APPENDIX Z. Part 4. NASA Center EMS Guidance

Z4.1 Introduction

a. NASA Center EMS Guidance (Part 4) is intended to serve as general guidance to Centers on satisfying applicable requirements of the bulk of NPR 8553.1.

b. Part 4 provides, as appropriate, for each element and sub-element of the EMS:

(1) Selected general guidance on satisfying the Center specific requirements within NPR 8553.1A.

(2) EMS implementation guidance in the areas of significant changes between NPR 8553.1 as issued in 2002 and NPR 8553.1A as issued in March 2005 (Note: Part 4 is not intended to repeat or replace the NASA EMS Implementation Guide[1]).

(3) Guidance on EMS effectiveness and using the EMS to promote continual improvement.

(4) Guidance on operating the EMS and adapting to change.

c. The content of each Section of Part 4 is set up to follow the numbering sequence in the Chapters of NPR 8553.1A.

d. Part 4 does not provide detailed content covered under Appendix Z Parts 1, 2 and 3 (EMS Review, Review Checklist and Self Declaration).

Z4.1.1 Principles of a Systematic Approach Applied to the Management of Environmental Issues and Promotion of Continual Improvement

a. The main focus of a management system consists of using a rigorous approach (less intuitive) for managing key issues consistently throughout the organization. The intent is to ensure that good practices are established and repeated, systematically and independently of the people involved with carrying out the tasks associated with these practices. The systematic approach is often referred to as the Plan-Do-Check-Review process.

b. The policy acts as the foundation and key driver behind a management system. An EMS is no exception. It reflects the values and culture of the organization. The policy sets the tone for subsequent prioritization of the organization's key issues that will be captured when setting objectives and targets, and when allocating resources for their achievement.

[1] NASA Installation EMS Implementation Guide. NASA Headquarters, Code JE, October 2001, revised September 2002.

c. Through the planning components (elements) of the system, the organization maintains a list of the issues (aspects) associated with its operations that could affect the environment, and assesses the level of "environmental risk" associated with these issues, to determine those that need to be addressed as priorities. Based on this assessment, objectives and targets are established, as well as environmental management programs (action plans) to achieve them. The programs include a series of specific actions driven to reduce the level of "environmental risk" through training, procedures, etc., each of which are assigned to an accountable party with set timelines to ensure their implementation.

d. The implementation components of the system make the system operational at the working levels in the organization, with the necessary resources.

e. The main goal of the "checking" components is to track progress towards completion of action items in programs to monitor the achievement of objectives and targets, as well as to verify the effectiveness of measures that have been established to reduce the environmental risk, and to make corrections where necessary. The more mature the system, the greater the degree of effort will be dedicated to the operation and maintenance of existing programs to manage risk at an acceptable level. Risk cannot typically be eliminated in complex organizations, but it can be appropriately managed.

f. Finally, the review part consists of top management (with the help of input from across the organization) conducting an overall verification of the whole system's effectiveness and adequacy, and looking for potential opportunities for continual improvement in both the level of performance and the means by which performance is achieved.

g. Part 4 strives to follow and promote these principles with a focus on the operation of an EMS and the achievement of continual improvement. NASA defines continual improvement as - the recurring process of enhancing the environmental management system in order to achieve improvements in overall environmental performance in line with NASA environmental policy. A definition designed to emulate ISO 14001[2]. Continual improvement is the intended result of the Plan-Do-Check-Review approach. The reality is that making it actually effective takes more than just stratifying the defined requirements for an EMS.

Z4.1.2 Effectively Sustaining an EMS

a. An EMS by virtue of being driven by a systematic approach has the capacity to improve both what it manages and how effectively it does this. For

[2] ISO 14001:2004 Environmental management systems – Requirements with guidance for use. International Organization for Standardization, URL: http://www.iso.ch/iso/en/CatalogueListPage.CatalogueList?ICS1=13&ICS2=20&ICS3=10.

this to occur / occur at an optimal rate, ongoing effort is required and having implemented an EMS that satisfies the strict requirements of NPR 8553.1 (or any other EMS model) does not ensure this will occur. Unfortunately it is easy, and somewhat human nature, to take a rest or breather once a determination has been made that the EMS is in place.

b. A viable EMS over the long term (some guidance on what a viable EMS is, is provided Part 3.4.2) cannot rest on its laurels. Simply maintaining the status quo is not what continual improvement is about. A viable EMS strives to be the equivalent of a "beyond compliance" program, where success is not defined by meeting strict requirements but rather success in achievements that are necessarily required, but which do provide benefits to the organization. For example: if the EMS allows for better relationships with stakeholders, this is not a defined requirement yet it can benefit a Center through tangible measures such as a lower regulatory inspection frequency or intangibles like improved community relations.

c. To sustain the EMS and do more than maintain the status quo requires efforts to look internally for what has worked well that can be applied in other areas of a Center. Use success in one EMS element or area as a driver to look for other ways to improve.

d. Sustaining the EMS over the long run also requires looking beyond the Center and NASA. Centers should share best practices. Centers should also consider interacting with other organizations nearby that have an EMS, where there will be times where the lesson learned may at times be an affirmation that a Center practice continues to be a best practice and at other times these external organizations may be able to share new information.

e. It is acceptable and desirable to periodically review procedures and other EMS documentation to identify where they can be simplified and if possible combined or eliminated. Understand the drivers behind the content of existing procedures, and assess if they remain applicable, appropriate and relevant. If upon review, a procedural requirement does not have a demonstrable benefit its continued use should be questioned. Focused requirements tend to be more effective. By integrating EMS requirements within general operating requirements, they become a part of the general operational functions of a Center.

f. Avoid a reliance on annual EMS reviews, environmental functional reviews and management reviews to drive improvement in the EMS. These functions while important are periodic in nature and do not tend to provide an ongoing opportunity to identify opportunities at detailed operational levels. If the operating level staff of an organization are active participants in identification of opportunities to improve, as the end users of the tools of an EMS, they can contribute significantly to the improvement in how those tools work.

Z4.1.3 Changes Potentially Effecting Environmental Management

a. At most large complex organizations, the following axiom holds true. “The only constant is change”. NASA is no exception to this. Change comes in many ways and forms. Some of the forms of change that effect an EMS are:

(1) Changes in the scope of the EMS.

(2) Changes in activities, products and services (revisions, changes in intensity, new or deleted) – includes changes in programs and projects, processes, equipment, infrastructure, property transactions.

(3) Changes in the roles, responsibilities and organizational structure at the Center.

(4) Contract / contractor changes.

(5) New or revised requirements – legal and other, NASA level requirements, mission / vision / policy.

(6) External or unforeseen factors – changes in stakeholder concerns, accidents, emergencies.

(7) Review of EMS status and viability.

(8) EMS audit and review.

b. While it is not practical or possible to anticipate all possible changes that might affect an EMS, a more resilient EMS will be designed in anticipation of change. Comments on change are provided as applicable to EMS elements below.

c. Most change effects aspects and impacts, and changes in aspects and impacts and legal and other requirements have the potential to effect all other elements and sub-elements of the EMS.

Z4.2 Environmental Policy

a. NASA Environmental Policy conveys NASA’s values and culture with respect to the protection of the environment, and these values need to be effectively communicated throughout the agency.

b. While Centers are not required to have their own environmental policies, if they do, they must not conflict with NASA policy and should focus on Center level values.

Z4.2.1 Policy Communication

a. Environmental policy is the driving force behind the EMS. Effective communications help explain the environmental policy and how it fits in with the overall agency vision and mission statement and similar Center level statements.

b. Effective internal communication requires mechanisms for information to flow top-down, bottom-up and across functional lines. Identify internal communication audiences and the information that needs to be communicated to these groups.

c. All employees and contractors need to be aware of NASA's commitments to the environment. Each organizational unit at a Center (directorate / office) should consider the work environment and the Center and the organizational unit should assess the most effective means for communicating the policy.

d. Methods of internal communication include:

(1) Referring to the policy at staff or all-hands meetings

(2) Incorporating the policy into training classes and materials

(3) Referring to the policy at staff meetings

(4) Posting it around work sites, posting it on the intranet, etc.

e. Options for external communication of the policy include:

(1) Ensuring it is easily accessed from the Center web site(s)

(2) Refer to the policy at relevant public outreach and support activities and events

(3) Include the core commitments under the environmental policy in relevant annual reports

Z4.2.2 Awareness and understanding of the policy

a. The value of policy is realized when words result in action. Beyond just communicating the text of the policy to employees, it is advisable to articulate the true meaning /intent of the policy, and what it really means to employees in terms of their day-to-day jobs.

b. Beyond internal assessments of the EMS, this does not mean a program of measuring awareness of the policy is required, but when decisions are made

with potential environmental impacts, staff making those decisions should be able to articulate how the decisions are consistent with the policy.

c. Management is required to ensure that all levels of their organization are familiar with the policy and that employees and other on-site personnel understand critical elements of the policy.

d. An effective means for achieving awareness is through focused meetings involving small groups.

e. Periodically test awareness and understanding of the policy. Ask employees what the policy means to them and how it affects their work. They do not need to be able to quote the policy but should be able to identify how they would obtain a copy if needed.

Z4.2.3 Availability of the Policy

a. NPD 8500.1 is available internally and externally via the internet and NODIS. NASA Policy on Environmental Quality and Control, 14 CFR, subpart 1216.1 is available on the internet. When these are updated, Headquarters Environmental Management Division ensures that changes and where to locate them are communicated across NASA.

b. Center environmental policies should be made similarly available to all staff, contractors and tenants within the scope of the Center's EMS.

c. The degree to which Center environmental policy is externally communicated is the choice of the Center. Options for externally communicating policy include: posting it on the Internet, including the policy in press releases, annual reports, advertising, include or incorporate mention of the policy at open houses, informal discussions, focus groups, etc.

Z4.2.4 Feedback and Review

a. Solicit feedback on the policy from all employees, contractors and other interested parties.

b. Plan to review Center policy at regular intervals. Incorporate feedback, where necessary, on the policy.

c. Management review is one opportunity for review of Center environmental policy. The review needs to consider changes at the Center (e.g. scope of the EMS, change in Mission at the Center, if management systems are being integrated) and if they requires changes to the policy. Ongoing suitability of the policy is important to consider since the EMS is a reflection of the high level direction within the policy.

Z4.3 Planning

Z4.3.1 Environmental Aspects and Impacts

a. Chapter 3.1 provides a step-by-step process for identifying environmental aspects and impacts essential to developing and maintaining NASA's EMS. Chapter 3.1 also defines the process for determining which aspects are high priority and therefore require objectives, targets and environmental management programs.

Z4.3.1.1 EMS Scope

e. As defined in the Preface of NPR 8553.1, "The scope of the EMS at each Center consists of management defined: activities, products, and services applicable to the EMS, over which the Center has control and/or influence"

f. Part of laying the groundwork for an EMS involves defining the scope of the EMS. In a generic sense, the EMS scope should define the boundaries of the agencies' or facilities' activities, products and services and the areas that management can control or have influence over.

g. When defining the scope of a Center EMS it is advisable to consider more than just geographic footprint / fence-line of the Center. By producing a Center EMS scope description that explains what the Center has determined it has control and /or influence over, there will be added clarity for the EMS throughout. A description should identify:

(1) The geographic limitations of the EMS

(2) The boundaries of environmental licenses, permits or approvals

(3) The boundaries of environmental aspects that NASA and the Center can control, and those over which the organization could only be expected to exert an influence

(4) The extent of authority to determine how the environmental policy is implemented

(5) The extent of authority to allocate appropriate resources

(6) The operational / administrative units included (directives and codes)

(7) The defined limitations between areas like health and safety versus environment, for example: if chemical handling and management are included

Z4.3.1.2 Stepwise approach

a. Chapter 3.1 provides the required steps that must be followed. The Chapter while more prescriptive than other Chapters in NPR 8553.1, still provides Centers with flexibility in interpretation of those requirements. Centers should be consistent in how they interpret and apply those requirements so that the determination of high priority aspects and resulting dedication of Center resources reflects the level of risk. The required records and documentation for Chapter 3.1 are summarized in Appendix B. Centers need to consider longer-term maintenance of the EMS and ensure that enough of the substance of the thought process associated with performing each step has been captured so that effort will not have to be repeated in the future when aspect and impact information is reviewed and updated.

b. Step 1: List all activities, products, and services.

(1) When listing activities products and services consider everything within the scope of the EMS. The list can in fact be the detailed description of the scope of the EMS.

(2) When developing the list be sure to think inclusively. Just because an activity, product or service does not have a known associated environmental aspect or impact does not mean it should not be on the list. The requirement to identify and document past present and future activities is geared towards ensuring that a comprehensive list is developed.

(3) It is advisable to have considered ahead of time what types of changes in the scope of the EMS / changes in operations, programs and projects will be triggers for a review of the output from Chapter 3.1. Change occurs all the time at a Center. What level or types of changes would necessitate an assessment as to if the approach to related environmental aspects and potentially their management (ongoing controls or EMPs under way) should be defined, at least in broad terms. This is separate from the periodic review of all aspects and impacts.

(4) Possible review triggers include: a revision of the Center Mission or environmental policy, the Center has a major new program area added or removed from its operations, the geographic footprint of the Center is modified or the overall scope of the EMS is changed.

c. Step 2: Identify environmental aspects and impact(s)

(1) NPR 8553.1 provides specific definitions for environmental aspects and impacts. Aspects can be thought of as what we can control and manage / modify, and the impact is the result of what we do and mange but which cannot directly manage or change.

(2) The concepts of aspects and impacts can be difficult to initially differentiate. As an example, a service at NASA would be engine testing; an interaction with the environment (aspect) would be the release of chemicals during testing, and potential environmental impacts would be contamination of air and noise.

(3) It is important to identify all aspects and impacts. This includes both ongoing or recurring impacts as well as potential ones. Considering impacts associated with past present and future activities and normal, abnormal and emergency conditions is intended to ensure that if there is a potential for an impact to occur it is recognized. Later steps in the process will exclude aspects from becoming high priority if the frequency of a potential impact is low.

(4) The generated list of aspects and impacts should be inclusive and a comprehensive list at this point is beneficial, but within limits (e.g. listing individual waste classes that are generated or the specific types of laboratory operations in one building as opposed to noting that hazardous waste is produced). This does not mean that detail should be included for its own sake. If a list of activities, products and services were generated by each organizational unit at the Center, then even though there might be similar aspects (e.g. hazardous waste accumulation) in a number of different buildings or directorates, this level of delineation could prove useful to retain for future reviews of aspects. Under Step 3 the generation of a manageable sized list is discussed.

(5) Organize information at the level of detail and along the some lines work and sub organizations are managed general day operational purposes.

d. Step 3: Group aspects and impacts for manageability

(1) Centers may group aspects and impacts to ensure that the number of aspects and impacts carried forward for further analysis is manageable. Grouping may be conducted using the following guidelines.

(2) Similar aspects associated with several distinct activities, products, or services should be grouped into one aspect. If, for example, hazardous wastes are collected and disposed of under several activities, their aspects may be combined into one.

(3) Ensure that as aspects are grouped, it is not done to the extent that the resulting objectives, targets, management programs, and operational controls are incapable of managing them.

(4) Chapter 3.1 provides for 12 aspect categories. While Centers can use whatever descriptive terms they wish to note their aspects, all aspects need to be organized into these categories so that they can be “rolled up” across NASA.

(5) An aspect may have impacts associated with it that cover more than one of the aspect categories. While Centers are free to determine which category to use, the most prevalent category or the category that is most closely associated with the highest risk ranking are ways to chose. When aspects and impacts are reviewed, the choice of aspect categories and the rationale for category choices should be a part of that review.

(6) Centers need to consider the level of record keeping that will allow them to avoid duplication of effort to group and assign aspect categories in future reviews.

e. Step 4: Categorize environmental impacts

(1) Chapter 3.1 provides a detailed description of impact categories. Both adverse and beneficial impact descriptions are provided. There is a tendency to at times focus on the adverse impacts associated with aspects (in part driven by legal requirements, which are often designed to ensure protection of the environment through command and control and processes like NEPA which focus on understanding adverse impacts). To counteract this tendency, the impact category descriptions also include specific references to examples of beneficial impacts.

(2) When identifying impacts and when categorizing them into one of the six possible categories: Safety and Health (S&H), Natural and Cultural Resources Impacts (NCR), Cost to NASA (Cost), Mission Impacts (MI), Reputation and Stakeholder Relationships (R&S), and Environmental Legal/Regulatory Implications (L&R), consider possible adverse and beneficial impacts as separate impacts.

(3) For any one grouped aspect there may be several adverse and / or beneficial impacts.

(4) The records generated at this stage should be sufficient that others with the same experience and capability would be able to apply steps 4, 5 and 6 in a similar way. Having this level of detail will be of considerable assistance in future aspect and impact reviews and updates.

(5) Remember that all aspects and impacts need to be considered at this point. While it might appear obvious that some aspects and impacts will not “score” high under steps 5, 6 and 7, if we only choose to score those aspects we already know are a higher risk, then we negate the objectivity of the process.

f. Step 5: Determine the environmental impact severity score for each category

(1) For each impact associated with each aspect, the severity score needs to be assigned. Remember that for this step it is important to avoid the temptation to "skip" a potential impact with a low probability.

(2) When assigning severity scores, a consistent approach should be used. The Impact category descriptions in Chapter 3.1 use terms such as "substantial" and "minimal" but do not define what these terms mean in relation to environmental impact severity. These terms have been used to allow each Center to set its own interpretation of what these subjective terms mean for that Center. Once a Center defines for example: what a minor injury or human health impact is for the Center, it needs to use a consistent "yardstick" for all such severity determinations.

(3) The actual severity scores need to include consideration of current practice at the Center. Example: If hazardous air pollutant emissions were not properly managed by a Center, it is likely to receive a fine and/or consent agreement in association with normal operations. Therefore, under L&R, the severity score would be a 1. But if there are effective management controls in place that have effectively reduce the likely severity to only occur in the case of a process upset, then for normal operations the score might be a 3. The severity score could still be a 1 for abnormal operations, but with a lower frequency for abnormal operations (see step 6) the overall risk ranking is less likely to be high.

(4) Centers should consider the level of detail to record from severity determinations. Too much detail will become cumbersome and awkward to manage, but if all that is recorded in the scores from 1 to 4, then the rationale behind the scores may have been lost.

(5) There is no expectation that data driven / scientific studies should be conducted to determine severity. The expectation is that one or more individuals will make severity determinations based on professional judgment and understanding of NASA and the Center.

(6) For a typical Center, once step 7 is complete, if there are fewer than 3 high priority environmental aspects or more than 10, then the interpretations of the subjective terms noted above may need to be revisited.

(7) Over time as the EMS is in place, if environmental management programs proceed and mature into ongoing management controls in place for high priority environmental aspects, these aspects should no longer be high priority. When Centers review the EMS in general and specifically how they interpret the impact category terminology, they may find that they will want to refine those interpretations. This is an accepted and desirable part of continuous improvement in an EMS.

(8) As the Center EMS matures, sustainability related and beyond compliance considerations, as well as beneficial impacts drive aspects to become high-priority aspects. This change in EMS focus is acceptable and encouraged. Be sure that as the focus shifts that the means for determining severity continues to be consistently applied across all impacts and related aspects.

g. Step 6: Determine the environmental impact frequency score for each category

(1) For each impact associated with each aspect, the frequency score needs to be assigned. Remember that for this step, base the frequency on current information. Information on frequency should be based on what information the Center has access to: internally, within NASA or other similar operations.

(2) Consider normal, abnormal and emergency situations as separate impacts with separate categories for that aspect, for which separate frequency scores and ultimately separate risk rankings will result. But if there is no known frequency for an abnormal situation for example or if the impact category only occurs with emergencies then only consider scoring as appropriate.

(3) Example: An impact with which three operational situations are associated would be solvent waste handling. Normal operation results in hazardous waste with the frequency category 1. Abnormal impacts would include solvent waste generated during special events and added solvent waste streams when small spills occur during maintenance operations. This type of situation historically has occurred once in the past 5 years for frequency of category 2. A potential emergency would be a fire involving flammable solvent waste, which has not historically occurred at the Center, and therefore, category 4 applies. The potential for all three situations is part of the rationale for storage and handling practices already in place.

(4) When a frequency is based on historical data from a regular or periodically occurring event, the predictability of future events tends to be more reliable (until other factors like improved controls take effect). When frequency estimates are based on data from other locations, and professional judgment, these estimates can change with new information. For example: by sharing information between Centers, on an ongoing basis, on the prevalence of different spills, a more reliable picture of the likelihood of future spills is possible. Records regarding frequency scores should provide an indication of the rationale for the score so that when reviewed, updating is simplified and does not necessarily require repeating background work already performed.

(5) Unlike severity, there is no subjective terminology used here, therefore so long as no new information is available on frequency these less subjective scores tend to be more stable.

(6) Changes that can effect frequency scores include: new information / new information sources, changes in how aspects are managed and changes in activity levels.

(7) Lower frequency levels for impacts (and hence lower risk rankings) due to more effective controls are a part of what should happen as environmental management programs are implemented.

h. Step 7: Determine the overall risk ranking level

(1) For each grouped aspect the risk ranking score for each of its impacts should be determined. The highest ranking out of those impacts for will be the ranking for that aspect.

(2) An aspect may have one or more impact categories associated with it and with differing severity and frequencies depending on normal, versus abnormal, or emergency situations.

(3) As noted under previous steps, records of how the determination is made are an important part of an EMS. Centers are free to determine how to keep the records but as a part of the required environmental aspect category determination should be able to identify the Center's high priority environmental aspects within each aspect category.

Z4.3.1.3 Example 1: The following is an example of the application of the stepwise approach.

In reviewing activities, services, and products, Center A identified aircraft engine testing, facilities maintenance, building a road, small parts cleaning, and foam blowing as major activities. Each of these activities has numerous sub-activities associated with it. For instance, some of the following sub-activities are associated with the testing of aircraft engines:

- Engine run-ups,
- Cleaning of engines,
- Visual inspections using fiber optics and bore scopes, and
- Dye penetrant testing to determine if there are microscopic cracks or defects.

Sub-activities associated with landscape maintenance include—

- Planting trees and greenery,
- Applying pesticides and herbicides, and
- Composting.

Sub-activities associated with building a road include—

- Crossing wetlands, and
- Destruction of habitat.

Sub-activities associated with small parts cleaning might include—

- Product substitution, and
- Hazardous Waste generation and disposal.

Sub-activities associated with mission deployment include—

- External tank foam blowing.

Each of these activities has various aspects, impacts, and risks associated with it. Below are examples of the results obtained when several of these sub-activities (engine run-ups, engine cleaning, composting, pesticide application, building a road through wetlands, external tank foam blowing, and small parts cleaning) were analyzed using the procedures outlined in Chapter 3.1.

The completed table on the following page shows that three of these activities were determined to have overall high-risk rankings and shall, therefore, be managed with objectives and targets. Although pesticide use and small parts cleaning were also determined to have a high-risk ranking, they were grouped with other similar activities having similar aspects and impacts (engine run-ups and engine cleaning); therefore, the impacts of hazardous waste generation all fall into a high-risk ranking, regardless of the specific activity. Those activities with risk rankings classified as medium should be managed to ensure they do not achieve a higher risk ranking. Those designated as low to very low need to be managed at the discretion of the Center.

The Risk Form is an example of how to organize the outputs from Chapter 3.1, but the specific format is not required.

Risk Matrix Form

Activity, Product, and Service	Aspect	Grouped Aspect	Aspect Category	Impact	Impact Category	Severity	Frequency	Overall Risk Ranking	O&T
R&D: *Aircraft Engine Testing*									
➢ Engine Run-up	NO_x/CO_2 emissions Generate/disposal waste Hearing degradation	Haz Waste	Air Emissions Hazardous Waste NEPA	Degraded air Impacts to land Noise	S&H L&R S&H	3 1 3	3 2 1	VL H/grouped M	✔
➢ Engine Cleaning	Solvent run-off VOC emissions Generate/disposal Less VOC's/ Less hazardous waste generation/disposal	Haz Waste	Water Air Emissions Hazardous Waste Sustainability	Water degradation Degraded air Water handling Prevention	L&R L&R S&H S&H	1 1 3 4	3 3 3 3	M H VL/grouped VL (beneficial)	✔
Facilities Maintenance: *Landscape Maintenance*									

Activity, Product, and Service	Aspect	Grouped Aspect	Aspect Category	Impact	Impact Category	Severity	Frequency	Overall Risk Ranking	O&T
➢ Mulching/ Composting	Less solid waste generation (beneficial)		Sustainability	Impacts to land	L&R	4	1	VL (beneficial)	
➢ Pesticide Use	Hazardous waste generation/disposal	Haz Waste	Hazardous Waste	Impacts to land	L&R	1	2	H/grouped	✔
Construction of Facilities: *Building a Road*									
➢ Crossing Wetlands	Loss of wetland habitat		Natural Resources	Decreases bio diversity	NCR	2	3	L	
Mission Deployment									
➢ External Tank Foam Blowing	Less HCFC's (beneficial) Less HCFC's (beneficial)		Air Emissions Sustainability	Degraded air	L&R MI R&S Cost	3 3 4 4	1 1 1 1	M M VL VL	
Personal Property Disposal Operations									
➢ Waste Paper Recycling	Less material to landfill (beneficial)		Sustainability	Less land use	L&R N&R	4 2	1 1	VL M	

Activity, Product, and Service	Aspect	Grouped Aspect	Aspect Category	Impact	Impact Category	Severity	Frequency	Overall Risk Ranking	O&T
Equipment Maintenance: *Engine Repair*									
➢ Small Parts Cleaning	Increase in hazardous waste generation/ disposal	Haz Waste	Hazardous Waste	Land use for disposal	L&R	1	1	H/grouped	✔

Z4.3.1.5 Change Effecting Aspects and Impacts

a. Most potential changes at a NASA Center (see Part 4.1.3) have the potential to effect aspects and impacts. As a result these changes can also affect the elements of an EMS in place to manage those aspects (objectives and targets through to records).

b. In order to understand what and how changes can affect an EMS, the background that drives an aspect, related impacts and their associated risk ranking needs to be understood. Documentation and records for aspects and impacts noted in Part 4.3.1 are where this information should be located.

Z4.3.2 Legal and Other Requirements

a. Legal and other requirements that need to be considered in NASA operations include:

(1) Federal laws (and related regulations)

(2) Executive orders

(3) Office of Management and Budget Circulars

(4) State laws (and related regulations)

(5) Local (county, city, regional) laws

(6) Ordinances

(7) Tribal requirements

(8) Agreements (Agency and local to international)

(9) Permit driven requirements

(10) Contractual obligations

(11) Internal standards

(12) Proposed changes to any of the above

b. The Environmental Management Division periodically creates lists of federal environmental laws and other legal requirements, potentially applicable to NASA. These serve as an initial introduction only to these requirements. Understanding of specific requirements and their applicability is necessary for making individual decisions.

c. Environmental legal and other requirements cover the majority of environmental subject areas within the scope of a Center EMS and are far more complex than any one person can comprehend or comply with, without help. Most Centers have several staff just to keep track of and cover these requirements, so it is clear that Center staff need to refine legal and other requirements information into focused versions for end users, for whom environmental requirements are a small part of their overall responsibilities.

d. Identification of applicable legal and other requirements includes a periodically updated overall baseline of requirements and a process to identify recent and proposed changes and additions to those requirements. Utility to staff at the Center environmental office and to end users, is achieved by having the applicability of requirements to actual Center activities, products and services defined to the greatest degree practical. The level of effort required to develop and maintain a clearly stated interpretation of the precise legal and other requirements that apply to each person's work at a Center would overwhelm the staff and resources available.

e. Centers need to strike a balance between the benefit of providing detailed information to end users so that they are aware all of the specific requirements that apply and can work to ensure they meet them, versus, a blend where end users are aware of key requirements that they must satisfy on a regular basis and more infrequent or exceptional requirements that environmental staff act as the resource for. The best balance on this choice is affected by factors such as: staffing levels, the stability of end users in specific roles (are they in place long enough to develop the required understanding), and the frequency at which legal and other requirements information is applied as part of an individual's work.

f. When developing processes and procedures for determining the applicability of legal and other requirements, the dissemination of information on these requirements within a Center and training on requirements, the degree of formality, structure and thoroughness will need to be considered. Indicators that more comprehensive processes are required include:

(1) Staff with regular environmental responsibilities are not aware of requirements or the implications of failure to adhere to them

(2) Changes in requirements have occurred but required changes in practices have not been noted as needed of put into place until they are discovered during an internal compliance review.

g. Legal and Regulatory (L&R) as one of the six consequence categories that result in risk matrix rankings, is affected by changes in legal and other requirements. As a result, consider how will changes in requirements feed in to review of risk matrix rankings.

h. Legal and other requirements tend to change on an ongoing basis, which is why tracking them is important. Legal requirements and the implications of changes to NASA involve relatively easily identified sources of changes (the legal authorities are well defined in law) and EMS and environmental programs at NASA are well developed to handle these issues. Requirements that originate from "other" sources are not as easy to predict and as result take more effort to identify and to determine applicability and the appropriate response.

i. Communication strategies for legal and other requirements include:

(1) Once applicable requirements have been identified and analyzed, communicate these requirements and plans for complying with them to employees, on-site contractors and others. The "plans for compliance", which may be operational controls, should be the focus, not the detail of the actual requirements.

(2) People will have different information needs so try to focus the information provided on the specific responsibilities of the individual. The required level of environmental legal and other requirements understanding at the end user level does not normally include the ability to cite actual text of those requirements. It is preferable that the end user understands and can articulate the requirements in terms of their actual work tasks and activities. For example: knowing the correct UST monitoring frequency and tasks as part of an overall operating procedure for a tank farm, is more important for the day to day operations staff, than being able to identify the tank regulations and quote them. It is beneficial to be aware of what operating procedural components are driven by the tank regulations but not what those detailed regulations are. If end users ever needed that level of detail, they could consult with the environmental office.

(3) Identification and communication of legal and other requirements needs to be an ongoing process, as legal and other requirements change over time.

Z4.3.3 Objectives and Targets

a. Chapter 3.3 requires Centers to establish environmental objectives and targets that demonstrate commitment consistent with the intent of NASA Environmental Policy and the environmental aspects established through the EMS process. The details of how this is accomplished, is up to a Center, but it would be expected that a process (but not necessarily a procedure) should exist.

b. Each objective should have a quantifiable target, including completion date (for example, pounds of waste reduced by a certain date). In keeping with NASA's commitments to move beyond compliance and continual improvement, at least some objectives and targets should strive to exceed current compliance requirements.

c. When developing environmental objectives and targets (i.e. goals, and when periodically reviewing to ensure they remain relevant), keep in mind the following:

(1) Do they satisfy Chapter 3.3.3 requirements?

(2) Be sure that the goals are realistic and fit your mission and overall business strategy

(3) Be sure the goals reduce your impacts on the environment /improve on benefits, have a timeline, and are measurable. For each goal, decide how to measure performance, and determine how the goal relates to environmental policy. Keep in mind that you need baseline data (which you may need to develop) to compare progress

(4) When appropriate consider obtaining views from internal and external parties on objectives and targets

(5) Set an action plan (EMP) for achieving the goals

(6) Communicate to your EMS Team the reasons for selecting each goal

(7) Ensure there is a process in place to measure and monitor progress toward goals on a routine basis and that this progress is communicated to appropriate individuals. Staggered, where there are interim and longer term objectives and targets, is one way to accomplish this

(8) When objectives and targets are adjusted, revisions to EMPs should be anticipated. Changes in the drivers that precipitate objectives and targets should be expected (with the likely hood of change increasing with time horizons) as well as the variables that drive their attainment

(9) The definition of EMS success is more than if objectives and targets are being met and internal audits reveal few non-conformances. Look for ways to continually improve by using objectives and targets. It will be important to periodically revisit what is considered success, as this will change over time and likely influence the setting of objectives and targets to be achieved

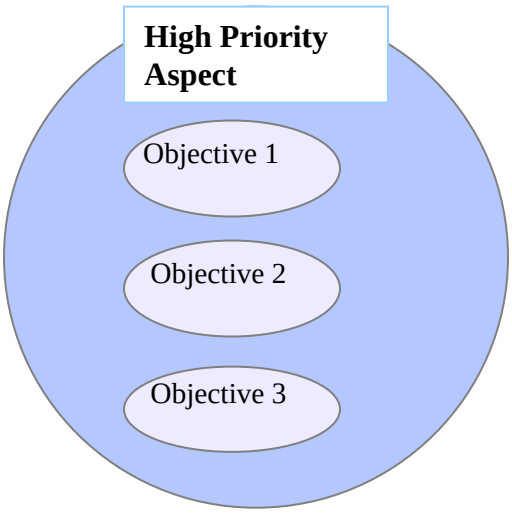
(10) Ideally as an EMS moves towards maturation, objectives and targets are stretch goals that are a key part of sustainability and moving beyond compliance

d. In the NASA EMS, setting an EMS objective or target is the primary trigger that drives requirements for an environmental management program (a plan of action to accomplish the objective / target) as well as, as appropriate, operational controls, monitoring and measuring requirements and other components within the NASA EMS model.

e. Experience has shown that at a practical level, management is hesitant to approve objectives and targets without detailed forecasting of the resulting resource commitments and implications for operations and mission success. As a result when proposing objectives and targets, a thorough understanding of associated implications across the organization is recommended.

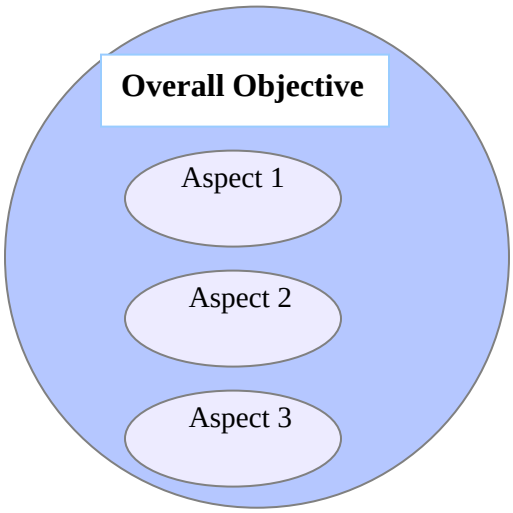
f. The figures below provide graphical representations of options Centers may utilize for configuring objectives, and targets for aspects.

Objectives for a High Priority Aspect



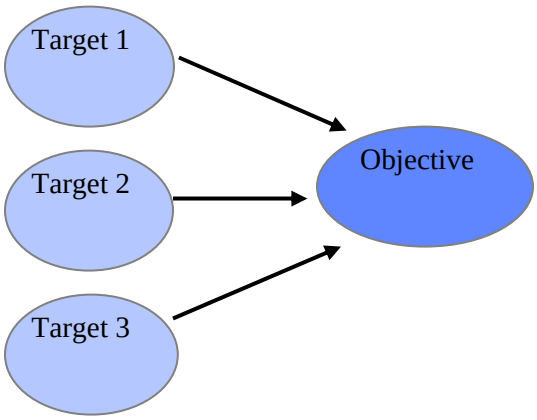
- **Multiple objectives may need to be established for one high priority aspect.**

Objective for Multiple Aspects

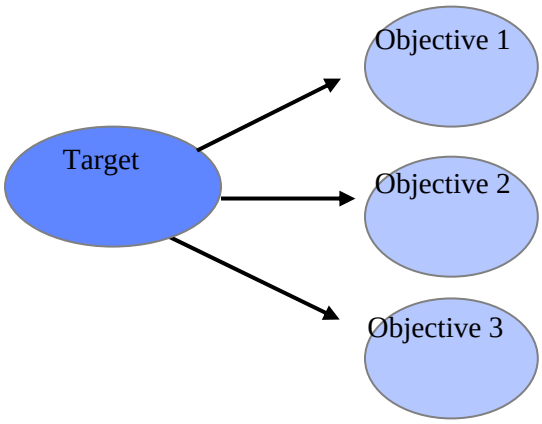


- **One objective may satisfy several high priority aspects.**

Multiple Objectives and Targets



- **Multiple targets may be needed to achieve a single objective.**



- **One target may satisfy several objectives.**

g. Sample objectives and targets for various categories directly associated with operations are given below.

Objectives	Targets
Chemical Inputs	
Increase use of non-hazardous chemicals by suppliers	• Increase use of suppliers that provide alternative chemicals by 15% by January 2008
Energy and Water Usage	
Reduce energy and water use	• Reduce energy use by 10% per 100 man-hours from 2005 levels by January 2009
	• Reduce water use per 100 man-hours from 2002 levels by January 2009
Point Source and Fugitive Air Emissions	
Reduce air emissions	• Reduce permitted air emissions by 10% by January 2007, relative to year 2005 baseline
Storm Water Discharge	
Improve storm water discharge quality	• Investigate improvements in storm water collection and filtration system by January 2007
	• Investigate effectiveness of additional best management practices by January 2008
Hazardous and Non-hazardous Wastes	
Reduce hazardous and non-hazardous waste	• Reduce hazardous chemical use by volume by10% relative to 2005 values by January 2007
	• Reduce hazardous filter waste by weight by 5% relative to a 2005 baseline by January 2007
	• Reduce process sludge waste by weight by 5% relative to a 2005 baseline by January 2007
	• Reduce plastic and foam waste by weight by 10% relative to a 2005 baseline by January 2007
	• Study plastic drum reduction – Complete study by January 2007
Spills	
Reduce occurrence of spills	• Reduce spill occurrence by 10% by January 2007 by a sub-team of the CFT conducting a root cause analysis of spills during 2006 that will be incorporated into a new training program and conducting the following training: o Spill prevention awareness training for all facility personnel by July 2006. o In-depth spill prevention training for all raw material handling personnel by July 2006. o Spill control training for production personnel by August 2006.

h. In communicating objectives and targets to employees and contractors, try to link objectives to the actual environmental improvements being sought. This should give people something tangible to work towards.

i. Communicate your progress in achieving objectives and targets across the organization. Consider a regular report on this progress at staff meetings.

Z4.3.4 Environmental Management Program(s) (EMPs)

a. Chapter 3.4 requires Centers to establish and maintain Environmental Management Programs (EMP) that achieve NASA's Environmental Policy and EMS objectives and targets. Aside from general high-level requirements for EMPs their content is a Center choice. The EMPs and their level of detail, should be in keeping with accepted practice at the Center and be detailed enough to guide the work but developing them should not consume resources better spent on actually meeting objectives and targets.

b. Each EMP should be linked directly to your objectives and targets, that is, the program should describe how the organization will translate its goals and policy commitments into concrete actions so that environmental objectives and targets are achieved.

c. An EMP can be a linear sequence of tasks with a defined time line and end point or it can be designed to put in place controls that have no known expiration. The common thread is control.

d. EMPs may be technical with procedural requirements or they may be primarily administrative with requirements to review and evaluate management processes. The content of an EMP should be customized to the audience of affected parties.

e. EMPs can be very simple and general in nature or they can be detailed. An example of a possible format for EMPs is provided at the end of Part 4.3.4. When developing EMPs, EMS elements in the example form should be considered. The form should serve only as a form of checklist to ensure that components are not overlooked and unless the EMP is very broad and inclusive, not all of the elements noted would likely be included.

f. Centers should consider:

(1) How EMPs will be kept up to date

(2) What triggers from part 4.1.3 are most likely to require review and possible revision of an EMP

(3) Where EMPs result in, or over time become, ongoing management controls that prevent aspects from becoming high priority, how they will be periodically reviewed (this applies to existing controls that play this role)

g. The defined requirements for EMPs in Chapter 3.4 need to be addressed. While there is no required format, an example is provided as a starting point (See Part 4 Attachment Z4.1 Sample Template for EMP Form). This form considers all of the various EMS elements that might be a part of an EMP. If the EMP is just being developed, initially only some of the possible items and associated questions can be answered. Over time as work under the EMP proceeds, more of the questions can be answered, which is in keeping with the evolving nature of action plans. The EMP may include references or pointers to the more detailed elements of the EMS such as Operational Controls.

Z4.4 Implementation and Operation

Z4.4.1 Structure and Responsibility

a. Chapter 4.1 of NPR 8553.1B requires Centers to identify roles, responsibilities, and authorities that will provide an organizational structure for implementing and maintaining the EMS. When identifying and defining EMS roles, responsibilities, and authorities, be sure to consider NPD 1000.3 and any Center role, responsibility, and authority documentation, and be consistent with them

b. Communicate roles, responsibilities and authorities related to the EMS, and document these (e.g. job descriptions, organizational charts, responsibility). The preference should be is to communicate, document and track roles, responsibilities and authorities for staff at all levels.

c. Whenever possible link resource allocation for addressing aspects to the risk ranking (high, medium, etc.), keeping in mind that resources are required for EMPs and for ongoing management to prevent aspect form becoming high priority.

d. While contracts are the primary venue for articulation of requirements to contractors, defined NASA and Center level policy and procedural requirements, which are referenced in contracts, provide information and clarity to contractors on how NASA operates.

e. The roles and responsibilities of the EMS Representative need to be retained, although they may not need to spend as much time on the EMS as before.

f. As an EMS continues to operate, it is also important to keep in place the cross-functional team that was formed to help with implementation. A team like this can deepen the knowledge base for the ongoing improvement of the EMS and continue to act as a liaison across the Center for the EMS.

g. Roles, responsibilities and authorities, should be kept up to date and reflect changes in other EMS elements. Keeping these up to date may be led by the EMS representative but must also be addressed by the “owners” of documented requirements (see Part Z4.4.4).

h. When EMS roles, responsibilities and authorities are reviewed in addition to ensuring that they are current and up-to-date, consider if they are appropriate, and effective. When considering effectiveness, choices need to be made regarding either which individual or position needs to conduct a task. If the level of environment management is consistent across options, then the one that requires the lower level of effort should be considered.

Z4.4.2 Environmental Training - Awareness and Competence

a. Environmental training should be comprised of two different elements: 1) job specific skills and competence training for employees whose work may have an impact on the environment as a result of their work; and 2) general environmental awareness training.

b. Job skill and competence training programs requires an understanding of what training is needed. This requires some form of training needs analysis. Training needs analysis is a process associated with initial EMS implementation and should also be periodically reviewed for both the staff performing in the role and for the role itself. Training needs analysis action steps include:

(1) Identify all job functions that affect the environment. Smaller organizations may wish to identify individuals.

(2) Identify minimum competencies required to carry out environmental management tasks, such as the ones pertaining to controlling high priority aspects. Competences is the goal and should be defined in terms of education, experience, training and skills. Training is required when there is a gap in competency. In assessment of environmental competency, several groups could be involved include Human Resources, immediate supervisor(s) and the EMS Representative.

(3) Identify the training and type of training these people currently receive that relates to the environment.

(4) Determine if EMS education could be integrated with existing training or whether there should be special EMS training, at least in the beginning (and for new employees).

(5) Identify training materials or programs available outside the organization.

c. Competency and training program development, can take on many forms. The following steps describe a process for developing and operating a training program:

(1) Step 1: Assess training needs and requirements

(2) Step 2: Define training objectives

(3) Step 3: Select suitable methods and materials

(4) Step 4: Prepare training plan (who, what, when, where, how)

(5) Step 5: Conduct training

(6) Step 6: Track training (and maintain records)

(7) Step 7: Evaluate training effectiveness

(8) Step 8: Improve training program

e. The following are examples of when evaluation and training might be needed (remember, training includes formal, informal and on-the-job training):

(1) A new employee is hired

(2) An employee is transferred to a new job

(3) An Individual doesn't follow a procedure / instruction

(4) A procedure is changed

(5) A new process, material or equipment is introduced

(6) Changes to objectives and/or targets

(7) New / revised regulations

f. EMS training needs and programs should be reviewed as part of the monitoring and measurement program, the corrective action process, EMS audit, or management review. This should be an ongoing process, following the principles of proactive continual improvement (see Part Z4.5.2 for discussion on preventative action), looking for weaknesses in programs, and areas that limit effectiveness as opposed to only addressing areas of known deficiency.

g. Training programs may also need to be revised in response to changes potentially affecting environmental management as noted in Part Z.4.1.3. Where

and when these changes occur, the training program documentation may need to be updated. Training may need to be updated just to reflect changes in the level of understanding and competency of the audience. I good rule of thumb is that a training package should be reviewed at least once every 3 years and no person should get the same training presentation / package more than twice.

h. If possible, tracking of defined environmental training needs and competency requirements should be fully integrated with the means by which the Center ensures that staff have the required training and skill for other facets of their work. Desirable tracking processes, track required training courses for job functions and tasks, the staff who are qualified for the job or task, and if periodic refresher training is required when existing training expires. Tracking systems are (even those with automated notification functions) only as effective as their users and their diligence in use.

Z4.4.2.1 Environmental Awareness Training

a. General environmental awareness training can be accomplished through: formal training classes or discussions, distribution of EMS informational material and information posted on the Intranet. Additional awareness training can be accomplished through EMS information being incorporated into the existing employee orientation programs.

b. The more focused and customized the approach to environmental awareness training, the more resource intensive and effective it will be. For each functional / organizational unit at the Center, awareness requirements need to be addressed. In providing initial and periodic ongoing awareness training, several overall considerations should be addressed:

(1) Providing a basic (simple perhaps 15 to 30 minutes in duration) level of EMS / environmental awareness training to all staff can cover in general, the essence of the requirements noted above. The downside of a general program is however that by definition it does not tend to focus on the specific areas of emphasis that can have the greatest effect on personal accountability and performance

(2) A dual level, awareness training program with the first level like the one mentioned above, and then one other level that has a higher level of detail for those that have a direct influence in high priority aspects, is more effective

(3) Using smaller group discussions with a less structured approach is also more effective. Smaller group discussions require more preparation but they can focus more on the specific issues at hand within the group

c. Don’t forget that awareness training is not a one-time event. As with skills based training, periodic review and refreshers will be needed.

d. When staff are reassigned to new duties as a result of position changes or changes in the organization, a part of the change should be to consider if environmental awareness training is needed and if the individuals with the change have been informed of:

(1) Changes in high priority environmental impacts associated with their work that they may affect

(2) Changes in requirements of the EMS applicable to their work, and awareness of consequences associated with their deviation from these revised requirements

Z4.4.3 Communication

a. An effective EMS should include procedures for:

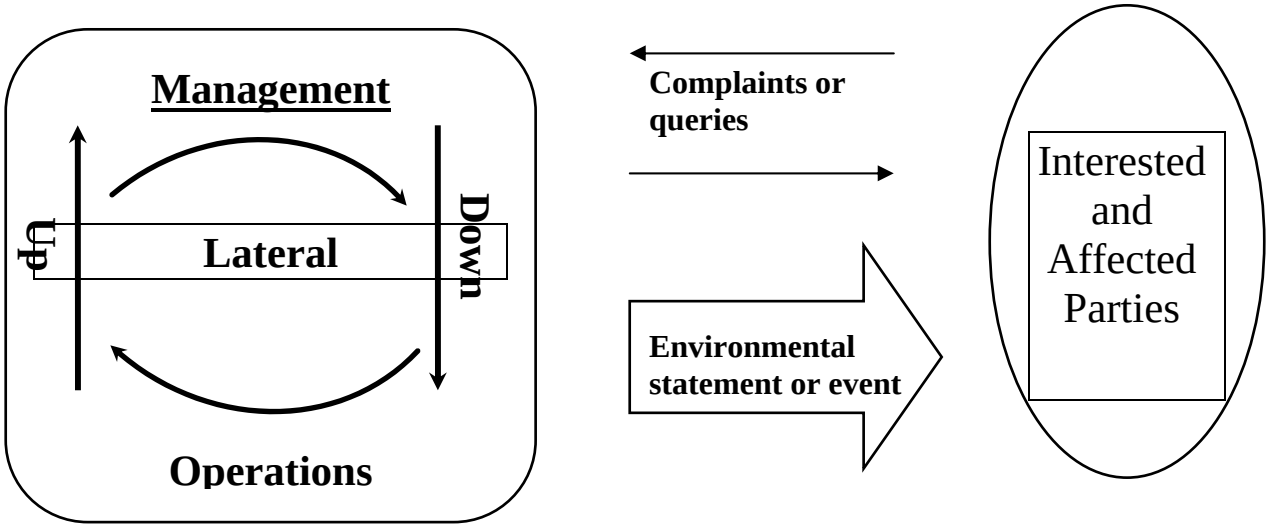
(1) Communicating internally (between levels and functions within the organization)

(2) Soliciting, receiving, documenting and responding to external communications.

b. All EMS communication is subject to NASA communication requirements. For an EMS, communication is a key factor in the operation of an EMS, it is often referred to as the life blood of the EMS.

c. The minimum level of understanding for the EMS that needs to exist within each Center organizational unit is an understanding of the various means by which it communicates environmental information. Consider the following graphical model.

Internal and External Communication



d. Communication includes specific reporting, and documentation and:

(1) Communication externally with external parties regarding the EMS. Aspect, impact and Center high priority environmental aspect information does not have to made available in general but may be accessed by the Public under FOIA

(2) Communication of environmental information with other Centers and with NASA Headquarters

i) Periodic requests of information by Environmental Management Division for internal uses and for external reporting

ii) Ongoing performance reporting with systems such as NETS

iii) Requests made by Mission Directorates and Mission Support Offices

iv) Provision of guidance, formal (including documented requirements) direction, and informal advice across the Center

v) Reporting of Metrics

vi) Providing and receiving information on legal and other requirements

e. Putting communication processes in place is the first step. The effectiveness of the processes is of equal if not greater importance:

(1) Consider not the content of the message, but what information is retained and how it influences what a person does. Providing information is not the goal, the goal is what the recipient does with the information, and the greater that is understood the more effective the communication

(2) Do not loose sight of fact that for the majority of staff, environmental responsibilities are one of many they are charged with, so the message needs to be easily understood and personally relevant

(3) When communicating requirements under and changes in the EMS, remember that the average person wants to know what you are asking them to focus on and do

(4) Do external outreach efforts actually reach the intended audience, what messages are the audience retaining. An environmental or EMS web site that is unknown, or not easily found is not an effective form of communication. Outreach is an active process where the medium and ease with which the intended

audience is able to access and understand the content is often at least as important as the content

Z4.4.4 EMS Documentation and Document Control

a. Under Chapter 4.4, Centers are required to establish and maintain procedures for EMS documentation and document control, general requirements are identified and Appendix B includes a list of required documents. The required list is intended as the minimum, Centers need to decide both if added documentation is needed to ensure that the appropriate level of control is achieved and the level of detail that is needed in the documentation.

Z4.4.4.1 EMS Document Control

a. It is a good idea to have all of the main EMS documents in one place, and documentation that pertains to specific operations or activities may be better managed by the operation (provided it is properly controlled). Document management software and web sites have advantages for complex systems. For less complex system, a paper-based system can be adequate. A document management system can be as simple as a directory on a server that has all of the current copies as read only Word files or PDF files.

c. If some or all EMS documentation is being managed outside of a formal document control system, provided and managed by non-environmental areas remember the Chapter 4.4.3.c requirements for EMS documents.

d. Each document needs to have an owner, who actually has a master copy (for editing to create revised versions in the future) securely stored someplace other than where others can access it. The keys to such a control system are one clear “owner” who is responsible for content and review, and having a built in footer in every file that notes that all printed copies are uncontrolled and which warns that the user should consult with … (the location of the files on the server) for the current version (NODIS uses this form of warning). This simple means can provide the ability to identify document: versions, owners, and facilitate regular reviews.

e. By establishing, documenting, and communicating roles and responsibilities for documentation and document control, the concept of document ownership becomes practice.

f. It is useful to think of a document as a piece of equipment, requiring periodic checking to ensure it is operating optimally and regular maintenance. All documentation needs to be periodically reviewed as a part of the maintenance of the documentation to ensure that changing circumstances are reflected. Periodic reviews occur as a part of regular document control and in conjunction with nonconformances, and corrective and preventive actions.

g. When reviewing existing documentation, involve end users, who are often able to identify opportunities for improvement that a single author will not be aware of.

h. As a part of maintenance look for ways to streamline, shorten and remove non value-added content. When streamlining:

(1) Consider if the document should exist at all. Aside from deleting a document, a balance should be struck between, larger documents that encompass under a set of responsibilities more activities, and shorter more focused documents. The right balance will in part depend on the Center's administrative burdens associated with new or revised documentation

(2) Strive to have operational environmental requirements fully integrated into operational requirements

(3) Involve end users, to discuss what level of detail provides useful guidance and direction, as opposed to preventing beneficial innovation.

Z4.4.4.2 EMS Documentation

a. Specific documentation requirements have not been included in NPR 8553.1 to allow Centers flexibility in describing how they describe the EMS, requirements under it and the means by which environmental aspects and impacts are managed.

b. Consider if an EMS pointer document / "EMS manual" as the central platform from a documentation point of view. This does not have to be complex and it should be something that covers each EMS element and how they work together in a systematic approach to managing all environmental concerns. This document can act as a source of general information on the EMS, and related practices, and to act as a pointer to other documentation.

c. The tendency with Center EMS documentation should be to develop short and general documentation so that the language can encompass issues that are managed. When generating new documents, start with a minimal approach and if during review, or as a result of feedback during use, added detail is identified as beneficial, add it then.

d. Documentation should be developed with the end user in mind, and when ever possible with end user participation in its development. This involvement should be more than a developmental review function (e.g. when developing procedures, the user of a procedure will often be the best source of how to document what is needed to accomplish a stated goal and with minimal excess language).

Z4.4.5 Operational Controls

a. Procedures can help your organization to manage its significant environmental aspects, ensure regulatory compliance and achieve environmental objectives. Key determining factors for assessing if a documented procedure is required include: Would a task or job still be carried out as effectively if staff assigned to the task leave? If the answer is “No”, you need to capture the method followed by the employees for carrying out the task in a documented procedure. Would the absence of a documented procedure (with or without changes in staff) result in an unacceptable risk of an adverse impact?

b. The following is a detailed description of considerations for drafting / “writing” operational control procedures. These considerations need not all be adapted when writing an operational control procedure and are provide as an inclusive format form which authors are free to select applicable portions. The style of this description is focused on high priority aspects. When contractor interaction and requirements are noted, these are subject to contractual limitations.

(1) Step 1: Determine which of the necessary procedures and work instructions already exist as well as gaps where new procedures need to be documented.

(2) Step 2: Document operational control procedures for identified activities where controls are absent.

(3) Step 3: Training /competency needs associated with operational controls need to be identified, planned for, and tracked.

c. Use the answers to the following questions to begin planning documented procedures to cover operational activities and situations where their absence could lead to deviations from the environmental policy:

(1) Have we identified operations and activities associated with priority environmental aspects, legal requirements, and environmental objectives? If not, how will this be accomplished?

(2) Do these include normal and abnormal conditions?

(3) Who should be involved?

(4) What operations and activities are associated with priority environmental aspects (and thereby legal requirements)?

(5) How are the above operations and activities controlled?

(6) What are the operating criteria that need to be maintained to avoid deviations from the environmental policy, goals, and objectives?

(7) How do we know whether these controls are adequate (i.e., to manage priority aspects, to ensure compliance, to achieve objectives)?

(8) What mechanisms should be considered for communicating operational controls?

(9) If new controls are needed (or existing ones need to be revised), what is our process for doing so? Who needs to be involved in this process? It is recommended that the input of employees who carry out the tasks covered in the documented procedure be considered.

d. It is useful to involve the people who implement the procedures in drafting these controls. This may be accomplished in different ways:

(1) Meet with employees and have them describe current procedures. Discuss the environmental objective desired and obtain their input on operational controls (procedures) to ensure that the objectives are met

(2) Have someone (possibly an intern) interview the employees to establish current (undocumented) procedures, then draft or revise operational controls as needed. Have the employees and a manager review the draft and incorporate their input

e. For all operational controls, there should only be one procedure for how to complete any one task. This goes for written or unwritten procedures. This means one procedure that includes the administrative and technical side as well as any environmental, health and safety requirements. Separate procedures for the same activity are a recipe for chaos. Added effort on the part of those defining procedures is usually involved in creating more integrated processes, but when done properly, the overall performance of the end user is worth it.

f. Remember to keep written operational controls simple and concise. They should include the appropriate actions, precautions, and notifications required. Focus on activities that may lead to impacts associated with high priority aspects and avoid getting overwhelmed by trying to control every activity and process.

g. There is no defined format for operational controls in part because they need to be customized. An operational control can, if necessary, be complex in nature and require detailed completion of forms, be directly linked to monitoring measuring requirements, as well affect training, communication and documentation and records (see the definition of operational control in NPR 8553.1). A maintenance manual and its associated defined requirements to ensure proper sampling analysis is an example of an operational control procedure. An operational control procedure might also define the steps that need to be taken when evaluating how to proceed with a project to ensure that

environmental risk as been properly considered in various project planning and execution stages.

h. Designate those responsible for maintaining the controls and for reviewing them to ensure that procedures are followed and deviations are corrected. Generally, the employees responsible for high priority environmental aspects under consideration are responsible for implementing the associated operational controls. The immediate manager would most likely be responsible for regular review of the controls. It is helpful to list those people responsible for each set of procedures.

i. Achieving success in meeting environmental objectives for each high priority environmental aspect depends upon making sure that each person responsible for maintaining or reviewing controls has received adequate training / has the required level of competence.

j. After operational controls are drafted, if deemed appropriate, develop a training program that ensures that everyone understands the controls and their role in ensuring that they are followed. Training can include on-the-job training. This information should be combined with general environmental training when creating an integrated training needs analysis for the EMS.

k. Operational controls may also be needed (though not necessarily documented operational controls) as a part of management controls to ensure aspects do not become high priority. An EMP in the long run may result in operational controls that result in a reduced ranking for an aspect (and thus it no longer may be a high priority). These may need to remain in place.

l. Existing operational controls (written and unwritten) should be periodically reviewed to ensure: they remain relevant, include appropriate detail, and they reflect changes affecting aspects and the EMS. The effectiveness of the operational controls should be considered, including their limitations. When reviewing operational controls consider whether controls are adequate and effective / match practice and principles at the Center.

m. Incident investigation and corrective and preventive action processes should point out when a failure to meet goals and objectives originates from an operational control or a lack thereof. Action should be taken to correct failures in operational controls as quickly as possible to meet environmental objectives.

Z4.4.6 Emergency Preparedness and Response

a. Chapter 4.6 requires facilities address potential incidents and their attendant adverse environmental impacts, through emergency preparedness and response procedures.

b. Emergency preparedness and response procedures must be reviewed and revised, particularly after the occurrence of an emergency or an accident.

c. Ensure that environmental issues are addressed in Center emergency preparedness and response plans and actions. Center environmental staff should periodically review and provide comment on the environmental components of the plans.

d. Environmental aspect risk ranking includes emergencies. Coordinate the emergency situations identified under aspect risk ranking with those considered under Center emergency preparedness and response plans.

Z4.5 Checking and Corrective Action

Z4.5.1 Monitoring and Measurement

a. Monitoring and measurement helps an organization to:

(1) Measure environmental performance

(2) Collect information that will enable analysis of problem root causes

(3) Assess compliance with legal and other requirements

Z4.5.1.1 Key Characteristics Associated with High Priority Environmental Aspects

a. Consider adopting as a management tool, the concept of the “vital few”—that is, choosing a limited number of factors that can have a substantial impact on the outcome of a process. The key is to identify those factors and how to measure them. Process mapping can help you determine those factors:

(1) Which activities, products and services have you defined with high priority environmental aspects?

(2) Which of these have key characteristics that when they are not monitored or measured could lead to deviations from the environmental policy, goals, and objectives? Monitoring of key operational parameters should have been identified as a control measure as part of the determination of environmental aspects

(3) How can your organization measure these characteristics?

b. Whenever practical, use existing measurements and measurement systems to gather data.

c. Where management controls already exist for non high priority aspects, do any of these have a monitoring and measurement component to them? If the existing management controls are resulting in satisfactory performance, there may not be any need to modify them, but it is still advisable to understand them.

d. Be sure to understand not only what you are measuring, but also how reliable and representative the data you collect is.

e. Monitoring and measurement processes may be highly linked, if not integrated, with some operational controls. A key part of managing aspect control may be satisfied in keeping with the acronym, “what gets measures matters”.

f. Monitoring and measurement includes identification of critical equipment used for this purpose. Ensure the equipment is properly calibrated and maintained (for example: consider scheduling repetitive maintenance and calibration tasks on monitoring equipment in maintenance software).

g. Monitoring and measurement is affected by change and can identify change which may then need to be considered throughout the EMS. Change (see Part 4.1.3) can require that what is measured needs to change, or the extent or to which it is measured.

h. Monitoring and measurement of objectives and targets (see Part 4.3.3) is needed in order to ensure that as EMPs proceed, they can be tracked and adjusted as appropriate.

Z4.5.2 Nonconformance, Corrective and Preventive Action

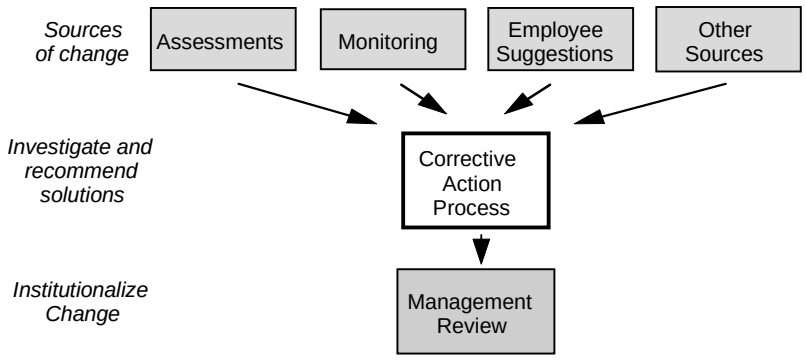
a. The EMS element that logically flows from monitoring and measurement is, nonconformance, corrective and preventive action. Once a non-conformance (failure to meet an EMS specified requirement, which can include non-compliance since compliance is a goal of the EMS), several things need to happen.

(1) Mitigate any associated impacts (“clean up the mess”)

(2) Determine what the cause was. This means more than just the last step in the chain of events and can involve root cause analysis

(3) Correct the problem, and prevent problems from happening again

b. The following is a simplified framework illustrating corrective action processes. Any element of the EMS can be a driver that results in a change, and changes occur at many different organizational levels.



c. The amount of planning and documentation needed for corrective & preventive actions will vary with the severity of the problem and its potential environmental impacts. Don't go overboard with bureaucracy — simple methods often work quite effectively.

d. Once you document a problem, the organization must be committed to resolving it in a timely manner. Be sure that your corrective & preventive action process specifies responsibilities, resources and schedules for completion. Review your progress regularly and follow up to ensure that actions taken are effective.

e. Make sure your actions are based on good information and an understanding of the root cause(s). While many corrective actions may be "common sense," you need to look beneath the surface to determine why problems occur. Many organizations use the term "root cause" in their corrective and preventive action processes. While this term can be used to describe a very formal analysis process (see above), it can also mean something simpler – looking past the obvious or immediate reason for a non-conformance to determine why the non-conformance occurred.

f. Preventive actions include those designed to prevent re-occurrence and benefit from near misses. They can also be based on external sources of information and lessons learned elsewhere in NASA.

g. Tracking systems for corrective and preventive actions do not need to be complex or elaborate. Centers may wish to use existing corrective and preventive action systems since they are likely to be already utilized and understood by Center personnel.

h. Corrective actions may result in changes to EMS policy or procedure, preventive action may include items such as planning, ongoing monitoring and

maintenance and training. The corrective and preventive action process is a key ingredient to the continual improvement.

i. Part of the success of a corrective and preventive action programs depends upon employee/ contractor understanding of: 1) their potential impact on the environment, and 2) that they have a responsibility to become involved in both raising and resolving concerns or non-conformances.

j. Root cause analysis (RCA) is a process by which you can identify causes and preventive actions. If an ongoing or repetitive problem or non-conformance is identified, identify the root cause so that the cause and prevent the problem in the future. Additional Root Cause analysis information is provided in Part 4 Attachment Z4.1.

5.2.1 Preventive Action and Approach to Change

a. For an EMS to be able to adapt to change and continue to improve, a proactive stance is needed. This means that preventive actions take on additional importance. The best way to adapt to change is to anticipate it. By anticipating change, measure (to the extend practical and appropriate) can be put in place to mitigate adverse impacts and effects on NASA and enhance beneficial ones.

b. Avoid the temptation to think of preventative action identification as primarily a process where problems that have occurred at other locations or in other organizations are the focus of where possible actions and lessons learned are identified. Situations for which preventative actions may be appropriate also include changes that have not yet occurred or trends that are emerging for which the best of course of action is to put measures in place proactively as opposed to reactively. These situations may be internally driven (e.g. shuttle termination) or externally driven (e.g. grants).

c. Parts 3.4.2 b. and c. include a number of potential actions and indicators that are forward looking and that can assist with continual improvement of the EMS. These can improve the EMS because they do not wait for issues to manifest themselves or appear.

Z4.5.2.2 A Learning System

a. In order to learn from the experience of operating an EMS and continue to improve it, it is not sufficient to identify problems and correct them. The root causes need to be understood and measures taken to resolve them as discussed above.

b. A learning system also looks at what has been working and understands the root causes for success. Understanding why an approach works is more than

just sharing lessons learned, and examples of operational excellence, it includes the underlying reasons for success, what pitfalls were avoided and what the 'winning formula" is.

c. Examples of operational excellence and lessons learned, across the Center (and the root cause and underlying reason for success) should be catalogued for future use.

Z4.5.3 Records

a. The purpose of Chapter 5.3 is to provide evidence of ongoing operations and maintenance of this EMS.

b. All records are important. If a decision was made that it was worth taking the time to record it then the effort should be taken to ensure it is accessible. Remember that the exercise of recording information in of itself does not improve performance. It is what is done with information to make decisions, and act, that results in improvement.

c. While creating EMPs, define within operational controls, required monitoring and measurement, and ensure that the required records are noted for each of these.

d. For managed programs, identify EMS records to ensure they are readily retrievable.

e. Ensure an effective storage and retrieval system. Do you know if records can be readily located? A good test of this is to have someone with only limited familiarity with the records management system locate records of several different types in different locations.

g. Record management technology is an evolving field. Changes to records management / storage processes normally are long-term decisions, be sure to consider where practices and technology is trending towards.

Z4.5.4 EMS Audit

a. As stated in Chapter 5.4, the purpose of this element is to perform: EMS audits that assess conformance to the manual's requirements and EMS performance, and functional assessments of environmental compliance activities. EMS auditing is a key driver in continual improvement, but since it acts effectively as a snapshot picture, recognize its limits as a change and continual improvement driver.

b. When reviewing the EMS, in addition to assessing conformance with NPR 8553.1 requirements, the review should consider the currency, appropriateness and effectiveness of each EMS element and sub-element.

c. Part 1, includes guidance on:

(1) Center EMS review drivers and using the results of EMS reviews

(2) EMS Review process

(3) How EMS reviews relate to other EMS elements

Z4.6 Management Review

a. Chapter 6.0 requires senior management to be involved in the review and evaluation of the EMS to ensure that it continues to be suitable, adequate, and effective. Part 3 provides guidance on EMS self-declaration, one of the major management review related activities.

b. When defining Center processes consider the roles and responsibilities for management review. The roles need not be highly structured but will likely need to follow others in place for general management and decision making processes at the Center. It can be advantageous to include / integrate management review with other management functions, just as environmental measures at operational levels are best integrated with operations in general.

c. Management review detail will tend to be more condensed with higher management levels. Be sure that as briefings become more focused, that primary content and goals are not over looked.

d. Consider the following for EMS review content.

(1) Results of EMS reviews, environmental functional reviews, reviews of compliance with legal and other requirements to which the Center subscribes

(2) Communication from external interested parties, including complaints

(3) The environmental performance of the Center

(4) The extent to which objectives and targets have been met

(5) Status of corrective and preventive action

(6) Follow-up actions from previous management reviews

(7) Changing circumstances, including changes in applicable legal and other requirements

(8) Recommendations for improvement

e. The output from a management review should include:

(1) Decisions and actions to be taken

(2) Changes to policy, objectives targets and all EMS elements

(3) Continuous improvement initiatives

f. Following a review progress towards changes and action items should be tracked. While the corrective action, tracking process is should be capable of this, the action items need not only be corrective actions, they may also be new initiatives.

Z4.7 Metrics

a. In Chapter 7.0, facilities are required to evaluate the success of the EMS and NASA's attainment of its environmental compliance objectives.

b. Metrics can be seen to reflect the quantitative and qualitative results of an EMS. They are used to track progress toward the goals defined by management.

c. In the early stages of EMS development, metrics developed tend to be very simple – such as the amount of metal and office paper recycled. These modest targets are often within easy reach. Yet if the EMS is to mature, more sophisticated metrics and more challenging objectives and targets will be needed in order to demonstrate value.

d. Centers are free to develop their own internal metrics, which may be a form of monitoring and measurement.

e. Metrics function as agents for change as well as respond to it. Analysis of metrics may identify weakness or opportunities for improved performance. Metric may also indicate trends in performance that occur due to external factors.

f. When trends are observed in metrics, as with monitoring data, it is beneficial (to the degree practical) to understand the drivers behind them.

g. The value and functionality of metrics should be periodically reviewed. As a Center, be sure that for any metrics being reported across NASA that there is clear understanding of how the data should be generated.

Part 4 Attachment Z4.1 Sample Template for EMP Form

DATE: (___/___/_____)	**INDIVIDUAL(S) RESPONSIBLE:**
HIGH PRIORITY IMPACT(S):	
OBJECTIVE(S):	
RELATED TARGET(S):	
EMP: ACTION PLAN	
PURPOSE: (State the purpose of this EMP.) **SCOPE:** (State the department(s)/ Directives and/or Office(s) to which this EMP applies.)	
PROCEDURE: **How will the objective(s) be met?** (State in general terms how the objective(s) will be met. Attach additional pages as necessary.)	
What RESOURCES will be required to achieve the objective(s)? (Include estimate of resources in terms of time, people, money, other, etc.) **Time:** **People:** **Money:** **Other:**	
RESPONSIBLITIES AND TASKS: NPR 8553.1, Section 4.1 Structure and Responsibility *"Purpose: To identify roles, responsibilities, and authorities that will provide an organizational structure for implementing and maintaining the EMS."*	

(State roles and responsibilities relating to this EMP. How are these roles and responsibilities documented and communicated?)

What type(s) of TRAINING (if any) would be required?

NPR 8553.1, Section 4.2 Environmental Training, Awareness, and Competence

"Purpose: To identify training and awareness requirements to maintain competence for the EMS."

(How training needs determined? How are training methods selected? How training is tracked and evaluated?)

How will this EMP be COMMUNICATED?

NPR 8553.1, Section 4.3 Communication

"Centers shall follow existing communication procedures (or create new procedures as necessary) in communicating with internal and external parties."

[How does internal communication operate at various organizational levels (including with suppliers and contractors)? Is feedback from internal parties solicited? Is the method of internal communication effective? Is external communication relevant to this EMP? If so, how is external communication received, recorded, and responded to?]

What DOCUMENTATION is needed and/or affected?

NPR 8553.1, Section 4.4 Documentation and Document Control

"Purpose: To establish and maintain procedures for EMS documentation and document control."

(What documents are affected or need to be created?
How is this documentation kept up-to-date?)

What DOCUMENT CONTROL procedures will be used?

NPR 8553.1, Section 4.4 Documentation and Document Control

"Centers are responsible for establishing and maintaining procedures for document control."

(Where will the documents created and/or revised reside?
EMS documentation shall be: legible, dated (with dates of revision), readily available, identifiable, maintained in an orderly manner, and retained for a specified period.)

What. OPERATIONAL CONTROLS might be needed to support the

achievement of the objective(s)?

NPR 8553.1, Section 4.5 Operational Control

"Centers are responsible for documenting procedures that limit adverse impacts associated with high-priority impacts to the environment or are needed in order to manage NASA's environmental policy or compliance activities."

(Which operations and/or activities require operational controls?)

How will this EMP be MONITORED and MEASURED?

NPR 8553.1, Section 5.1 Monitoring and Measurement

"Centers are responsible for establishing and maintaining documented procedures to track, monitor, and measure the key characteristics of operations associated with EMS objectives and targets and high-priority impacts."

(How will overall performance of the EMP be tracked, monitored, and evaluated? How will compliance with legal requirements be assessed?
What monitoring and measurement activities will the EMP require?)

NPR 8553.1, Section 5.2 Nonconformance, Corrective, and Preventive Action

"Centers are responsible for establishing procedures to track nonconformances and corrective actions."

(How will non-conformances be identified, tracked, corrected and/or prevented?
How will failure to meet the EMP requirements be addressed?)

What RECORDS are needed for this EMP?

NPR 8553.1, Section 5.3 Records

"Purpose: To provide evidence of ongoing operations and maintenance of this EMS."

(What records need to be maintained for this EMP? Where will these records be stored on site at WFF?)

ADDITIONAL NOTES

3.1. Additional notes:

Part 4 Attachment Z4.2. Root Cause Analysis

Root Cause Analysis (RCA) Technology Area

Description:

Root Cause Analysis (RCA) is a structured step by step questioning process that focuses on finding the real cause of a problem (such as an identified performance gap) and dealing with that cause rather than continuing to deal with a cause's symptoms (the problem). If you can find the cause, you can find the solution.

- Root cause analysis helps identify what, how and why something happened, so it can be solved and doesn't happen again.
- Root causes to analyze are those that underlie the problem, are reasonably identifiable (i.e., they shouldn't cost too much to investigate), fall under the control of management and lead to recommending solutions.
- The root cause analysis *process* should be logical and repeatable and involves
    - determining the problem (or choosing which problem to address). Some questions to ask:
        - Why did this event happen?
        - What occurred to create it?
        - What occurred before the event?
        - What occurred after the event?
        - How is the event important?
        - When did it occur?
        - Where (physical location, environmental condition)?
    - collecting data
    - charting cause(s)
    - identifying root cause(s) (in addition to contributing causes)
    - making recommendation(s)
    - implementing the recommendation(s)

  The above is partially from Root Cause Analysis for Beginners, by by James J. Rooney and Lee N. Vanden Heuvel, Quality Progress, July 2004, 9 pages. Includes a list of steps, a flowchart, a root cause map, and a summary table.

Other resources and tips

This short article on root cause analysis is clearly written and provides several examples of the importance of determining root causes and deciding if it is more cost effective to fix the cause or just treat the resulting problem.

- **Tips for conducting root cause analysis include:**
    - Must involve people most familiar with the process
    - Must include leadership of the organization
    - Stay as impartial as possible
    - Analyze underlying systems by digging deeper and repeatedly asking

"Why" to determine the policies, practices, or procedures causing the problem.
    - Analyze adverse events, and important serious events such as close calls or near misses, and contributing factors (eliminating or fixing these wouldn't solve the problem)
    - Identify risks and their possible contributions to the problem of solution
    - Must consider effects of related systems and processes
    - Identify what changes **can** be made to a system
    - Must carefully consider possible solutions. (Developing the action plan might be the most important part of the process. It must address the most basic underlying cause or system deficiency.)
    - Focus improvement efforts on the larger systems. Fixing the component process cannot prevent a problem from recurring.
    - Redesign to eliminate the root cause. This may involve changes in training, policies, procedures, forms, equipment, and so on.
    - Include metrics in the solution to make sure the solution worked and that the situation doesn't happen again.
    - Assign responsibility for each action taken.
    - Set up some sort of "tickler" system for follow-up to assess the effectiveness of each action item.
- **Possible techniques:**:
    - Change analysis – compare an unsuccessful process to a similar but successful process
    - Barrier analysis – assess the adequacy of installed barriers, or the lack of barriers or safeguards. Identify failures in processes and systems that lead to failures.
    - Events and causal factors analysis – examine events and related conditions and causal factors in chronological order
    - The five Why's: Repeatedly (at least 5 times) ask why or how it is so that something happened. This can reveal the deeper root cause that made it possible for an event to occur.
    - Tree diagrams – create a graphic display that describes the event's contributing factors
    - Logic trees
    - Fault Trees (fault analysis)
    - Brainstorming
    - Flowcharts
    - Cause & Effect diagrams
    - Pareto charts
- A Statistical Comparison of Three Root Cause Analysis Tools By Dr. Anthony Mark Doggett, Journal of Industrial Technology, Volume 20, Number 2 - February 2004 to April 2004, 9 pages, a peer-refereed article. "**Three root cause analysis tools** have emerged from the literature as generic standards for identifying root causes. They are
    - the cause-and-effect diagram (CED),
    - the interrelationship diagram (ID), and

    - the current reality tree (CRT)."
- **Possible Pitfalls:** Some pitfalls came from Using Root Cause Analysis to Make the Patient Care System Safe, 2003.
    - Be careful not to just point to the last person associated with a problem. Blaming one person or situation overlooks the evidence that there are usually a dozen errors that lead to most problems. Keep blame out of the analysis process.
    - Punishing a person (or just training them again and again) is unlikely to solve any problem. Root cause analysis focuses on processes rather than individual performance. Poorly designed processes set people up to make errors.
    - Placing budget ahead of everything else. (Fundamentally the organization does not understand the cost of the problem.)
    - Placing schedule first. (We don't have time to do it right. Ready, Fire, Aim.)
    - Placing political considerations first (internal politics and external marketing).
    - Arrogance. (The laws of nature and Congress should not apply to us.)
    - Some writers say that root causes reside in the values, beliefs as well as the practices of an organization. Until the analysis moves into this level, it has not begun to grapple with root causes.
    - It is important to be thorough. Even if you make improvements along the way, do not stop your analysis before you have dug deeply to find the root cause.
    - Be wary of brainstorming or problem solving discussions where the team just goes along with the boss's causes or solutions.
    - If, as can happen, a root cause is found to be inadequate management or leader oversight, try to continue digging to determine underlying organizational causes.
- Be sure to see the 3-page aid provided in Human Performance Professional Working Guidelines, September 2003.
- One way to look at the organization being analyzed is:
    - Organizations tend to operate like thermostats to maintain the status quo
    - Each group wants to set the thermostat at a different temperature
    - Change efforts disrupt the status quo and are undermined unless there is a broad consensus for a new standard
    - The way systems operate may undermine change efforts even if the change is desired
      From Root Cause Analysis , New England Comprehensive Assistance Center, January 2004. This slide presentation also describes force field analysis and stakeholder analysis.
- A Framework for Conducting a Root Cause Analysis is a three-page grid that can help you organize the steps in a root cause analysis. It is available in Lotus 1-2-3, Microsoft Excel spreadsheet formats and as an MS Word file.
- An Example of Root Cause Analysis on root causes of sweatshops. Includes

steps, a model, several root cause charts, links to another example, a story chart and a hidden cost chart.

- Route cause analysis for beginners - http://www.asq.org/pub/qualityprogress/past/0704/qp0704rooney.pdf
- Other source material is available at https://www.spider.hpc.navy.mil/index.cfm?RID=TTE_OT_1000064