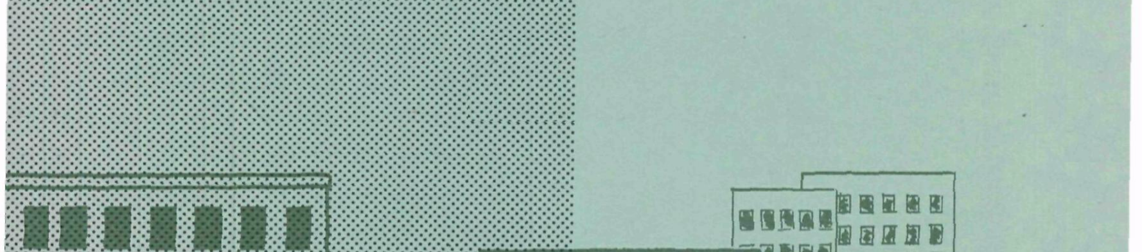
GUIDE FOR CONTROL OF AIR POLLUTION EPISODES

In Medium-Sized Urban Areas



U. S. ENVIRONMENTAL PROTECTION AGENCY

GUIDE FOR CONTROL OF AIR POLLUTION EPISODES IN MEDIUM-SIZED URBAN AREAS

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GUIDE FOR CONTROL OF AIR POLLUTION EPISODES IN MEDIUM-SIZED URBAN AREAS

1. INTRODUCTION

1.1 OBJECTIVE

This manual has been made available through the efforts of the Air Pollution Control Office's (APCO's) Emergency Operations Control Center (EOCC) and is intended to assist local air pollution control officials concerned with the design and implementation of emergency action plans for the avoidance of air pollution episodes. In this document, an air pollution episode is defined briefly as the occurrence of stagnant air masses during which air pollutants accumulate, so that the population is exposed to an elevated concentration of airborne contaminants. It is not specifically designed for utilization in the "man-made" type incident in which an accident or spill results in a localized fumigation of emergency proportions. Much of the direction provided herein, however, will be applicable to such a situation.

1.2 SCOPE

This manual is directed toward the needs of medium-sized to relatively large urban areas and, possibly, to many state air pollution control programs. Currently, agencies in this broad classification can be expected to have both the staff capabilities and resources to design a basic effective episode control effort. These agencies vary widely in the total number of staff, equipment, facilities, and support. Through the use of outside resources, however, both affiliate and voluntary, a program in sufficient depth to meet their individual responsibilities can be implemented. Obviously, these responsibilities vary relative to the severity of the episode problem, but currently, few United States urban areas can claim that their situation does not warrant a specific action plan for pollution incident control.

The manual is "geared" to aid and assist these local control officials in the development of an Emergency Action Plan (EAP) for recognizing and coping with potentially severe episodes. Regardless of the size of the control authority, effective control actions can be taken in any area if proper procedures are developed before the episode occurs.

This guide describes the planning steps necessary to forestall the adverse effects of air pollution episodes. Different regions have varying legal and administrative frameworks, as well as different meteorological, topographical, and emission source characteristics. There are common elements, however, such as the need for knowledge of emission sources, an understanding of the behavior and conditions of the atmosphere, and the development of action plans for recognizing and coping with potentially severe episodes.

Because essentially the same elements must be considered for episode control as for long-range or chronic control, and because, therefore, this manual could cover an enormous spectrum of information, some practical limitations are set:

1. This guide emphasizes episode control; items not specifically concerned with this objective have been de-emphasized.
2. "Accidental episodes," such as emergencies resulting from the rupture of chemical vessels or transport lines, have not been considered.
3. Detailed technical information needed in the practice of specialized technological or legal disciplines has been excluded.

As indicated, this guide is directed toward a large and diverse group. Although the character of a town with a population of 30,000 is quite different from that of a city populated by 300,000, moderately sophisticated plans are proposed that will serve the needs of cities that fall within this size range. Certainly, the city capable of supporting a competent, full-time staff and operating the latest automatic sampling devices should do so, if such are required. On the other hand, if proper channels have been established, a city should be capable of implementing effective episode emergency actions with merely a handful of trained personnel. A joint planning effort is required by the control authority and those that operate emission sources. This manual provides the structure to create such a plan.

1.3 EPISODE POTENTIAL

High Air Pollution Potential Advisories (HAPPA), issued daily by the National Weather Service, were initiated on a regular basis in August 1960. Advanced warnings of meteorological conditions that can lead to the accumulation of air pollutants are provided by this system. To provide this service, a set of semi-arbitrary conditions has been selected for defining high air pollution potential. These advisories, plus their possible utilization, will be described later in this guide.

In general terms, a description of weather conditions conducive to air pollution episodes is as follows:

1. A stationary or slow-moving, high-pressure weather system prevails over the area.
2. No precipitation occurs.
3. Winds are light and variable, generally less than 7 miles per hour near the surface, and relatively light aloft.
4. Air in the low levels is stable, exhibiting little motion or mixing in the vertical layers.
5. Temperature increases with height (inversion).

From a meteorological standpoint, a weather situation conducive to the accumulation of high concentrations of air pollutants is said to have "high pollution potential," regardless of the number and type of pollution sources existing in the affected area.

2. DEFINITION OF EPISODE FACTORS

High concentrations of man-made pollutants in the air have produced the following observed effects:

1. Reduction of visibility.
2. Deterioration of fabrics, metals, and building materials.
3. Damage to vegetation and animals.
4. Injury to man.

If, under chronic conditions, the pollutant levels are sufficient to produce some of these manifestations, then, under acute (episodal) conditions, these effects can interact to create an emergency or, perhaps, a disaster. When the population is subjected to these extreme pollution levels, public concern and cooperation are at a maximum. Compulsory and voluntary emission reduction is most easily justified and obtained, provided proper direction is available from the local authority. Thus, this section deals with information that should help the local authority to understand and define the factors that constitute an air pollution episode. A glossary of air pollution terminology can be found in Appendix A.

2.1 ATMOSPHERIC POLLUTANTS–THEIR NATURE AND EFFECTS

Additional information on the effects of air contaminants is contained in the Air Quality Criteria Documents published by the Air Pollution Control Office.

2.1.1 Particulates

Particles of solid–and occasionally liquid–matter in the air constitute an important portion of community air pollution in most cities and towns in the United States. Sources of particulates include such activities as fuel combustion, various manufacturing and processing operations (production of steel, cement, and petroleum products), and open burning and incineration of refuse.

Particulate air pollution is widely regarded as objectionable because it is often aesthetically bothersome. It interferes with visibility and is associated with the soiling and corrosion of metals, fabrics, and other materials. Its adverse effects on health are far more subtle but, nonetheless, significant. In general, concern about the health effects of particulates is related to (1) the ability of the human respiratory system to remove particulates from inhaled air and retain them in the lung, (2) the presence in particulates of mineral substances having toxic or other physiologic effects, (3) the presence in particulates of polycyclic hydrocarbons having demonstrated carcinogenic (cancer-producing) properties, (4) the demonstrated ability of some fine particles to increase the harmful physiologic activity of irritant gases when both are simultaneously present in inhaled air, and (5) the capacity of some mineral particulates to increase the rate at which sulfur dioxide in the atmosphere is converted by oxidation to the far more physiologically active sulfur trioxide.

The size of airborne particles has an important bearing on whether and to what extent they will reach the lungs. Most coarse particles—those about 5 microns or more in diameter—lodge in the nasal passages. Smaller particles are more likely to penetrate into the lungs; the rate of penetration increases with decreasing particle size. Particles smaller than 2 to 3 microns usually reach the deeper structures of the lungs, where there is no protective mucous blanket.

The capacity of particles to accentuate the adverse physiological effects of simultaneously inhaled gas is one of the most important aspects of the health hazard of particulate air pollution.

2.1.2 Sulfur Oxides

The sulfur oxides (SO_X) that are of concern as atmospheric pollutants are sulfur dioxide, sulfur trioxide, and their acids and acid salts. Fossil fuels such as coal and petroleum contain elemental sulfur; when the fuel burns, the sulfur is converted to sulfur dioxide and, to a lesser degree, sulfur trioxide. Because fossil fuels are burned abundantly in the United States to heat buildings and to generate electric power, pollution of the atmosphere with SO_X is widespread and is especially prevalent in cities. Petroleum refineries, smelting plants, coke-processing plants, sulfuric acid manufacturing plants, coal-refuse banks, and refuse-burning activities are also major sources of sulfurous pollution.

The evidence is considerable that SO_X pollution aggravates existing respiratory disease in humans and contributes to their development. Sulfur dioxide alone irritates the upper respiratory tract; adsorbed on particulate matter, the gas can be carried deep into the respiratory tract to injure lung tissue. Sulfuric acid, when inhaled in a certain particle size, can also deeply penetrate the lungs and damage tissue.

The documented severe air pollution episodes had common factors: they occurred in heavily industrialized areas for relatively brief periods during high pressure atmospheric conditions; sulfur dioxide levels were excessively high, as were levels of other gaseous and particulate pollution. Although the pattern of effects was not perfectly uniform in all these episodes, generally the elderly, the very young, and those with pre-existing cardiorespiratory disease were most affected.

Epidemiological and clinical studies substantiate the evidence that certain portions of the population are more sensitive than others to SO_X pollution. For example, prolonged exposures to relatively low levels of sulfur dioxide have been associated with increased cardiovascular morbidity in older persons; prolonged exposures to higher concentrations of sulfur dioxide have been associated with an increase in respiratory disease death rates and an increase in complaints of nonproductive cough, mucous membrane irritation, and mucous secretion by school children; the residual air in the lungs of emphysematous patients has been reduced significantly when the patients breathed ambient air that had been filtered of pollutants.

Sulfur oxides pollution can also adversely affect the more robust segments of the population. Experiments in which healthy human volunteers were exposed to sulfur dioxide concentrations several times higher than the taste-threshold concentration indicate that such exposures will produce pulmonary function changes including increased respiration rates, decreased respiratory flow rates, and increased airway resistance. The impairment of function was greater when the sulfur dioxide was administered together with particulate matter.

2.1.3 Carbon Monoxide

Carbon monoxide (CO) is one of the most common of all urban air pollutants and can be one of the most harmful to man. Its ability to impede the oxygen-carrying capacity of the blood makes it lethal in high concentrations. Though all processes involving combustion of carbonaceous material produce CO, the motor vehicle is by far the most important source from which this pollutant gas reaches the atmosphere. The wide use of motor vehicles, coupled with the fact that they discharge pollutants from points close to the ground, makes them the prime contributor to most people's daily exposure to CO.

Carbon monoxide poisoning is a well-understood phenomenon. As with many other harmful gases, the degree of damage that man sustains as a result of exposure to CO is related to the concentration of the gas in inhaled air and the length of exposure. The hazards of CO arise mainly from its strong affinity for hemoglobin, which carries oxygen to body tissues. The effect of CO combining with hemoglobin is to deprive the tissues of needed oxygen. At concentrations of slightly more than 1,000 parts per million (ppm), CO kills quickly. Fifty parts per million is now recommended as the upper limit of safety for healthy industrial workers exposed for an 8-hour period. At approximately 100 ppm, most people experience dizziness, headache, lassitude, and other symptoms.

It is quite possible that during episodes, the levels of CO that are reached both in vehicles and close to highways are frequently high enough to affect some especially susceptible persons, such as those already suffering from a disease associated with a decrease of oxygen-carrying capacity of the blood (e.g., anemia), or those suffering from cardiorespiratory disease. The extra burden that is placed on the body by the reduction of the oxygen-carrying capacity of the blood induced by CO may cause injury to vital organs. People already burdened by the presence in their blood of unusual amounts of CO because of tobacco smoking or occupational exposure, may also adversely be affected by the extra amount of CO they inhale from contaminated air.

2.1.4 Oxidants

Oxidants are a major class of compounds found in photochemical smog–a major air pollution problem caused by atmospheric reactions of gases derived from the combustion of organic fuels. Emissions from motor vehicles are a prime factor in the formation of photochemical smog in virtually all parts of the country. Other factors that contribute to smog formation are the combustion of fuels for heat and electric power, burning of refuse, evaporation of petroleum products, and handling and use of organic solvents. The principal identifiable oxidants in polluted urban air are ozone, the peroxyacyl nitrates (PAN), and the oxides of nitrogen (NO_X), primarily nitrogen dioxide (NO_2).

The most commonly experienced effect of photochemical smog is eye irritation. The components causing eye irritation have not been completely identified, but there is some correlation between the occurrence of eye irritation and overall levels of oxidant in the atmosphere. There is a characteristic pungent odor associated with photochemical smog. Ozone is an acrid component of this odor.

Studies have shown that it is harder for humans, particularly patients suffering from chronic respiratory disease, to breathe in areas having even a moderate level of photochemical air pollution (0.10 ppm total oxidant or higher).

2.1.5 Oxides of Nitrogen

Oxides of nitrogen (NO_X) are an important group of atmospheric contaminants in many communities. They are produced during the high-temperature combustion of coal, oil, gas, and gasoline in power plants and internal combustion engines. The combustion fixes atmospheric nitrogen to produce the oxides. At the high temperatures, nitric oxide (NO) forms first; in the atmosphere it reacts with oxygen and is converted to NO_2. While this oxidation is very rapid at high concentrations, the rate is much slower at low concentrations. In sunlight, especially in the presence of organic material as typified by Los Angeles type photochemical smog, the conversion of NO to NO_2 is greatly accelerated.

Nitrogen dioxide, an acutely irritating substance, is considerably more toxic than NO. In equal concentrations, it is more injurious than CO. The proven effects of NO_2 on man and lower animals are confined almost entirely to the respiratory tract. With increasing dosage, acute effects are expressed as odor perception, nasal irritation, discomfort in breathing, acute respiratory distress, pulmonary edema, and death. The relatively low solubility of NO_2, however, permits penetration into the lower respiratory tract. Delayed or chronic pulmonary changes may occur from high but sublethal concentrations and from repeated or continuous exposures to lesser concentrations.

It should be noted, however, that combined effects with other air pollutants may be more critical than the adverse health effects of NO_2 alone.

2.1.6 Other Pollutants

There are, of course, many air pollutants other than those mentioned here; and these may be of prime importance in specific localities. Since episode criteria have not yet been developed for these pollutants, they are not included here.

2.2 FORECASTING AIR POLLUTION POTENTIAL

The meteorological character of a region is determined by geographical location and local topography. Location identifies the broad-scale weather patterns that dominate the area, and topography accounts largely for local variations during particular weather situations.

Observations over the United States have indicated that when certain meteorological conditions are met in the vicinity of a source or sources of air pollution, the pollutants tend to disperse slowly with respect to the usual rates of atmospheric diffusion and transport. The intensified pollution continues until meteorological conditions change so as to provide better ventilation for the affected area. Air pollution potential, therefore, may be defined from the meteorological standpoint as a set of weather conditions conducive to the accumulation of high concentrations of air pollutants.

2.2.1 High Air Pollution Potential Advisories

High Air Pollution Potential Advisories (HAPPA) are prepared at the National Meteorological Center (NMC) in Suitland, Maryland, by meteorologists of the National Oceanographic and Atmospheric Administration (NOAA), Department of Commerce.

Advisories are based both on reports received hourly via teletype from Weather Service stations in the United States and on numerous analyses and forecasts prepared by the NMC. With its electronic computer facilities, the NMC prepares mixing-depth and wind-speed data from all upper-air-observing stations in the contiguous United States (about 70 stations). These data are analyzed, interpreted, and integrated with other meteorological information.

National air pollution potential advisories based on these data are transmitted daily at 12:20 p.m., E.S.T., to Weather Service stations via teletype service "C." When meteorological conditions do not warrant issuance of a HAPPA, the teletype message is "none today." When the forecast indicates that an advisory of high air pollution potential should be issued, the message designates the affected areas. The daily message indicates significant changes in the boundaries of advisory areas, including termination of an episode.

After extensive experimentation and testing, the High Air Pollution Potential Advisory Program went into routine daily operation on August 1, 1960, to service the portion of the United States east of the Rocky Mountains. On October 1, 1963, the program was expanded to include all of the contiguous United States.

Figure 2-1 presents a summary of the total number of days and episode events recorded by this service through October 31, 1969. Of the episodes (advisories on consecutive days for an area) that have been evaluated in detail, most have been verified by air quality data taken concurrently in the forecast areas.

Because conditions of atmospheric transport and dispersion typically vary with location and time, the forecasting staff cannot prepare advisories for each city in the United States. For this reason, the NOAA meteorologists limit their

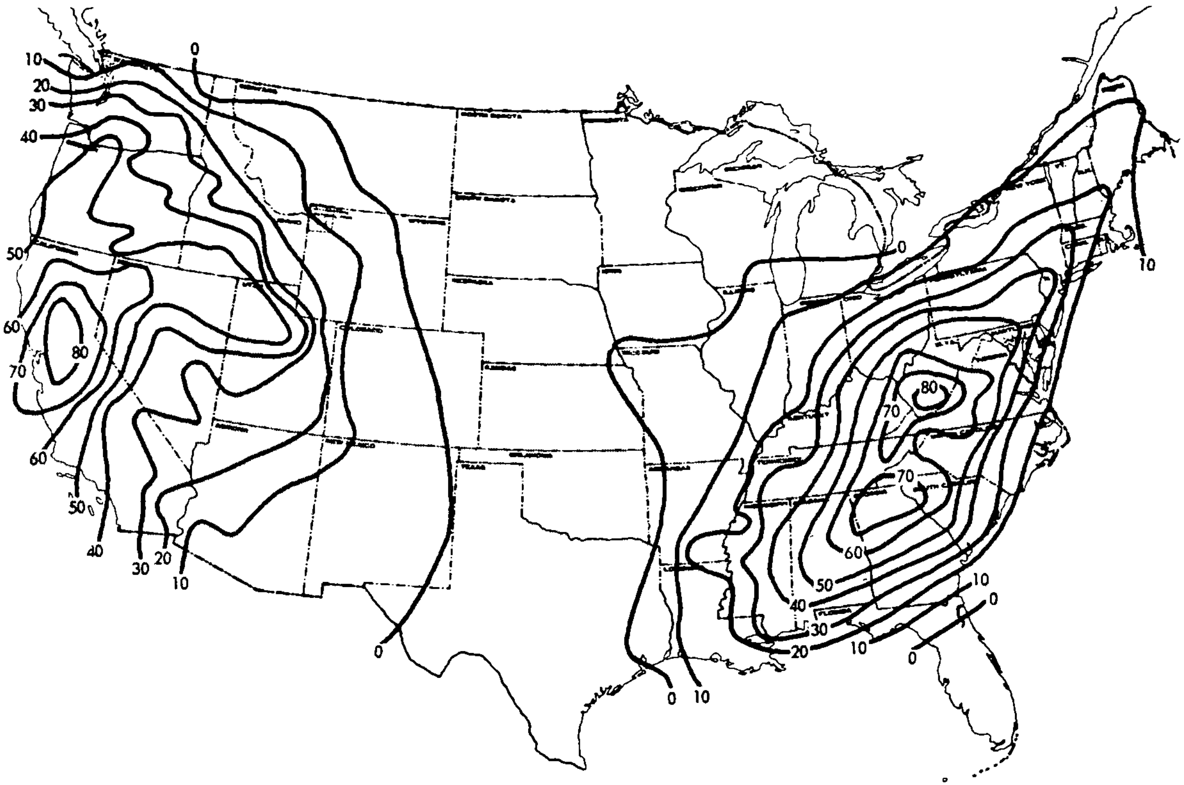


Figure 2-1. Forecast high air pollution potential days.

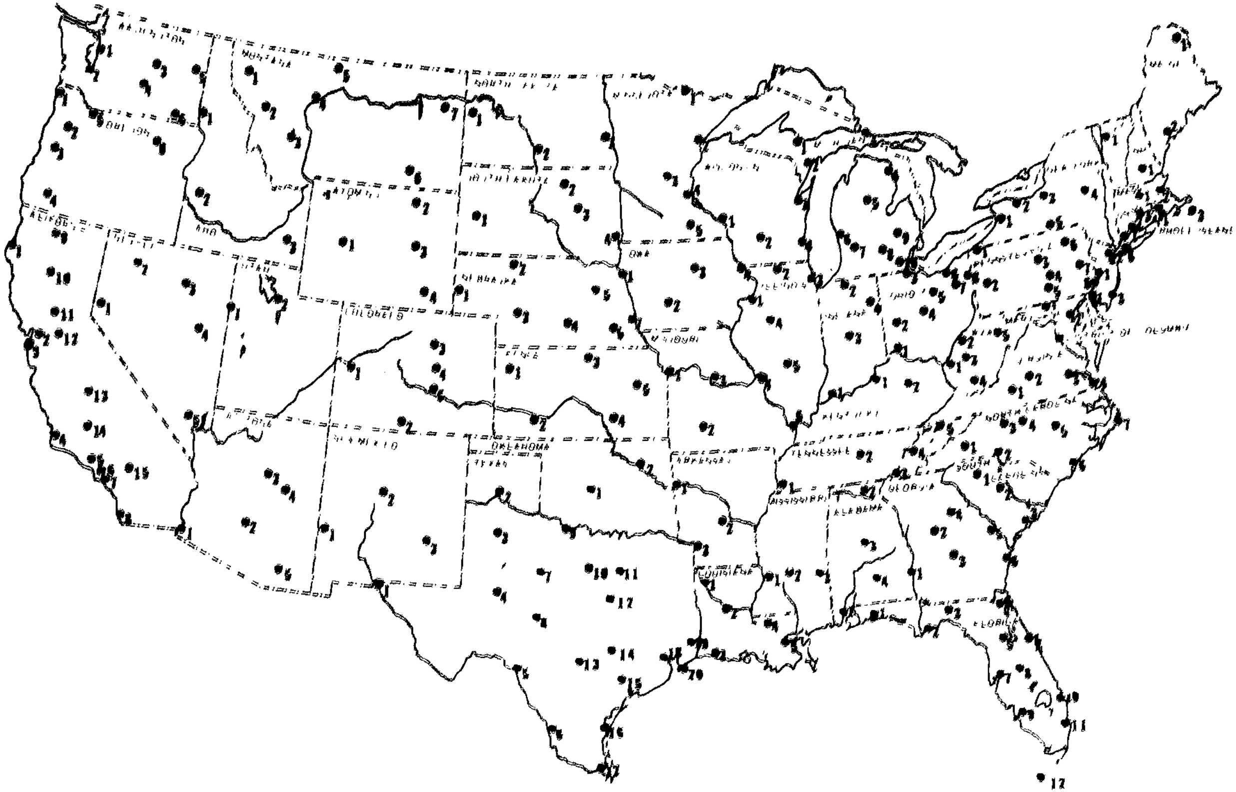


Figure 2-2. National Weather Service Stations in United States.

forecasts to areas at least as large as 75,000 square miles (roughly the size of Oklahoma), in which stagnation conditions are expected to persist for at least 36 hours. Individual Weather Service stations may modify these generalized forecasts on the basis of local meteorological conditions.

Users of the service should realize that boundaries of the forecast areas of high air pollution potential cannot be delineated exactly. For practical purposes, the lines defining the advisory areas should be interpreted as bands roughly 100 miles wide.

To be notified of these advisories, air pollution control or research officials must initiate arrangements with the nearest Weather Service station shown on Figure 2-2. Once arrangements have been made, the local Weather Service office will notify the officials when their area of interest is included in an advisory. Since the forecasts are issued for a given area only when meteorological conditions warrant, it is possible that some affiliates of the program will not receive any notifications at all, and many will receive them only rarely.

Because the forecasts are for special purposes, NOAA suggests that they be disseminated through local air pollution control agency channels. Any public announcements should be made in terms of expected pollution conditions rather than as weather news, and should relate to the issuing agency rather than to the Weather Service office.

2.3 AIR QUALITY DECISION CRITERIA

Deciding which pollutants in a given locality require control depends mostly on past research, historical occurrence, and a common-sense view of existing and forecast emission source contributions to the atmosphere. Sulfur dioxide, carbon monoxide, hydrocarbons and their photochemical products, oxides of nitrogen, and particulate matter are of universal interest; any one may be the principal problem in a given area at a given time. Reduction of these air contaminants—mostly associated with fuel combustion—will have an impact on air concentrations of "trace metals" and other low-concentration pollutants. Individual sources may contribute fluorides, chlorides, and many kinds of particulates in specific receptor areas, but these are a minor factor in a "first attack on episodes" where the concern is protecting general health in whole cities and regions.

2.4 DATA REQUIREMENTS

Three major categories of data are required to support an Emergency Action Plan (EAP). These categories are:

1. Emission source inventory.
2. Meteorological monitoring.
3. Air quality monitoring.

An emission source inventory should be conducted during formulation of the EAP to identify the area sources and the types and quantities of pollutants.

Detailed information on production schedules and control techniques is also needed for the control authority. With this information, abatement schemes can be created for the various phases of an alert.

Meteorological monitoring is essential; an examination of existing atmospheric conditions can be used to predict the conditions during future periods. As pollutant concentrations continue to increase during an episode, additional predictions of the expected atmospheric conditions are essential. Such forecasts will be used to predict the severity and duration of an episode; they also can be used to determine the effects of control actions that are required to reduce the possibility of hazardous pollutant concentrations.

Air quality monitoring data complement the meteorological data in predicting future conditions during an episode. Alert stages are determined by the reported concentrations of various pollutants. To effectively respond to the conditions of an episode, near-real-time data describing the quality of the atmosphere are essential.

2.5 DATA COLLECTION

2.5.1 Emission Source Inventory

If the impact of emissions from specific sources of pollution is to be estimated, such emissions must be quantified. More importantly, if emissions are to be reduced during episodes, the possible means of curtailment must be identified. It is therefore recommended that the authority obtain as much of the following information, in as much detail as possible, that is available. A questionnaire may be used; but, if the number of sources is not too great, visitation and consultation is the method suggested for gathering the following information:

1. General information.
   a. Location and property boundaries.
   b. Plant capacity, normal and maximum.
   c. Fuel usage by shift, day of week, month, and season.
   d. Fuel type and composition, especially sulfur and ash content.
   e. Fuel heating value.
   f. Input-material flow rates.
   g. Number and frequencies of operating levels if process is continuous.
   h. Number and frequencies of "batches" if process is "batch."
   i. Source emission height and stack diameter.
   j. Emission rate of pollutants per unit of input material.
   k. Emission gas flow rates and temperatures, including variation.
   l. Individuals (and telephone numbers) to be contacted on air pollution matters.
   m. Type, efficiency, and cost of pollution control equipment.
   n. Plant and expansion.
   o. Process flow diagrams.
   p. Interruptability of batch processes.
2. Dual fuel capability.
   a. Advance notice desired.

b. Alternate fuel, ash and sulfur content.
c. Time required to switch fuel.
d. Seasonal availability of alternate fuel.
e. Added costs of dual fuel capabilities.

3. Process curtailment capability.
   a. Advance notice required.
   b. Curtailment methods.
   c. Emission rate after curtailment.
   d. Number of employees released on curtailment.
   e. Estimated economic loss per day of curtailment.

In some cases, the source management will not be able to supply pollutant emission rates; if not, rates may be estimated by techniques described in Duprey's *Compilation of Air Pollutant Emission Factors*, available from the Environmental Protection Agency's Air Pollution Control Office as PHS Publication No. 999-AP-42.

2.5.2 Meteorological Monitoring

During potential episodes, the control agency will require special meteorological data that provide a more detailed understanding of local atmospheric conditions than can be derived from routine Weather Service reports. HAPPA data from nearby Weather Service airport offices seldom represent conditions in the city, particularly at night. The control office should have a means for providing supplementary up-to-the-minute data from locations within its area of concern. This will require a plan for data acquisition and processing. The plan could be a simple, cooperative arrangement with privately equipped facilities such as schools, power plants, newspaper offices, and industrial establishments. For reliable data reporting and control, however, a permanent observational network operated by the local agency is advisable.

Of primary importance are measurements of wind direction, speed, and gustiness. Surface temperature measurements are useful, but measurements of temperature differences with height, to indicate atmospheric stability, are more valuable.

The number of reporting sites required depends upon local topography, including urban structures. Many practical considerations govern the plan of a reporting network; a grid spacing of 2.5 miles within city limits and 5 miles in adjacent suburbs is fine for research needs, but excessive for control needs. Reporting sites should include one or more installations atop tall buildings and on hilltops.

Because wind flow is marked by rapid fluctuations that are of little individual importance in transporting air pollutants, wind data should cover specified periods between 10 and 30 minutes. A wind record is important, however, because:

1. Trends may be observed.
2. Atmospheric stability can be estimated from wind-direction fluctuations.

If available wind-measuring equipment provides only for visual readings from meters or flashing-light indicators, a minimal record should consist of hourly wind data with remarks about observed gustiness.

2.5.3 Air Quality Monitoring

For episode avoidance purposes, one fact emerges clearly when air monitoring requirements are examined: data are needed quickly—in no less than a few hours after the sensor is contacted by the pollutant. While it is possible to obtain data rapidly by manual methods with telephone reporting, there is a trend toward automated monitoring networks. Obviously, the severity of the problem, size of the receptor area, and availability of resources influence both the scope and sophistication of the system.

It is necessary to utilize continuous air samplers because an episode lasts only a few days and the control actions taken must be based on "real-time" measurements correlated with the decision criteria.

The collection and analysis must be accomplished rapidly if the data are to be useful immediately. There is no time to check out the methods, run blanks, calibrate, etc., after the onset of episode conditions. In general, either personnel must be stationed at the sites during the episode or automated equipment must be operated that can provide automatic data transmission to a central location.

The commonly used instruments for measuring the pollutant parameters utilize wet chemical techniques (such as colorimetry, coulometry, or conductivity) for SO_2, or physical methods for CO (infrared absorption) and soiling particulates (filtration followed by optical density).

Chemical analysis always involves the use of consumable supplies. The chemicals must be replaced on a schedule that is determined by the rate at which samples are taken. Currently used instruments store adequate supplies of chemicals for operation for periods of from 3 days to 1 month. In some cases, analytical reagents for specific air contaminants deteriorate rapidly and should have protective storage.

Physical methods of measurement are performed with relatively complex equipment. These instruments must be installed correctly and cared for by trained personnel. Their accuracy is affected by mechanical shock, ambient temperature extremes, voltage supply stability, dirty or dusty atmospheres, and corrosive chemicals.

Designing a sampling network presents a difficult problem because the measure of effectiveness is elusive. Confining the problem to episode avoidance rather than chronic air pollution control objectives, the measure of effectiveness is the success in avoiding the public health "disasters," given adequate emission curtailment methods. If concentrations are uniform in the area, a single station might be sufficient. Although there is some evidence that concentrations are more uniform within a given area during episodes than during nonepisode conditions, the extent to which this is true in all areas obviously depends on many factors.

Generally speaking, a minimum of three monitoring sites is required. As many as ten might be justified, however, in a large, complex region with a high frequency of episode conditions.

2.6 COMMUNICATIONS

A potential or actual episode requires rapid control response to changes in meteorological conditions and pollutant levels. This requirement means that the design of a communications plan is one of the most important elements in the implementation of an EAP. A major portion of the communications network is used to transmit status reports and control actions to non-control-agency personnel. Individuals and agencies needing such information include:

1. Public Officials–Mayor, Governor, city council, health commissioner, etc., who may be called upon to participate in a decision-making process.
2. Personnel at Major Emission Sources–Personnel at major emission sources require alert status reports to effect source control plans designated to reduce emissions. If execution of such plans is mandatory, a formal system may be required for legal notification of the alert status.
3. Public Safety Agencies–The police, fire, civil defense, and public health departments, may be assigned definite tasks during an alert and need to be kept informed on the status of the event. In some locations, existing civil defense, disaster, or emergency networks and procedures may be available for use. The telephone company, though not a public agency, similarly needs to be informed, mainly because of the possibility of overloading facilities.
4. Sensitive Persons–Those people who are most susceptible to acute health problems must be kept advised during an episode. Thus there must be a coordinated effort between the local air pollution officials, public health officials, physicians, hospitals, and the public. It may be ill advised to notify these sensitive people via the public news media as it is important that the physician be able to detect whether a particular patient is reacting physiologically to the pollution levels or psychologically to the episodes. Communicating information through the local health agency or medical society may be more advisable.
5. General Public and News Media–A direct communications link to major local news media in the area is required. The use of good judgment in dealing with news media is extremely important, and consultation with those experienced in this procedure is highly desirable.

An example of a typical episode news release is shown in Figure 2-3.

NEWS RELEASE - (Date)

__________________Agency
Department of Air Pollution Control
(Address)
(City)

FOR IMMEDIATE RELEASE

CONTACT: (Staff Member - Phone No.)

At 12:30 p.m. today (date), the local Weather Service notified the City's Department of Air Pollution Control that weather conditions consisting of a high pressure area and low wind speeds were developing in the metropolitan ___(city)_____ area. These are the same weather conditions that are being formed over the Eastern seaboard from Maine to the Carolinas. These weather conditions are expected to continue until late tomorrow (date) and may result in an increase in the levels of some air pollutants.

"There has been some increase in the levels of sulfur dioxide, but the proportions of other contaminants have not reached a point at which calling of an 'air pollution alert' is necessary or required," stated Mr. ___________, (title).

Mr. _____________also announced that the Air Pollution Control Department's laboratory had been placed on a 24-hour operational basis. Normally, the staff works a 40-hour week while the instruments measuring air quality record their results continually without attention around the clock. "However", the ___(title)____ said, "in order to be fully cognizant of the problems as they arise, we shall maintain a close watch on the conditions and report to the public if there is need for any specific activity." Mr. _________, air pollution specialist for the ___(city)____ Weather Service, stated that because cool air at the surface was trapped by a lid of warm air aloft, it would remain stagnant over the ___(city)___ area. It is expected that the Department of Air Pollution Control will issue another statement within 24 hours.

Figure 2-3. Sample press release.

2.7 SOCIO-ECONOMIC FACTORS

2.7.1 Social Considerations

In the broadest sense, social considerations encompass all those factors that relate to human society, the welfare of human beings as members of society, the interaction of the individual and the group, and the cooperative and interdependent relationships of members of the group. This section is restricted to a rather narrow field of human behavior. There are several social factors that the episode planner must prepare for:

1. It must be realized that any action whatsoever that is taken will have a social effect.
2. Generally, these effects will increase with the duration of the episode.
3. Initially, the effects will be of the nature of inconveniences.
4. The effects are primarily those related to restrictions on normal activity, and the anxieties associated with a pervasive hazard from which there is no escape.
5. Finally, with some exceptions, these effects disappear at the termination of the episode.

The principal means available to the local authority to minimize these types of social effects is through a program of public education. The episode planner must provide for an effective public information program before, during, and after an episode. The public must be prepared to endure the inconveniences of personal restrictions and to assess calmly the nature of the hazard. Figure 2-4 displays a sample public information approach.

While the public in smaller communities will face only minor inconveniences, such as restriction of backyard refuse burning, certain emotional individuals and some citizens with severe heart or respiratory disease will undoubtedly become alarmed. The agency must be able to reassure such persons that they will be protected from possible injurious effects by either a reduction of source emissions or a warning to leave the immediate area of high pollution until the episode terminates.

2.7.2 Economic Considerations

It is important to appreciate the fact that the benefits of improved air quality are as difficult to assess as are the many costs of air pollution control. As with any health-related control program, the costs involve human factors that are difficult to express as equivalent dollars. For "episode control," the benefits include the avoidance of acute illness and death. The duration of much of the economic impact is a few days; when human lives are concerned, the costs involved in control are relatively slight compared to the possible benefits.

During the source inventory, information can be gathered that will assist the authority in evaluating part of the economic impact of emergency action options. It is to industry's advantage to release accurate economic and emission data to help insure that designed actions are realistic and effective. The necessary information may be supplied voluntarily or regulations may be

WHEN AIR POLLUTION IS HEAVY

Here's what you can do to help yourself and your neighbor

Use public transportation wherever possible. Use your automobile only if absolutely necessary. If you must drive, try to team up with neighbors or co-workers.

AIR POLLUTION FROM AUTOMOBILES IS A MAJOR PROBLEM

Reduce room temperatures to the legal minimum, unless health considerations prevent such action.

AIR POLLUTION FROM HEATING EQUIPMENT IS A MAJOR PROBLEM

Stop all outdoor burning.

AIR POLLUTION FROM OPEN OR REFUSE BURNING IS A MAJOR PROBLEM

Use as little electricity as possible, either for lighting or appliances.

AIR POLLUTION FROM POWER PLANTS IS A MAJOR PROBLEM

Observe the restrictions recommended by your health department or air pollution control agency.

IF YOU SUFFER FROM A RESPIRATORY AILMENT OR HEART CONDITION--

Remain indoors with the windows closed.

Don't smoke. Avoid rooms where others are smoking.

Eliminate unnecessary physical exertion.

Stay under your physician's care.

AIR POLLUTION CONTRIBUTES TO RESPIRATORY DISEASE

Figure 2-4. Flyer published by the National Tuberculosis and Respiratory Disease Association.

required. The agency should observe industrial proprietary rights to economic and technical information.

The costs incurred by industry during an episode will be a combination of the fixed or recurring costs associated with being prepared for an episode, and costs approximately proportional to the duration of emergency abatement action during an episode. Both of these classes of costs will vary widely in magnitude and nature from place to place, among types of industries, and among various plants within each industry. Consequently, data should be collected from each individual plant or plant classification.

3. EMERGENCY ACTION PLAN

3.1 INTRODUCTION

This section discusses the formulation and operation of a "typical" Emergency Action Plan (EAP). The intent is not to spell out a universal model plan, but to provide a worklist of items that should be considered in designing and implementing a plan. Each area or region contains special conditions and limitations, and each planning item must be considered in the light of local requirements.

The necessity for careful and detailed pre-planning cannot be overemphasized; the time for reaction may be a matter of hours. Planning is necessary to insure that the required equipment, resources, personnel, and procedures are available and the desired communications and control actions are ready to be implemented. An air pollution episode is an unusual event; the emergency actions may be appreciably more drastic than the normal abatement activities undertaken to meet long-term air quality goals.

The major elements of an EAP are shown in Figure 3-1.

In preparing the subsequent material in this section, the following generalization has been made:

The existence of a central air pollution control agency, either municipal, county, or state, is essential. This entity possesses, or can obtain, sufficient staff and resources to implement its specific air pollution episode action plan.

3.2 EMERGENCY ACTION PLAN FORMULATION

There are actually two phases involved in the creation of an EAP. One phase must be formulated for activities within the air pollution control authority itself, while the second relates to the interactions between the authority and others such as governmental agencies, sources of pollution, and news media. The integration of these two elements into a single "master plan" involves the following considerations and activities.

3.2.1 Responsibility and Authority

1. Determine the boundaries of the control area and explore cooperative relations with adjoining areas; decide on interagency strategies in calling alerts; examine special boundary problems.
2. Establish the lines of authority for emergency actions. Local agencies often have authority that has been delegated by the State; but in such cases, the final responsibility still lies with the State.
3. Determine whether an advisory emergency committee will be part of the plan; if so, each member should have an alternate.
4. Establish the legal authority to exercise emergency control actions, including civil or criminal law enforcement tools.

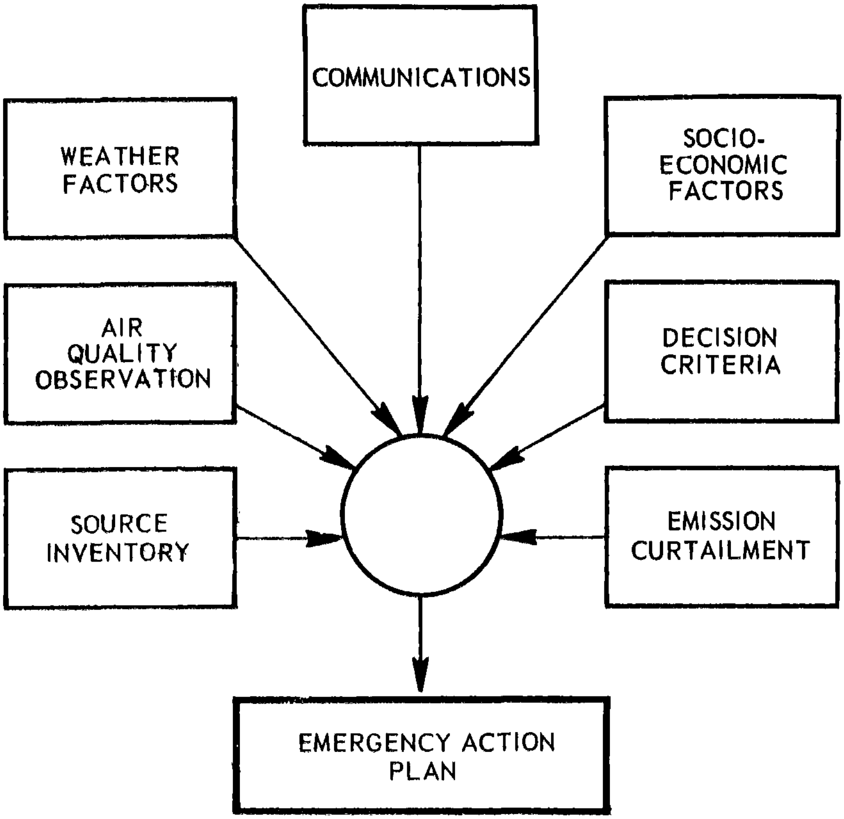


Figure 3-1. Elements of an Emergency Action Plan.

5. Obtain the approval of the Mayor, appropriate State authority, and APCO (if a federally designated region).

3.2.2 Emergency Action Criteria

1. Assemble the available emission source and air quality information to define the local situation.
2. Establish a committee to review and recommend criteria; the committee should include the disciplines of medicine, meteorology, air pollution engineering, government, and law and public safety (police).
3. Review the criteria that have been adopted in other similar areas, if any; prepare arguments for revising them or developing new criteria, considering episode-proneness, local air quality status, and controllable elements.

4. Determine the responsibility and establish procedures for emergency actions.
5. Plan for annual review of criteria, or special review following a major episode.

3.2.3 Background Information

1. Develop emission inventory data, using records of other agencies (Planning, etc.) where possible; develop means for updating periodically.
2. Define the air quality observation program necessary to recognize pre-episode conditions.
3. Define the physical data to be obtained during potential and actual episodes.
4. Establish procedures for reviewing data during potential and actual episodes.

3.2.4 Emergency Source-Curtailment Actions

1. Establish the emission-curtailment actions to be taken for:

    a. Power generation.
    b. Other industrial sources, by class and size.
    c. Commercial sources, by class and size.
    d. Incineration and open burning: municipal, commercial, construction, and residential.

2. Establish which actions should be voluntary and which should be mandatory.
3. Define inspection and enforcement procedures, including personnel and equipment requirements.

3.2.5. Communications

1. Establish direct communications with personnel at major emission sources; establish contacts and alternates for each.
2. Determine the information desired by State and Federal authorities, and the form in which it is desired.
3. Design the local information system, utilizing police, civil defense, public safety, and private communication links; coordinate with each to define their roles. (Police and taxicab radios can serve as emergency communication networks.)
4. Prepare sample news releases; consult with other control agencies experienced in problems of dealing with the public in these matters.
5. Develop recommendations to local medical groups on advising their patients.

3.2.6 Reporting

1. Determine whether legal documentation of data is required; if so, the HAPPA bulletin plus local sampling station measurements may suffice.
2. Prepare an outline for a technical summary report; include a record of the times of emission-curtailment actions, air quality observations, and observed effects, as well as the climatology of the event.

3.3 EMERGENCY ACTION PLAN IMPLEMENTATION

The EAP provides for the flow of information between different elements and allows for appreciable interaction between the elements. The information flow into the authority includes data on the current status of the atmosphere. Information is also required on both pollutant emissions and the availability of control actions. The authority interprets the incoming information and, using judgment in conjunction with such tools as atmospheric dispersion estimates, predicts the present and future status of the atmosphere. The prediction is then compared with the air quality criteria established. If the defined levels of pollutant exposure and expected persistence of meteorological conditions are reached, the authority calls an alert.

When an alert has been called, information then flows outward from the authority as planned actions for control of emissions and information dissemination are executed. Typical communications at this point include:

1. Notification to pertinent personnel of requirements for increased air quality observations, meteorological measurements, and inspection.
2. Notification to those people most susceptible to acute health problems.
3. Notification to the public (through news media), interested public officials, and public agencies of the present status.
4. Notification to management of pollutant sources of the requirement to reduce emissions in accordance with the EAP.

As the pollution sources reduce emissions into the atmosphere, the effects are detected by air quality observations; depending on local conditions, pollutant levels either hold, continue to rise, or decrease. If the pollutant levels rise, it may be necessary to take more drastic control actions. Surveillance of air quality and effects continues until the episode terminates. At that point, communications similar to those listed above are utilized to reduce or stop observations, inform all interested public parties, and allow sources to resume normal operating conditions.

3.3.1 Emergency Action Plan Criteria

Following are the suggested EAP criteria that trigger the pre-planned episode emission-reduction scheme:

1. Status: *Forecast*—The *Forecast* level indicates that an internal watch will be activated by a Weather Service HAPPA or equivalent report stating that a high air pollution potential will exist for the next 36 hours.
2. Status: *Alert*—The *Alert* level is that concentration of pollutants at which short-term health effects can be expected to occur. An *Alert* will be declared when *any one* of the following levels is reached:

   SO_2—0.3 ppm, 24-hour average

   Particulate—3.0 Coh, 24-hour average

   SO_2 and Particulate combined—Product of 24-hour SO_2 average (ppm) and Coh equal to 0.2

CO—15 ppm, 8-hour average
Ox—0.1 ppm, 1-hour average

and adverse meteorological conditions are expected to continue for 12 or more hours.

3. Status: *Warning*—The *Warning* level indicates that air quality is continuing to deteriorate and that additional abatement actions are necessary. A *Warning* will be declared when *any one* of the following levels is reached:

   SO_2—0.6 ppm, 24-hour average
   Particulate—6.0 Coh, 24-hour average
   Combined SO_2 and Coh—Product of 24-hour SO_2 average (ppm) and Coh equal to 1.0
   CO—30 ppm, 8-hour average
   Ox—0.4 ppm, 1-hour average

   and adverse meteorological conditions are expected to continue for 12 or more hours.

4. Status: *Emergency*—The *Emergency* level is that level at which a substantial endangerment to human health can be expected. These criteria are absolute in the sense that they represent a level of pollution that must not be allowed to occur. An *Emergency* will be declared when it becomes apparent that *any one* of the following levels is imminent:

   SO_2—1.0 ppm, 24-hour average
   Particulate—10 Coh, 24-hour average
   Combined SO_2 and Coh—Product of 24-hour SO_2 average (ppm) and Coh of 2.4
   CO—50 ppm, 8-hour average
   75 ppm, 4-hour average
   125 ppm, 1-hour average
   Ox—0.4 ppm, 4-hour average
   0.6 ppm, 2-hour average
   0.7 ppm, 1-hour average

It should be made clear that an Air Pollution Alert, Warning, or Emergency can be declared on the basis of deteriorating air quality alone; a High Air Pollution Potential Advisory need not be in effect. The appropriate episode "status" should be declared when any monitoring site records ambient air quality below that designated in the criteria. The criteria should be applied to individual monitoring sites and not to area-wide air quality.

The levels used to designate an Air Pollution Emergency are those that pose an imminent and substantial endangerment to public health. Because these levels should not be permitted to occur, an Air Pollution Emergency should be declared when it appears imminent that these levels may be reached.

3.3.2 Emission Curtailment

The reduction of pollutant emissions as a measure to avoid potential episodes requires information not ordinarily available to the local authority.

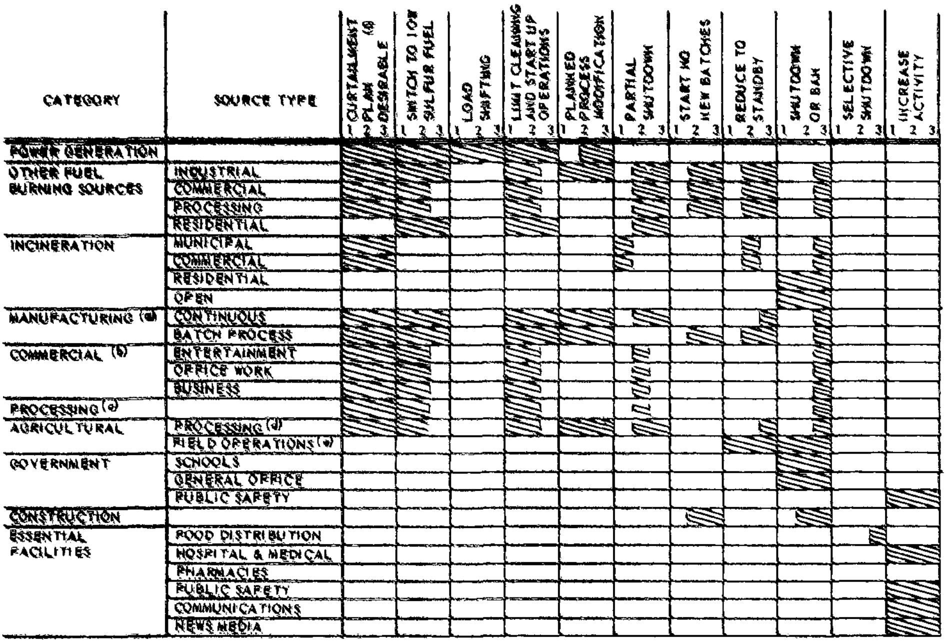
Information pertaining to fuel switching, power interchange, curtailment, and postponement operations can only be obtained through the development of a close and knowledgeable contact with the source management. These data should be obtained as part of the emission inventory. In many instances, the switching to a lower-sulfur-content fuel, postponement of refuse combustion, and curtailment of nonessential operations such as the filling of reservoirs are adequate emission-reduction procedures. Each source management should be required to submit curtailment plans covering the elements as described in the source inventory section, and the operations changes to be made in curtailing emissions.

The public may be requested to help reduce emissions by keeping heating and electrical loads to a minimum. All private incineration and open burning should be curtailed.

The curtailment of major sources can be planned to be implemented on a voluntary basis. The voluntary actions to be taken should be known to the authority, and surveillance should be conducted as though the curtailment were mandatory. Experience to date with voluntary compliance by major emitters has been excellent, and indicates that pollution control is more easily achieved in the "emergency" case than in the "chronic" case. It is not difficult, however, to obtain legal authority in the form of a court order for curtailment of emissions in an emergency situation. In fact, it is recommended that the legal groundwork be previously laid if a state of extreme noncooperation by personnel at major emission sources is found to exist.

Figure 3-2 lists alternate emission control actions that could be implemented as various EAP criteria levels are reached.

Appendix B presents a more detailed discussion of emergency emission-reduction possibilities.



(a) Manufacturing includes metallurgical, chemical, petroleum, mineral, paper, mining, etc.
(b) Commercial includes financial, stores, entertainment, offices, services, wholesalers, restaurants, etc.
(c) Processing includes laundries, dry cleaners, garages, service stations, food preparation, etc.
(d) Agricultural processing includes ginning, milling, feed and feed supplement processing.
(e) Agricultural field operations include spraying, dusting, field burning, grading, plowing.
(f) Size and emissions determine which commercial, processing, and agricultural plants must file plans.

Figure 3-2. Alternate emergency control actions. Criteria levels: 1 = alert status; 2 = warning status; and 3 = emergency status.

4. EMERGENCY ACTION SYSTEM

4.1 INTRODUCTION

An extremely flexible organization is needed to implement an Emergency Action Plan. This organization merely conducts surveillance during normal nonepisode periods, yet is capable of expanding to satisfy the demands of episode conditions. The Emergency Action System (EAS) is the tool that responds to the needs of episode and surveillance conditions. This section presents the EAS and describes its role in implementing an EAP.

An EAS is the organization of equipment, technical experts, and administrators in an effort to analyze and combat the conditions of an episode. The equipment is comprised of the tools required to sample and analyze air quality and meteorological conditions, transmit information to a control terminal, and disseminate instructions to the public and those responsible for sources within the city. The technical experts are the engineers, meteorologists, lawyers, technicians, and physicians who analyze data for the decision-making process. The administrators coordinate the essential activities, determine the emergency action, announce abatement requirements, and deal with the public. The organization that coordinates all these efforts into an effective package is discussed in Section 4.3. Before turning to this organization, there are some assumptions pertaining to the minimum resources of the air pollution control authority that must be established.

The EAS will likely be developed from an existing air pollution control agency that is equipped with certain minimum resources. Some of the resources that are normally used during nonepisode conditions will be required to fill the needs of the EAS. The minimum resources assumed for the EAS are as follows:

1. *Routine manning*—The services of one individual (perhaps only part-time) knowledgeable in air quality surveillance to perform under nonepisode conditions.
2. *Air quality monitoring network*—At least three air-sampling stations that regularly monitor particulates, SO_X, and CO. They should be capable of short-interval-sampling during an episode.
3. *Emergency Action Center*—A room or area that has been designated for conducting emergency action activities.

These are considered to be the minimum resources for any EAS. The EAS also incorporates other resources that, together with these, produce an effective episode-avoidance tool.

4.2 MODES OF THE EMERGENCY ACTION SYSTEM

The EAS will have three modes of operation; each mode becomes progressively more complex. The modes are based on the degree of activation of the EAS as it responds to the severity of an episode. The three modes are:

1. *Routine Surveillance*—The period between emergencies when the only activity is surveillance.
2. *Partial Activation*—The period of response to increased ambient pollutant concentrations or to a forecast of stagnant meteorological conditions.
3. *Full Activation*—The period during an episode in which the entire EAS is responding to the emergency.

The EAS will develop from the least complex mode to full activation as the atmospheric conditions progress from nonepisode to episode. Additional equipment and manpower are drawn into the EAS as it progresses from one mode to the next higher mode. Figure 4-1 shows how the different modes are coordinated to determine an EAS.

4.3 ORGANIZATION OF THE EMERGENCY ACTION SYSTEM

The Emergency Action System is the organization that responds to the needs of the three operational modes. As described previously, the EAS is a flexible system for conducting emergency procedures during an episode. The core of this system is the Emergency Action Center (EAC). The EAC is the central organization that receives and analyzes air quality and meteorological data, determines recommended actions based on these and other input data, and stimulates abatement activities under episode conditions. The EAC encompasses the operations of the air pollution control agency and other invited specialists who are prepared to respond to episode conditions. The EAC is presented as part of the EAS in Figures 4-2, -3, and -4. The functions within each block are considered part of the EAC.

It is evident from the three figures that the EAC becomes more complex as it progresses from the Routine Surveillance Mode to the Partial Activation Mode and, eventually, to the Full Activation Mode. This progression is essential since the minimal required resources should be used whenever possible.

4.3.1 Routine Surveillance Mode

The Routine Surveillance Mode (Fig. 4-2) is in effect during nonepisode periods. This is the normal mode of operation and its essential tasks are receiving, evaluating, and recording air quality and meteorological data. This act of surveillance examines ambient conditions in search of episode indicators. When no episode indicators are observed, the input data are recorded; no other activities are required. When increased ambient pollutant concentrations are observed or when a High Air Pollution Potential Advisory is announced, procedures for the Routine Surveillance Mode are abandoned; then procedures for the Partial Activation Mode are initiated.

The Routine Surveillance Mode can be handled by a part-time junior engineer or meteorologist. Channels should be established for contacting the sources of air quality and meteorological information. It is likely that the source of air quality data for a medium-sized city will be one technician operating the field monitoring network. The Weather Service will likely be used

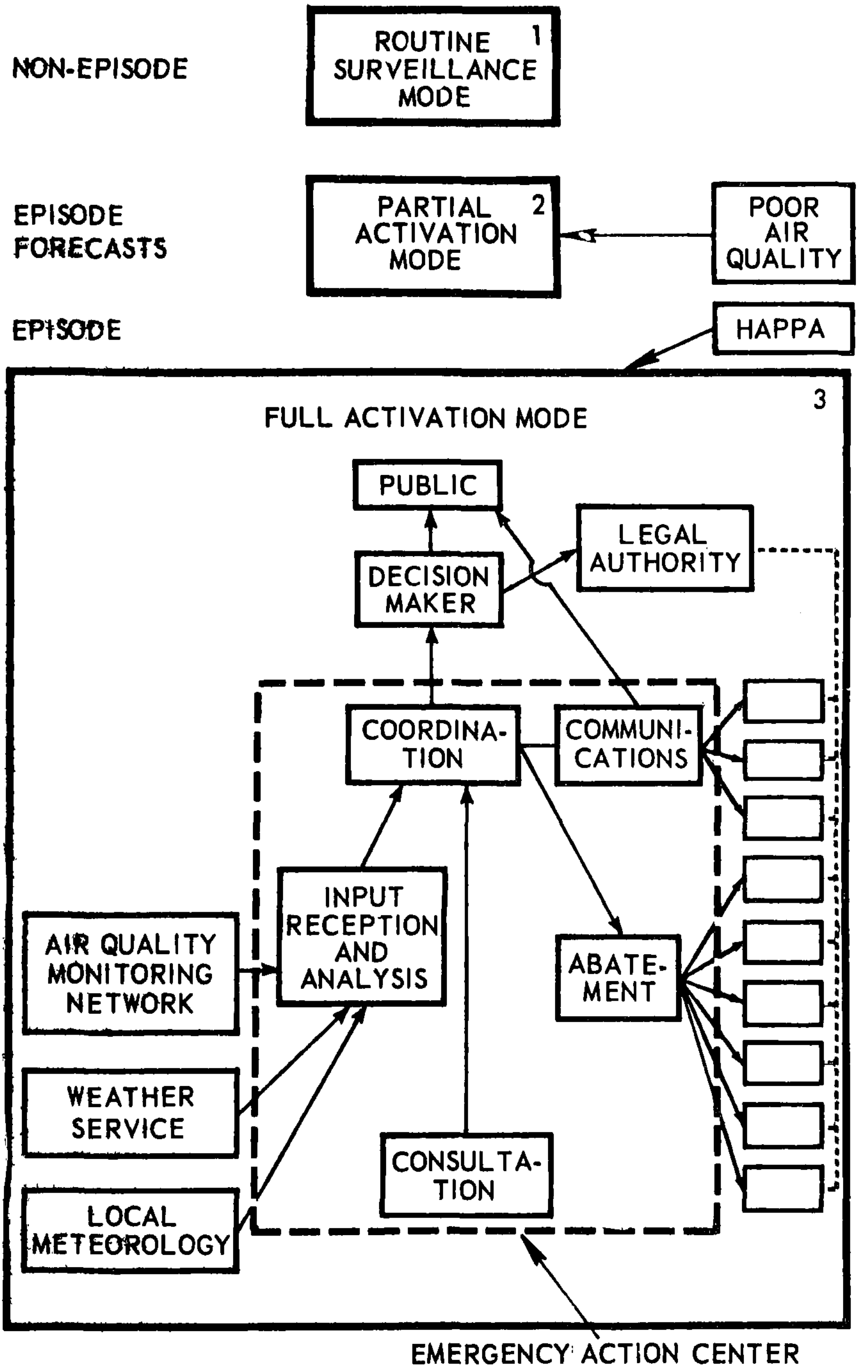


Figure 4-1. Emergency Action System.

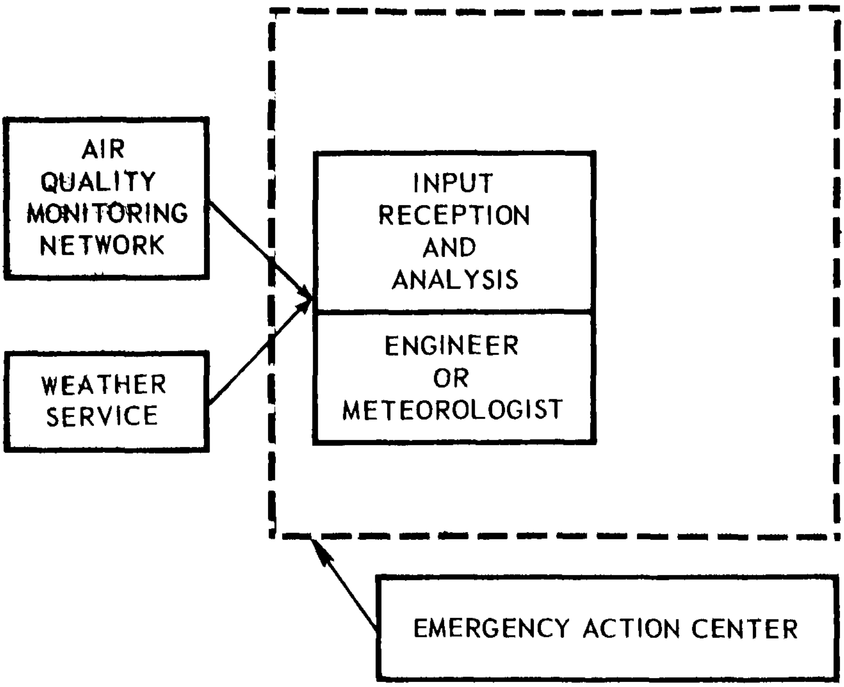


Figure 4-2. Information flow during Routine Surveillance Mode.

for meteorological information. The common channel for communication will be the telephone.

It is important that an operating procedure be established. The Routine Surveillance Mode operator in charge of data input should know the precise conditions that stimulate the Partial Activation Mode of the EAS. He should know how and where to contact the Coordinator of the EAC when alert conditions are forecast. Standard operating procedures are presented at the end of this section.

4.3.2 Partial Activation Mode

Activities within the EAC expand when indicators of an episode are

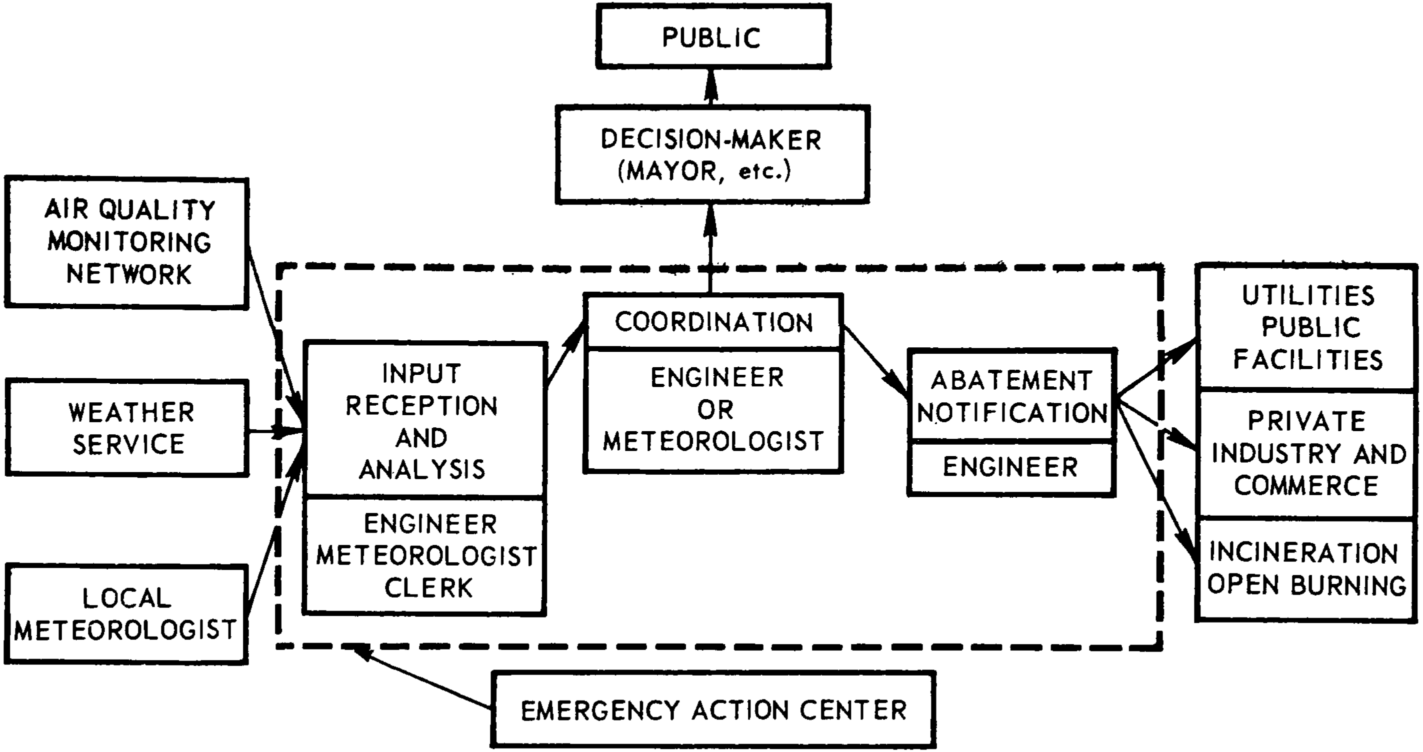


Figure 4-3. Information flow during Partial Activation Mode.

forecast. Additional manpower will be required to satisfy the requirements of the Partial Activation Mode. The latter is presented in Figure 4-3.

The Partial Activation Mode corresponds to the alert phase of the Emergency Action Plan. A Coordinator (or supervisor) and an additional engineer join the staff. The expanded staff is needed to handle the increased rate of inputs and communicate with relevant parties outside the EAC, including the public and managers of emission sources.

The individual responsible for monitoring inputs will contact the air-sampling network and the source of meteorological data (i.e., the Weather Service), and request an increased frequency of reporting. Hopefully, air-sampling stations will be located near municipal buildings (i.e., firehouses or public stations) where frequent reports can be volunteered with minimal additional burden. Advanced planning in sampling-site selection and advanced training of municipal servants will enhance the transition from nonepisode to episode procedures.

If the closest Weather Service is outside the area, a local meteorologist may assist during episode periods with micrometeorological data. Local airports and private industry should be surveyed in advance for voluntary meteorological assistance during episodes.

The input data should be recorded and displayed in the EAC. Adequate staff should be provided for receiving, evaluating, and displaying the relevant input data.

The Coordinator should assist in analyzing the situation, direct the activities within the EAC, plan for requirements of the Full Activation Mode, and communicate with outside authorities and the public. During this Mode, an alert should be announced. The Coordinator then requests voluntary abatement of nonessential activities and imposes selected controls. An engineer may assist the Coordinator in notifying the management of emission sources and also provide technical assistance if required.

The Partial Activation Mode continues until the episode forecast is retracted or until episode conditions are declared. When the episode forecast is retracted, the EAC returns to the Routine Surveillance Mode. A report should be prepared that documents the actions taken during the Partial Activation Mode; it also should include the air quality and meteorological conditions that developed.

4.3.3 Full Activation Mode

The Full Activation Mode begins once an episode has been declared. During this Mode, the EAC should be operating at full capacity. All required air pollution control agency personnel should be actively participating in implementing emergency activities. Pre-selected specialists from the fields of medicine, law, engineering, communications, and transportation should be at the EAC or on-call for consultation. See Figure 4-4 for the organizational structure that coordinates the efforts of such a body of diverse talents.

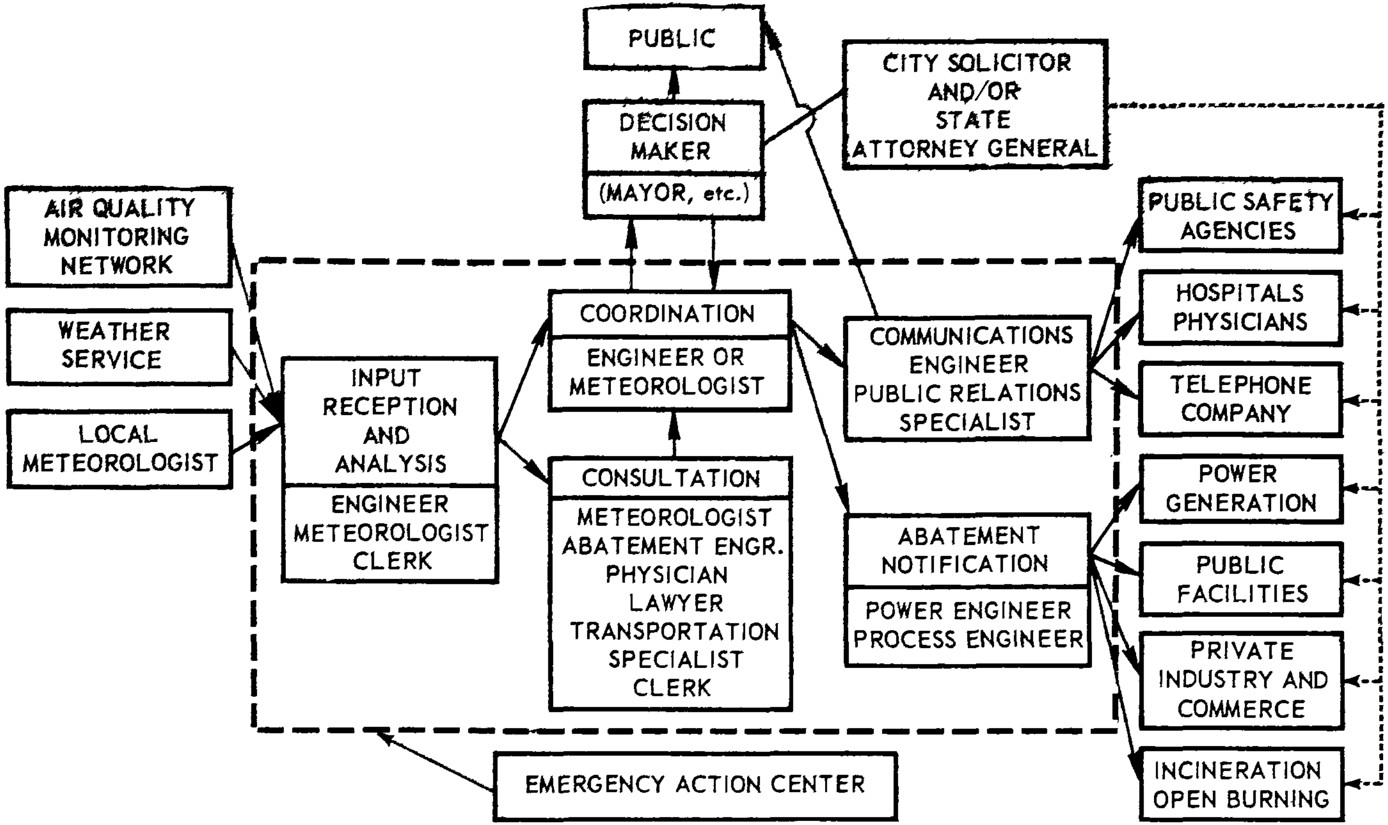


Figure 4-4. Information flow during Full Activation Mode.

Air quality and meteorological inputs for this Mode should either remain at the level determined for the Partial Activation Mode or be increased. If additional air monitoring equipment and voluntary manpower are available, an extension of the network should be considered.

The Coordinator receives increased assistance during this Mode. The specialists provide inputs and recommendations as emission sources within the city curtail operations. These specialists should also be capable of providing assistance in evaluating input data as well as devising emergency plans for reducing pollutants from specific area emission sources.

In this stage, there should be direct communication between the Coordinator and the decision maker of the area. The decision maker, in most cases, is responsible for direct contact with the public and authorizing necessary emergency actions. The City Solicitor, or equivalent, and the State Attorney General may also be involved in certain decisions. Channels that incorporate the participation of these functions outside the EAC should be established as part of the Standard Operating Procedures. Abatement notification to area emission sources may be transmitted by telephone or in person. The police department may be used to assist curtailment of both stationary and mobile source activity.

The Full Activation Mode remains operational until the episode period passes. Following this Mode, the Partial Activation Mode is required until an episode report is prepared and conditions justify Routine Surveillance. Naturally, all sources are to be notified to return to the normal rate of activity when such is advisable. The public also should be notified that the episode has terminated.

4.4 EMERGENCY ACTION CENTER

4.4.1 General

The essential consideration here is to have an identifiable location that will serve as the Emergency Action Center (EAC). The EAC will function during the minimal action periods or Routine Surveillance as well as during hectic periods of Full Activation. The EAC should provide resources for all predictable activities of the EAS; it should not be a makeshift conversion of someone's office during an actual episode, and then relegated to a desk drawer in between episodes. The displays of trends and other data should be maintained up-to-date between episodes, not only in a ready-to-go status, but to help keep the organization episode-oriented. The EAC should be conveniently located.

4.4.2 Data Display in the Emergency Action Center

The data display for the EAC should be maintained manually. Charts with movable markers are recommended. The design should be inexpensive and easy to maintain. For example, magnetic markers could be used for plotting data.

One wall of the EAC could be covered with sheet metal (iron) display

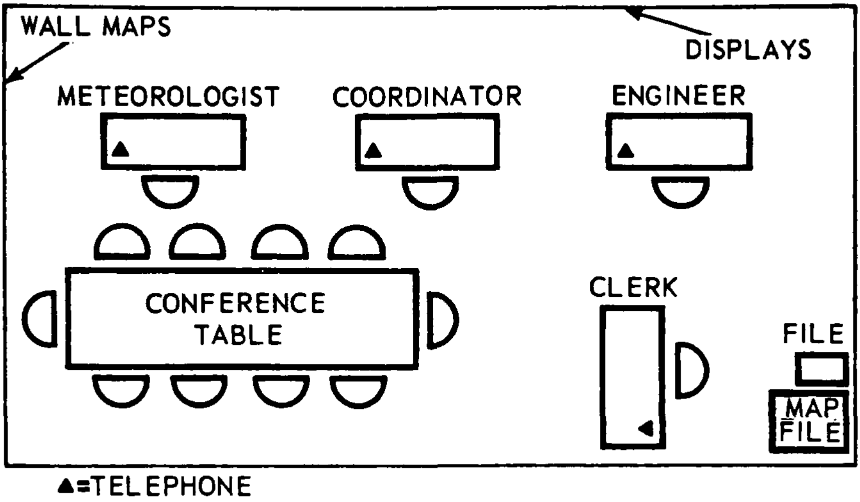


Figure 4-5. Typical Emergency Action Center layout.

panels, painted, or papered in a solid color. A time-history graph for sampling locations around the city could appear on this wall. The coordinate axes of each graph would consist of ¼-inch, colored plastic tape.

Each graph would contain space for 28 days of data. Data should be recorded daily, except during episodes when more frequent recordings are recommended. As new figures are reported for a particular day, the new data would replace the oldest.

4.4.3 Operations Room

A room as large as 20 by 30 feet could be utilized. While the actual layout will depend on the size, shape, door and window locations, and other features of the room finally selected, a representative plan is shown in Figure 4-5.

The layout is designed to accommodate the recommended Full Activation Mode and equipment. At least one wall should be free from windows or other obstructions to facilitate the mounting of display panels. A 30-foot wall should accommodate the maximum required air quality monitoring and meteorological displays. The desks of the staff should face the displays and be far enough away (about 6 feet) to allow wide-angle observation.

A conference or work table, files, and space for a clerk-typist make up the rest of the room. Four telephones are required to meet maximum communication needs.

4.4.4 Estimated Costs

The estimated costs of equipment for the EAC are shown in Table 4-1.

Table 4-1. ESTIMATED COSTS OF EQUIPMENT FOR EMERGENCY ACTION CENTER

Equipment	Number needed	Estimated unit cost, $	Total cost, $
Desk chairs	4	50	200
Folding chairs	10	15	150
Conference table	1	150	150
Telephone lines	4	10	40
Displays	9	50	450
Desks	4	100	400
File	1	50	50
Map file	1	150	150
Typewriter	1	400	400
Total			1,990

Monthly operating costs would be comparable to those of a small, partially used business office because the only expenses would be local phone calls, expendable office supplies, etc.

4.5 STANDARD OPERATING PROCEDURES

4.5.1 Routine Operation

4.5.1.1 Hours of Operation

During nonemergency conditions, the EAC needs to be manned briefly once a day. A total of approximately 10 hours per week should suffice to receive and record data. On weekends, emergency phone calls from the Weather Service or from the Air Monitoring Program could be received by the engineer-in-charge at home.

4.5.1.2 Communication Procedures

The EAC should be equipped with four telephone lines to retrieve the daily data reports. (During emergencies, the phones should be used to accept the inward flow of data as well as to distribute essential curtailment requests and public announcements.)

4.5.1.3 Communication Schedule

The team manning the field monitoring network should be called each day for air quality on particulates, SO_x, and CO. The Weather Service also should be called daily. Input data should be recorded in a log book and displayed on the wall charts. Data from weekends could be recorded on Monday. The high and low measured concentrations for particulates, SO_x, CO, or other selected pollutants should be displayed daily.

4.5.2 Reports of Poor Air Quality

A report of poor air quality is defined as a scheduled or nonscheduled report of a contaminant reaching or exceeding the predetermined criterion for the first level of alert. After receiving a report of poor air quality, the person on duty at the EAC should:

1. Alert the EAC Coordinator.
2. Check the meteorological situation and, if an advisory is in effect, determine the area affected.
3. Check air quality reports of contiguous areas to determine the extent of the potential emergency.
4. Check with local authorities of the affected area(s) for any information on the seriousness of the potential emergency.
5. Arrange for more frequent reports from the monitoring stations.
6. Be prepared to recommend that the EAC be partially activated.

4.5.3 HAPPA Reports

The HAPPA is defined as a High Air Pollution Potential Advisory from the National Meteorological Center, which forecasts stagnant meteorological conditions. After receiving a HAPPA, the person on duty at the EAC should:

1. Alert the EAC Coordinator.
2. Check the air quality reports from the surrounding areas.
3. Arrange for more frequent meteorological contacts with the cooperating Weather Service office.
4. Arrange for more frequent air quality reports from the monitoring stations.
5. Be prepared to recommend that the EAC should be activated.

4.5.4. Preparation for Partial Activation of the Emergency Action Center

After any one of the above events, the person on duty should:

1. Refresh himself on activation procedures.
2. Insure that current personnel duty rosters, with telephone numbers, are available.
3. Be prepared to remain on duty at the EAC until either relieved or a decision has been made not to activate the EAC.

4.5.5 Partial Activation

When the EAC is partially activated, the person on duty in the EAC should:

1. Tell the Coordinator to report to the EAC.
2. Call personnel on the on-call duty roster to advise them of the situation.
3. Advise the field air quality monitoring personnel and the local meteorologist that the EAC is operational and arrange for increased frequency of reporting.
4. Advise the EAC decision makers of the city that the EAC is operational.

5. Request municipal and nonessential sources of emissions to curtail activity.
6. Prepare news releases.
7. Maintain a log of all significant events during the Partial Activation Mode.
8. Notify the telephone company of conditions and request activation of planned emergency telephone communications.

4.5.6 Full Activation

When the EAC becomes fully activated, the Coordinator and the person on duty should:

1. Call those persons on the duty roster whose presence is required at the EAC.
2. Call personnel on the on-duty roster to advise them of the situation.
3. Advise the decision makers of the city that the EAC is fully operational.
4. Advise police of appropriate actions.
5. Prepare a news release informing the public of conditions and public activities that must be curtailed.
6. Advise the City Solicitor, or equivalent, and the State Attorney General of the situation.
7. Notify management of emission sources of abatement procedures.
8. Communicate with hospitals in the city.
9. Coordinate inspection of major sources to assure compliance.
10. Predict future trends of pollutant levels.
11. Maintain a log of all significant events during the emergency.

4.5.7 Termination of an Emergency

When the criteria of "all clear" are met, the Coordinator shall:

1. Notify the decision makers, legal authorities, hospitals, the public, and others that the emergency is over.
2. Notify the management of emission sources in the area that emergency abatement procedures can be terminated.
3. Notify the telephone company of return to normal procedures.
4. Revert the EAC to the Routine Surveillance Mode.
5. Assemble all appropriate data and prepare an episode report.

APPENDIX A.

GLOSSARY OF AIR POLLUTION TERMS

1. Acute	Having a sudden onset and a short and relatively severe course.
2. Aerosol	A dispersion of solid or liquid particles of microscopic size in gaseous media. Examples are smoke, fog, and mist.
3. Air Pollution	The presence of unwanted material in the air. The term "unwanted material" refers to material in sufficient amount and under such circumstances as to interfere significantly with comfort, health, or welfare of persons, or with full use and enjoyment of property.
4. Air Pollution Index	One of a number of arbitrarily derived mathematical combinations of air pollutants that gives a single number attempting to describe the ambient air quality.
5. Ambient Air Quality	A physical and chemical measure of the concentration of various chemicals in the outside air. The quality is usually determined over a specific time period (for example, 5 minutes, 1 hour, 1 day).
6. Anticyclone	An area of relatively high atmospheric pressure. In the northern hemisphere, the wind blows spirally outward in a clockwise direction.
7. Atmosphere, The	The whole mass of air—composed largely of oxygen and nitrogen—that surrounds the earth.
8. Atmosphere, An	A specific gaseous mass, occurring either naturally or artificially, that can contain any number of constituents and in any proportion.
9. Breathing Zone	That stratum of the atmosphere in which people breathe.

10. Coh	Abbreviation for coefficient of haze, a unit of measurement of visibility interference.
11. Collection Efficiency	The percentage of a specified substance retained by a gas-cleaning or gas-sampling device.
12. Collector	A device for removing and retaining contaminants from air or other gases. Usually this term is applied to cleaning devices in exhaust systems.
13. Combustion	The reaction of carbon-containing substances (or other oxygen-demanding materials) with oxygen, producing a rapid temperature increase in a flame.
14. Density	The mass per unit volume of a substance.
15. Diffusion, Molecular	A process of spontaneous intermixing of different substances, attributable to molecular motion, that tends to produce uniformity of concentration.
16. Dispersion	The most general term for a system consisting of particulate matter suspended in air or other gases.
17. Diurnal	Daily, especially pertaining to actions or events that are completed within 24 hours and that recur every 24 hours.
18. Dust	A term loosely applied to solid particles predominantly larger than colloidal and capable of temporary suspension in air or other gases.
19. Dust Fall	The amount of large particulate matter deposited per month per square mile of land.
20. Dust Loading	An engineering term for "dust concentration," usually applied to the contents of collection ducts and the emissions from stacks.
21. Droplet	A small liquid particle of such size and density as to fall under still conditions, but which may remain suspended under turbulent conditions.

22. Efficiency	The ratio of attained performance to absolute performance, commonly expressed in percent.
23. Emissions	The total substances discharged into the air from a stack, vent, or other source.
24. Emission Inventory	A list of primary air pollutants emitted into a given community's atmosphere, in amounts (commonly tons) per day, by type of source.
25. Emission Mixture	The total mixture in the atmosphere of emissions from all sources.
26. Environment	The aggregate of all external conditions and influences affecting the life, development, and, ultimately, the survival of an organism.
27. Episode	The occurrence of stagnant air masses during which air pollutants accumulate, so that the population is exposed to an elevated concentration of airborne contaminants.
28. Fly Ash	The finely divided particles of ash entrained in flue gases, arising from the combustion of fuel. The particles of ash may contain incompletely burned fuel.
29. Fog	Visible aerosols in which the dispersed phase is liquid. In meteorology, a visible aggregate of minute water droplets suspended in the air near the earth's surface.
30. Fume	Properly, the solid particles generated by condensation from the gaseous state, generally after volatilization from melted substances and often accompanied by a chemical reaction such as oxidation. Fumes flocculate and sometimes coalesce. Popularly, the term is used in reference to any or all types of contaminants and, in many laws or regulations, with the added qualifications that the contaminant have some unwanted action.
31. Gas	One of the three states of aggregation of matter, having neither independent shape nor volume, and tending to expand indefinitely.

32. Grab Sample	A sample of an atmosphere obtained in a very short period of time, such that the sampling time is insignificant in comparison with the duration of the operation or the period being studied.
33. Impaction	A forcible contact of particles (often used synonymously with impingement).
34. Impinger	Broadly, a sampling instrument using impingement for the collection of particulate matter.
35. Inversion	A layer of air in which temperature increases with height.
36. Isokinetic	A term describing a condition of sampling, in which the flow of gas into the sampling device, at the opening or face of the inlet, has the same flow rate and direction as the ambient atmosphere being sampled.
37. Mass Concentration	Concentration expressed in terms of substance per unit volume of gas or liquid.
38. Mist	A term loosely applied to dispersions of liquid droplets, the dispersion being of low concentration and the particles of large size. In meteorology, a light dispersion of water droplets of sufficient size to be falling.
39. Month	For reporting analyses of ambient air on a monthly basis, rate results are calculated to a base of 30 days.
40. Odor	That property of a substance that affects the sense of smell.
41. Odor Unit	Unit volume of air at the odor threshold.
42. Odorant	Odorous substance.
43. Opacity Rating	A measurement of the opacity of emissions, defined as the apparent obscuration of an observer's vision to a degree equal to the apparent obscuration of smoke of a given rating on the Ringelmann Chart.

44. Oxidants	A measure of the presence of organic oxidizing chemicals, such as ozone, in the ambient air. An indicator of photochemical smog.
45. Particle	A small discrete mass of solid or liquid matter.
46. Particle Concentrations	Concentration expressed in terms of number of particles per unit volume of air or other gas. Note: In expressing particle concentrations, the method of determining the concentration should be stated.
47. Particle Size	The size of liquid or solid particles expressed as the average or equivalent diameter.
48. Precipitation, Meteorological	The precipitation of water from the atmosphere in the form of hail, mist, rain, sleet, and snow. Deposits of dew, fog, and frost are excluded.
49. Precision	The degree of agreement of reported measurements of the same property. Expressed in terms of dispersion of test results about the mean result, obtained by repetitive testing of a homogenous sample under specified conditions.
50. Pollutant	Any matter that, upon discharge to the ambient air, creates or tends to create a harmful effect upon man, his property, convenience or happiness, or that causes the contamination in ambient air to exceed legally established limits, or that is defined as a pollutant by a regulatory agency.
51. Receptor	Any person or piece of property upon which an air pollutant creates an effect.
52. Ringelmann Chart	Actually a series of charts, numbered from 0 to 5, that simulates various smoke densities by presenting different percentages of black. A Ringelmann No. 1 is equivalent to 20 percent black; a Ringelmann No. 5, 100 percent. Used for measuring the opacity of smoke arising from stacks and other sources by matching with the actual effluent the various numbers, or densities, indicated by the charts. Ringelmann numbers are sometimes used in setting emission standards.

53. Sampling — A process consisting of the withdrawal or isolation of a fractional part of a whole. In air analysis, the separation of a portion of an ambient atmosphere, with or without simultaneous isolation of selected components.

54. Smog — A combination of "smoke" and "fog." Applied to extensive atmospheric contamination by aerosols arising partly through natural processes and partly from human activities. Often used loosely for any contamination of the air.

55. Smoke — Small gas-borne particles that are produced by incomplete combustion, consisting predominantly of carbon and other combustible material, and present in sufficient quantity to be detectable independently in the presence of other solids.

56. Soot — Agglomerations of particles or carbon impregnated with "tar" that are formed in the incomplete combustion of carbonaceous material.

57. Synergism — The cooperative action of separate substances, such that the total effect is greater than the sum of the effects of the substances acting independently.

58. Tape Sampler — A device used in the measurement of both gases and fine particulates. It allows air sampling to be done automatically at predetermined times.

59. Thermal Turbulence — Air movement and mixing caused by convection.

60. Topography — The configuration of a surface, including its relief and the position of its natural and man-made features.

61. Vapor — The gaseous phase of matter that normally exists in a liquid or solid state.

62. Volume Concentration — Concentration expressed in terms of gaseous volume of substance per unit volume of air or other gas, usually expressed in percent or parts per million.

63. Week	For reporting analysis of ambient air on a weekly basis, results are calculated to a base of seven consecutive 24-hour days.
64. Year	For reporting analysis of ambient air on a yearly basis, results are calculated to a base of twelve 30-day months.

APPENDIX B.

EMERGENCY EMISSION-REDUCTION POSSIBILITIES

The following paragraphs briefly discuss representative emission-reduction actions and some of the factors that must be considered in developing the plan.

REDUCTION OF EMISSION RATES WITH MINOR CHANGES IN THROUGHPUT

A number of actions may be taken to reduce the quantity of emissions from industrial processes without appreciably affecting the overall throughput of the operation. Typically, these are steps that may be economically undesirable for normal operation at the time, but which represent the most economical solution during potential episode conditions.

DUAL FUEL CAPABILITY (FUEL SWITCHING)

Dual fuel capability, or provision for temporary use of a lower sulfur fuel, will be determined separately for each class. Ordinarily, power production is the largest single fuel consumer in a given area. Industries of all kinds use fuel for both space and process heating and may have dual fuel capability.

Whether a specific source is already equipped to switch fuels depends on the economic advantage to the source, or on "chronic" air pollution regulations. The operating cost of burning low-sulfur coal or oil is now between 10 and 25 percent more than that of using grades with high-sulfur content; the cost differential may decrease, and will be related to the market value of sulfur. This cost is not an obstacle for the avoidance of air pollution episodes. Switching from oil or coal to gas may have an economic advantage, however, and, therefore, be independent of regulations, except for timing that may result from emergency requirements such as potential episodes.

Some factors that must be considered in fuel-switching actions are:

1. Availability of substitute fuels:
   a. Relative scarcity of alternate fuels.
   b. Competitive demands.
2. Availability of storage:
   a. Space requirements.
   b. Handling facilities.
   c. Turnover of stockpile.
3. Technical features:
   a. Alternate burners.
   b. Ash compatibility.
   c. Particulate emissions.
   d. Auxiliary equipment (heaters, pumps).

Low-Sulfur Coal

Coal contains from about 0.4 to 10 percent sulfur; that coal having 1 percent or less is classified as low-sulfur. The average sulfur content for coal used in the United States is about 2.4 percent. Most of the high-sulfur coal is consumed by the power industry. Most anthracite and some bituminous coals have low-sulfur content. The sulfur in coal may be pyritic, organic, or as sulfate. Sulfate is usually a minor form; pyritic may be removed mechanically (but not necessarily economically); and organic sulfur usually appears as SO_2 in the flue gas.

The steel industry is a strong competitor for the limited supplies of low-sulfur coal. Combined with its lower natural occurrence, this makes low-sulfur coal more costly than high-sulfur coal. Depending upon the geographical location of the consumer relative to the high- and low-sulfur coal sources, transportation changes can alter the cost differential resulting from competition.

The cost of storing low-sulfur coal will be determined primarily by the interest and taxes on the land and the losses due to weathering of the coal, assuming the stockpile is located so that the normally used handling equipment can service it. The stock should be turned over periodically, i.e., used and replaced, when episodes have not occurred.

The substitution of low-sulfur coal imposes two potentially significant technical problems: ash and particulate handling. Low-sulfur coals often have high ash-fusion temperatures. So-called wet-bottom furnaces are designed to discharge the ash as a molten stream. If the ash-fusion temperature is too high (above about 2,600° F), the ash may pile up as a semifused or solid mass in the furnace bottom; this mass could force the plant to shut down in 12 to 18 hours and also cause extensive damage to the furnace. High-sulfur coals provide a good electrolyte in the flue gas so that the resistivity of the fly ash is relatively low. If the plant has electrostatic precipitators designed for low-resistivity fly ash, a change to low-sulfur coal may significantly increase the particulate emissions because of lower collection efficiency. If switching to low-sulfur coal is to be the emergency control action, it may be necessary to modify the particulate control devices by adding more precipitators or by installing a mechanical separator in series with the electrical precipitators, or to arrange to decrease the flue gas temperature (and hence increase SO_2 absorption by the precipitated dust) to compensate for the reduced resistivity during the episode. A 10° to 15° F change is significant. On the other hand, an increase in flue gas temperature, while not economical as a chronic control measure, has the effect of increasing the effective stack height, which, if it penetrates the base of the inversion, may discharge the gases outside the stagnant region, depending on stack height and the height of the inversion. Increasing the stack temperatures by bypassing the air heaters would require plant modification. The trade-offs must be examined by experienced power plant engineers for the specific cases at hand.

Low-Sulfur Oil or Gas

Plants that are normally either coal- or oil-fired can conceivably switch to low-sulfur oil or gas. Natural gas is practically sulfur-free, but oil, however, may contain sulfur. During the refinery processes, sulfur tends to be concentrated in the heavier residual fractions. The sulfur content of oils may be specified as shown in Table B-1.

Distillate oils are usually used for residential heating and, industrially, in heat treatment and nonferrous glass and ceramic furnaces, and residual oils are used in large space heaters and industrial furnaces.

Local availability of low-sulfur oil and gas is more a question of location with respect to source and the means of transportation than one of inherent scarcity. With advances in the technology of desulfurizations, low-sulfur oil is likely to be more plentiful. Oil, like coal, may be stockpiled for use during an episode, but storage costs will be incurred. At the well, gas compares favorably with other fuels on a cost per unit heat content. Away from the well, sufficient pipeline facilities are required to distribute gas. Consequently, in localities distant from the gas fields, the use of gas as a dependable alternate fuel may not be practical. Its availability must be determined locally.

The substitution of low-sulfur oil or gas for other fuels usually requires the provision of special burners, especially for coal-fired furnaces. For oil-fired furnaces, the fuel-handling equipment (including heaters) and the burners are designed for high-viscosity residual oils rather than for low-viscosity distillate oils or gases. In addition, the ignition characteristics and safety features of the furnace must be compatible with the substitute fuel; serious explosions can occur in a furnace with improperly operated burners.

The feasibility of substituting low-sulfur oil for high-sulfur coal must be examined by experienced plant engineers for each specific situation. In addition to differences in burners and auxiliary equipment, the impact on particulate emissions should be examined if electrostatic precipitators are used.

COMBINATION ACTIONS

For power systems, complete shutdown is generally impractical because electric power is required to maintain public health and safety. The local

Table B-1. SULFUR CONTENT OF OIL, BY GRADE

Grade	Type	Maximum sulfur, %
1	Distillate	0.05
2	Distillate	0.10
4	Residual	No limit specified;
5	Residual	range is 0.34 to 4.0;
6	Residual	average is about 1.6.

situation may, however, permit some steam-generating plants to either shut down or curtail their outputs if the balance of the connected system can pick up the load. For other industries, it may be possible to combine curtailment and fuel substitution by providing substitute fuel only to those elements of the industry that are technically difficult or otherwise impractical to shut down or curtail.

POWER INTERCHANGE

The electric power industry must have reserve capacity to handle peak demands and to provide for the maintenance of equipment. During a potential episode, it may be possible to shift the electrical load within and between power systems to reduce the quantity of pollutants emitted in a particular region. Power interchange is a complex system-wide procedure involving a continuous equalization of generation and load. As a result of the Northeast blackout in 1965, power interchange by portions of a power system is now a generally accepted procedure during crises. Since the capacity to shift loads is very sensitive to the geographical extent of the episode, this emergency action will require interregional coordination as well as detailed engineering by the power systems' technical staff.

Typical actions might include maximum use of hydroelectric power, shifting to plants utilizing low-sulfur fuel, shifting to plants with superior pollutant-removal or dispersion capability (scrubbers, taller stacks), shifting to more favorably located plants (downwind), and maximum use of nuclear plants.

PROCESS CURTAILMENT OR ADJUSTMENT

The factors involved for some processes used in industry are discussed below. The possibilities are practically endless, and will have to be explored for each major pollutant source. Cooperative analyses with engineers of each company may turn up a great many possibilities. In a large city, with thousands of sources, this is likely to be possible for only the major point sources. While process shutdown is an obvious curtailment action, any measure contributing to reduced exit loadings or to better dispersion must be considered. Delay of certain noncritical functions, temporary (presumably less profitable) adjustment of control "set-points", and increasing stack temperatures or velocities are suggestions of possible general approaches to be investigated. Soot blowing, cleaning, and painting may be temporarily deferred.

High-Temperature Continuous Processes

This category includes such activities as the operation of blast furnaces, manufacture of glass, oil refining and other petrochemical operations, coking, acid manufacturing plants, calcining operations such as the manufacture of cement, some food processing operations, and many chemical manufacturing processes.

The two primary problems encountered in the curtailment of any continuous process are how to stop the process efficiently and how to purge the system of in-process material. These problems are aggravated when the process involves high temperatures. Generally, neither hot nor cold in-process material can be left in the furnace, oven, or reactor. Another problem is that of keeping the equipment in standby condition, since it may be severely damaged if allowed to cool. For example, blast furnaces and continuous glass furnaces are usually operated until their linings fail, and cannot be allowed to get cold without severe economic loss.

Electrolytic processes such as are used in aluminum and magnesium production also incur severe damage if allowed to cool, although the power requirements may be reduced temporarily.

In refineries, in-process materials are often toxic or hazardous volatile liquids and gases. Refineries are designed with vapor-disposal systems as both safety features and to handle normal turnaround operations for various pieces of equipment. Because the refinery is such a close-coupled system, a complete shutdown is a technically difficult and perhaps unrealistic undertaking, particularly for a short-period transient situation.

High-Temperature Batch Processes

This category includes such processes as the manufacture of steel in electric, open hearth, basic oxygen, and Bessemer furnaces or converters; some primary nonferrous and all secondary smelting; batch glass manufacturing; paint and varnish manufacturing; and a multitude of chemical manufacturing processes.

In batch processing, the process is usually terminated at the completion of each batch. Consequently, the primary problem associated with shutdown is that of putting the equipment in standby condition. Batch processes vary in time per batch from a few minutes to as many as 36 to 48 hours. Thus, time is a significant consideration in shutdown plans involving batch process industries, since the potential economic loss may be severe.

Processing of Perishable Materials

This category includes many of the food-processing industries, and others involving biological and active chemical systems. Processing or storage of photographic materials, leather, and electrical batteries, for example, could be included in this class.

There may be at one or more points in a process a possibility of spoilage or decay of the raw material, an intermediate product, and the final product. In addition to causing economic loss, the spoilage could contribute to local air pollution. The situation can arise in a plant being shut down if the flow of incoming raw material is not adjusted or if no allowances are made for refuse disposal. Of course, only those operations contributing to air pollution will be directly curtailed, except when all "nonessential" activities are ceased.

Other Point-Source Processes

This category includes other processes or unit operations not included in the above classes, such as materials handling, evaporation, crystallization, agitation, heat transfer, and packaging.

Some processes may be incidental to the primary purpose of the industry, yet be significant. An example is evaporation at points where large volumes of volatile materials are handled, such as petroleum loading-and-storage facilities and dry cleaning plants. Others of these processes may be "in-line" with processes that cannot be readily curtailed; a water cooling tower that is emitting hydrocarbons must be phased with associated equipment; waste gases—such as SO_2—supplied as raw materials to neighboring plants must be managed carefully.

REDUCTION OF EMISSION RATES BY CURTAILMENT OF OPERATIONS

Curtailment of industrial and commercial operations without actual shutdown of the operation may sometimes represent the most effective means of reducing the quantity of pollutants emitted. Care must be taken to ensure that the curtailment will really result in an overall pollutant reduction. The purposes of such curtailment may include:

1. The reduction of pollutants directly emitted by the affected operation.
2. The reduction of power demands upon utilities to enable them to reduce their emissions.
3. The reduction of natural gas usage to enable gas to be used in more essential operations such as power generation.
4. The reduction of transportation requirements with resulting lower power demands and lower mobile source emissions.

Refuse Disposal

The incineration of solid waste by municipalities and individual operations (such as lumber mills, construction sites, and large apartment buildings) may be curtailed completely or combined with fuel shifting, particularly as a control measure in low-level alert stages. The curtailment of individual residential backyard burning poses no problem other than communication and enforcement. The shutdown of incinerators can cause increased emissions for a short time when the episode is over. In all cases, there will be the problems of accumulating raw waste, and of higher throughput following the period of curtailment.

Advance Notice Required

The advance notice needed by emitters concerning curtailment may vary from an hour to several days. This information can be supplied best by persons with knowledge of the process and its relationship with other processes, either internal or external to a given operation, e.g., reduction of power demand. The advance notice required by various industry classes will be determined.

Time-Histories of Pollutant Emissions

It is desirable to know the change in total emissions with time, for the following reasons:

1. Curtailment causes some emissions to increase temporarily.
2. The time to achieve a reduction in concentrations will be important for future planning.
3. Emissions during restart may influence the decision to curtail.

The preparation of curves summing the total emissions against time in a specific city would, of course, depend on cumulating individual source emissions; this would be difficult because emissions under changing operational conditions are not known. Representative time-histories for each industry class, based on knowledge and observation of the operations, will be developed during the preparation of the EAP.

The overall time required for curtailment may be the most useful data produced from time-histories. In the absence of estimated emission rates during curtailment, the overall time required can always be estimated. Even if emissions rise before descending to a new reduced level, the effect may not be severe if the time period of elevated emissions is brief.

Side Effects

Some important side-effect considerations in preparing the emergency plans are:

1. Releasing employees at unusual times to spread out traffic flow.
2. The suppliers and customers of each emission source may be affected.
3. Overloading of communications systems.