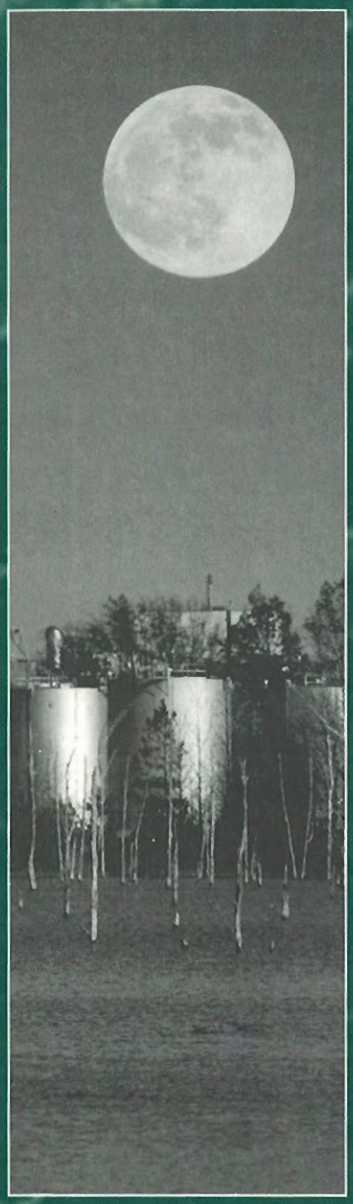
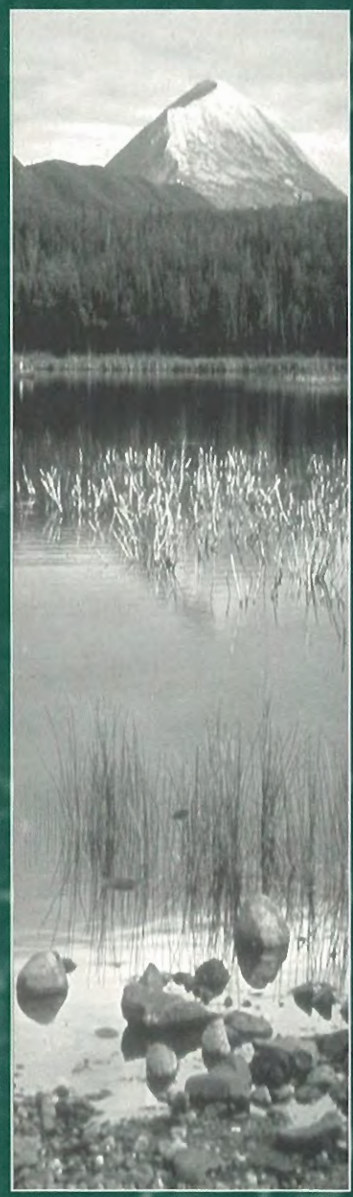
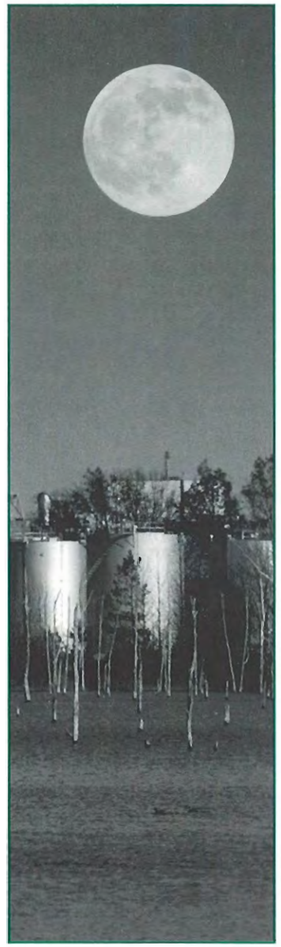




Environmental Guidelines for the Military Sector



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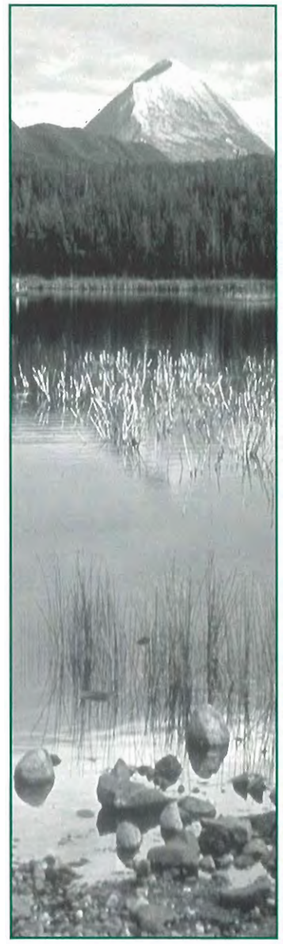


Environmental Guidelines for the Military Sector

A Joint Sweden-United States Project

Sponsored by the NATO Committee on the Challenges of Modern Society

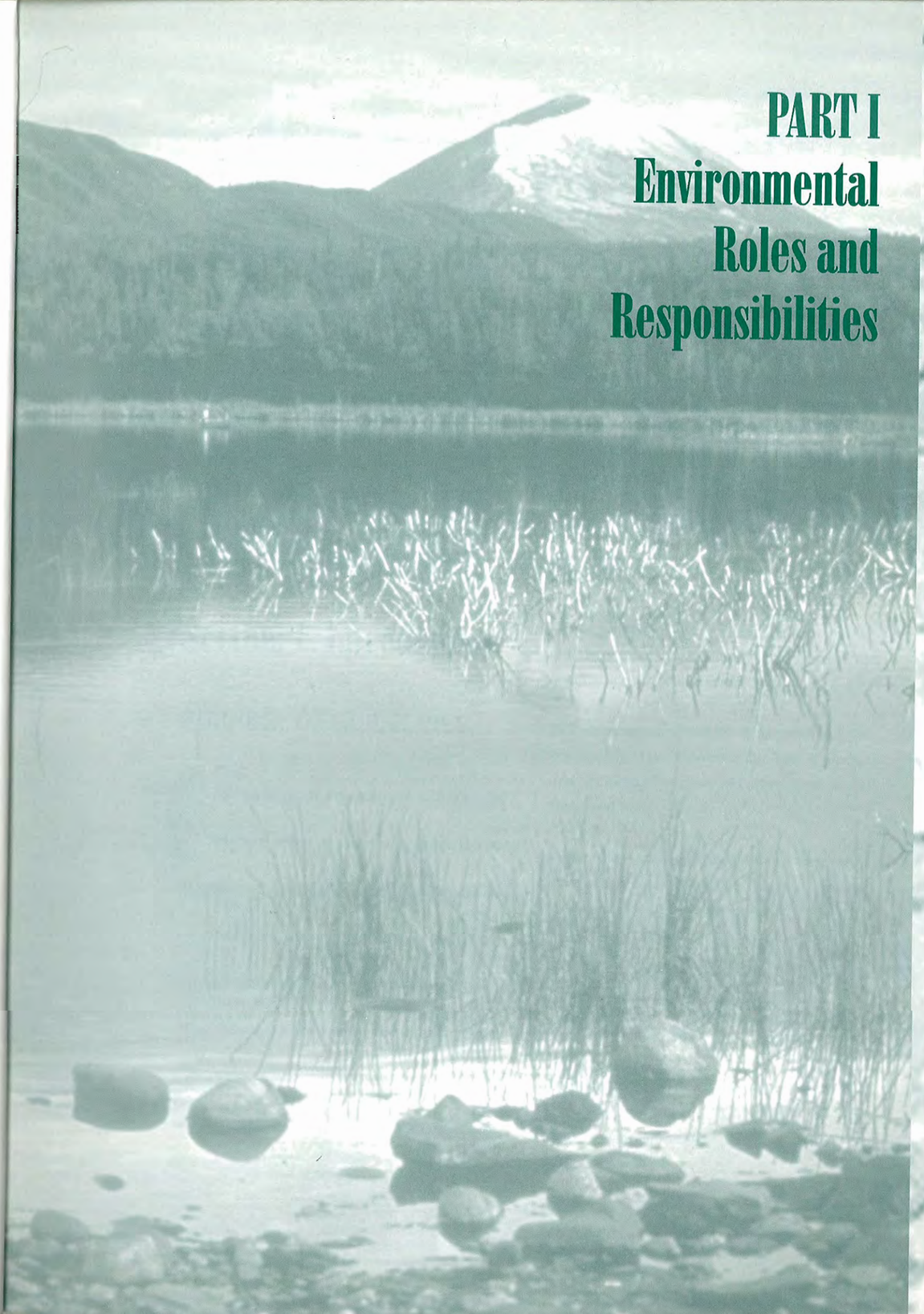
Preface

This document is divided into two parts. The first part discusses the international framework for environmental work within the military sector, the responsibilities of the government and the military sector, and principles for developing an environmental program. The second part provides guidance on establishing environmental policies, implementing environmental programs, developing budgets and measuring progress for planning, environmentally sound practices, conservation, cleanup of contamination, education and training, and research and development.

Table of Contents

Part 1. Environmental Roles and Responsibilities

Part II. Building the Environmental Program



PART I
Environmental Roles and Responsibilities

Section 1. Introduction

PURPOSE OF GUIDELINES

These guidelines are prepared to assist the military sector of any country with the development of an effective program to protect human health and the environment. The guidelines use international agreements, treaties or conventions to establish the framework for recommended actions. The guidelines also use the experiences of many countries to provide approaches to solving environmental problems.

DEFINITIONS

Armed forces - includes personnel of any nation's army, navy, marines, and air force

Conservation - implies the protection of natural and cultural resources

Environment - includes air, water, ground, flora and fauna, and archaeological and historic resources

Government - as used in this text, includes the duly appointed or elected chief minister of the country and subordinate offices

Industrial sector - includes commercial and government factories involved in any kind of production, including weapons and other materials for the armed forces

Legislature - a deliberative body composed of representatives of districts or states, responsible for the passage of laws (for example, Parliament, Congress, National Assembly, Diet or Duma)

Local authorities - includes offices within municipal or state governments that are responsible for issuing and enforcing environmental standards

Military sector - includes the armed forces and the defense administration responsible for supporting military activities

Section 2. International Treaties, Conventions and Guidance

This section discusses some major international agreements and treaties that influence the development of national environmental programs. In addition, it provides sources of guidance on the manner in which concerns about environmental protection should be integrated into military activities.

The Rio Conference 1992

The United Nations Conference on Environment and Development (UNCED) met in Rio de Janeiro in June 1992. The major agreements resulting from the conference were:

- The Convention of Climate Change - The convention declares as a goal the restoration of greenhouse gas emissions to 1990 levels by the year 2000.
- The Convention on Biological Diversity - The biological diversity convention recommends the development of national strategies for the conservation and sustainable use of biological diversity, and for inventories of species to be conserved.
- Agenda 21 - This document is intended to be a comprehensive workplan for national actions and international cooperation for sustainable development and global environmental protection into the 21st century. Among the provisions of Agenda 21 are:
  - Governments are urged to adopt national strategies for sustainable development.
  - Governments should ensure the integration of economic, social and environmental considerations in decision making at all levels and in all ministries.
  - Governments should ensure that military sectors conform to the national environmental standards governing the treatment and disposal of hazardous wastes.
- The Rio Declaration - The declaration includes a number of legal principles vital to achieving sustainable development, such as environmental impact assessments, public access to government information on the environment, the precautionary principle, and prior and timely notification of activities that have significantly harmful transboundary environmental effects. In addition, the declaration acknowledges the special responsibility of developed countries for global environmental restoration - within the constraints of their technological and financial capabilities - and the pressures that consumption of resources and pollution place on the global environment.

The Maritime Pollution Protocol

The Maritime Pollution (MARPOL) Protocol is an international agreement to preserve the marine environment by reducing pollution from ships. The protocol would limit - and eventually eliminate - deliberate discharges of oil, chemicals, sewage and garbage from ships at sea or in ports. It also would minimize the potential for accidental discharges of oil and chemicals. The protocol provides higher standards for ships operating in portions of the oceans that are extremely sensitive or that contain valuable marine resources. It also establishes requirements for the construction of ships and for the equipment on ships.

Currently, the protocol has five annexes. These annexes, which have not been implemented fully, cover the following topics: oil pollution, chemicals transported in bulk, harmful substances transported in packaged form, sewage and garbage.

The Montreal Protocol

The Montreal Protocol was developed in 1987 and is tied to the Vienna Convention on the Protection of the Ozone Layer. The signatories to the protocol agreed to a plan to reduce the use of chlorofluorocarbons (CFC) by 50 percent by the year 2000. In addition, they agreed to freeze future halon use at or below 1987 consumption levels.

In 1992, the protocol was renegotiated, and the signatories agreed to more ambitious goals for the phase out of CFCs and halons. In addition, they agreed to establish phase-out dates for 1,1,1-trichloroethane and carbon tetrachloride. A fund was established to co-finance the phase-out in developing countries, and those countries also were granted additional time to achieve the phase-out.

The Basel Convention

The Basel Convention regulates the disposal and transboundary movements of hazardous wastes. The purpose of the convention is to reduce the generation of hazardous wastes. Another purpose is to ensure that hazardous wastes are disposed of in an environmentally sound and efficient manner, and as close to the generating source as possible. The convention specifies that the transboundary movement of hazardous waste should be undertaken only when no alternative is available, and should be conducted in a manner that does not endanger human health or the environment. In September 1995, the signatories agreed to ban all transboundary movements of hazardous waste from Organization for Economic Cooperation and Development (OECD) countries to non-OECD countries. The ban will become effective 1 January 1998.

The Bonn Convention

The Bonn Convention, also known as the Convention on Migratory Species, was signed in 1982. The purpose of the convention is to conserve terrestrial, marine and avian migratory spe-

cies through their range. A migratory species is listed if it is in danger of extinction throughout its range or in a significant part of its range (endangered status) or if the sum of all influences acting on the migratory species may affect its long term distribution and abundance (conserved status). Agreements that specify actions to be taken to restore listed migratory species to favorable conservation status are developed by the convention's decision-making body, the Conference of the Parties.

The United Nations Environment Programme

In May 1993, the Governing Council of the United Nations Environment Programme (UNEP) issued its decision 17/5 "Application of Environmental Norms to Military Establishments." The UNEP reaffirmed that decision in 1995. Governments were encouraged to establish a national policy for the military sector. In addition, the Executive Director of UNEP was invited to collect information about :

- Compliance by military establishments with their respective national environmental standards in the treatment and disposal of hazardous wastes
- The contribution of the military sector to national environmental policies
- Assessments of the damage to the environment by military activities, as well as the need for and the feasibility of cleanup and restoration of areas that have been damaged

Meeting on Military Activities and the Environment

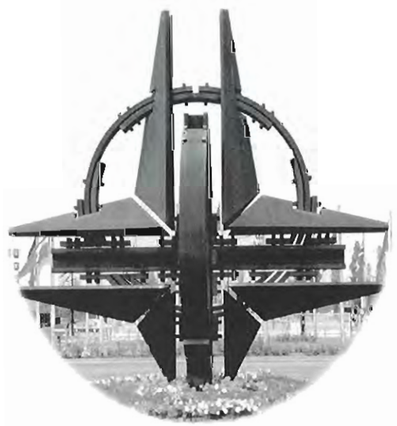
In June 1995, the Meeting on Military Activities and the Environment was held in Linkoping, Sweden. The meeting was convened by UNEP in cooperation with the Economic Commission for Europe (UN/ECE). The participants adopted the Linkoping Document, which contains recommendations for future military activities that affect the environment. The meeting also presented a list - Items Raised at the Linkoping Meeting - to serve as reference in future considerations and discussions.

The NATO Committee on the Challenges of Modern Society

In 1969, NATO established the Committee on the Challenges of Modern Society (CCMS) to provide a new "social dimension." The CCMS uses the expertise and technology available in member countries to solve environmental problems and recommend actions to benefit all countries. Also participating in the work of the CCMS are representatives of the North Atlantic Cooperation Council (NACC), Cooperation Partners and Partnership for Peace (PFP) countries.

The CCMS does not engage in any actual research activities; instead, it accomplishes its work on a decentralized basis through pilot studies. Subjects for pilot studies cover a wide spectrum of aspects of environmental protection and quality of life, including defense-related environmental problems. To date, the CCMS has overseen the completion of more than 40 pilot studies.

The CCMS is a useful forum for exchanging experiences and obtaining guidance in the development of environmental policies for the military sector. ■



Section 3. Importance of the Environment to the Nation

The environment has an important influence on all human activities, yet it often is taken for granted. This section explains some of the means by which the environment influences daily life.

The environment and quality of life

The quality of life that people enjoy is affected directly by the quality of the environment in which they live. People need clean air or they will suffer respiratory problems and illnesses. The lack of clean water in some parts of the world is a major cause of deadly disease. In addition, many types of wildlife essential to the human food chain cannot exist in polluted waters. The destruction of the ozone layer has caused a significant increase in the cases of skin cancer, particularly in the southern hemisphere. Finally, hazardous materials indiscriminately disposed of in landfills are known to cause illnesses, particularly in the young and the aged who live in the vicinity of the contaminated site.

The environment and the economy

The economic vitality of a country is also dependent upon the environment. Examples are numerous of human actions that have left entire regions desolate and incapable of supporting any development. A significant portion of the damage is caused by uncontrolled exploitation of a country's natural resources. Slag piles, a relic of coal mining activities of the 19th and early 20th centuries, have left large areas adjacent to coal mines totally incapable of supporting vegetation. Mineral washings associated with copper and other mining activities have turned rivers and streams so acidic that no fishlife can survive. In many parts of the world, there are few if any controls on the cutting of forested lands. Without appropriate replanting or erosion controls, large areas of wildlife habitat are lost each year. Very often, vital topsoil is lost in heavy rains, leaving the land barren and incapable of supporting any crop.

In the 20th century, a considerable amount of the damage is cause by the operation of factories. Uncontrolled air emissions from factories are the source of acid rain that gradually destroys valu-

able forests downwind of the factories. Moreover, uncontrolled releases of polluted effluents from factories pollute rivers and streams so severely that those waters cannot be used for domestic or industrial purposes.

A country that unwisely allows the overuse or misuse of its valuable natural resources to meet short-term needs creates significant problems for future generations. Destroyed forests and lost topsoil will take many generations to replace, if they can be replaced at all. Some countries, originally exporters of food, have been forced to use their limited financial resources to import food to support their populations. In rare circumstances, when all financial resources have been exhausted, countries have found it necessary to rely on international relief organizations. Cleanup of contamination of streams and soils caused by the careless exploitation of a country's mineral resources or the release of toxic materials from unregulated industrial plants would be costly and take many years to complete. Further, resources necessary to accomplish that cleanup must be diverted from other actions that might have contributed more to the overall economic well being of the nation.

The environment as a cause of conflict

Environmental concerns are among many factors that may contribute to tension and potential regional or worldwide conflict. As a country exhausts its own resources, the population may become dissatisfied. In some cases, civil war may erupt as various factions fight over the limited remaining resources. In other cases, the population may be driven to emigrate to other countries to seek a better life. In either situation, the fabric of the country is destroyed and its ability to recover is compromised severely. Further, tensions are created in the countries that support newly arrived and often unwanted immigrants.

Since environmental damage is not always contained within national boundaries, poor environmental practices can cause tension with neighboring countries. For example, many countries are affected by acid rain, which often is created by the emissions of factories located in other countries. In addition, some countries cannot use water from the rivers passing through them because the water has been polluted so heavily by factories in countries located upstream. In other cases, so much water has been diverted from a river for irrigation, that the river has been reduced to a trickle by the time it crosses the country's boundary.

In recent years, tension has arisen between countries concerning the proper management of international resources, such as the oceans and the atmosphere. Considerable attention has been focused on the whaling and fishing industry. Some countries are driven by the need to provide food for their growing populations, while other countries are concerned that the resources are being overexploited. In fact, it is becoming apparent that fish populations are not sustainable.

Considerable international attention has been focused on the evidence of global warming. However, there is considerable dissent about the proposed actions to take. For example, developing countries want to build new factories and cut down forests to clear land for economic growth. Such action contributes to global warming. Developed countries, however, are reluctant to shut down their factories, since the factories are the sources of those countries' current economic well-being.

Another cause of international tension is the responses of some countries to the evidence of the increasing size of the hole in the ozone layer. Some countries, particularly those in the extreme northern and southern portions of the two hemispheres, have taken extraordinary measures to eliminate the use of ozone-depleting chemicals. Further, many countries have signed an international agreement to eliminate production of those chemicals. However, some countries have elected, for economic reasons, not to sign the treaty and to continue producing ozone-depleting chemicals. ■

Section 4. The Relationship Between the Military Sector and the Environment

This section discusses the relationship between the military sector and the environment. There has been growing concern in many countries about the apparent diversion of funds originally budgeted for military activities to the support of environmental protection. In numerous cases, however, actions that the military sector takes to protect the environment are consistent with and contribute to the effectiveness of that sector's primary mission.

The military mission

The main task of a country's armed forces is to protect the sovereignty of the nation. To meet that responsibility, the military sector must have weapons and train members of the armed forces to use those weapons effectively. By necessity, actions to equip and train the armed forces will have an effect on the environment. However, by demonstrating both the capability and the will to successfully defend the nation, the armed forces deter others from aggressive action and thereby prevent an even greater threat to the environment - war.

The military sector as an environmental leader

To the extent practical without affecting its ability to protect the country, the military sector should comply with the environmental policies and laws established for the rest of society. By acting in an environmentally responsible manner, the military sector is able to exert significant influence on the rest of society to do likewise.

The military sector is positioned uniquely to influence environmental activities throughout the country. As the manager of large tracts of land to support testing and training, the military sector can set the example for wise ecological practices and, in some circumstances, can be the catalyst

for developing regional land management programs. As the operator of industrial complexes on many installations and the consumer of vast quantities of products, the military sector can change the marketplace throughout the country, and sometimes the world.

The military sector should keep to a minimum the areas set aside for its sole use. Such areas may include artillery or bombing impact areas, safety zones around storage facilities for hazardous or explosive materials, high accident potential zones around runways, and areas important for national security. Public access to other areas, such as those used as safety buffers during training exercises, may be authorized during nontraining periods. Those areas may be suitable for farming, forestry or hunting. It should be noted that, in many cases, because of military land management practices in support of the various missions, plants and animals have thrived. In fact, there are numerous examples of populations of endangered species that are found only on lands controlled by the military sector.

In some countries, the military sector is the genesis of the development of regional land use plans. Through military leadership, community leaders and other major land owners are motivated to develop plans that support responsible industrial and community growth, but prevent encroachment on vital natural resources and on those lands necessary for military activities. The quality of life in the region is thereby preserved and, most important, the ability to perform the military mission is protected.

As the operator of industrial plants and the purchaser of enormous quantities of materials and equipment, the military sector is able to influence the marketplace. If the military sector insists on purchasing only environmentally preferred products, manufacturers are motivated to adjust their product line to sell products to the military sector. In some countries, governments attempt to stimulate the growth of industries that manufacture environmentally preferred products by mandating that government agencies purchase only those products. With its significant purchasing power, the military sector makes such focused procurement programs effective.

Incorporation of environmental considerations into military activities

To the extent consistent with primary mission, the military sector should follow the same environmental rules as the rest of society. In most cases, the military can do so without compromising the mission.

In most circumstances, the military sector can comply with the requirement, common in many countries, that potential environmental effects of proposed and alternative actions be analyzed before a decision is made. The analysis can assist senior military officials in selecting the option that meets military requirements, with a minimal effect on the environment.

With careful planning, the military sector can meet mission requirements on the ranges without significantly affecting natural and cultural resources. Training and testing activities can be planned to avoid intrusion into sensitive areas or can be timed to permit the full recovery of vegetation or to minimize effects on wildlife during mating or birthing seasons.

Environmental requirements that are imposed upon industrial processes for the production of nonmilitary goods generally can be applied to processes for the production of military goods, without affecting military critical performance. For example, many of the environmentally sound maintenance practices adopted for commercial aircraft are equally acceptable for high-performance military aircraft. Changes in specifications for the operation and maintenance of military equipment should be made only after suitable testing of the alternative processes or materials. In certain cases, particularly those involving the operation and maintenance of equipment covered by multinational (for example NATO) specifications, the adoption of changes may be more complicated.

Improvement in military performance through improved environmental protection

Attention to environmental considerations actually contributes to mission readiness and, in some cases, improves mission performance or capability. That result is attributed to more realistic training opportunities, more efficient or effective materials or processes, or a more supportive general public.

The careful management of natural resources on a military training range contributes directly to the realism and, therefore, the effectiveness of the training. Such management ensures that each mock battle or exercise is conducted on terrain that resembles the area where the armed forces may be expected to be deployed. Lands that are barren of vegetation through poor management practices are of little value for military exercises.

Changes in manufacturing or maintenance practices, spurred by environmental considerations, sometimes improve mission performance. New processes that do not require the use of hazardous materials are sometimes more effective and efficient. For example, aqueous washers (which use water at high velocity to remove grit) actually clean critical aircraft components better than the ozone-depleting chemicals previously used and do not create a large amounts of hazardous waste residue. One new method of stripping paint from aircraft combines the use of robotics and bead blasting techniques. The method, which must be tested and validated for each application, completely strips an aircraft in several hours, places no worker at risk, and generates only a few buckets of hazardous waste. That performance compares favorably with that of the old method that used chemical agents, required several days to complete, placed workers at risk, and generated a large volume of hazardous waste.

In many countries, the military sector's ability to operate on an installation or range is subject to the support of the local population. If the military sector behaves in an environmentally responsible manner, the local population is more likely to accept the noise and other irritants associated with testing and training. Conversely, if the military sector is perceived to behave in an irresponsible manner, the local population may attempt to convince government officials and the legislature to curtail or even halt military activities. Accordingly, the installation commander not only should ensure that activities are conducted in an environmentally responsible manner, but also should keep local community leaders and representatives of environmental groups and the news media informed about those activities. ■

Section 5. Responsibilities: The Government

This section explains the roles of the government in developing a national program to protect the environment.

Policies and laws

The government and the legislature are responsible for developing the national policies and laws that protect the environment. Those policies and laws should meet national needs, but should consider the advice and obligations of international organizations such as the United Nations (UN) and NATO when they are prepared or modified. Moreover, the policies and laws should incorporate the provisions of international treaties and conventions, such as the Montreal and MARPOL protocols and the Basel and Bonn conventions. Unfortunately, national needs often are identified only after an environmental disaster that has resulted in either loss of life or calamitous effects on sensitive or important natural resources. A legislature, in the process of establishing national policy, may gain considerable insight by surveying policies and laws already implemented in other countries.

National goals and strategies

The government is responsible for implementing laws and policies. Since the laws passed by the legislature may be broad statements of intent, the government must provide additional guidance to the various sectors so that they understand fully what they must do to comply with the law. Usually, such guidance is provided as national goals and strategies.

A goal is a readily understood statement of a tangible and measurable objective, with a realistic date for reaching that objective. A goal can be the desired maximum level of pollution in the air and the date by which that level must be achieved. A goal also can be the date of the phase-out of all industrial processes that use a hazardous material.

The strategy is the method by which the government intends to achieve the goal. For example, the government may require the construction of plants to treat all effluent that goes into lakes and rivers so that contamination is reduced to an acceptable level. The government can require factories to install emission control mechanisms on smokestacks that formerly discharged poisonous fumes into the air. In some countries, the government charges a tax for the privilege of emitting air pollutants. The tax money can be used for other environmental projects. In addition, the imposition of the tax usually motivates the owners of the factories to seek other, less environmentally damaging technologies.

The government should exercise care in developing goals and strategies. Although it may be desirable to meet environmental standards as soon as possible, establishing goals that are too ambitious or imposing a strategy that is too rigorous could have negative effects on the economic vitality of the country. The government should establish goals for the military and other sectors that reflect a balance between environmental goals and other national considerations.

Since appropriations for environmental work are limited in most countries, the government should establish priorities for environmental expenditures. Usually, the priority is based upon an evaluation of the risk to human health and the environment that would arise if the proposed action is not taken. The priority also can be based upon an evaluation of the extent of the environmental improvement created by each potential action.

Following are brief descriptions of areas to consider in developing goals and strategies:

Prevent environmental damage from current activities

The government should establish goals and strategies to ensure that current activities in the military, industrial, agricultural and other sectors are conducted in a manner that does not place persons at risk or bring about unacceptable environmental consequences. A typical strategy is the imposition of rigid procedures for the safe handling, storage, use and disposal of hazardous materials. Other strategies entail establishing and ensuring adherence to limits on the levels of toxic substances that may be released to the air, water or ground.

Prevent environmental damage from future activities

The government also should establish goals and strategies that mandate the adoption of practices and the use of materials that do not present a risk to the environment. Typical strategies entail the prohibition of the use of hazardous material, the levy of a high tax on the purchase of the material, or the imposition of rigid and usually costly constraints on the use of the material. In all cases, the user either is forced or is motivated to seek an alternative, more environmentally benign material. Another strategy commonly used is the adoption of recycling programs that reduce the amounts of virgin materials extracted or harvested.

Repair environmental damage from past activities

The government also should establish goals and strategies for the cleanup of contamination that presents a risk to public health or the environment. In some countries, the government has held the original polluter responsible for the cleanup, even though the activity was accomplished in accordance with the laws in effect at the time. When the original polluter cannot be found, or is fiscally unable to clean up the contamination, the government must initiate action to clean up the contamination. In many countries, the government does not have sufficient resources to clean up all identified contaminated sites. Accordingly, those governments have devised methods of establishing priorities for work, based upon the risk posed to human health. In some cases, when technologies for cleanup are not available or are too expensive, governments have not initiated any cleanup of contaminated areas. Instead, they isolate those sites from any public access or development until cleanup is technologically or fiscally practical.

The government must report periodically to the legislature on the effectiveness of its efforts. Reports are based upon surveys of those sectors that are covered by the law. The surveys usually measure performance against the goals or implementation of the strategies.

Guidance for the military sector

The government must provide clear guidance on the military sector's support for nation's environmental goals and strategies. In most cases, the government would expect the same conduct on the part of the military sector as it has imposed on all other sectors. However, there may be an exception if a new environmental requirement would interfere severely with the ability of the military sector to perform its primary mission or with military security. The government must establish a balance between the interests of the military sector and environmental interests.

Usually, the government would solicit comment from the military sector before proposed goals and strategies are adopted formally. If the military sector can demonstrate that the new requirements may compromise military preparedness or performance, the government may grant a special exemption.

The government should expect the military sector to comply with national goals and strategies, even if the activity is secret because it involves national defense. Even if a project is secret, it is important to protect the health of workers, as well as the surrounding environment.

In some cases, the government may grant the military sector an exemption from a standard if compliance with that standard would undermine military readiness. International agreements recognized the need to grant the military sector special exemptions. For example, the MARPOL Protocol recognizes that military vessels operate under entirely different environmental conditions than commercial vessels. Military vessels remain at sea for long intervals, are equipped and provisioned for warfare, and have limited space to store garbage and to install garbage processing equipment. Consequently, the protocol is more flexible with respect to the handling of garbage on military vessels.

The use of chemicals is another area in which governments grant the military exemptions to environmental standards. For example, while the governments of many countries are attempting to quickly eliminate the use of ozone-depleting chemicals, they grant exceptions when the application is for a critical military use for which there is no acceptable substitute. Such a case is the use of halon as an engine firefighting agent on military aircraft. While considerable research is underway, no alternative material has yet been found that provides the same degree of protection.

Budget support

Having established goals and strategies, the government must be prepared to support the budget request of the military sector to support environmental goals and strategies. The government should establish budget preparation procedures that facilitate its review of requests from the military for environmental funds. It may be helpful to display the required budget in relation to the pertinent goal or implementing strategy. If budget requests are presented in that manner, the government is better able to determine whether sufficient funds have been requested.

Audit of environmental performance

The government should establish an environmental audit program to determine whether the strategies are being implemented properly and whether any further guidance or fiscal assistance is necessary. Some governments require the office or ministry responsible for developing environmental goals and strategies to perform the audits. Other governments have delegated the responsibility to local or regional authorities.

The audit program should be applied equally to all sectors of the economy. The government may determine the interval between audits of a facility (military installation or factory) according to the potential threat that facility poses to human health or the environment. In some cases, the government may determine the interval according to how well or how poorly the facility fared in previous audits.

Audits can be quite varied in their scope. For example, a comprehensive audit would be both expected and useful at a new facility or operation. Such an audit also may be necessary for a facility that has a record of poor management practices, as evidenced by too many accidental releases or criticism for numerous violations identified in previous audits. A focused audit that examines only one medium may be useful to determine adherence to a new environmental requirement.

The need for secrecy may prevent access to a military installation by an independent audit team. In such a circumstance, members of the military sector can perform the audit. Usually, the military sector's audit team uses a checklist that has been developed in coordination with the appropriate environmental authorities.

Audit teams have been given varying degrees of authority. In some countries, auditors may impose fines for noncompliance. In very unusual circumstances, auditors can stop operations if they pose an unacceptably high risk to workers, the public or the environment. The authority to fine and to stop operations applies, in many countries, to the military as well as the commercial sectors. ■

Section 6. Responsibilities: The Military Sector

This section explains the responsibilities of the military sector in the development and execution of an environmental program.

Specific goals for the military sector

Clearly defined environmental goals that are specific to military activities should be established. The goals should be easily understood and should reflect national goals. Each goal should specify clearly what is to be accomplished and when it is to be accomplished. Only when goals are defined clearly can workable strategies be developed to meet them. In addition, the military sector should attempt to anticipate changes in national priorities that may affect its goals. Such an approach would permit a more orderly, cost-efficient transition to meet new or more stringent requirements.

Strategy to achieve goals

The military sector must be committed to meeting the environmental goals established by the government and the legislature. Each organization within the sector also must understand the goals and its role in their accomplishment.

The military sector must determine its strategy - the manner - in which it intends to meet its environmental goals. The strategy establishes the basis for budget development. The strategy includes specific objectives that will contribute to achieving the overall goal and establishes time limits for the accomplishment of those objectives. Generally, many strategies, each with its own objective, will contribute to achievement of the overall goal.

Measures of success

The government must be able to determine whether adequate progress is being made in meeting the goals of its environmental program. Therefore, the military sector not only must establish plans to meet the national goals, but also must develop measures to determine whether goals are being met. A measure should reflect progress toward a defined goal. As an alternative, the measure might reflect progress on only one component of the overall plan to achieve the goal. In such a case, the measure is used as an indicator of overall progress.

Periodic reporting

The government must have a clear understanding of the effectiveness of the military sector's environmental program. That understanding is accomplished by periodic reporting on both the military's environmental expenditures and its progress toward meeting specific military or national environmental goals. In many countries, such reporting is done annually in conjunction with the budget request for the next fiscal year. The government can use that information to assess the success of the current program and any need for changes in policies or budgets.

Organization

The military sector must ensure that it is organized properly to meet its environmental responsibilities. Each country must organize according to its priorities, needs and available resources. Therefore, there is no "standard" or "correct" method of organization. However, persons responsible for environmental matters should be identified at all levels of the organization and those persons should be trained to meet their responsibilities. A core group of environmental experts at a senior level generally is required to establish goals and strategies, obtain resources, and oversee the execution of the program. Each installation requires environmental experts to advise the commander and to execute the program. Other environmental centers of expertise may be established to support research and development activities or to clean up contaminated sites.

Budget development

The military sector must develop a budget to implement established strategies. There must be consistency among all components of the sector in the preparation and presentation of budget requests. A dictionary of standard terms should be established. In addition, a standard format should be developed for displaying the line items in the budget. Usually, a budget line item would be developed for each established strategy. Only when the budget request is presented in a standard, logical fashion can senior officials evaluate its adequacy to meet the overall environmental goals.

Guidance manuals

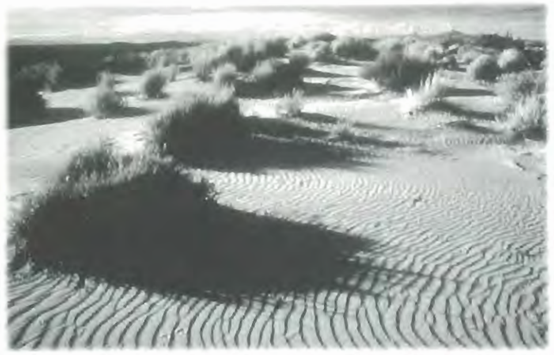
The military sector should prepare manuals that provide guidance on the development and execution of an environmental protection program. The manuals should define the goals, strategies and measures of success as they apply to the military sector. The manuals also should establish clear organizational responsibilities for specific components of the environmental program. Finally, the manuals should describe budgeting procedures, and priorities, as well as the frequency with which required reports are to be submitted and the format in which they are to be submitted.

Education and training

The success of the environmental program is dependent upon a knowledgeable workforce. Each year, significant environmental damage is caused by improperly trained personnel. In addition, decisions are made each year that destroy valuable environmental resources because military and/or government leaders did not understand the environmental consequences of their decisions. Therefore, an environmental education and training program that reaches every segment of the workforce must be developed.

Research and development program

In many countries, as environmental costs increase, the military sector is motivated to aggressively seek alternative, environmentally benign materials or processes that meet its requirements. Because research budgets are constrained, the military sector generally must concentrate its research and development program on those materials and processes that are the worst polluters or that are unique to the military, or for which substitution of alternative materials promises significant savings. ■



Section 7. General Principles for Program Development

This section identifies the principles that should be integrated into the environmental program of any military organization.

Balanced approach

On occasion, the activities of the military sector conflicts with achievement of the country's environmental goals. The activities are required to ensure that the armed forces are equipped and trained sufficiently to pose a creditable deterrent to any possible adversary. Since protection of the sovereignty of the country is of paramount importance, and since actual conflict would cause far greater environmental damage than even the most harsh training scenarios, some of the negative environmental aspects of training must be accepted.

The need to maintain military readiness must be balanced with the need to protect the environment. If military training is performed with complete disregard to environmental consequences, a country's valuable natural resources could be lost irretrievably. In addition, the quality of the training would be degraded gradually because the training areas no longer would resemble the terrain where actual fighting might occur. Conversely, if protection of the environment becomes the dominant consideration, the ability of the armed forces to train could be limited. As a consequence, the ability of the armed forces to protect the sovereignty of the country could be jeopardized. Since neither of those extremes is acceptable, it is obvious that the military must work closely with environmental experts to identify methods that best meet overall interests of the country.

Consistent application of requirements

With some exceptions, all elements of the military sector must be held to the same environmental standards as the rest of society. The military sector can set the example for the rest of the nation. If the military sector is being held to the national standards, it is more difficult for other sectors to complain.

A major problem in ensuring that the military sector complies with environmental standards is the differences among the various services within the military sector. For example, during peacetime, the army, navy and air forces in many countries operate as independent organizations. However, the general public makes no such distinction. Accordingly, poor performance by any one service undermines public confidence in the environmental leadership exhibited by the entire military sector. It therefore is important that standards and budget support for meeting those standards be uniform among elements of the military sector.

Local authorities

The military sector and the local authorities should work together to identify the best options that meet military needs while imposing the minimum adverse consequences on local communities and the environment.

Cooperation

Many activities of the military sector affect the environment outside the perimeter fence of the military installation. Typical effects are noise associated with aircraft and vehicular operations, air emissions from industrial plants, accidental releases of pollutants into waterways and rivers, and the construction of unsightly or potentially dangerous facilities near residential communities. Such effects concern local authorities and the public.

Representatives of the military sector should work closely with local authorities and the public to seek solutions to such concerns. For example, when military and safety considerations permit, flight paths could be changed. In some instances, flying or other noisy activities could be curtailed during night-time hours. In many situations, the military sector is able to place a building at a location that is less visible or poses less risk than on a site to which the community has objected.

A major cause of dissatisfaction on the part of local authorities and the public is the lack of adequate response to an emergency, such as a chemical spill. The military sector must be prepared to respond to an accidental release, contain the pollutant, repair any damage, and provide appropriate compensation for any losses.

Failure to act in a responsible manner could have significant consequences for the military installation. If local authorities and the public believe that their interests are being ignored, they could become less supportive. In some countries, dissatisfied local authorities have been able to persuade the government to terminate or relocate undesirable activities and, in some cases, to close the installation.

In many countries, the military sector has found it advantageous to establish formal committees that are made up of members of the military sector, local community leaders, and representatives of environmental groups. The committees are an excellent forums for the exchange of information; the identification of potential problems; and, on many occasions, the successful resolution of problems. When the committees conduct discussions in an open and objective manner, they often can identify solutions that satisfy all parties.

Assistance

Sometimes, the military sector must combine its resources with those of the local authorities to handle emergencies adequately. Local authorities are responsible for responding to most emergencies in the community. However, sometimes those emergencies are beyond the ability of local authorities to handle. Typically, those cases are environmental emergencies, such as chemical spills, floods, and forest fires. These emergencies easily can overwhelm the resources of local authorities. In those environmental emergencies, an additional disciplined force is required. The armed forces can meet that requirement.

The military sector's dependence upon local emergency response forces varies from country to country and sometimes even within a single country. In some cases, the local authority is the sole provider of emergency services. In other cases, local authorities provide emergency support to the military installation only in extremely unusual circumstances. In either situation, the emergency response forces of the local authority must be trained to respond to incidents involving any chemical that is stored on the military installation.

Mutual emergency response agreements often are established between the military installation commander and representatives of local authorities. The agreements specify that, under unusual emergency conditions, either party to the agreement may call upon the other for assistance.

The general public

The general public can be the source of considerable opposition to ongoing or proposed activities by the military sector. Such opposition often is the result of lack of adequate information about the activity or lack of public involvement in the decision-making process.

Information

Whenever possible, the military sector should inform the public about its activities. In many countries, the public distrusts the military sector. The public is often suspicious that the military may be using the screen of security to mask dubious environmental practices. The military sector should attempt to overcome such suspicion by divulging as much as possible about its activities. It should explain carefully how it is meeting its environmental responsibilities as it performs the activities. The more the public understands what is being done, why it is being done, and that it is being done in an environmentally conscientious manner, the more likely it is that the public will support those activities. It should be noted, however, that, in some cases, for reasons of national security, information is classified and therefore cannot be released.

Decisions

Provided the security of the country is not compromised, the military sector should involve the general public in decisions that may directly or indirectly affect the environment. Today, the general public is more aware than ever before of the importance of protecting the environment and of the consequences on the environment of the pursuit of ill-conceived plans. Accordingly, the military sector should inform the general public about proposed actions, the reasons for the actions, and the possible environmental consequences of the actions. Further, the military sector should invite the general public to comment on the proposed actions and even to propose alternative actions for consideration. When the public is intimately involved in the decision-making process, it is more inclined to support the final decision.

In some countries, the military sector and other government agencies are required to solicit comments from the public before making a commitment to any specific action. In many cases, the public provides new perspectives that might reveal less environmentally damaging approaches to the problem. If no other option is identified that meets the military need, the public, if it has had an opportunity to review and comment, is more willing to support the action, even though there might be some adverse environmental consequences.

Program implementation

An effective environmental program is based upon a sound foundation of information and a fiscally and technologically executable plan.

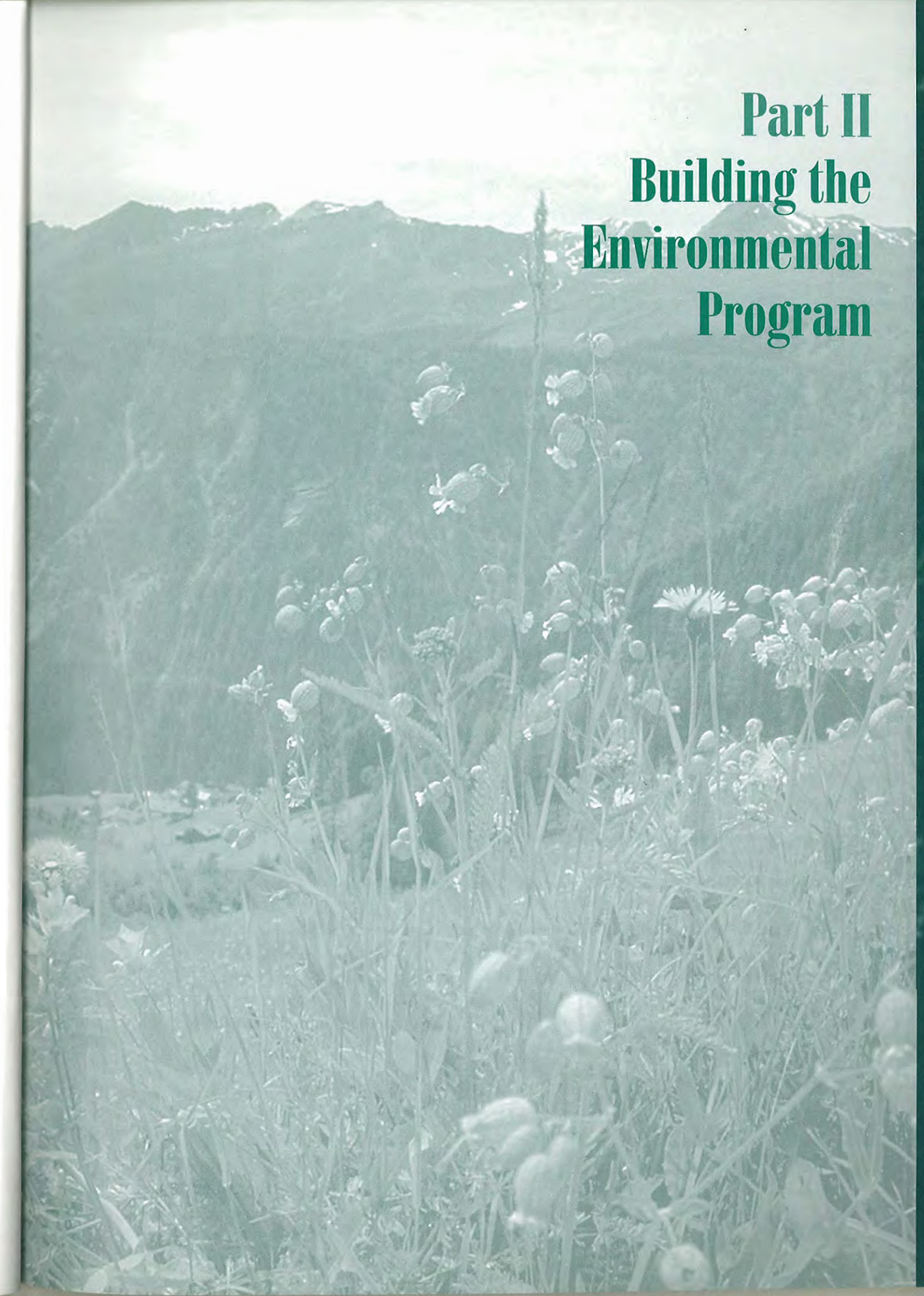
Inventories

The military sector must conduct a comprehensive inventory before any plan is developed. A variety of inventories may be needed. For example, before a management plan for natural resources is developed, the military sector must conduct a survey to identify the natural resources on its lands. Before developing a cleanup program, the military sector must complete a survey to determine the locations, sizes and types of contaminated sites of concern. Before developing a pollution prevention plan, it must first determine the sources of pollution on its property. Lacking such a foundation, a plan is likely to be focused poorly and therefore unsuccessful.

Plans

The military sector must develop plans that are realistic and that support national goals and strategies. Plans developed without consideration of technological or fiscal limitations are doomed to failure. The planners must establish priorities, based upon such considerations as risk to human health, environmental payback on investment, and cost, to help in the allocation of limited resources. If existing technologies are ineffective or too expensive to use planners must consider deferring the work and promoting further research. ■

Part II Building the Environmental Program



Section 1. General

This part describes the types of actions that might be taken to build an effective environmental protection program in the military sector. The suggestions are based upon the experiences of the military sectors of many countries. They are provided merely for consideration and not as mandatory components of a program. The military sector of each country should select those program elements that meet its particular needs.

Part II addresses the following major environmental functions:

- Planning
- Environmentally sound practices
- Conservation of natural and cultural resources
- Cleanup of contamination
- Education and training
- Research and development

Under each of these headings, the following subjects are discussed:

- Goals
- Strategies
- Budget preparation priorities
- Measures of merit

Goals

A goal is a statement of an objective to be achieved. It could be a level of performance or a specific result. The goal provides the basis for the development of strategies and associated budgets.

Strategies

Strategies are the specific policies and procedures that are designed to achieve the stated goals. The strategies include clearly defined objectives and milestones that contribute to the overall goal; the strategies also form the basis for budget preparation and are the source of performance indicators.

Developing a strategy first requires the preparation of an inventory of current resources, requirements or opportunities. Then, based upon this inventory, a coherent implementation plan to achieve the overall goal(s) can be developed, and, provided that sufficient funds are available to support the plan, executed. The third element of any strategy is the conduct of a periodic audit to determine whether or not goals are being met.

Budget preparation priorities

The budget necessary to execute strategies may exceed available funding. Therefore, a priority system must be developed to support those actions that provide the greatest protection of human health and the environment, yield the greatest improvement in the environment, and ensure the ability of the military sector to perform its mission.

Measures of success

Senior management officials must have the means to assess the effectiveness of strategies in meeting desired performance goals. A few measures of success should be developed for major components of the environmental program. Total sources of pollution can be a measure. Examples include the amount of hazardous waste disposed of or the amount of pollutants discharged as air emissions. Another measure may be the total effect of environmental protection activities. Examples include the abundance of certain types of fish and wildlife or the number of contaminated sites that still pose a significant health risk to the surrounding population. The measures provide senior management officials an indication of the overall effectiveness of the program. When there is a major deviation from desired performance targets, additional information may be needed. ■

Section 2. Planning

The foundation of a good environmental program is a relatively detailed road map of future actions, based upon the examination of environmental issues and constraints and the evaluation of reasonable alternatives.

Goal

It is important that significant environmental problems and issues be considered early in the planning process to allow sufficient time to consider alternatives, take different courses of action, or adopt strategies to compensate for unavoidable adverse environmental consequences.

Strategy

Strategies are described for two types of planning efforts. The first planning strategy is that for the development, procurement, deployment and eventual disposal of weapon systems. The second planning strategy is that for the development of installations to support the training of units (so that they are able to perform their military missions), the testing of the weapon systems, or other activities.

Weapon Systems

The planning strategy for weapon systems involves the identification of military requirements and constraints and the development of an implementation plan that meets those requirements within the constraints.

Inventory of requirements and constraints

Many countries that produce weapon systems now require that the environmental costs and consequences associated with the total life of a weapon system be evaluated at every major decision point in its development. All engineering solutions that meet the performance criteria of the weapon system are analyzed. The total life cycle of the system includes development, procurement, deployment and disposal. Decisions made during development about materials and propellants can have significant cost and environmental implications throughout the life of the system. When the identification and subsequent objective analysis of all practicable options are required, the less costly and environmentally destructive option most likely will be selected.

Many countries require that, before any decision is made to deploy or redeploy a weapon system, the decision maker complete an analysis of the environmental consequences associated with each reasonable deployment option. Factors that may determine that particular deployment options are reasonable could include such characteristics as the availability and size of testing or training ranges, proximity to locations where conflict is possible, remoteness from civilian communities to ensure secrecy or safety, or the availability of special facilities to support testing or training.

For any type of actions, the process of analyzing the environmental consequences of reasonable alternatives is similar. Each reasonable alternative must be evaluated objectively. For such analyses, the following topic areas usually are considered:

- Socioeconomic factors - This area concerns the ability of the local community to provide housing, education and emergency services to the additional workers associated with the proposed action, as well as any effect that an influx of military personnel or other workers may have on the cultural integrity of the local community.
- Transportation - This area concerns the ability of existing railroad, road and air travel facilities to support the increased traffic associated with the proposed action.
- Natural and cultural resources - This area concerns the potential effects of activities associated with the proposed action on natural and cultural resources. Those activities include construction, maintenance and operations, as well as recreational use and possibly vandalism.
- Noise - This area concerns the potential effects of noise from construction and operational activities associated with the proposed action on living and working conditions on the installation, in nearby communities, and on wildlife.
- Air Quality - This area concerns the potential cumulative effect of emissions from sources connected with the proposed action on the air quality in the region. Sources can include aircraft, automobiles, trains, ships, industrial processes and power and heating plants.
- Water Quality - This area concerns the cumulative effect of activities associated with the proposed action on rivers, lakes and streams in the region. Activities can include increased sewage effluent, new or increased industrial waste flows, contaminated runoff from hard surfaces, and soil erosion associated with construction or training activities.

In most cases, involvement of the general public in the decision-making process is highly desirable. A public process allows the military sector the opportunity to describe the need for the particular action proposed. The public, however, may be able to offer insight on factors that military planners overlooked. The result could be a cooperative effort between the two parties to find the best solution for both the military sector and the environment. It should be noted, however, that public disclosure may not always be possible, particularly if the proposed actions are extremely sensitive to the defense of the country.

Implementation plan The implementation plan describes the manner in which a military action is to be conducted. The plan should be tempered by constraints identified during the initial analysis to avoid adverse consequences as much as possible. However, adverse consequences sometimes cannot be avoided. In such cases, early detection of the problem would permit identification and adoption of an environmental mitigation (an action that may reduce the adverse effect or may compensate for the adverse effect) as part of the implementation plan. For example, the introduction of a new aircraft at an existing installation may cause some unacceptably high noise levels in nearby dwellings. While it may not be possible to relocate the aircraft to another installation, the effect of the noise could be reduced by adding additional sound insulation to the dwellings, changing takeoff and landing procedures or flight patterns, limiting hours of operation, or, if those actions are not satisfactory, relocating residents living in the nearby dwellings.

Installations

The planning strategy for installations involves the identification of requirements and constraints and the development of an implementation plan that meets military requirements within those constraints.

Inventory of requirements and constraints

The effects of good planning are most visible in the development of military installations. Facilities should be located and constructed to provide a good quality of life, support efficient execution of the mission, and impose minimal adverse effects on the surrounding environment. To achieve these objectives, the planner first must understand the operational and support requirements of the intended mission. The planner also must identify the natural and physical constraints on construction, and understand the relationships among the various activities on the installation.

Operational and support requirements Operational and support requirements are those features that are necessary to permit performance of the intended military mission in an acceptable manner. Such features may include: training or testing areas; air space for training or testing; special terrain (mountainous, desert, forest, or tropical jungle) to support specialized training or testing; and facilities such as runways, railheads, maintenance buildings and housing.

Natural and cultural constraints Natural constraints are those features that prohibit normal development or unique or special features that deserve special attention or protection. Natural features that constrain or, at a minimum, influence installation development include: flood-prone areas; soils susceptible to erosion; lakes, rivers, streams and other waterways; marshlands; habitat of certain animal and plant species; productive timberlands; productive farmlands; and rough and difficult terrain. Cultural features that impose constraints on installation development include: archaeological sites; burial or other sacred sites; and facilities of historical or architectural significance.

Safety, noise and visual constraints Various types of constraints related to safety affect the development of an installation. The most obvious constraints are the safety or buffer zones surrounding highly dangerous activities or places processing highly dangerous materials. For example, safety zones usually are established around ammunition storage facilities. They are also imposed around firing ranges and bombing ranges to protect people from an errant shell or bomb. Safety zones also are established on approaches to runways where statistics have shown an unacceptably high risk of an aircraft accident.

Sources of loud noise also require safety or buffer zones to protect people. Sources of noise on a typical military installation include aircraft on takeoffs and landings, engine test cells, firing and bombing ranges, and even major motorways. Sufficient clearances should be provided between these noise sources and facilities, so that activities in the facility can be conducted safely or in a reasonable manner. Standards have been established for the loudest permissible noise commensurate with the safe conduct of an activity. Typically, noise contours are prepared for a military installation according to the types of aircraft or

vehicles, anticipated frequency and time of operation, and proposed flight or driving patterns. Planners can use noise contours to aid in the placement of new facilities.

An often overlooked constraint is that resulting from the visual effect of a new facility or activity on the landscape. A poorly designed or located facility can significantly mar an otherwise aesthetic setting. Generally, insofar as is consistent with the needs of the mission and available funding, new facilities should have architectural features that match or blend with existing facilities in the vicinity. In addition facilities and activities should be located in a way that avoids obscuring or damaging scenic views.

Existing infrastructure The most obvious constraints on an installation are the existing utilities and facilities. That infrastructure can be altered or demolished, but probably only at an unacceptably high cost. In addition, areas that have been contaminated by chemicals or other pollutants from past military or industrial activity also may be constraints on development.

Implementation plan This plan guides the location and type of construction of new facilities, roads, and utilities; the management of natural and cultural resources; and the conduct of training, testing and recreational activities at an installation based upon known requirements and anticipated resources. The plan guides development toward a functional, environmentally friendly installation.

Functional relationships Facilities should be located in a way that not only respects the constraints identified above but also supports operational efficiency. Industrial facilities may be arranged to complement each other and be located near a major transportation hub such as a railhead or airport freight terminal.

Long-term perspective Because of physical and financial constraints, the plan usually is accomplished over a period of many years. However, each action, whether construction, alteration or demolition, is accomplished in accordance with the plan. Eventually, perhaps several decades later, the vision of the planner is realized.

Periodic Review Planners must review the plan periodically and update it as necessary to ensure that it continues to meet changing military needs and current environmental constraints.

Budget preparation priorities

The costs to support intelligent environmental decisions about the development, procurement, deployment and disposal of a weapon system should be considered an integral part of the development or deployment costs for the weapon system. In essence, such costs should be considered part of the cost of doing business.

The implementation plan for an installation is the foundation for intelligent development in the future, including expansion of the installation to meet future mission needs. As the foundation of the entire development effort, the implementation plan deserves high priority for funding.

Measures of success

It is very difficult to evaluate the success of planning efforts. Certainly, a decision made after carefully considering the environment is expected to create less environmental damage, encounter less public hostility, and perhaps be less expensive than one made carelessly. However, it is difficult to measure success in quantitative terms. Perhaps the best approach is to ensure that there are established procedures for evaluating the environmental consequences of proposed actions, that those procedures are followed, and that the decision maker is aware of the results of the evaluation before making the decision. ■

Section 3. Environmentally Sound Practices

Many actions taken by the military sector, either on installations or during exercises, can cause severe health problems or damage to the environment. Hazardous materials handled incorrectly have caused a wide variety of physical ailments · some resulting in the deaths of workers. The release or disposal of such hazardous materials without proper environmental safeguards has caused serious degradation of rivers, groundwater and coastal waters, killing wildlife, destroying vegetation, polluting sources of drinking water, and causing illnesses.

Goal

The requirements of national security are the first priority of a nation's military sector. Nevertheless, the military should protect human health and the environment - to the maximum extent possible - through controls on the handling and disposal of hazardous materials and prevention of the release of contaminants into the air, water or ground.

Strategy

There is a hierarchy of actions that can be taken to protect human health and the environment. Those actions are:

- **Source reduction**
- **Recycling**
- **Treatment**
- **Disposal**

At the top of this hierarchy is **source reduction.** One method of source reduction is the substitution or replacement of a process or system that uses hazardous materials or generates hazardous waste with a process or system that does neither. For example, the use of high-pressure, water-based cleaners for aircraft parts eliminated the need to use chemical solvents and the resultant need to dispose of hazardous waste.

When substitute processes are not available, source reduction may be accomplished through the introduction of processes that use or apply the hazardous materials more efficiently. One example is the use of physical vapor deposition (PVD) processes to coat critical components of weapon systems. Traditional coating methods, which entail the immersion of the components in plating solutions, create a significant volume of hazardous waste. PVD processes, which entail the introduction of an electrically charged coating material into a vacuum chamber containing the oppositely charged component, may achieve up to 99 percent application efficiency. Another example is the use of electrostatic spray method to paint components. Traditional paint spray methods create considerable overspray, achieving between 30 and 60 percent application efficiency, and do not always provide uniform coverage. The electrostatic spray methods, which rely on an electrically charged component to attract oppositely charged paint spray, may achieve up to 90 percent application efficiency.

Recycling is next in the hierarchy of actions to protect human health. Recycling often reduces operating costs. It also reduces environmental damage by reducing the need for new materials obtained through additional mineral extraction or timber harvesting required to meet the production or industrial need. In addition, recycling decreases the demand for landfills, with their associated potential for environmental damage. For example, antifreeze used in vehicle cooling systems traditionally was used for a set period of time and then disposed of as waste. Used antifreeze now is being cleaned and used again, resulting in a savings in both costs of disposal and the cost of new antifreeze.

The third choice in the hierarchy of actions is **treatment** of the contaminated waste resulting from an industrial process. This approach exposes both workers and the environment to potential harm. This method often is extremely expensive, since large quantities of waste must be treated to reduce the harmful effects of the contaminants.

Sometimes the contaminated waste cannot be treated and the least preferred option in the hierarchy must be used — that is ***disposal*** of the waste in a specially prepared and managed facility. The cost of such disposal can be extremely high. In addition, there is always the possibility of improper handling of the material, the result of which is additional expense when contaminated sites must be cleaned, usually at a later date. The third and fourth options in the hierarchy often are referred to as "end-of-pipe" approaches.

In implementing an environmental protection program, a country is more likely to focus on treatment and disposal than on the more preferred options in the hierarchy. Standards for "end-of-pipe" emissions or actions generally are easier to establish and monitor, cause the least disruption to existing industries, and usually require less initial investment. However, as the environmental program matures, both the affected industries (including the military) and the environmental agencies of the government begin to realize the environmental and fiscal advantages of source reduction and recycling. The strategies described below are presented in the order in which they usually evolve.

Treatment and Disposal

This section presents the strategy for the treatment and disposal of hazardous and toxic wastes.

Inventory of Requirements The first step in developing an "end-of-pipe" or compliance strategy is to identify those actions necessary to protect workers and the environment. Such actions may be responses to laws enacted by the country's legislature. However, even in the absence of such laws and regulations, it is incumbent upon organizations working with hazardous materials, or releasing hazardous wastes into the air, water, or ground, to take the necessary precautions to limit harmful exposures and control environmentally destructive emissions.

It is clearly in the nation's interest that the military sector be involved in the development of legislation and the regulations to implement the legislation. Legislators must be informed fully of the possible consequences of proposed legislation before it is enacted. Inattention by legislators to the training and testing needs of the armed forces could result in the passage of laws that severely restrict those activities or impose such high costs for compliance that other important military requirements may be unsatisfied.

To assist in the development of requirements and to identify to the installation commander any conditions that may pose a threat to the health of workers or the environment, an environmental self-audit of the installation should be accomplished at least annually. The self-audit checklist should be based upon the country's laws and regulations, as well as any additional precautions deemed necessary by the military sector to protect workers and the surrounding environment. While the self-audit should be managed by the installation's environmental officer, experience indicates that the most effective inspection is performed by those persons who actually work in the facilities.

Examples of "end-of-pipe" actions that should be performed to protect the lives of the workers and the quality of the surrounding environment are described below.

Hazardous materials Two of the most challenging environmental problems facing the military sector are the use of hazardous materials and the generation of hazardous wastes. Many of the materials are required by standard maintenance procedures to maintain and operate weapon systems. Fortunately, much can be done to minimize the potential damage to both human health and the environment as the result of the use of such materials.

Handling and storage of hazardous material Proper control of hazardous materials is the foundation of any environmental program. Many military sectors are establishing central management functions at each installation to buy and store such materials and to distribute them to maintenance shops in quantities suitable to support the immediate mission.

Careless control, however, can create stockpiles of excess materials around an installation. The excess materials increase the risk of health problems and environmental hazards through spills or inadvertent exposure. Moreover, funds used to purchase those materials could have been used more productively elsewhere. Finally, excess materials often become obsolete before they are used. The materials then must be disposed of at additional cost to the installation.

Extreme care must be taken in the storage and movement of hazardous materials. Such materials should be moved and stored in structurally sound containers that are marked distinctly to indicate that the contents are hazardous. Further, every precaution should be taken to ensure that, in the event of a leak or sudden rupture, the contents can be contained. That goal can be accomplished easily by placing the containers on a nonporous surface that is surrounded by a wall of sufficient height to retain the total volume of all materials that might be stored in the containers.

Work force training In addition to the careful control of hazardous materials, proper training of the workers who must use those materials can help avoid many of their potentially harmful effects. Such training should include procedures for correct handling and disposal of the materials, the proper use of protective clothing and breathing apparatus, and actions to be taken in the event of exposure or a spill.

Emergency equipment and procedures Every facility that contains or uses hazardous materials should have an emergency plan, and the appropriate equipment and supplies readily available for responding to emergencies. Information should be available to each worker on the hazards presented by each material and the appropriate actions to be taken should the materials be spilled, contact skin, or be released into the environment in an uncontrolled manner. Eye washes and entire body showers should be available in the work area for personnel to quickly remove any contaminant from their skin.

A trained response force should be available to handle emergencies because an untrained force could be at risk or could greatly complicate a minor incident. At many installations, the responsibility for providing a response force is given to the fire department. However, even if the installation's fire department is not the response force, it should be advised of the storage of hazardous materials in a facility, because the presence of such material might alter the department's response to a fire emergency. The information also should be provided to the emergency response forces of nearby towns because they might be required to respond to an emergency on the installation.

Hazardous waste disposal A significant amount of environmental damage has been caused by the negligent disposal of hazardous wastes. Therefore, the military sector must ensure that the task of hazardous waste disposal is given to a person or an organization qualified to properly handle, transport, treat if necessary, and dispose of the hazardous material in an environmentally acceptable manner. It should be noted also that care must be exercised in the disposal of weapon systems since many contain hazardous materials. The hazardous components must be removed for disposal as a hazardous waste.

Contaminant releases Harmful pollutants can be released into the environment during routine maintenance and operations, even when those activities are conducted in strict conformance with standard maintenance procedures. Small, isolated releases may be environmentally acceptable. However, the cumulative effect of many minor releases could create considerable environmental harm. Accordingly, the military should take every precaution to limit its releases as much as is consistent with the performance of its primary mission of maintaining its forces in a high state of readiness.

Standards for releases As countries become aware of the damage caused by harmful releases, they are enacting laws to reduce such releases. But, even without those laws, military commanders must use good judgment in determining what releases are consistent with protection of the health of military personnel and persons living in communities adjacent to installation.

Water releases The source of drinking water for the installation and the nearby communities is, or should be, an issue of vital concern. Many wells and rivers have become contaminated because of the release of untreated or inadequately treated sewage or the indiscriminate disposal of hazardous wastes.

Many factors influence the type of sewage treatment that may be required. Raw sewage may be placed in holding ponds until the natural breakdown of fecal matter has occurred, provided the ponds are well insulated from any source of drinking water. However, untreated sewage should not be released into any lake or river that is an immediate source of drinking water or that is used for recreation. A minimum of secondary biological treatment of the sewage is required to ensure that the effluent is safe. Even effluent that has received secondary treatment still will have high concentrations of nitrates and phosphates, which can stimulate algae growth and reduce the oxygen supply in the lake or river. The reduced oxygen supply can limit the types of fish that can survive in the water. If such a circumstances becomes a significant concern, additional (tertiary) treatment may be needed.

The mixture of wastes from industrial processes with sewage presents a unique problem. The resulting sludge from a sewage treatment system could contain hazardous materials that, in turn, would require special disposal actions. Use of the contaminated sludge to fertilize fields could contaminate the food supply. This problem can be avoided either by separating the two disposal systems or by treating the industrial waste before it enters the sewage collection system.

Runoff from paved or compacted surfaces also can present a threat to vital water sources. Often, the runoff contains lubricants, fuel, oils and other petroleum products that may have dripped from vehicles or other equipment. Oil-water separators strategically placed on drainage systems and other waterways may prevent the entry of the contamination into vital water supplies. Oil-water separators are structures that slow the flow of contaminated water, allowing petroleum products and water to separate because of their different densities (petroleum products rise to the top), and then releasing only the water downstream.

Both the drinking water and the water releases should be monitored regularly. Sampling and analysis should be conducted at regular intervals to ensure that no contaminant has entered the drinking water supply and that contaminated wastes have been treated adequately and reasonably can be assumed not to pose a threat

Air releases The release of pollutants in air emissions presents a more difficult problem. Preliminary studies of typical military installations indicate that far more pollutants are released through air emissions than are released into the ground or water. The releases come from boilers, power plants, automobiles, ships, aircraft, incinerators, painting operations, construction activities, and other industrial processes associated with maintaining weapon systems. Pollutants can be particulate matter, nitrogen oxides, carbon monoxide, volatile organic compounds, ozone, sulfur dioxide or lead. When pollutants are released in small quantities, the effect is not noticeable. However, the cumulative effect of many operations, particularly if they are confined physically to a region by mountain ranges or by a thermal inversion, can be devastating.

Prudent measures should be taken to control such releases. Simple measures, such as spraying construction sites with water, can significantly reduce the amount of particulate matter (dust) rising in the air. The pollutants from fossil fuels can be controlled through catalytic converters on auto-

mobiles and the use of control devices on smoke stacks. The control devices can rely on a water screen or an electrostatic charge to remove the offending pollutant. In addition, the release of volatile organic compounds, which is associated most often with painting, can be controlled through the use of paint booths. The booths are enclosed facilities or pieces of equipment that use various filtering systems to reduce the release of contaminants to the air. The release of volatile organic compounds during fueling operations can be controlled through the use of low-cost vapor recovery systems.

Ground releases Many formerly acceptable practices have been found to be highly destructive to the environment because they put contaminants directly into the ground. For example, firefighting training activities often have been performed by pouring fuels on bare ground, igniting them, and then extinguishing the flames with a variety of environmentally damaging firefighting chemicals. Unburned fuels seeped into the ground and, in some cases, contaminated groundwater. Such practices should be stopped, and firefighting training conducted on impervious surfaces with containment walls and collection tanks for any runoff. In addition, many fire departments now use propane instead of fossil fuels to reduce the amount of noxious materials emitted into the air.

Old landfills are the focus of considerable cleanup activity. A landfill is an excavated trench that is used to deposit both hazardous and nonhazardous waste. Because of poor siting, poor preparation or poor operation, hazardous materials have leached from landfills and threaten to contaminate, and, in some cases have contaminated, important groundwater resources.

Many countries are closing poorly sited and operated landfills and are establishing rigid standards for the safe location and operation of new landfills. The military sector should endeavor, whenever possible, to use those government-approved facilities.

If government-approved landfills are not available, the military sector must take extreme care to locate and operate its own disposal facilities in accordance with national laws and in a manner that allows avoidance of future liabilities and environmental damage. Sites should not be located in flood-prone areas, nor be near streams, intermittent streams, lakes or groundwater. An impervious membrane should be laid at the bottom of the excavated landfill to prevent the leaching of the materials that may be placed in the landfill. At the end of each day of operation, the freshly deposited wastes should be covered with soil to prevent access by scavenger birds or animals.

The military sector must take even more stringent precautions if it must dispose of hazardous wastes. The disposal facility should be separate from that used for nonhazardous wastes. The hazardous waste landfill should have two layers of impervious membrane to provide additional protection against accidental releases. In addition all hazardous wastes should be placed in secure containers. The landfill should be checked regularly for possible leaking of hazardous wastes and access should be limited to only those persons trained and authorized to handle hazardous wastes.

Implementation plan The implementation plan describes the manner in which the installation commander intends to meet commitments (requirements) to protect workers and the surrounding environment. The plan describes the scope and cost of each environmental project and the proposed time for construction.

Phased approach In many circumstances, the military sector does not have adequate resources to implement all requirements. There are more requirements than there is money available to satisfy them. The implementation plan should establish priorities for the work over a defined planning period. In some countries, there are new requirements that each underground storage tank must have two walls, a leak monitoring device, and spill protection. However, that goal would be financially and physically impossible to accomplish in a single year. Accordingly, a plan that calls for the conversion of a set percentage of tanks each year should be developed and implemented. In addition, older tanks normally should be the first replaced. They usually pose a more immediate threat to the environment because of the length of their exposure to the effects of corrosion.

Risk-based approach In some cases, the implementation plan should establish priorities for environmental work based upon risk or return on investment. For example, many countries have decided that they no longer can accept heavily polluted streams and rivers, and they have imposed standards on all effluent being discharged into those waters. The standards require the treatment of all sewage and industrial wastes. With limited budgets, the necessary treatment plants cannot be constructed simultaneously, nor, in most cases, can the sources of pollution be eliminated without causing economic chaos or affecting crucial operations. Accordingly, the entire river network must be analyzed to identify areas of "extreme sensitivity." Those areas might be locations of intakes for domestic water; groundwater source of drinking water that is threatened by encroachment of pollution; or vital economic resources, such as fish hatcheries or shellfish beds. A master plan for the sequential construction of treatment plants then could be developed. This plan would provide for the protection of the sensitive areas and establish priorities for the construction of treatment plants. Under the plan, treatment plants would be located and built according to their environmental importance to the river system.

Source Reduction and Recycling

For many years, the focus of most environmental professionals was on the treatment and disposal of hazardous wastes being released during industrial processes. While those "end-of-pipe" activities are effective, they are also expensive. Further, as governments and communities became aware of the potential damage resulting from releases, they passed ordinances and laws that required more restrictive standards that, in turn, increased costs.

Regardless of the degree of care, "end-of-pipe" solutions could not eliminate the possibility of accidental releases. Such releases can affect human health, cause environmental damage, and result in significant monetary liability. Consequently, many environmental professionals now believe that the most effective method of protecting human health and the environment, as well as reducing costs and limiting liabilities, is to eliminate or reduce the use of hazardous materials and the processes that generate hazardous wastes. In essence, attention is being placed on the first two options in the hierarchy.

Examples of the types of actions that may be taken at installations or in support of weapon systems to reduce and recycle hazardous materials are described below.

INSTALLATIONS

This section discusses source reduction and recycling programs appropriate for military installations.

Inventory of opportunities The basis of a cost-effective pollution prevention strategy must be a thorough assessment of the opportunities available on an installation.

To begin with, each user of hazardous material and each generator of hazardous waste must be identified. Next, the costs associated with the safe handling and disposal of the hazardous waste must be determined. However, some costs, such as the loss of vegetation or the pollution of soils, may be difficult to quantify.

The second step is to identify alternative, more environmentally benign materials or processes that might be available to prevent pollution. Each alternative must be assessed for its cost, the degree to which it reduces releases of hazardous waste and its effectiveness in meeting operational and maintenance requirements. The alternatives must be aligned in order of preference, usually, but not always, based upon monetary return on investment. The return on investment is determined by comparing the operating costs of the old method with the initial purchase price and the operating costs of the new method. Usually, the greater the return on investment, the higher the preference. However, there may be exceptions to that rule. For example, if hazardous materials present an unacceptably high risk to human health or, as in the case of ozone-depleting chemicals, the materials are no longer produced, it may be necessary to adopt alternative processes or materials, regardless of the return on investment.

A variety of measures can be implemented on an installation to reduce the use of hazardous materials or the generation of hazardous wastes. The noxious emissions attributed to the burning of fossil fuels can be reduced through such actions as the conversion of power plants from coal or oil to natural gas, a prohibition on burning high-sulfur coal, the use of vehicles that are fueled by electricity or natural gas, and the mandatory or encouraged use of mass transit systems or car pools by workers. Ozone-depleting chemicals once used to fight fires in computer rooms can be replaced with water extinguisher systems, which are just as effective. On the flight line, fire extinguishers once filled with halon now can be replaced with extinguishers filled with an environmentally friendly powder flame repellent. Non-lead-based paints are now the standard and are just as effective as lead-based paints. In addition, there are many new environmentally benign industrial processes available that are just as effective as processes that used hazardous materials or generated huge quantities of hazardous waste. One example is the high-pressure water washers that have been found to be far more effective in cleaning precision parts than washers that required the ozone-depleting solvents that previously were used.

Implementation plan The results of the inventory of opportunities should be incorporated into an implementation plan. The plan identifies the sources of pollution, the alternative materials or processes available, the return on investment, and the reduction in emissions of contaminants. The plan is built to support future budget requests. It also can be used to identify areas in which no solution, or no cost-effective solution, is available. That information can be used to mold the research and development program that will be discussed later.

Balanced approach In recent years, a small but growing number of environmental experts have questioned the wisdom of the rigid application of environmental standards. They contend that such an inflexible approach often requires large expenditures of funds with little or no improvement to the environment.

As the benefits of pollution prevention initiatives have become apparent, some authorities have exchanged the rigid enforcement of standards for the rigid enforcement of pollution emission reduction goals. Those goals can be percentage reductions in solid waste generated, toxic releases, hazardous materials purchased or hazardous wastes disposed of. While this emphasis on pollution prevention is good, the desire to achieve arbitrarily established reduction goals could force some unwise investments. The cost to achieve the last few incremental decreases in pollutants released may be extremely high.

A new approach that considers both cost and performance in the development of an environmental program is attracting increasing support. The total array of options - including pollution prevention projects, "end-of-pipe" controls and even no environmental action - would be evaluated to determine the best combination to protect human health and the environment, at the least cost over a set planning period (in many countries, five years). Preliminary studies indicate that this more flexible approach can achieve better overall environmental performance, and at less cost, than would be achieved through a more authoritarian approach.

Recycling Recycling is an effective means of reducing the requirements for disposal of used products in landfills. Recycling programs traditionally have focused on materials such as aluminum, glass, paper, tires, oils, and plastics. However, any material can be recycled if: 1) the cost of recovery is equal to or less than the cost of obtaining virgin materials; 2) significant undesirable environmental consequences are associated with the extraction or the harvesting of the material; and 3) the recycled product meets the desired performance standards.

Creation of industries that process recycled materials into new products is difficult. For example, there are significant startup costs and there is generally a small supply of recyclable material available at the beginning of the effort. It also takes time to establish an efficient collection network, and, in many cases, the product made from recycled materials costs more than that made from virgin materials.

To have a positive effect on the environment, a government may decide to aid new recycling industries in overcoming initial obstacles. The most obvious method of helping is to mandate the recycling of certain materials. However, the government can stimulate the market for the goods produced by these fledgling industries. That goal can be accomplished by mandating that the military and other government agencies purchase materials and supplies that contain recycled content, unless it can be demonstrated that such products do not meet performance standards.

Experience indicates that, as the market for products with recycled content expands, unit production costs fall to the point that recycled products are competitive with products made from virgin materials. As the demand for products made with recycled content grows, so must the demand for the recyclable materials. To meet production demands, industries are willing to pay more for the recyclable materials. Higher prices, in turn, stimulate the recycling ethic, eliminating the need for further government involvement.

Normal phase-out The military sector should not replace automatically all systems that use hazardous materials. If those systems, when operated in an approved manner, do not pose an unreasonable threat to the environment and do not require that huge expense be incurred to dispose of the wastes, little is gained by premature replacement. In addition, early phase-out will impose an additional financial burden. The military should replace the systems when they reach the end of their economic or useful life. For example, air conditioning equipment that uses chlorofluorocarbons (CFC) as a coolant should remain in service until the mechanical components begin to fail and it is no longer economically feasible to repair the equipment. The manufacture of CFCs is prohibited under the terms of the Montreal Protocol because they destroy the ozone layer that protects the earth from harmful ultraviolet radia-

tion. However, in some countries stocks of CFCs may be available for servicing existing equipment. That equipment must be carefully maintained so that of the coolant does not leak.

WEAPON SYSTEMS

More than 80 percent of hazardous materials used and hazardous wastes generated on a military installation is a result of the direct support of weapon systems. Those uses are required by the standard maintenance procedures for the weapon systems and account for a large portion of the environmental costs and potential environmental liabilities at an installation. However, a military commander usually is reluctant to arbitrarily make any changes in such procedures because it might jeopardize the performance of the weapon system. Accordingly, weapon system developers must seek new solutions that meet performance requirements, but at less cost to the maintenance and operations budget and with less adverse effect on the environment.

Inventory of opportunities In recent years, there has been a change in the manner in which weapon systems are developed. In the past, the developer was concerned only with meeting the performance parameters specified by the future user and with delivering the product at a specified target price. Little attention was paid to the future costs to operate, maintain, and eventually dispose of the system. Indeed, those costs represent more than 70 percent of the total life-cycle costs of the system, including development and initial procurement. Now more sensitive to the costs and potential liabilities associated with the use of harmful materials, many countries are requiring that the weapon system managers, seek environmentally benign alternatives, both for new and existing systems, that still meet military performance specifications.

New systems Weapon system managers in some countries now are required to consider the total, including environmental, life-cycle costs at every decision point in the development of the system. The full environmental consequences of the development, procurement, deployment and disposal of a weapon system must be analyzed carefully and accepted before proceeding to the next phase of the program.

If the environmental costs or consequences associated with a weapon system are considered when it is still in the development stage, making adjustments will be easier and less expensive at that stage than later in the procurement or deployment stages. Doing so does not guarantee that no hazardous materials will be used or that there will be no adverse environmental effects. To achieve the desired military critical performance, it still may be necessary to select hazardous materials and processes that generate hazardous waste or to conduct operations in a manner that causes adverse effects. However, such decisions at least now will be made with full understanding and acceptance of future costs and liabilities.

Existing systems Weapon system managers must reevaluate the maintenance and operations procedures prescribed in the manuals for existing systems. The rate of development and procurement of new weapon systems is expected to

decrease because of the end of the Cold War. Accordingly, many older systems, developed well before people became concerned about the environment, therefore are expected to remain in service well into the 21st century. The maintenance and operations manuals for these systems require the use of hazardous materials that are responsible for considerable environmental costs and liabilities. Rather than accept those costs over the extended period of use, weapon system managers must seek, test and validate and adopt alternative, environmentally safe maintenance and operations practices. The managers first must screen manuals to identify all prescribed hazardous materials and their appropriate applications.

Implementation plan The military sector should pursue a variety of approaches to reducing the amount of hazardous materials necessary to maintain and operate existing weapon systems and thereby lower the potential for adverse effects on the environment.

Prioritized approach The military sector should develop a plan to find environmentally acceptable alternatives to the hazardous materials that are specified for use in the production, maintenance and operation of weapon systems. Because of the magnitude of such an effort, the military cannot change, in a short time, every manual that specifies the use of a hazardous material. Accordingly, the military should focus its efforts on those weapons and processes that pose the greatest threat to human health or to the environment.

Central management Central management of all hazardous materials purchased and used is the key to the development of an effective program to eliminate or reduce the use of harmful materials in the operation or maintenance of weapon systems. Data on the volume of hazardous materials used and hazardous waste released, collected at each installation, can be used to identify major sources of pollution. Weapon system managers, in turn, can use that information to identify those maintenance manuals and procedures on which they should initially focus their efforts.

Test and validation Alternative materials and processes must be tested and validated for every application. A process that may be suitable for one weapon system may not be effective for others. A good example is the stripping of paint from an aircraft. This process formerly used chemicals that were toxic, generated large quantities of hazardous waste, and took several days to complete. Bead blasting was developed as an environmentally more benign alternative to chemical stripping. Bead blasting entails propelling small plastic beads at high velocity against a painted surface. The paint is removed through abrasion. An aircraft can be stripped in a matter of hours. Very little hazardous waste is generated and the beads can be reused. Although this method is effective, it cannot replace every former use of chemical strippers. For example, bead blasting might damage the thin skin of a fighter aircraft. Moreover, the process might damage some large-framed aircraft, such as KC-135 tanker, because the bead blasting on the wing might contribute to wing fatigue. Consequently, new processes, even those that look promising, should be used with care and only after the military authority in charge of the weapon system has confirmed that they can be used without affecting performance. It should be noted that, in some cases, if the weapon system is to be phased out of use in the immediate future, the prudent course of action may be to do nothing.

International cooperation The search for environmentally more benign processes and materials might benefit from the increased cooperation among nations. Weapon system managers and environmental engineers throughout the world are facing many of the same problems. In addition, the environmental damage caused by harmful materials or processes may not necessarily be confined within the borders of the country that is using them. There are many cases in which the release, either controlled or uncontrolled, of hazardous materials in one country has caused significant environmental damage in neighboring countries. Consequently, all countries benefit from the expedited transfer of information on new, environmentally safe technologies or materials.

Budget preparation priorities

A system for establishing priorities is crucial for the conduct of an efficient and effective environmental program. Typically, budgets are developed to implement the requirements of a nation's environmental laws and regulations. Current operations, such as the safe handling and disposal of hazardous materials, would have the highest priority. Upgrading infrastructure, such as sewage treatment systems, to meet new standards would have second priority. Projects to upgrade systems to satisfy future standards would be ranked third. Projects that contribute to the environment, but are not required by law or to remedy a high-risk environmental problem, would be ranked fourth.

Another approach to establishing priorities might be based upon the incremental reduction of future environmental costs that results from each investment. At any installation, there are many potential projects that will reduce the use of pollutants and the costs associated with the handling, controlling and disposing of them. The installation commander must determine the payback period for each project - that is, the period of time it would take for the savings derived from the new process or procedure to equal the cost of implementing the project. For example, a machine to clean solvents for reuse may pay for itself within one year through reduced purchases of new solvent and reduced payments for disposal of dirty solvents. Other projects that may have a longer payback period also are worthy of implementation. However, projects with payback periods of five years or more are not good business decisions and therefore should not be funded.

Exceptions to this approach may occur if the government is attempting to establish or support a new industry. In such a case, the implementation of recycling programs, the purchase of products made with recycled materials, or the purchase of vehicles that run on nonfossil fuels may not appear to be a good business decision to the installation commander, but may contribute to the long term environmental goals of the government.

Measures of success

Senior decision makers must have some means of evaluating progress. In countries that have comprehensive regulations and enforcement agencies, a simple measure might be the number of formal citations issued by regulatory authorities. The military sector might maintain its own records of legal requirements and of the percentage of its activities that meet those requirements. For example, in a country that has standards for the effluent from a sewage treatment plant, military leaders should know how many military plants can comply with the standard. That information, which can be obtained through the self-audit program described earlier in these guidelines, also helps to support the development of budget requirements.

Some measures are required to provide senior management officials with an assessment of the progress being made in eliminating the sources of pollution. Information can be collected periodically about such measures as the volume of hazardous materials purchased, the volume of hazardous waste that is disposed of, the volume of solid waste that is disposed of, or the volume of materials sent to recycling centers.

An even more significant measure would be the annual total cost of the environmental program. An effectively implemented pollution prevention program should realize significant savings over the military's fiscal planning period (usually five years), as hazardous materials are eliminated and the costly procedures necessary to handle, store and dispose of those materials are no longer required. ■

Section 4. Conservation

Conservation implies the protection of natural and cultural resources that may exist on or near a military installation from the effect of such activities as training maneuvers.

NATURAL RESOURCES

Natural resources include the land, water, minerals, and biological life forms (plant and animal) of a nation. It is essential to the economic life of a country that those resources be protected. Moreover, management of those resources in a manner that supports sustainable use, while minimizing adverse consequences, is essential for the well-being of future generations. Countries that have not protected their natural resources have seen their forests disappear, their fertile topsoil wash away, their rivers and streams become polluted, and their food self-sufficiency be lost.

Military activities, particularly those of an army's mechanized units, can be very destructive to natural resources. Overuse of some training areas has left the land barren and highly susceptible to soil erosion that could foul local streams. Indiscriminate activities also have contributed to the loss of forests and woodlands that provide a habitat for wildlife.

Military activities, and indeed readiness, can be affected by the poor management of natural resources. Land used in an irresponsible manner in support of military training soon can be reduced to a barren landscape, not resembling any area in which the troops may be deployed and, therefore, offering an unrealistic training environment.

Understanding the behavior patterns of species can assist in the development and implementation of land management activities or the planning of operations to ensure the safe accomplishment of military training. For example, aircraft are lost or damaged each year in collisions with birds nesting near the approaches to runways. By maintaining the grounds surrounding the runways in a manner that discourages nesting, the danger of "bird-strikes" can be reduced. Many low flying aircraft and their pilots are lost each year in collisions with flocks of birds. By identifying the seasonal migratory patterns and daily flight habits of birds, planners are able to route aircraft to minimize the potential for such incidents.

Goal

Maintain the mission readiness of the armed forces by providing realistic training opportunities while minimizing, to the extent practical, adverse effects on the natural resources.

Strategy

The strategy involves the identification of resources and the development and implementation of a long-term plan for the careful management and nurturing of those resources.

Inventory of natural resources

The first step in developing a strategy is to prepare an inventory of the natural resources present on lands under the control of the military or lands that could be affected by activities of the military sector. Resources that should be considered in the preparation of such inventories include:

- Wildlife whose continued existence is threatened
- Special areas such, as marshlands
- Types of soils
- Vegetation, with emphasis on that which can be harvested and that which provides wildlife habitat
- Streams, rivers and lakes
- Flood-prone areas

Implementation plan

An integrated natural resources plan is essential to the long-term protection of the natural resources on an installation. The plan establishes the management practices necessary to fully support the performance of the mission, while limiting any damage to wildlife, vegetation, soils and waterways.

The approach that natural resources managers take in developing implementation plans has changed markedly in recent years. In previous decades, a separate plan was prepared for each resource. A plan was developed for the planting, maintenance and harvesting of forests. Another plan was developed for the management of fish and game including maintenance of herd size. Still more plans were developed, as appropriate, for agricultural lands, minerals and endangered species. Little or no consideration was given to the interrelationships among these resources.

In recent years, the natural resources managers of many countries have changed their approach. They have recognized the interrelationships among the various resources and have developed an integrated resources plan for each installation. While this approach represented a significant improvement in the planning process, it had one major weakness: it did not consider adequately the needs of the military user.

The natural resources managers of several countries are now developing management plans that balance the training requirements of the armed forces against the ability of the land to sustain them. Among the factors considered in the development of a combined training and natural resources management plan are:

- The type of exercises and weather conditions. Mechanized equipment can be highly destructive to the ground and vegetation. Wet weather can make the land more susceptible to heavy rutting, but tanks can operate with relative impunity over land that is frozen.
- The interval between exercises. Sufficient time must be permitted between exercises for plant life to recover.
- The type of soil. Training on desert lands or tundra will leave imprints that may last for centuries, whereas a heavy loam may be able to absorb and recover quickly from even heavy tank use. Training on sandy soil that might be susceptible to erosion should be conducted at intervals that permit vegetation to recover fully. It may be necessary to construct erosion barriers after the use of such lands.
- Presence of sensitive areas such as streams, wetlands and wildlife preserves. It may be necessary to construct special stream or river crossings to reduce erosion and fouling of the stream. Other sensitive areas might be placed off limits. Planners can protect sensitive areas by identifying them on training maps as minefields.

The advantage of this approach to land management is that both the natural resources are protected and that the military continues to have a realistic training area.

Military land managers in some countries are seeking to develop, in coordination with other major landowners, management plans that cover the entire ecosystems in which the installation is located. While more challenging to accomplish, the plans may provide increased flexibility for the use of military lands. For example, biologists and other natural resource managers are better able to assess the relative effects of proposed actions if they understand the health and sensitivity of resources throughout the ecosystem. In addition, ecosystem-wide land use plans can spread responsibility for protecting sensitive resources among several landowners, thereby giving the individual landowners greater flexibility in the use of their lands. Finally, plans developed on an ecosystem-wide basis have greater chance of success.

Because military installations are not isolated ecosystems and because land set aside for use by the military is usually public land, the military, when security permits, should invite public comment on how the land should be managed. In addition, when security and safety considerations permit, the public should be allowed access to enjoy the land for or such activities as farming, grazing of livestock, and recreational activities, such as hunting, wildlife watching, fishing, boating or hiking.

Budget preparation priorities

An effective management program for natural resources is extremely important to provide realistic training for military forces. Consequently, budget requirements to maintain training areas should be considered part of the operational costs of training.

Activities involving natural resources that can affect the safe conduct of the mission also should receive high priority in the budget process. Such activities include studies of the migratory patterns or the nesting preferences of birds.

Next in the budget priority are the funds necessary to manage other important or sensitive areas that have been entrusted to the military's management. Some management activities may be mandated by the country's laws.

Last in budget priority for the military sector are funds to enhance wildlife or to provide for recreational use of natural resources.

Measures of success

The development of true measures of success for a natural resources management program has proven to be elusive. To date, the measures used are related to building the foundation of the program. One measure of success is the satisfactory completion of inventories of the individual resources on an installation. The inventories, how-

ever, must be completed in sufficient detail to enable a technical expert to manage and protect the resources. Another measure is the completion of implementation plans for each installation so that there is, at least on paper, a well-planned series of actions that will protect and nurture the resources, while continuing to support the military mission. However, no satisfactory measure has yet been developed that assesses the effectiveness of such plans when implemented.

As a general rule, most senior managers must rely on a series of subjective assessments of the health of the natural resources program at each installation to judge the success of the program. The assessments may be based on favorable examples of the return or expansion of populations of special wildlife, the careful management of game, the sustained growth and harvesting of timber, and the development of recreational areas. Unfavorable examples might include the destruction of vegetative cover and the resulting erosion of soils and silting of streams, the loss of special species in the area, or the presence of unhealthy animal populations (for example, a sick herd), uncontrolled population growth or the inability of the land to support the herd.

CULTURAL RESOURCES

An important part of a nation is its heritage, which includes structures and areas of historical, cultural and religious significance. Each country must determine what facilities and sites are important within its own frame of reference. Each country also must determine what facilities and sites should be preserved without undermining the ability to support today's requirements. Facilities and sites to be considered for special protection might include: buildings where major events occurred; battle sites; cemeteries and burial sites; the homes and birthplaces of important or famous people; churches, synagogues, temples and mosques; ancient buildings and structures; and buildings and facilities that have unique architectural features. Loss of structures and areas that are of historical, cultural or religious importance destroys a country's heritage and thus the very fabric that unifies its people and makes it unique in the world of nations.

Goal

The armed forces must meet the operational requirements to maintain mission readiness while minimizing, to the extent practical, any adverse effects on cultural resources.

Strategy

This section presents the strategy for cultural resources. That strategy includes the identification of historic and archaeological resources and the development of an implementation plan to protect them.

Inventory of cultural resources

The first step in developing a strategy is to prepare an inventory of all cultural resources present on lands that are under the control of the military or that could be affected by military activities. Resources that should be considered in the preparation of the inventory are identified in the introduction to this section.

Implementation plan

A cultural resources management plan is essential for the long-term protection of archaeological sites and historic properties on a military installation. The plan should identify the procedures that will be followed in the event of a discovery of a site of archaeological or historical importance, and should specify how those sites and facilities that already have been uncovered or identified are to be maintained. Before completing the plan, the military should seek advice from competent authorities on the maintenance of such properties.

General guidance for preparation of the plan includes:

- It is not the function of the military sector to seek and recover data from archaeological sites. However, the military must be ready when such a site is discovered to protect the site from any damage or, if that is not possible, to arrange for competent authorities to investigate and recover in a scientific manner anything of value before the site is affected.
- Properties of historical importance also should be preserved, if possible. Again, the military sector is neither chartered nor funded to operate and maintain museums. Certainly, it would be better, both for the property and the budget, if the property can be used to support current activities of the military sector. Some modifications of the property may be required, but those modifications should be carried out in such a manner that the essence of what made the property historically significant is not lost. For example, if a building has unique architectural features, every attempt should be made to preserve those features as the building is modified for a new function.
- When avoidance or modification is not a practicable option, the military sector should seek to preserve the property through relocation or, if that is not possible, through recordation (that is, documentation and photography) before demolition. Such a step should be considered the means of last resort.

Budget preparation priorities

Generally, funding for any archaeological research effort is difficult to justify in a military budget. However, researchers competent to investigate and recover data from archaeological sites might be recruited at no cost from universities or other qualified reputable organizations. Archaeological research to collect data before destruction of a site for a military project should be funded as part of the cost of the project.

The best method of maintaining historic properties is to use them to support the current mission. It is often less expensive to change the historic structure to meet a current need than to build a new facility. The normal care and maintenance of the property then would be part of the military's operations and maintenance budget.

Measures of success

As in the case of natural resources, there is no good measure of success for the management of cultural resources. The measures used are related to building the foundation of the program. One measure is the satisfactory completion of inventories of resources such as archaeological and historic sites on a military installation. The inventories must be completed in sufficient detail to enable a technical expert to manage and protect the resources. Another measure is the development of an implementation plan to protect and maintain the resources. However, no objective measure has been developed to judge the effectiveness of the execution of the plan. Such measurement is left to subjective evaluation of actions taken. ■

Section 5. Cleanup of Contamination

The government must protect the nation's people and its natural resources from the ful effects of military activities. That responsibility includes the cleanup of contaminated sites on installations, as well as on nonmilitary lands that have been contaminated by military activities.

Most installations have sites at which petroleum products, solvents or other forms of contamination are present. The contamination is the result of activities conducted before people knew about the environmental consequences of those activities, or activities performed in a manner deemed acceptable at the time but later found to be environmentally destructive. The contamination also can be the result of accidents or the deterioration of infrastructure, such as underground storage tanks.

The contamination could pose a threat to the health of workers and persons in nearby communities and could threaten valuable water supplies, vegetation and wildlife. If left untreated, the contamination could continue to spread, increasing both the scope environmental damage and the complexity and cost of cleanup.

Goal

The military sector must take actions to reduce the risk of human exposure to toxic and other hazardous materials and prevent the spread of contaminants, while it conducts a cost-effective cleanup. It should be noted, however, that, in some countries, the responsibility for cleanup of any government land is given to a ministry or department of the environment.

Strategy

This section presents a strategy for cleanup of contamination. That strategy includes the identification of contaminated sites and the development of a plan to cleanup those sites.

Inventory of cleanup requirements (contaminated sites)

Before any cleanup program can be implemented, the military sector must complete an inventory of all sites known or suspected to be contaminated. Contaminated sites are areas of ground or water that contain materials harmful to human health and the environment that were placed at those sites through human activity. Examples of areas at which contamination is likely to be found are crash sites, live firefighting training facilities, landfills, storage areas, below and aboveground bulk storage tanks, underground fuel lines, vehicle and aircraft maintenance areas, washracks and deicing facilities.

A variety of techniques can be used to identify potentially contaminated sites. It is often desirable to start with a records search to determine where accidents occurred, highly suspect activities were performed, or hazardous materials that may have leaked or been spilled were stored. Interviews of persons who have worked on the installation for a long time can supplement the records search.

Upon completion of a list of potentially contaminated sites, an investigation should be conducted to confirm the presence of contamination at a level that warrants further action.

Implementation plan

A plan that establishes the courses of action for the cleanup of contaminated sites on an installation, within anticipated funding levels, is essential to ensure an effective and efficient cleanup effort. The plan would include:

- A description of the type and extent of contamination at each site
- An assessment of the risk to human health and the environment posed by each site
- The schedule to complete the investigation, determine the appropriate cleanup remedy, and perform cleanup at each site
- An estimate of the anticipated yearly and total costs to complete cleanup at each site

The plan would be updated as additional information is obtained about the site or available cleanup technologies and the schedules and cost refined.

Since the extent of the contamination and the approach to and timetable for cleanup of the sites may affect, or be perceived to affect, the local community, it is often advisable to involve the general public in the development of the implementation plan. In some countries, special advisory groups are formed to hear and comment upon the proposed cleanup actions. The installation commander or members of the commander's staff, representatives of the country's environmental regulatory agencies, community leaders and representatives of environmental interest groups might serve as members of such advisory groups.

Site investigation The approach to cleanup of a contaminant is affected directly by the conditions in which that contaminant is found. Consequently, to develop a realistic cleanup plan, a detailed investigation of a contaminated site is necessary. Investigators must attempt to determine the full extent of the contamination in the ground. They also must accurately identify the geological formations surrounding the contaminant, including the types of soils and the existence of possible fractures through which the contaminant might flow. The depth of the groundwater, as well as its rate and direction of movement, is also an important factor in the development of a cleanup strategy. Other information that may affect actions includes rainfall that might induce leaching of the contaminant and the proximity of any critical resources or activities that might be put at risk. Such activities and resources include wells for drinking water, residences, schools and wildlife.

Feasible approaches to cleanup Cleanup of contaminated sites is expensive and, in some cases, can take years. However, past practice has revealed that the approaches to cleanup of some contaminated sites are fairly predictable.

A large number of cleanup approaches are available. For example, petroleum products, which are the most prevalent contaminants on military installations, can be treated by a variety of techniques, depending upon their location and the pertinent physical, environmental, and time constraints. When found in water, some petroleum products often can be skimmed off the surface; occasionally, such products can be used for its

originally intended purpose. When petroleum products are found in the ground, the contaminated soil can be excavated and incinerated. This relatively fast method of cleanup can be expensive and may not be practical in an area that has significant air quality problems or when devastation of vegetation growing on the contaminated area is not desirable.

There are several new approaches to the cleanup of sites contaminated with petroleum products. If there is no urgency to the cleanup effort or if excavation is not feasible, naturally occurring microorganisms in the soil can be used to break down the petroleum molecules into their inert components. If the cleanup must be completed quickly, the rate of decomposition can be accelerated by increasing the supply of oxygen to the microorganisms. That effect can be accomplished by pumping oxygen into the ground, a process called bioventing. If excavation of site contaminated with petroleum products is feasible, a method called land farming may be used. The contaminated soils are tilled periodically to increase exposure of the microorganisms to the air. Sometimes the effort must be accomplished in an enclosure - often a very large tent - so that the fumes from the soil can be captured in a filtration system. It should be noted that the method is cost-effective only if the contamination is limited in both area and depth.

For some forms of contamination, the cleanup options are limited and expensive. If a contaminant is found to be leaching from a landfill, it might be necessary to excavate the contents of the landfill if the sources of the water causing the leaching action cannot be controlled. Therefore, excavation generally is required if the landfill is located near groundwater or in an area subject to periodic flooding. Leaching from a landfill that is remote from sources of water can be eliminated by placing a clay cap over the landfill. The cap prevents the penetration of rainwater that would induce the leaching. The tedious excavation and sieving of soil is the only acceptable method for removing lead from impact barriers on firing ranges.

For some contaminants, particularly those in groundwater, there is no cost-effective cleanup technique. In such situations, the best approach may be to control the spread of the contaminant and to await the development of a cost-effective cleanup solution. Control techniques include the construction of hydraulic dams or the insertion of impervious membranes across the direction of groundwater flow.

Much of the contamination found on military lands is similar to that found in the civilian sector. However, some contamination is unique to the military's defense mission. Such contamination includes unexploded ordnance and, in some countries, radioactive materials.

Cleanup of lands containing unexploded ordnance is a challenge for the military of many countries. While not a contaminant, the ordnance does pose a hazard to persons trespassing legally or illegally on ranges. The challenge becomes even more acute when the military determines that a range is no longer required and local community leaders seek access to the land for some other use. As a general rule, in most countries, the military performs periodic surveys of its ranges to locate, defuse or otherwise safely dispose of unexploded ordnance. However, some ordnance might penetrate deeply into soft soil or sand or sink to the bottom of a lake or coastal waters and not be detected during surveys. Equipment is now under development to detect ordnance even at great depths. The equipment detects the ordnance either because of its ferrous content or because of its higher density, compared with surrounding soil. While initial tests are promising, the equipment is not considered reliable, particularly for ordnance buried at great depths. Accordingly, it may be more appropriate that, until detection equipment is available that can be operated with a high degree of confidence, the impact areas of ranges be placed off limits for development.

Cleanup of lands that contain radioactive materials presents an extremely difficult and expensive challenge. Radioactive materials remain hazardous for many years. Typically, the remedy is to place the materials in special containers that are deposited in secure, long-term storage areas. In some cases, if the level of radioactivity is low or there is no suitable storage area, the contaminated area simply is placed off limits.

Budget preparation priorities

Typically, there are more requirements in any one year than there are resources to satisfy them. Accordingly, it is necessary to develop a logical plan of allocating resources to provide the maximum benefit. However, before such a plan is developed, an assessment must be completed of the risk to human health and the environment posed by each contaminated site. The limited funds then should be allocated to those sites that pose the greatest risk.

Several factors must be considered in the determination of risk. The first factor to be addressed is the concentration and toxicity of the contaminant in the ground. A highly toxic compound, even in small quantities, may pose a greater threat than a less toxic material spread over a wide area.

The second factor to be considered is the existence of a pathway for the contaminant to move. A fast-moving underground stream may move the contaminant well beyond the confines of the military installation in a relatively short time. On the other hand, a contaminant on desert sand, far above any groundwater and with little rainfall to induce leaching, could remain immobile for centuries.

The last factor to be considered is the presence of a receptor that could be put at risk, such as a person living or working in close proximity to the contaminated site. Other receptors might be a community that obtains its supply of drinking water from a contaminated aquifer or consumers who eat fish from contaminated rivers and streams.

This qualitative analysis of the relative risk of all contaminated sites provides the basis for the distribution of the limited funds. Cleanup of sites that pose the most immediate threat should receive priority for funding. Conversely, sites that pose no foreseeable threat may not require immediate cleanup.

Measures of success

Developing measures of success for cleanup is difficult because so many factors are beyond the control of the person attempting the work. For example, the geological formation in which the contaminant is located may be quite different from that predicted through a few borings. Consequently, the cleanup activity may be ineffective or, in some cases, counterproductive. In addition, there are currently no cost-effective cleanup techniques available for some contaminants. With these uncertainties, it is difficult to develop objective standards of performance.

Many countries therefore have developed simple measures of success that focus on the establishment of a management foundation for the cleanup program. Such measures determine whether a full investigation of possible contaminated sites at each installation and a complete analysis of the potential risk posed by each site have been completed.

Various measures have been proposed to evaluate the progress of cleanup. One possible measure is to compare over time the total number of contaminated sites discovered with the total number that have been cleaned up. A second measure is to compare over time the total number of contaminated sites discovered with the total number for which cleanup activities have been initiated or completed. A third measure is to monitor the level of risk posed by the contaminated sites. This measure would record periodically the number of sites that are categorized as high, medium or low risk, or for which a determination is made that no further action is required. ■

Section 6. Education and Training

A good environmental protection program needs the commitment of the entire military establishment. A program that relies on the efforts of a small cadre of environmental professionals is doomed to failure. Every person in the military can take actions, or fail to take actions, that result in environmental damage. It therefore, is necessary to make all military personnel aware of their environmental responsibilities.

Goal

Each member of the military must be trained so that he or she can meet the environmental responsibilities associated with his or her job.

Strategy

This section presents the strategy for environmental education and training. That strategy includes identification of training and education needs and the development of a plan to satisfy those needs.

Inventory of training and education requirements

The first step in the development of an effective education and training program is to identify all individuals who have direct responsibility for protecting the environment, who may affect the environment in the performance of their jobs, or who have overall responsibility for environmental performance. The next step is to identify the type and level of education or training that is required to ensure that those individuals can meet their environmental responsibilities.

Implementation plan

A plan must be developed that identifies the manner in which the training and education requirements are to be met. Generally, it would be cost-prohibitive to provide a special environmental course to every individual. The best approach for the majority of military and civilian personnel is when possible, to include environmental instruction in existing training. However, specific technical courses may be necessary for environmental professionals. In addition, special courses often are needed to instruct personnel in safe procedures for handling, storing, transporting and disposing of hazardous materials.

Recruit training All recruits entering the military should be given general environmental awareness training as part of their basic training. The introductory training could prove beneficial, since recruits come from different backgrounds and often have no knowledge of environmental concerns. For example, a recruit from the city may not be aware of the simple actions needed to preserve the natural environment outside an urban area.

Specialty training Technical specialty training should include instruction on environmental concerns directly applicable to the execution of that specialty. For example, persons being trained in the maintenance of jet engines also should be trained in the safe handling, storage, and disposal of hazardous materials associated with that maintenance. In addition, they should be trained in the correct procedures for responding to an emergency involving those materials.

Professional military education The officer corps and civilian equivalents also should be educated on environmental issues and the ability of the military to affect them. Such education could start as early as the officer commissioning programs, and it should be a subject for discussion at professional military schools. Only through understanding environmental issues can military officers be expected to provide the necessary environmental leadership.

Continuing education for environmental professionals The corps of military environmental professionals must remain technically proficient and aware of the most current developments in the environmental field. Because that field is a rapidly changing one those professionals will require technical update courses. If there is sufficient demand, the military might elect to develop the capability to teach such courses.

Protective training Some workers will be required to respond to emergencies involving hazardous materials or will be required to handle such materials when performing their jobs. Those individuals should be given periodic training to ensure that they do not become complacent and that they follow procedures established to ensure their safety.

Education of senior leadership While an educated and trained workforce is essential to a successful environmental protection program, the program will not be successful without the full support of the senior military personnel at each installation. The programs previously discussed will ensure that future leaders will be sensitive to environmental concerns. However, it may be appropriate to establish special education programs for those persons already in positions of leadership so that they understand, support, and, most important, lead the effort to protect the environment.

Budget preparation priorities

A significant portion of environmental education and training can be accomplished through existing programs, without any appreciable increase in costs. However, some training, particularly that associated with the safe handling of hazardous materials, should be considered mandatory and therefore receive the highest priority for funding.

Measures of success

Education should not be considered an end in itself. It supports all other aspects of the environmental program. The effectiveness of the education program will be reflected indirectly in the success of the pollution prevention, conservation and cleanup efforts. ■

Section 7. Research and Development

With a growing percentage of many nations' military budgets devoted to meeting environmental concerns, there is an increased emphasis on developing or obtaining new materials or processes that will reduce the expense of environmental functions. However, since military research and development budgets are also under constraints, every effort must be made to share technologies among nations and to focus research and development programs on those problems that are unique to the military.

Goal

The military sector must seek alternative materials and processes that meet performance requirements unique to the military with less adverse environmental consequences than the materials and processes currently in use.

Strategy

This section presents a strategy for research and development. That strategy includes identification of research and development needs and the development of a plan that responds to those needs.

Inventory of research and development needs

Before any research and development plan can be developed, the military must complete an inventory of all known environmental research and development needs. This inventory should be prepared by identifying those processes and applications that use the largest quantities of hazardous materials, generate the largest volumes of hazardous wastes, or produce the largest releases of contaminants to air and water. The inventory can be refined by reviewing pollution prevention plans for those practices for which there is no environmentally sound solution or no cost-effective solution that meets performance requirements. The persons responsible for the maintenance and operation of weapon systems also can provide valuable information about which processes or materials are most likely to cause environmental damage.

Implementation plan

A plan should be developed that guides future investment in research and development in response to identified needs. The plan should provide a prioritized list of proposed projects, including realistic schedules, budgets and evaluations of chances of possible success in meeting the defined environmental needs of the military sector.

Existing technologies or ongoing research efforts Before research and development project proposals are prepared, a review should be conducted to determine whether existing technologies available might satisfy the need. If no existing technology is found, a survey of government and commercial laboratories should be conducted to determine whether research is being performed that might satisfy the needs. It should be noted that many countries are entering into protocols to share information about proven technologies or ongoing research and development efforts.

Prioritized project list If no technology or ongoing research is found, the laboratories should develop project proposals to respond to environmental needs. The projects then should be prioritized according to upon the following factors:

- Extent of problem
- Criticality of the solution to mission performance
- Existing risk to human health
- Potential return on investment in research and development
- Timeliness of the effort to meet needs
- Confidence in the possible success of effort

Budget preparation priorities

The available funds for research and development should be focused on those issues that are unique to the military. The military should rely on the commercial sector or other government agencies to conduct research to develop solutions to problems that are not unique to the military.

Measures of success

Research and development should not be considered an end in itself. It supports all other aspects of the environmental program. The success of the research and development program will be reflected indirectly in the success of pollution prevention, cleanup and conservation efforts. ■

Abbreviations

CFC	Chlorofluorocarbons
CCMS	Committee on the Challenges of Modern Society
ECE	Economic Commission for Europe
MARPOL	Maritime Pollution (Protocol)
NACC	North Atlantic Cooperation Council
NATO	The North Atlantic Treaty Organization
OECD	Organization for Economic Cooperation and Development
PFP	Partnership for Peace
UN	United Nations
UNEP	United Nations Environment Programme
UNCED	United Nations Conference on Environment and Development