Standard
8	Check condition of car fan (if applicable)	No abnormal noises

Car Door/Swing Door

Step	Maintenance task	Method and Standard
9	Check fixing of the door closer (dictator) and door contact bridge (swing door)	Check that the door closer and the door contact bridge are properly fixed, and the door closes properly
10	Test door open button in the car operation panel (COP)	In the normal mode give a car call. When the door starts to close push the door open button. The door should open and close after the open time has elapsed
11	Check the closing force limiter	Block the door manually when it is closing. The closing force limiter should reopen the door (Fmax = 150 N, check if local regulation is lower)
12	Test function of curtain of light, photocell or safety edge	Activation of the curtain of light, photocell or safety edge should re-open the door (test from two different heights)
13	Check the sill groove of the car	Remove obstacles from the sill groove, if any
14	Check condition of car door panels and guide shoes	Shake car door panels and identify loose fixings. Ensure that the panels are not scratching each other or the frames and have no sharp or damaged edges. Worn out bottom guide shoes must be replaced

General Operation on Each Floor

Step	Maintenance task	Method and Standard
15	Swing doors: Check that landing door does not open when elevator is running	Verify that the landing door does not open, or contact does not stop elevator when going upwards to the next floor by pushing /pulling the landing door
16	Check the displays and buttons on the landing	Manually check that landing buttons operate correctly, and signalization panel fixings are secure Visually verify the function of the landing displays
17	Check the stopping accuracy. Check advanced door opening (if applicable)	Check the stopping accuracy on each floor to both directions. Tolerances depend on the drive and local requests and building
18	Check landing door sill and clearance between car/car door sill and landing door sill (if applicable)	Remove obstacles from the sill groove, if any. Clearance of the sills should be equal (approximately 30 mm with automatic doors)
19	Check the landing door frontage	Check that the landing frontage is properly fixed and tidy. No sharp edges or dents should exist. In case of swing doors check the door handle and glass window for proper fixing and condition

Step	Maintenance task	Method and Standard
20	Check condition of landing door panels and locks and bottom guide shoes	Check condition of the door panels and locks and clearances between the door panels and frames. Ensure that the panels are not scratching each other or the frames. Follow local regulations on the allowed clearance. Worm out bottom guide shoes must be replaced
21	Check function of the door contact and lock (swing door).	When the door is open, give a car call. The elevator must not move
22	Lubricate hinges if needed (swing door)	Open the door fully against the limiter/buffer and check function of the hinges
23	Perform a test drive to check ride comfort. Drive the car in up direction and try to swing the car	Check the ride comfort by driving the car whole travel from the topmost to bottom floor and in reverse direction. There should be no knocks, scrapes or any other noises especially from bearings. Swing the car while travelling up direction to identify worn guide shoes and rollers

Control Panel

Step	Maintenance task	Method and Standard
24	Check the fault codes	Write down possible repetitive faults into the service logbook. Reset the fault memory
25	Check condition of control panel and drive module interior	Clean if dirty. Clean the floor level and easily accessible platforms without removing parts. If required, generate separate cleaning service order