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Operation and Maintenance (O&M) Risk Management Procedure

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1.0 PURPOSE

The purpose of risk management in the Assets and Facilities Management (A&FM) field is to decrease the likelihood and minimize the potential impact of events or uncertainties (threats) that could adversely impact upon the successful achievement of Assets and Facilities Management (A&FM) objectives. This procedure applies to all A&FM activities and details underpinning principles, identifies key roles and responsibilities, and describes the overall process for application of A&FM risk management to a facility or to assets.

Good A&FM risk management is fundamental to ensure that assets are maintained to be in good working order and condition, and that the work environment is safe.

> ***The benefit of having a defined A&FM risk management process is to give asset owners, asset operators, facilities managers and other appropriate stakeholders, assurance that risks are being appropriately managed.***

The A&FM risk management process described herein establishes common requirements for **National Manual for Assets and Facilities Management Specific Risk Management Plans** that reflect best practices and ensures seamless integration with other A&FM procedures. **National Manual for Assets and Facilities Management Risk Management Plan Template (EOM-EM0-TP-000001)** has been developed for this purpose. Risk management plans provide the benefits of:

- Assigning clear responsibilities and hierarchical structure with regards to A&FM risk management within the A&FM team
- Establishing common risk language, which enhances team communication, and commonality of approach
- Ensuring that the A&FM risk profile is developed in a consistent and clear format to support common understanding of the key risks
- Providing risk-based information to the Facility Manager in a form that supports development of prioritized risk treatment plans, informs the development of realistic A&FM targets, and ensures that any risk contingencies are informed rather than based on 'rules of thumb'
- Ensuring that a more holistic view of risk is taken, that extends beyond cost and time risks to include safety; quality; environment; community; reputation; and security
- Helping to reduce the likelihood of poor A&FM performance.

The concepts defined in this procedure are consistent with ISO 31000: 2018 Risk Management - Guidelines.

This procedure has been designed to be flexible and to allow for alignment with any pre-existing risk frameworks and risk programs - where appropriate. This flexibility in design and execution allows for the unique context, circumstances, structures, and other Entity needs to be included, as appropriate, in each project's risk management plan.

(Note: In this procedure ***'threats'*** are considered as the key dimension of interest for risk management. More information on this is provided in the **National Manual for Assets and Facilities Management Volume 12 - Risk Management Introduction Guideline (EOM-EM0-GL-000001).**

2.0 SCOPE

This procedure applies to the life cycle of all **Facilities / Assets** that are defined and managed by an Entity and should be implemented and executed as described in the **National Manual for Assets and Facilities Management Volume 12 - Risk Management Introduction Guideline**

This procedure applies to the A&FM phases of an asset life cycle.

Additionally, in recognition that each facility is unique, and that there are a multitude of contract types that exist, and that any facility adopting this procedure will have specific contextual challenges, this procedure is designed to be inherently flexible and can be tailored to allow for these variances.

3.0 DEFINITIONS

A full glossary of risk management terms and definitions is provided in **Attachment 1**.

4.0 REFERENCES

The following documents are referred to in this procedure.

- EOM-EM0-TP-000001 – Operation and Maintenance (O&M) Risk Management Plan Template
- EOM-EM0-TP-000002 – Operation and Maintenance (O&M) Risk Register Template
- EOM-EM0-GL-000001 – Operation and Maintenance (O&M) Risk Management Introduction Guideline

The following documents are useful references. The procedure developed here has been informed by them and the reader is referred to them for additional background reading.

- Project Management Institute (PMI) Practice Standard for Project Risk Management, 2009
- Association for Project Management (APM) Project Risk Analysis and Management (PRAM) Guide, 2004
- IEC/ISO 31010:2009 Risk Management - Risk Assessment Techniques
- ISO 31000:2018 Risk Management - Guidelines
- ISO Guide 73:2009 Risk Management – Vocabulary
- ISO 41000 Series of standards on Facility Management
- EN 25221 Series of standards on Facility Management.

5.0 RESPONSIBILITIES

For the application of A&FM risk management to be effective on a facility/asset, adequate resources must be allocated, individual roles identified, and their responsibilities clearly defined and will identify the chain of authority and how risk decision processes can be escalated. The A&FM risk management plan will define all the key roles and responsibilities and, where appropriate, will name the individuals who will hold the key posts. **National Manual for Assets and Facilities Management Risk Management Plan Template (EOM-EM0-TP-000001)** has been developed and can be used to inform development of the A&FM risk management plan and ensure alignment with the requirements of this procedure.

For any facility/asset, it will be important that the Entity is involved in the A&FM risk management process. The extent of this involvement will be detailed in the A&FM risk management plan.

5.1 Facility Manager

The Facility Manager has overall responsibility for the successful implementation and execution of the A&FM risk management program of activities on in a facility / asset. As part of this duty, the Facilities Manager can delegate individuals to oversee and manage aspects of the A&FM risk management process and a Risk Manager should be appointed to this role. If required, risk management steering groups or committees to oversee or provide governance for the risk management process can be formed. The risk management plan will define these groups and the constituent members of each group. Whatever delegation or governance arrangements are implemented; the Facilities Manager will always retain overall responsibility for the risk management program.

Specifically, the Facilities Manager is responsible for:

- Providing high-level direction for the facility/assets risk management activities, while considering external and internal stakeholder interface requirements, and ensuring adequate resources are assigned and available for the execution of the A&FM risk management program and supporting activities
- Approving and implementing the risk management plan and the A&FM risk management program based on the defined A&FM objectives, while ensuring that customer requirements are considered and factored in
- Communicating with the customer in relation to the coordination and execution of the A&FM risk management program
- Providing clear instructions, to include roles and responsibilities, to the A&FM team on the management of the A&FM risk management program; typically detailed in the A&FM risk management plan
- Specifying the governance arrangements that will be employed for the facility/assets in the risk management plan
- Reviewing and approving risks on the risk register, to include Risk Owner, treatment activities, treatment plans, and the priority in which they are executed
- To be the approval authority for any risk management interventions (risk treatments) and their implementation
- Reviewing the effectiveness of risk treatments and the A&FM risk management program on a regular basis
- Approval of transfer of risks that have become Trends to the project control's function
- Escalating risks to the Entity that are beyond the A&FM scope and/or ability to manage.

5.2 Risk Manager

Every major facility / asset has unique challenges. Consequently, the A&FM risk management requirements for different facilities / assets can be different and the Risk Manager's responsibilities can vary accordingly. A&FM risk management personnel may be assigned full-time with no other duties or responsibilities, part-time; perhaps acting as the Risk Manager for several facilities / assets or have a dual role in another function in addition to the Risk Manager role on the same facility. For major facilities / assets, there may be a need for a full-time team of assigned A&FM risk management personnel. The makeup and design of the A&FM risk management program and supporting personnel will be detailed in the A&FM risk management plan and according to direction from the Facility Manager. Regardless of who or how many personnel are involved in executing the A&FM risk management program, the Risk Manager will have the following minimum responsibilities:

- Manage the A&FM risk management process and all supporting activities, in accordance with the requirements described in the risk management plan, and under direction from the Facility Manager
- Support the Facility Manager in the development and execution of the A&FM risk management plan – which will include advice on an appropriate risk assessment methodology and the associated A&FM risk tolerance criteria that should be employed
- Ensure active engagement and participation by the A&FM team in the risk management process
- Engage and work with facility functions; A&FM team members; customer representatives; contractors; sub-contractors; suppliers; and other stakeholders, in a collaborative execution of the A&FM risk management process
- Plan and facilitate A&FM risk identification and review workshops and conduct follow-up discussions with appropriate personnel as necessary
- Manage, and act as custodian of, the A&FM risk register; ensuring the quality, timeliness, and completeness of the information captured in the A&FM risk register
- Support Risk Owners and Risk Treatment Owners through on-going engagement, communication and facilitation activities to ensure that all risk-based information held in the A&FM risk register

around: risk identification, risk description, risk treatment options, risk response plans, and the status of any risk management interventions, is maintained, kept up-to-date and communicated to all relevant stakeholders in a timely manner

- Prepare and issue reports concerning A&FM risk management health, the A&FM risk profile, and the status of any A&FM management interventions in accordance with the periodic A&FM risk reporting requirements described in the risk management plan, as well as on an ad-hoc basis.
- Develop and provide risk management trainings to the O&M team members to enhance and improve the overall risk management awareness and culture.

5.3 Operations and Maintenance Team Members

The A&FM team comprises everyone on associated with the facility / asset, including consultants, joint venture partners, sub-contractors, facilities management service providers, and the customer. A&FM team members are integral to the success of the A&FM risk management program and will specifically:

- Follow the A&FM risk management plan and associated risk management procedure by carrying out the risk management roles and responsibilities assigned to them and to review, actively manage, and take actions against those assigned risk activities
- Monitor their work areas and the facility / asset in general for information or indications which could serve to identify new risks or changes to existing risks, to include treatment activities
- Participate in the A&FM risk management process on an ongoing basis by communicating any new risk information; participation may also include attending risk workshops, owning risks and / or risk treatment activities, reviewing and providing information concerning risk status, and / or supporting risk reporting.

5.4 Risk Owner

Risk owners are fully responsible and have the authority for the management of any risks assigned to them as approved by the FM. This includes clarifying and defining risks, developing treatment activities and their associated treatment plans, ensuring the information contained in the A&FM risk register, is accurate, timely, and complete, and keeping the Risk Manager appraised of the status to enable risk register updates. Additionally, Risk Owners will:

- Participate in risk identification and review workshops
- Participate in A&FM risk reviews and other A&FM risk status / health meetings to provide status updates of their assigned risks to project leadership and other stakeholders
- Manage assigned risks and their treatment plans; be responsible for the timely implementation of risk treatment plans, reporting of risk status, progress, and effectiveness of treatment activities undertaken
- Assign treatment activities and requirements to applicable risk treatment activity owners within risk owner authority and arrange for mutual agreement when risk treatment activity owners are within different departments.
- Update the Risk Manager of the risk management status to meet A&FM reporting requirements when requested.
- Monitor and review A&FM activities and hold discussions with risk treatment activity owners and other relevant personnel on the status of assigned risks.

5.5 Risk Treatment Activity Owner

Risk treatment activity owners (assigned by the Facilities Manager / Risk Manager) are responsible for the management and reporting of the treatment activities assigned to them by the Risk Owner (typically the Entity). The risk treatment activity owner will:

- Have authority to take action on the risk treatment activity
- Execute the treatment activities in a timely manner in accordance with dates stated in the risk treatment plan
- Monitor the progress and effectiveness of the treatment activities in relation to the projected / desired results
- Report to the Risk Owner on the treatment activity status so the risk register can be updated in accordance with the A&FM reporting requirements.

6.0 PROCESS

The risk management process should be an integral part of day-to-day A&FM management. It should be embedded in the culture, the people and practiced throughout all A&FM activities.

In line with the principles and guidance provided in **ISO 31000: 2018 Risk Management - Guidelines**, a five-step A&FM risk management process will be adopted.

To initiate this process effectively, it is vitally important that the context surrounding A&FM initiation, delivery and execution is established, understood, and communicated.

6.1 Establishing the Operations and Maintenance Risk Management Context

Establishing a A&FM risk management context involves gathering the relevant facts, defining the scope and objectives of the risk process, and establishing risk tolerance criteria. This can be informed by consideration and clarification of the following aspects:

- External influences and concerns
- Internal influences and concerns
- A&FM objectives
- The expected A&FM risk profile.

External Influences and Concerns

The external context, or external environment, will have an influence over how a facility seeks to achieve its objectives. External impacts on the facility can include regulatory; financial; economic; technological; cultural; social; political; legal; competitive; and the natural environment at the local, regional, national, and international levels. External stakeholder values, relationships, and perceptions will also impact on a facility achieving its objectives, e.g., local communities or stakeholders may need to be consulted for planning approval purposes. All of these need to be considered in establishing, monitoring, and updating a facility's / asset's risk management objectives over the duration of the facility / asset life cycle.

Internal Influences and Concerns

The internal context, or internal environment, will also impact on how the A&FM plans realizes its objectives. A&FM risk management program must be aligned with and work within the A&FM culture, processes, structure, and strategy. Anything within an A&FM organization that could influence how risk is managed is considered within this internal context. The list of internal influences to consider when developing a A&FM risk management program includes but is not limited to: established roles and responsibilities; governance arrangements; contract structure; policies; capabilities; resources; technology and information systems; reporting requirements; standards, and relationships with internal stakeholders (both established and perceived).

A&FM Objectives

The A&FM objectives must be clearly defined, understood, and communicated before the risk management process can be applied. These objectives will have differing levels of detail associated with them - depending on the nature of the A&FM activities. This might include consideration of the following: cost;

schedule; safety; environmental; quality; operational delivery; reputational; community benefit/improvement requirements, asset condition and asset performance.

Risk Tolerance Criteria

As indicated in the risk management plan a set of risk tolerance criteria will be established that define the risk tolerability limits that will be employed for risk management purposes.

The risk tolerance criteria will be established following an assessment and consideration of relevant factors which should include the following:

- Cost
- Schedule
- The political, legal and regulatory constraints
- Safety considerations
- Environmental obligations
- Customer expectations/satisfaction
- Other factors as appropriate.

The A&FM will define the risk tolerance criteria in the risk management plan.

Attachment 2 describes risk impact categories that can be used in this determination. The impact categories described are: cost; safety; quality; environmental; regulatory requirements; asset / facility condition; asset / facility performance; FM contractor service level; community; reputation and security. **Attachment 3** provides an illustration of how risk tolerance criteria can be defined using these impact categories.

6.2 Five-Step Operations and Maintenance Risk Management Process

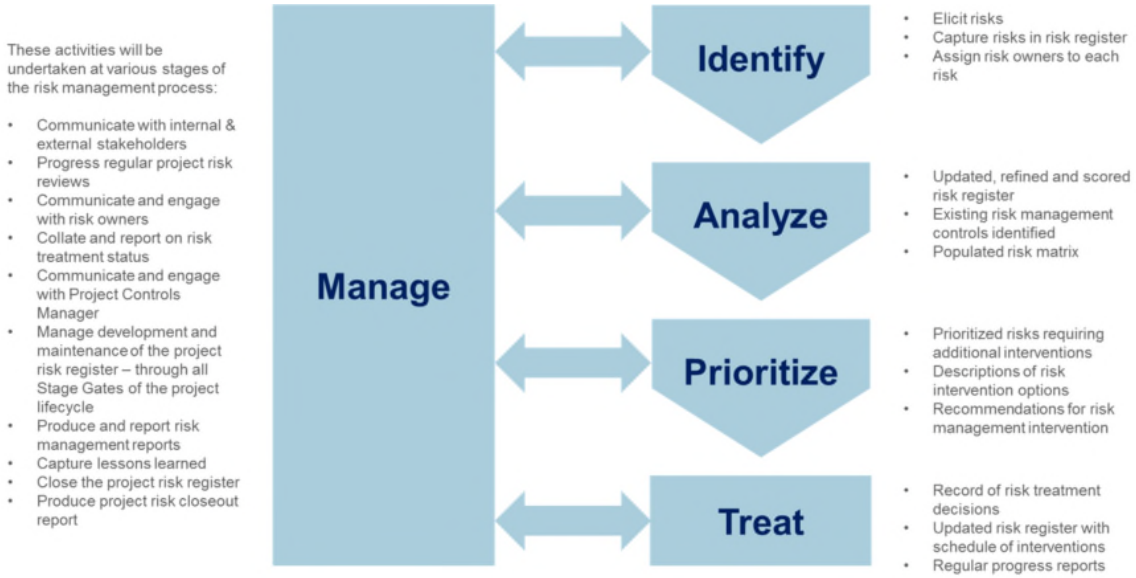
Once the previous contextual items have been identified and understood, the A&FM risk management process is then developed. The five-step A&FM risk management process, outlined below, can be tailored to A&FM specific needs but should always follow these five basic steps.

The A&FM risk management process is incorporated into the A&FM risk management plan. The risk management plan defines the A&FM risk management philosophy, details, and communicates how the A&FM team will execute the A&FM risk management process.

A visual representation outlining the five-basic A&FM risk management process steps (or stages): *Identify*, *Analyze*, *Prioritize*, *Treat*, and *Manage* along with their associated activities is shown in **Figure 1**.

The subsequent sections describe the activities associated with each step or stage, in more detail.

Figure 1 – A&FM Risk Management Process Outline



6.2.1 Identify

Risk identification is a A&FM activity that is undertaken at all stages in the facility / asset life cycle. The purpose of this activity is to identify events or uncertainties that may or may not happen, but which could have an adverse impact on the achievement of the A&FM objectives.

In the ***Identify*** stage the risk events and uncertainties are identified and examined. Previous knowledge and lessons learned could be used as a source of information to identify risk events.

From these considerations, a comprehensive list of risks that could have an adverse impact on realizing the A&FM objectives will be generated and descriptions of their sources, root causes, and the impacts if the risks materialize. It is important to ensure that a thorough risk identification is undertaken at the beginning of each A&FM phase, and reviewed regularly (especially when a change to the A&FM is being considered), so that any new or emerging risks can be identified for subsequent analysis in a timely manner.

In the ***Identify*** stage, risk descriptions will need to be sufficiently clear so that there is complete understanding as to what the risk includes and does not include, even if the risk cause or source is not readily evident. The following should be included in the risk identification examination effort:

- Whether the risk source is within or outside the A&FM control
- Consideration of all significant relevant potential impacts
- Any knock-on, cumulative, or cascading effects of the identified impacts.

Identified risks will be documented in a risk register which will include, as a minimum, the following:

- A risk titles
- A description of the risk sources
- A description of the risk causes
- A description of the potential risk impacts if the risk materializes (for all relevant risk impact categories)
- Identification of a named Risk Owner.

A spreadsheet-based risk register tool has been provided for this purpose (see the template in the Expro A&FM: Volume 12 - Introduction to Risk Management), and it is recommended that in the absence of any other tool, then this should be used. The spreadsheet template provides detailed guidance on the type of information that should be recorded.

Outputs from Identify Stage

1. A list of A&FM risks that have been identified with initial impact and likelihood scores.
2. The risks will be captured in a Risk Register.
3. All risks will have a named Risk Owner assigned to them.

6.2.2 Analyze

Once a risk has been identified and recorded in the Risk Register, it must then be analyzed to determine whether it requires additional risk management interventions such as controls, actions or mitigation measures.

Risk analysis involves a more refined **assessment of the risk impacts and associated likelihoods** of being realized, than will have been developed in the ***Identity*** stage.

During this stage the risk understanding should be more thoroughly developed, risk levels determined, and risk statements developed. The need for risk management interventions (treatments) will be assessed, potential interventions evaluated, and strategies for employment explored.

During the ***Analyze*** stage, risk causes, and sources will be fully identified, their potential impacts and associated likelihood of occurrence are estimated, and a risk statement is synthesized. The risk statement should provide a summary overview of the risk event or issue, its root causes and resulting impacts.

Risks can have interdependencies, multiple consequences, and can impact multiple A&FM objectives. All these factors, including any pre-existing or potential controls and mitigation measures, should be carefully considered. Risk analysis results can be expressed in qualitative, semi-quantitative, or quantitative format, or a combination thereof. The type of analytical approach that should be adopted will depend on the situation and will consider things such as: available information, data quality, and the resources available to undertake any analysis.

Risk impacts and their associated likelihoods can be determined in a variety of ways. Events and scenarios can be modelled, results can be extrapolated from historical experience and available data, and expert judgement can be employed.

Attachment 2 presents **impact categories** that can be used to characterize a risk. The definitions of the impact ratings A to E are also presented in Attachment 2 so that the risk impacts can be assessed consistently. The most severe risk impact category will determine the impact level in the Risk Matrix evaluation.

A set of **likelihood rating** definitions are also presented in Attachment 2. Both qualitative and quantitative descriptions are provided for likelihood ratings ‘Rare’ to ‘Almost Certain’. The quantitative scale is expressed in probabilities in the range 0% - 100% (which is the preferred form) but it can also be expressed in terms of frequency (e.g. number of events per year) - if the situation being assessed is more conducive to this.

Analyze efforts should consider the confidence level of determining the risk, sensitivity to input variables, information and data limitations, availability, quality, quantity, and timeliness, as well as conflicts or divergence of subject matter and expert opinions. These all need to be communicated to A&FM decision makers when results are presented so that the best-informed decisions can be made.

Risks should, where possible, be assessed by facts and remove as much as possible individual perception when considering the impacts and likelihoods that the specified risk impact will be realized. For sophisticated Monte Carlo analysis of risks, then the impact **or** the likelihood (note - only one or the other, never both at the same time) may have a range associated with them for risk quantification purposes, but this is beyond the scope of this procedure.

All risks should be mapped onto the **Risk Matrix** which will have been defined in the risk management plan and which will also define the risk tolerance criteria that will be employed for the facility / asset. This, in turn, will define the need for any additional risk management interventions such as controls, actions or mitigation measures. **Attachment 3** provides an example of a risk matrix as well as an illustrative example.

Note that the residual risks that are mapped onto the risk matrix provide a visual illustration of the **A&FM risk profile**.

Once the risk analysis has been completed, risks can then be evaluated for treatment prioritization.

Outputs from Analyze Stage

1. A revised and updated risk register that contains more information about the nature and scale of the risk as well as any risk management controls that are employed.
2. A populated risk matrix.

6.2.3 Prioritize

Prioritize uses the outputs from the ***Analyze*** stage to inform decisions about which risks require risk management interventions (treatment) and the priority order in which they will be treated. The risk level outcomes from the *Analyze* stage will be compared with the risk tolerance criteria defined in the risk management plan and priorities established according to the scheme described in **Attachment 3**.

During this stage, decision makers will ensure that all relevant factors are considered, including:

- Comparison of the analyzed risk levels with the risk tolerance criteria
- Ensuring that any residual risks are compliant with all legal and regulatory obligations
- An assessment of the residual risk levels against Ministry, customer and other stakeholder expectations
- Confirmation that existing controls are implemented effectively
- An assessment of the feasibility and practicability of any additional risk management interventions (treatments) that are required
- Determination of the need for any additional analysis before a decision can be made.
- Risk management interventions or treatments can take the form of different types of activity. These are: controls; actions; contingency plans; and / or fallback plans.

Risk treatment controls are any ongoing system, procedure, process, device, or other means of treating risk. A key characteristic of risk controls is that they are routine and typically a normal part of day to day operations. Controls can take many forms, including physical equipment, process control systems, management processes, operating or maintenance procedures, emergency response plans, and staff competences. Note that 'audit' is not a control. It is a mechanism for providing assurance that controls are being employed correctly and effectively.

Risk treatment actions are normally one-time or limited duration risk management interventions, that are undertaken to reduce the risk impact and/or its likelihood of occurrence. A risk treatment action can convert to a risk treatment control if a decision is made to operationalize the action and adopt it as 'business as usual' going forward.

For example, consider the following scenario. During the design stage for a particularly complex and constrained construction site with lots of moving vehicles, the residual safety risk to construction workers has been judged to be unacceptable. As a result, the designers revise the construction site operating configuration so that moving vehicles and construction site workers are segregated and the residual risk is judged to be tolerable. When this configuration and the associated operating logistics are adopted during the construction stage of the project, then the segregation of the vehicles and the workers becomes a risk treatment control.

A **contingency plan** is the management response that will be undertaken if a risk is realized, as determined by a pre-defined trigger agreed by the A&FM team.

A **fallback plan** is executed only in the case where a contingency plan proves to be ineffective or fails.

Both contingency plans and fallback plans will be developed, costed and assessed for practicability in exactly the same way as for all other risk treatment options. This will be done to ensure that the A&FM team is fully informed when they consider risk treatment options and priorities.

The treatment options will contain fully developed and defined individual activity items with supporting facts and rationale, required resources, identified owners, and timelines for implementation. Draft risk treatment plans providing recommendations as to which risks to treat, treatment options to pursue, and the order in which to pursue those options will be prepared for consideration by the A&FM team. Which treatment option or combination of options selected for implementation will be determined by the A&FM team in the next A&FM risk management stage - ***Treat***.

Outputs from Prioritize Stage

1. A list of prioritized risks which have been judged to require additional risk management intervention or treatment.
2. A description of the risk treatment options that could be considered for implementation to address each of these prioritized risks.
3. A description of any contingency plans and fallback plans that could be considered for employment for risks that might merit them.
4. A recommended plan of action that considers all the above for consideration by the A&FM team.

Risk identification and problem prioritization leading to the development of Risk Based Inspection (RBI) processes (refer to Volume Operational)

6.2.4 Treat

From the ***Prioritize*** stage the risks prioritized for treatment will have been identified, optional risk treatment options will have been evaluated, and recommendations made as to which risk treatment options should be implemented. The A&FM team (under the guidance of the Facility Manager) will then review these recommendations and make decisions about which risk management interventions or treatment activities will be implemented. Following these decisions, the **risk treatment plans** will be finalized.

At a minimum, the **risk treatment plans** will contain:

- The justification and rationale for selecting the treatment activities
- The treatment activity implementation resource requirements (i.e. cost, time, manpower and materials)
- Timing for implementation of the treatment activities and evaluation
- The named individuals who will be accountable for the treatment activities
- The expected outcomes in terms of risk benefits.

If a risk has been determined to require treatment, then the A&FM team will develop risk management intervention or treatment options. These will be evaluated to identify the most practicable interventions (i.e. considering both effectiveness and costs) for the specific A&FM risk. This evaluation will involve one or a combination of any of the following strategies:

- Avoiding the risk to eliminate a threat by not starting / continuing the activity that results in the risk
- Removing the risk cause removing the risk source
- Reducing the likelihood of a risk happening
- Reducing the impact
- Transferring or sharing the risk with another party / parties (e.g. by insuring against the risk).

If the post risk treatment residual risk is not tolerable then the risk treatment approach will need to be modified and revised risk treatment plans developed. This cycle is repeated until the residual risk reaches a tolerable level. If any residual risk is not tolerable then other risk management intervention options must be explored.

The risk management plan will provide detailed guidance on how the practicability of risk management interventions will be assessed for the facility/asset. In broad terms the practicability tests will include the following:

- Are all legal and regulatory requirements being complied with?
- Are there any standards or Approved Codes of Practice (ACoPs) that are applicable? If so, are they being employed?
- Have all customer specific requirements been addressed (e.g. related to environmental or societal concerns)?
- What are the costs of additional risk management interventions?
- What are the associated risk benefits?
- Are the costs grossly disproportionate for the benefits that are expected to accrue?

Risk treatment activities will be recorded, tracked, and monitored in the Risk Register. Particular attention will be paid to ensuring that the risk treatment activity owners are aware of their responsibilities. The Risk Manager will ensure that the status and effectiveness of the timed risk management intervention (whether it is an action, contingency plan of fallback plan), is monitored and reported to the A&FM team.

Outputs from Treat Stage

1. A record of the project team decisions about which risk treatment options will be implemented (note - these may take the form of actions agreed at project team meeting minutes), and who has been assigned as the risk treatment activity owners.
2. An updated Risk Register that captures the agreed risk treatment plans, owners and timings for implementation.
3. Regular updates to the A&FM team on the status / evaluation of the risk treatment activities.
4. Continuous assessment of the results against the pre-defined risk tolerance criteria to assess whether the residual risks are tolerable.

6.2.5 Manage Process

The final element of the risk management process is not a separate step as it is a continuous activity that weaves throughout all of the steps that have been described above.

The Risk Manager will be responsible for all activities undertaken to support ***Manage Process***. These can be summarized as ensuring that the right risk-based information is communicated / elevated effectively and in a timely manner to the right people so that risk-based decision making, and associated risk management interventions are executed in compliance with the requirements of the risk management plan and this procedure. The Risk Manager's communication activities will include providing feedback to leadership as to the effectiveness and efficiency of the risk management program and ensuring any control failings or weaknesses are identified and elevated to the appropriate level to ensure corrective actions are identified and put into place.

Managing the A&FM risk management process relies on contributions from all A&FM team members. Some of the applicable key ***Manage*** activities are detailed below.

Consultation and Communication

The key for efficient management is consultation and communication - continual, consistent, timely, and relevant consultation and communication with all relevant stakeholders, internal and external to the A&FM environment. This type of interaction will ensure that the interests and potentially divergent views of the customer and other stakeholders, are fully understood and considered as appropriate when A&FM risk

tolerance criteria are determined. Continuous communication will ensure that a consistent understanding and appreciation of the scale, nature and source of A&FM risks is shared by all stakeholders. This consistency will ensure that any decisions around the need for additional risk management interventions, for example, are based on a common and collective understanding.

All risk management interventions (controls, actions, contingency plan and fallback plans) have individuals allocated who 'own' the risk treatment activities. These Risk Owners will be responsible for implementing the risk treatments, and reporting on the associated costs, benefits and overall effectiveness. The Risk Manager will be responsible for collating this information and disseminating it to the rest of the A&FM team.

When a risk event or issue is realized - or there is good evidence that it will be realized - then it will be recorded as a ***trend*** and transferred to the Facilities Manager. The Risk Manager is responsible for ensuring that this line of communication is maintained and that trends are identified and communicated to the Project Controls Manager as early as possible. The Facilities Manager is responsible for addressing the trend in accordance with the A&FM Blue Book.

Monitoring and Review

Regular monitoring and review of all aspects of the risk management process are necessary components of the *Manage* element and is key to tracking performance management. It is the mechanism by which the effectiveness of risk treatment activities is evaluated, while ensuring that any changes to the overall project risk profile is continually assessed. Continuous monitoring and review of these aspects means that the need for any additional risk management interventions can be anticipated and acted upon in a timely and effective manner.

The **A&FM risk management plan** will define the nature and frequency of all A&FM risk management monitoring and review activities. This will address the following activities:

- The frequency with which the A&FM team will consider A&FM risk (for example this may be a standing item on monthly team review meetings)
- The frequency with which A&FM Risk Treatment Owners will report progress on the status of their risk treatment activities to the Risk Manager
- The frequency and format of risk management reports and metrics (e.g. there may be a monthly 'dashboard' report, as well as an annual risk review report)
- The nature of A&FM changes that will trigger a review and reassessment of the A&FM risks
- How risk related lessons will be captured and who they will be communicated to
- How the customer will be involved in risk reviews.

Occasionally, ad hoc meetings will be needed to focus on evaluation of treatment activities or to perform further analysis and quantification. If necessary, smaller group meetings may be able to handle detailed evaluations better than the A&FM team. The risk management plan will describe how the outputs and findings from these reactive activities will be fed back into the A&FM team reviews.

Lessons learned will be documented as they arise through the monitoring and review process. Lessons learned provide invaluable insight for future analysis and A&FM activities. At a minimum, the lessons learned documentation will include an overview of the item, the challenge presented, the solution employed, and the resulting outcome. Lessons learned collected throughout the A&FM life cycle will be included in the A&FM risk closeout report.

Reports and Metrics

The risk management plan will define metrics and reports, including level of reporting and reports to Customers, that indicate the status of the A&FM prioritized risks and the status of the risk program's effectiveness, concerns, and process improvement activities. The metrics will be reviewed and acted upon at planned intervals during the monthly risk review cycle.

A trigger risk level threshold and communication protocol will be developed and documented in the risk management plan. Protocols for escalating risks that are judged to be intolerable, after all risk treatment options have been exhausted, will also be described.

Transfer of Risks

The risk management plan will define the conditions or circumstances under which a risk will transfer ownership. A facility / asset may change ownership of its life cycle. In the case of change of facility / asset owner, the risk register and risk owner will be passed from one owner to the next.

It will the responsibility of the Risk Manager to manage the process of passing the risk register between the relevant facility / asset owners at the appropriate time.

Closing Risks and the Risk Program

The risk management plan will define the conditions or circumstances under which a risk can be closed. These will include:

- A&FM scope change resulting in the risk being no longer relevant
- The A&FM phase associated with the risk exposure having passed
- The risk event or issue is realized (or is judged to be realized imminently) in which case it is passed to the Trend program under control of the Facilities Manager.

In all cases when a risk is closed the circumstances around the closure must be evaluated to ensure any residual or emerging risks are properly captured, recorded, and included in the A&FM risk register. When a risk is closed, the information contained within the A&FM risk register will be updated to reflect:

- The fact that the risk was closed
- Date when the risk was closed
- Why the risk was closed
- If any residual or emerging risks were identified, and what those risks were.

When the A&FM risk program is being closed, every risk contained within the risk register will be reviewed and, where appropriate, individually closed. Once all risks within the A&FM risk register have been reviewed and properly closed the Risk Manager will:

- Close the A&FM risk register
- Generate a A&FM risk closeout report which will contain, as a minimum:
    - Summary of the A&FM objectives, risk management plan, risk tolerance criteria, and closed risk register; redact any Customer sensitive and/or A&FM identifying information from the risk register file contained in the report
    - Historical overview of the execution of the risk program, to include any significant challenges and successes
    - Lessons learned
- Provide a copy of the risk closeout report to the Facility Manager and A&FM team.

6.3 Tools & Techniques

There is a wide range of techniques that can be employed at different steps in the risk management process. For example, qualitative and quantitative methods can be used to identify and assess A&FM risks. **Attachment 4** presents a selection of these, indicates some of the strengths and weaknesses of different techniques, and provides some guidance on the circumstances, A&FM life cycle stages and risk management process steps, when different techniques may be more applicable.

The risk register is a critical tool for successful A&FM risk management. To encourage a standard and consistent approach to A&FM risk management, it is recommended that a simple format for recording A&FM risks is adopted. It is therefore recommended that a risk register based on a Microsoft Excel spreadsheet

is used to capture A&FM risks, and to record how they are being managed. An Excel spreadsheet template has been provided for this purpose (A&FM Risk Register Template (EPM-EM0-TP-000001)) and a sample of this is presented in **Attachment 5**.

As the risk management maturity level within an Entity develops, then it may well look to employ a more sophisticated web-based and commercial off the shelf software package such as Active Risk Manager (http://www.sword-activerisk.com/products/active-risk-manager-arm/) on its facilities / assets.

Regardless of the tools used to support development and management of the risk register, and of the techniques used to identify and assess A&FM risks, Entities will follow this procedure.

6.4 Interfaces

Risk management is integral to every A&FM system and process, and all benefit from a risk-based approach. Interfaces between A&FM risk management and other A&FM management functions will be formally defined in the risk management plan. Over the A&FM life cycle, the Risk Manager will interact regularly with other A&FM management functions to ensure that the A&FM risk register reflects any changes or emerging issues in a timely manner. The risk management plan will describe the nature and frequency of these interactions which will depend on the A&FM needs, and which stage in the A&FM life cycle, the asset / facility has reached.

7.0 ATTACHMENTS

1. Attachment 1 - Risk Management Terms and Definitions
2. Attachment 2 - Guide to Risk Impact and Likelihood Categories
3. Attachment 3 - Guide to Risk Matrix and Risk Tolerance Levels
4. Attachment 4 - Examples of Risk Management Tools and Techniques
5. Attachment 5 – EOM-EM0-TP-000001 Operations and Maintenance (O&M) Risk Management Plan Template
6. Attachment 6 – EOM-EM0-TP-000002 –Expro Facility Management Risk Register Template

Attachment 1 - Risk Management Terms and Definitions

Term	Definition
Action	A one-time measure to avoid, reduce, transfer or accept a threat.
Asset	A resource owned by a person / company.
Bow Tie	A risk evaluation tool in the shape of a bow tie
A&FM	National Manual for Assets and Facilities Management
Consequence	A potential risk outcome that could affect the attainment of the A&FM objectives. The Risk Consequence can have several impact categories such as cost, time and safety. Refer to **Attachment 2** for full details of a set of rating schemes for risk impact categories.
Control	A repeated intervention that modifies a risk. This can include execution of any process, procedure, physical device, operational practice or worker competence, that has a modifying effect. Controls may not achieve the desired results so they need to be monitored for effectiveness.
Contingency Plan	An action (or set of actions) that will be executed after a risk event has occurred.
Dashboards	
Delphi	
Event	In the A&FM risk management context, an event is something which might or might not happen, but which if it does happen has the potential to adversely impact upon successful attainment of the A&FM objectives.
Facility	Building and/or enclosed or unenclosed industrial processes as well as all its site features
Fallback Plan	A recovery plan of action (or set of actions) that will be executed if the **contingency plan**, employed after a risk has occurred, fails.
Impact	See **consequence** above. These terms are used interchangeably in the risk management discipline. Impact is the preferred term. **Impact Factors** are facts or factors that inform the A&FM team's belief about the potential **risk impact**, if the risk is realized.
Likelihood	The chance that a risk event might happen. Likelihood is often expressed as a probability (the preferred approach) or frequency. See **Attachment 2** for full details of a standard likelihood rating scheme.
Monte Carlo Analysis	A mathematical modelling technique that through repeated random sampling simulates the interaction of multiple risks to model the statistical distribution of different A&FM outcomes (e.g. cost, schedule). This technique enables sensitivity as well as 'what if' scenario analysis. There are a range of commercially available tools that are available to undertake such analyses.
Quantitate	
Qualitative	

Term	Definition
Residual Risk	The risk that remains after implementation of all existing and/or planned **risk management interventions** (**risk treatments**). It is the residual risk which is considered when determining whether or not the project risk profile is tolerable or not.
Risk	A risk is an uncertain event or condition that, if it occurs, can adversely affect successful achievement of the A&FM objectives. Best practice risk management considers risk as either an opportunity or a threat. However, for the purposes of this risk management procedure, and in accordance with the approach described in the risk management plan, we only consider threats. Risk is usually characterized as a potential event with a specific impact than can be realized by a specific cause with a specific likelihood.
Risk Analysis	Risk analysis is the process used to understand the nature, impact and associated likelihood of a risk on the A&FM objectives and then the use of that information to make decisions on which risks should be treated and the appropriate treatment options to pursue. Risk analysis can be conducted and expressed in **qualitative**, **semi-quantitative**, or **quantitative** terms, or a combination thereof. **Qualitative risk analysis** is a technique concerned with subjectively describing a risk and estimating and expressing the risk impact and associated likelihood in a textual format. **Semi-quantitative risk analysis** is a risk assessment technique that provides an intermediary level of effort between the textual evaluation of qualitative risk assessments and the technical numerical evaluation of quantitative risk assessments. Typically, this is accomplished by evaluating and expanding on the textual information obtained in a qualitative risk analysis and providing a score that can allow risks to be ranked against one another. To allow this, risk scoring categories are used – as defined in the A&FM risk management plan. **Quantitative risk analysis** is the process of numerically quantifying the impact on overall A&FM objectivities of identified risks. The power of quantitative risk analysis is it allows multiple risks to be considered and compared at once, instead of individually as with qualitative and semi-quantitative techniques. It is typically undertaken using Monte Carlo simulation and conducted to quantify A&FM cost and schedule risks. It usually includes sensitivity analysis to identify key drivers of overall risk and risk uncertainty.
Risk Cause	Causes are events or circumstances which currently exist and might give rise to risks.
Risk Driver	This is a fact or A&FM related factor that informs the A&FM team's belief about how likely a risk is. **Risk drivers** are the basis for estimating the **risk likelihood** which can be expressed as a Probability or Frequency (although probability is preferred over frequency). The **cause** field in the **risk register** is where Risk Drivers should be recorded.
Risk Exposure	
Risk Management Intervention	These are activities (**risk treatments**) that could alter the likelihood of a risk being realized, or the impact if it is realized.

Term	Definition
	Risk Management Interventions can take the form of one of the following: **control**; **action**; **contingency plan**; **fallback plan**.
Risk Management Plan	Document defining the A&FM-specific risk management scope, roles and responsibilities, risk tolerance criteria, the application of the A&FM risk management process, communication strategy (e.g. meetings, reports to be generated, minimum reporting cycle), and the sequence and timing of the A&FM risk related meetings and reports.
Risk Matrix	A two dimensional 5 × 5 matrix representation of **likelihood** and **impact** used for visual representation of risks. It is used to inform decisions about priorities for **risk management intervention (treatment)**. The **risk matrix** maps each individual risk from the **risk register** onto one of the matrix cells defined by its likelihood and impact risk scoring categories. If the risk has impacts in several categories, ***the highest Impact level is used***. The individual cells of the risk matrix have a priority sequence ranging from 1 to 25 to provide a **risk ranking** (see the risk management plan and **Attachment 3**). Risks are prioritized for the attention of the A&FM team according to the colored priority bands to which they belong and are sequenced in reports according to this priority sequence.
Risk Register	The repository for all the A&FM identified risks, information about the nature and scale of the risk, who is responsible for managing the risk and the nature of any risk management interventions employed to maintain the risk at a tolerable level. Risk registers are typically held in spreadsheets although there are commercially available products that can be employed.
Risk Score	Risks are scored against a A&FM **risk scoring scheme** which is defined in the **risk management plan**. The risk scoring scheme has two component parts: likelihood and impact. Five categories of impact and likelihood are defined.
Risk Source	Where the risk originated. A risk can have more than one source.
Risk Statement	A concise statement that describes the uncertain risk event and its major causes along with impact levels. The risk statement is typically not fully refined and defined until after the risk has been fully analyzed.
Risk Tolerance Criteria	The risk tolerance criteria are the combinations of risk impact and likelihood that are defined in the risk management plan as falling into one of the following categories: **unacceptable**; **tolerable**; **broadly acceptable**. This is usually presented as colored cells on the risk matrix with guidance as to the risk management response that will be employed for risks assessed as being in each color.
Risk Treatment	See **risk management intervention**. Modifying the likelihood or consequences (or both) of a risk. This is achieved through a treatment plan composed of treatment activities which can consist of controls, actions, contingency plans, and/or fallback plans.
Risk Treatment Plan	Also known as the **risk response plan**. Establishes how the A&FM team will alter the likelihood of a specific risk and the scale of its impacts by detailing the risk treatments that will be implemented.

Term	Definition
Root Cause	
Semi–Qualitative	
Stakeholder	Person, group, or organization which can affect or be affected by the A&FM objectives, policies, and execution. Some examples of stakeholders include the customer, A&FM team, sub-contractors, local communities, regulators, other government departments and local communities.
Threat	A Threat is a risk with a potential adverse effect on at least one of the A&FM objectives.
Uncertainty	The situation which involves imperfect and / or unknown information and applies to predictions of future events, to physical measurements that are already made, or to the unknown. Uncertainty is not knowing exactly what is going to happen next, nor what the distribution of possible outcomes looks like.

Attachment 2 - Guide to Risk Impact and Likelihood Categories

Asset & Facilities Management Risk Impact Rating Scheme

Impact Category	A Very Low	B Low	C Medium	D High	E Very High
Cost	*A&FM Specific* *e.g. < 1% of annual A&FM budget*	*A&FM Specific* *e.g. 1-5% of annual A&FM budget*	*A&FM Specific* *e.g. 5-10% of annual A&FM budget*	*A&FM Specific* *e.g. 10-25% of annual A&FM budget*	*A&FM Specific* *e.g. > 25% of annual A&FM budget*
Safety	First aid or slight injury/illness with no treatment.	Recordable, medical treatment, restricted work, temporary effect.	Lost time injury/illness or permanent disability.	Single fatality or permanent disability of 3 or more persons.	Multiple fatalities.
Quality	Defects in work identified. Minor corrective action contained within operational role in that shift. Insignificant impact, fully contained. Minor productivity impact.	Defective work identified. Corrective action spanning multiple shifts required. Minor impact on test, inspection & maintenance.	Systemic defective work produced & identified prior to operational testing. Multiple corrective actions required over many assets & facilities. Test, inspection & maintenance schedule is disrupted by several days.	Defective work not identified until operational testing. Multiple corrective actions spanning multiple weeks. Significant impact on test, inspection & maintenance schedule.	Systemic defective work produced & not identified until operational testing. Multiple corrective actions required spanning months. Test, inspection & maintenance schedule disrupted so severely that certain assets and facilities will have to be taken out of service.
Environmental	Insignificant impact. fully contained.	Negligible short-term impact, confined on site, no regulatory exceedance.	Moderate to significant impact confined on site, regulatory exceedance, or any off-site impact.	Significant impact on or off site, or potential enforcement action.	Catastrophic impact, long-term liability, or irreversible damage.
Regulatory Requirements	Minor breach in Asset / Facility operating requirements	Several breaches in Asset / Facility operating requirements in a short time period (3 months)	Multiple breaches in Asset / Facility operating requirements in a short time period (6 months). Regulator taking an interventionary interest in the Asset / Facility operations	Asset / Facility Operator put on improvement notice by Regulator	Regulator withdraws Asset / Facility Operating Licence
Asset / Facility Condition	Asset / Facility condition has degraded and requires additional maintenance activities to maintain performance.	Evidence for accelerated Asset / Facility Condition degradation is being provided by increased frequency of fault reports.	Asset / Facility Condition has degraded to the point where it demands considerable additional resources to maintain it in a safe and operational state.	Asset / Facility Condition degrades at much higher rate than anticipated reducing expected lifetime by greater than 50%.	Asset / Facility requires renewal or replacement as the condition is irreparably damaged or it is life expired.

Impact Category	A Very Low	B Low	C Medium	D High	E Very High
Asset / Facility Performance	Asset / Facility is shutdown / unavailable for operational use for a brief time (less than 1 week)	Asset / Facility is shutdown / unavailable for operational use for a short period (1-2 weeks)	Asset / Facility is shutdown / unavailable for operational use for a period (2-4 weeks)	Asset / Facility is shutdown / unavailable for operational use for an extended period (1 – 3 months)	Asset / Facility is shutdown / unavailable for operational use for a long time (greater than 3 months)
FM Contractor Service Level	Minor breach in FM Contractor performance against service level agreement.	Significant breach in FM Contractor performance against service level agreement.	Multiple & consistent breaches of FM Contractor performance against service level agreement	FM Contractor is in notice to improve performance against service level agreement.	FM Contractor services are terminated.
Community	Little or no complaint(s) to site and/or regulator from abutters, local stakeholder groups or local government.	Minor complaint(s) from abutters, local stakeholder groups or local government.	Significant complaint(s) from abutters, local stakeholder groups or local government. Isolated, small-scale protest.	Persistent complaints from community and national stakeholder groups or national government. Large-scale protests. Threat of legal action.	Community/NGO legal action. Significant concerns expressed by key international stakeholder groups or from more than one national government. Sustained large-scale protests with injury or damages.
Reputation	No negative media coverage. No disruptions in current operations.	Local negative media coverage. Some limits on current operations.	Regional negative media coverage. Disruptive impact on current operations. Issue creates complications with customer relationship.	Sustained negative regional or national media coverage. Significant and/or sustained impact on A&FM operation operations. Issue creates significant customer conflict.	Influential national or international negative media coverage. Significant impact on A&FM operations. Customer publicly states dissatisfaction with EPMO. Significant legal action.
Security	A threat exists against the asset or a person. A willful criminal act or condition resulting in a Category I impact. Normal management action required.	A threat exists against the asset or a person. A willful criminal act or condition resulting in a Category II impact. Normal management action required. Low level of external emergency service assistance may be required.	A threat exists against the asset or a person. A willful criminal act or condition resulting in one or more Category III impacts. External emergency service assistance may be required.	A threat exists against the asset or persons. A willful criminal act or condition resulting in one or more Category IV impacts. External emergency service assistance is required.	A threat exists against the asset or persons. A willful criminal act or condition resulting in one or more Category V impacts. Multiple external emergency services assistance is required.

Asset & Facilities Management Risk Likelihood (Probability) Rating Scheme

Category	A Rare	B Unlikely	C Possible	D Likely	E Almost Certain
Likelihood	Risk has an occurrence of less than 1% in the relevant industry.	Risk is unlikely to occur during A&FM operations with current processes and procedures in place.	Risk occurs often within the industry or Company.	Risk has recently occurred during similar A&FM operations within the industry or Company.	Risk is highly likely to occur during A&FM, potentially multiple times.
Probability	< 10%	10% to 30%	30% to 70%	70% to 90%	> 90%

(**Note** - only likelihood OR probability will be used, never both at the same time.)

Attachment 3 - Guide to Risk Matrix and Risk Tolerance Levels

The risk management plan will define the risk dimensions (impact and likelihood) that will be adopted to assess A&FM risks, and it will define the risk matrix categories (red, amber, yellow, green) that will be used to prioritize risk management interventions.

Within each risk category, a scoring mechanism will be adopted to enable prioritization within each category. Note the numbers are assigned for prioritization purposes only. They are not derived from any numerical calculation.

The following example illustrates this concept.

RISK MATRIX

5	10	15	20	25	Almost certain	Likelihood
4	9	14	19	24	Likely	
3	8	13	18	23	Possible	
2	7	12	17	22	Unlikely	
1	6	11	16	21	Rare	
A	B	C	D	E		
Impact						

The risk management plan will define how priorities will be established based on the risk categories defined, and it will define the level of risk management intervention that will be required for risks in different priority categories.

This is illustrated in the following example:

	Level of Risk Exposure			
	Red Priority 1	**Amber Priority 2**	**Yellow Priority 3**	**Green Priority 4**
Risk Tolerance	Risks that significantly exceed the risk tolerance threshold	Risks that exceed the risk tolerance threshold	Risks that lie on the risk tolerability threshold	Risks that are below the risk tolerability threshold
Risk Response	Requires urgent and immediate attention	Requires proactive management	Requires active monitoring	Do not require active management

Attachment 4 - Examples of Risk Management Tools and Techniques

Tried and tested structured techniques should be applied to derive the outputs of a step of the A&FM risk management process. Organizations such as ISO describe a large number of common techniques which can be used in risk management. For brevity, this attachment only reviews a selection of these, and provides a brief introduction to each. The techniques are introduced here in alphabetical order.

Technique	**Bow Tie Analysis**
Description	This diagramming technique is helpful for clarity in risk analysis, and for rigor and completeness in identifying risk treatment options. On the left of the diagram the causes of the risk event are listed, structured by risk source. Lines from the list of causes converge on a description of the risk event in the center of the diagram, and diverge to a list of consequences on the right, resulting in a bow tie shape, hence the name of the technique. Drawing the bow tie of causes and consequences is an aid to risk analysis in the Analyze step. During the ***Prioritize*** step barriers which could prevent the causes and consequences are added to the diagram. These imply treatment activities (normally controls). The technique helps team members methodically identify controls for all the causes and consequences of a risk, rather than brainstorming an ad hoc subset.
Technique	**Controls Effectiveness**
Description	When a risk treatment activity is an ongoing control, it is essential to monitor its effectiveness in achieving the stated treatment objectives. If the control proves not to be fully effective or to generate unintended results, it will be necessary to improve its design or even change the treatment option. There are regulatory requirements in some industrial sectors concerning controls effectiveness. For example, there may be a requirement for a critical control monitoring program, verifying that all causes and consequences of top priority risks have controls in place, and that the performance standard for each control has been specified along with the test frequency. Similarly, there can be required checklists for control design effectiveness.
Technique	**Dashboards**
Description	During the ***Treat*** step, visualization of status data via dashboards is essential to keep on top of the detail. Pie charts, bar charts, 'speedometers' and similar representations help those responsible understand key measures such as: number of priority 1 risks without treatment plans; number of risks with no next review date; number of risks overdue for review; number of overdue risk treatment activities.
Technique	**Delphi**

Description	The Delphi technique is applicable whenever consensus is sought from a group of subject matter experts. This risk management procedure particularly recommends it when seeking consensus on the estimated likelihood and consequences of a risk. A questionnaire is sent to the chosen subject matter experts, in this case asking for their estimated likelihood and consequences for the risk. The results are collated and distributed to the experts without saying who made which estimate. If an individual finds his or her estimates are significantly different from most, this will prompt them to check and if necessary reconsider. A second round of submissions is made, and the process repeated until consensus is reached or, if necessary, consensus but with some dissenting views. Delphi achieves consensus from a starting point which encourages divergence, avoiding the problem of the instant group-think which can occur when a dominant or persuasive individual contributes to a group discussion.

Technique	**Documentation Reviews**, including: • Review of project constraints and assumptions • Review of customer and industry risk databases • Review of published checklists
Description	It is tempting to focus solely on group brainstorming sessions to identify risks, but there is a wealth of evidence-based risk intelligence documented by the customer and industry sources. Also, each constraint or assumption in the project's baseline, documented in the contract or project execution plan, may imply risks to the project if it proves to be infeasible or invalid or changes over time. This review of documentation is most valuable as a completeness check after more creative techniques have been used with the project team.

Technique	**EMV Comparison**
Description	The Expected Monetary Value (EMV) of a risk with a single-point cost consequence estimate is the estimate multiplied by the probability of the risk event (or derived using frequency and time interval, if likelihood was specified using frequency rather than probability). In the case of a three-point estimate of cost consequence, the EMV is the average expected value of cost (as implied by the probability distribution and the three estimates) multiplied by the probability or derived from the frequency. EMV provides a simple semi-quantitative way of comparing the cost consequences of a risk after applying different treatment options, supporting a cost-benefit based choice between options.

Technique	Fishbone Analysis
Description	Fishbone Analysis is a technique to facilitate a group discussion of the possible causes of an effect (impact) and help the group identify which are most likely. It uses a horizontally oriented diagram with the effect in question in a box at the right-hand side, categories of contributing causes in boxes to the left, above and below a backbone-like line coming out of the effect box, with branches and sub-branches of causes drawn between the backbone and the cause category boxes. It is easy to read and aids group participation. It should be contrasted with other cause and effect (impact) diagramming techniques which focus on logic, showing AND / OR gates or Yes / No / Condition nodes, or focus on the probabilities of the various branches and the resulting combined probability.

Technique	Individual Team Member Reporting
Description	In addition to the scheduled activities of the Identification step of the risk management process, the Facility Manager and Risk Manager function should promote a culture of risk-based thinking where individual team members are encouraged to report potential risks at any time.

Technique	Quantitative Risk Analysis
Description	Quantitative Risk Analysis (QRA) can first be used in the *Analyze* step, producing three-point estimates for the cost and time consequences of a risk, but this Procedure particularly highlights its use in the *Prioritize* and *Treat* steps. In *Prioritize*, the three-point estimates are used to compare a risk with the project's risk criteria as specified in its consequence and likelihood rating schemes, placing it in the appropriate cell of the A&FM risk matrix for prioritization for treatment. The exact interface between risk and the A&FM cost estimating and scheduling functions is not detailed in this procedure, but the three-point estimates of the cost and time consequences of risks can be included in their Monte Carlo simulations, both at the current consequence levels and after the application of various treatment options. From the risk management perspective, this is particularly useful for understanding how event-based risks affect the project's critical path. A tornado diagram will highlight those most in need of treatment. Comparison of the critical path before and after various treatment options may help understand their relative cost-benefit positions, enabling a well-informed recommendation of treatment options as input to the *Treat* step. See also EMV Comparison, above, for a simple approach to comparing the effect on cost consequences of different treatment options.

Technique	**Risk Identification Workshops**, including the use of: • Brainstorming • Scenario reviews • PESTLE • Risk source hierarchical checklists
Description	In the *Identify* step of the risk management process, it is common to break down the full scope of the A&FM, for example by team, by work or risk breakdown structure components, or by areas of the risk sources hierarchy, and to hold a series of risk identification workshops scoped accordingly. There are several ways of structuring each Risk Identification Workshop. A brainstorming session needs careful facilitation to set the scope, pose thought-provoking questions, and then allow free-flowing suggestions to be made without discussion or evaluation, because that would inhibit lateral thinking and off-the-wall ideas. Common methods that are typically used in support of gathering individual contributor's inputs in brainstorming sessions include Crawford's Slip Writing Method (using post-it notes) and Affinity Diagrams to then organize those individual inputs. Brainstorming is often immediately followed by an evaluation session to filter the brainstormed ideas and assign Risk Owners. In contrast, in scenario reviews, first the changes which could affect the project are identified, then corresponding scenarios are drawn up, usually covering worst case, best case, and expected case. The implied risks are then identified. This approach is often a rich source of opportunities as well as prompting risks from situations people are reluctant to contemplate. In contrast to these creative, team-oriented approaches which start from a 'blank sheet of paper,' tried-and-tested prompt lists can be used to facilitate a risk identification workshop. One widely used in risk management across all sectors is PESTLE: Political, Economic, Social, Technological, Legal, and Environmental.
Technique	**Root Cause Analysis**

Description	Classic 'Root Cause Analysis' is about learning from an asset loss due to a failure, or a financial loss due to an external factor or catastrophe. Evidence is gathered about the failure or loss, and a structured analysis technique is applied in the ***Analyze*** step to uncover the root cause, so that treatments options identified in the ***Prioritize*** step and selected in the ***Treat*** step will address that root cause and not superficial symptoms. The structured analysis techniques used to get to the root cause include 5 Whys, Failure Mode and Effects Analysis (FMEA), Fault Tree Analysis, Fishbone (Ishikawa) Diagrams, Pareto Analysis, and Root Cause Mapping. More informally, for any type of identified risk, a diagram can be drawn showing the causal chain between an immediate cause of the risk and its underlying causes, or showing a chain of risks triggering each other. As any node on the diagram will have multiple causes, the diagram will actually show a network, not a linear chain.

Technique	**Structured Team Member Interviews**
Description	In this approach, individual team members are asked pre-prepared questions which help them examine the A&FM from a number of angles and identify risks accordingly. It is a valuable technique when divergent thought is needed, to avoid group-think or undue influence by the stronger personalities in a team.

Attachment 5 – EOM-EM0-TP-000001 Operations and Maintenance (O&M) Risk Management Plan Template

Refer to the attached template; EOM-EM0-TP-000001 - Operations and Maintenance (O&M) Risk Management Plan Template.

Attachment 6 – EOM-EM0-TP-000002 – Expro Facility Management Risk Register Template

	Risk Title	RISK OWNER	OWNING FUNCTION	RISK STATUS	CAUSE(S)	CONSEQUENCE(S)	RISK STATEMENT	CURRENT				TREATMENT PLAN TITLE	TREATMENT PLAN OWNER		ACTIVITY TITLE	ACTIVITY OWNER	ACTIVITY TYPE
								RISK TYPE	RISK RANKING		RISK LEVEL						
1									Probability/ Likelihood	Select	Nil			1			
									Cost	NIL				2			
									Safety	NIL				3			
									Quality	NIL				4			
									Environmental	NIL				5			
								CONSEQUENCES	Regulatory Requirements	NIL				6			
									Asset / Facility Condition	NIL				7			
									Asset / Facility Performance	NIL				8			
									FM Contractor Service Level	NIL				9			
									Community	NIL				10			
									Reputation	NIL				11			
									Security	NIL				12			
2									Probability/ Likelihood	Select	Nil			1			
									Cost	NIL				2			
									Safety	NIL				3			
									Quality	NIL				4			
									Environmental	NIL				5			
								CONSEQUENCES	Regulatory Requirements	NIL				6			
									Asset / Facility Condition	NIL				7			
									Asset / Facility Performance	NIL				8			
									FM Contractor Service Level	NIL				9			
									Community	NIL				10			
									Reputation	NIL				11			
									Security	NIL				12			
3									Probability/ Likelihood	Select	Nil			1			
									Cost	NIL				2			
									Safety	NIL				3			
									Quality	NIL				4			
									Environmental	NIL				5			
								CONSEQUENCES	Regulatory Requirements	NIL				6			
									Asset / Facility Condition	NIL				7			
									Asset / Facility Performance	NIL				8			
									FM Contractor Service Level	NIL				(Ctrl)			
									Community	NIL				10			
									Reputation	NIL				11			
									Security	NIL				12			
4									Probability/ Likelihood	Select	Nil			1			
									Cost	NIL				2			
									Safety	NIL				3			
									Quality	NIL				4			
									Environmental	NIL				5			
								CONSEQUENCES	Regulatory Requirements	NIL				6			
									Asset / Facility Condition	NIL				7			
									Asset / Facility Performance	NIL				8			
									FM Contractor Service Level	NIL				9			
									Community	NIL				10			
									Reputation	NIL				11			
									Security	NIL				12			