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1. CONSEQUENCE ASSESSMENT

1.1 Introduction

Consequence assessment is the process used to evaluate the impacts of a release of radioactive or other hazardous materials. Consequence assessment capabilities necessary to meet the time-urgent needs of emergency response are addressed in this chapter. The guidance focuses on the process of performing timely initial assessments necessary to support critical first decisions and the continuous process of refining those initial assessments as more information and resources become available.

The term "consequence" as used in this guidance means "the result or effect of the release of hazardous materials into the environment." Specifically, the "consequences" of concern are human health effects. The assessment of consequences is the evaluation and interpretation of all available information concerning an actual or potential release of hazardous materials to the environment for the purpose of estimating personnel exposure/dose. These estimates are then compared to human health and/or Protective Action Criteria (PAC) and used as the basis for emergency management decision-making (e.g., event classification, protective actions, notification, public information, etc.)

The primary objective of the consequence assessment process is to provide timely, useful information to Emergency Managers for use in making informed decisions to protect people (e.g., workers, the public, and responders). For purposes of this guidance, "timely" means fast enough so that decisions can be made and implemented in time to avoid or reduce consequences to people. "Useful" means the right information in the correct units communicated clearly and effectively. "Information" includes answers to the questions "Who will be affected?", "What will be the nature and magnitude of the impact?", "When will the impact begin and end?", and "Where (geographically) will the impact be felt?". In addition to Emergency Managers, other important audiences for consequence assessment information include responders, workers, the public, the media, regulators (state, local, and federal), and tribal or other government officials.

Consequence assessment capability should be consistent with the type and magnitude of actual and potential facility hazards assessed and should primarily apply to the Emergency Planning Zone (EPZ). However, the capability should provide for limited extension beyond the EPZ, including support to offsite organizations for field/environmental monitoring.

This chapter will provide a description of how the consequence assessment process works during the course of an emergency (sections 1.2, Elements of a Consequence Assessment) and then will guide the user through the process of developing the tools necessary to conduct consequence assessment during an event (sections 1.3, Consequence Assessment Process, 1.4 Timely Initial Assessment, 1.5 Continuous Assessment). The tools are developed as part of the planning aspect of the Emergency Management System. Finally, the chapter will provide guidance on how the information from consequence assessment is used to support decision making during an emergency (Section 1.6, Integration, Coordination, and Quality Assurance).

The guidance will provide suggestions and recommendations for developing the following: 1) a timely initial consequence assessment tool comprised of predetermined source terms (taken from Volume II) receptors and calculations based on appropriate assumed meteorological conditions; 2) continuous assessment tools, based on level of hazard, 3) procedures for using the timely initial assessment tool and the continuous assessment tools; 4) specially formatted and worded results of the consequence assessment to be used by the Public Information Officer; and 5) documentation of quality control measures used to ensure that the consequence assessment tools can confidently be used to make decisions for protecting the workers and the public.

Base Program. There are no minimum requirements specified for the Base Program site/facility in Consequence Assessment. Consequence Assessment capabilities for the Base Program will be derived from other DOE orders, Federal laws/regulations, or local ordinances. The guidance presented in this chapter could be useful in developing such a capability.

1.2 Elements of Consequence Assessment

Consequence assessment is conducted in three phases during emergency response.

During the first phase, performed immediately upon recognition of the emergency, tabulated results of consequence calculations are used to make an initial rough estimate of the consequences.

The second phase, Timely Initial Assessment (TIA), is performed in the first few minutes of response and involves the use of any available real-time event and meteorological information and simplified models to estimate event-specific consequences.

The third phase, Continuous Assessment, begins with activation of the consequence assessment capability of the Emergency Response Organization (ERO) and continues throughout the response.

Once the emergency response is terminated and recovery begins there may be a need for a facility and/or environmental assessment. Assessment activities during recovery operations are beyond the scope of this guidance. However, some of the references provided in this guidance do address these activities.

1.2.1 Event Detection, Recognition, Categorization, and Classification

Initial activity associated with a facility's emergency response includes detection, recognition, categorization, and classification of an emergency event.

Events and event symptoms are recognized through direct observation and/or the monitoring of indicators. These indicators are compared to Emergency Action Levels (EALs) to determine the level of severity, resulting in event classification and appropriate level of response. EALs are based on consequence estimates and evaluations performed using information from the Hazards Assessment. These calculations, based on postulated events and pre-selected default input parameters, indicate potential consequences of an emergency event. This represents the first phase in the assessment of consequences.

The process and methodology for performing a facility Hazards Assessment are discussed in Volume II. Guidance on developing criteria for event categorization and classification is discussed in Volume III, Chapter 3.

1.2.2 Timely Initial Assessment

In the first minutes of response (within 30 minutes), actions are taken to improve the quantitative understanding of impacts. This is the TIA phase of assessment.

The goal is a rapid assessment that yields a conservative estimate of the upper bound of the potential consequences. TIA actions are designed to require minimal time and effort and the results may have a high degree of uncertainty. However, the decisions influenced by the TIA are some of the most crucial made during the entire response. TIA is conducted at a time when only limited information and data are available; as a result, reliance is placed on pre-calculated results found in the Hazards Assessment and simplified calculational methods. Methods typically include simple computerized calculations and pre-calculated values, plume overlays, nomograms, and graphs. Tools for performing TIA are developed from the Hazards Surveys and Assessments, Safety Analysis Reports (SARs), Probabilistic Risk Assessment (PRA) Reports, and/or regulatory compliance activities. These calculational tools can be organized into a single reference (see Appendix A for an example). TIA actions are often completed by first response personnel prior to the arrival of the ERO consequence assessment staff.

Steps in the TIA process are depicted in Figure 1.1. The TIA process is replaced with a continuous assessment process once the consequence assessment ERO staff arrive.

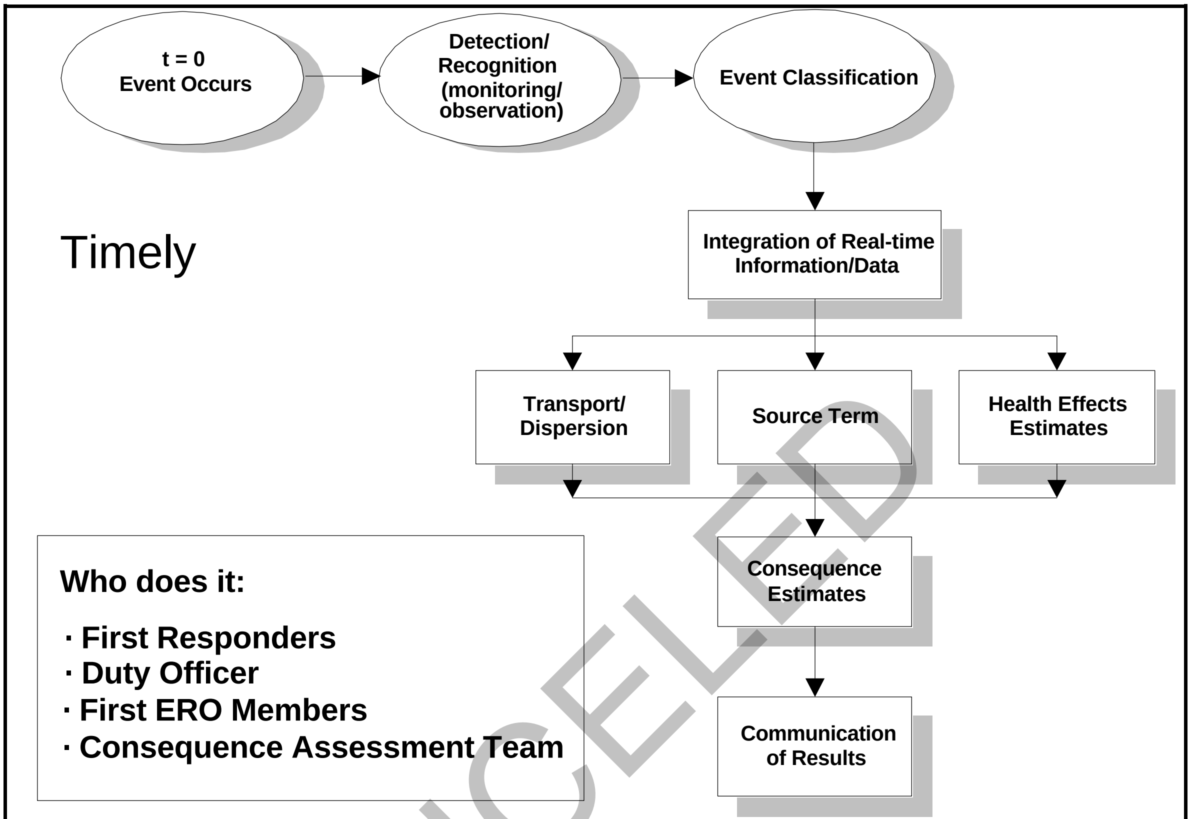

Figure 1. The process of timely initial assessment.

1.2.3 Continuous Assessment

As the ERO, facilities, and resources are activated, additional information is gathered and emergency conditions become better understood. This is the "continuous” phase of the assessment process. The same general steps are employed (see Figure 1.2) as in TIA, but the process is cyclical, with increasing levels of sophistication in the analysis tools, input accuracy (e.g., source term and meteorology), technical expertise, and eventually feedback from field monitoring efforts. This part of the process is conducted with the resources and professional judgment of the consequence assessment staff of the ERO.

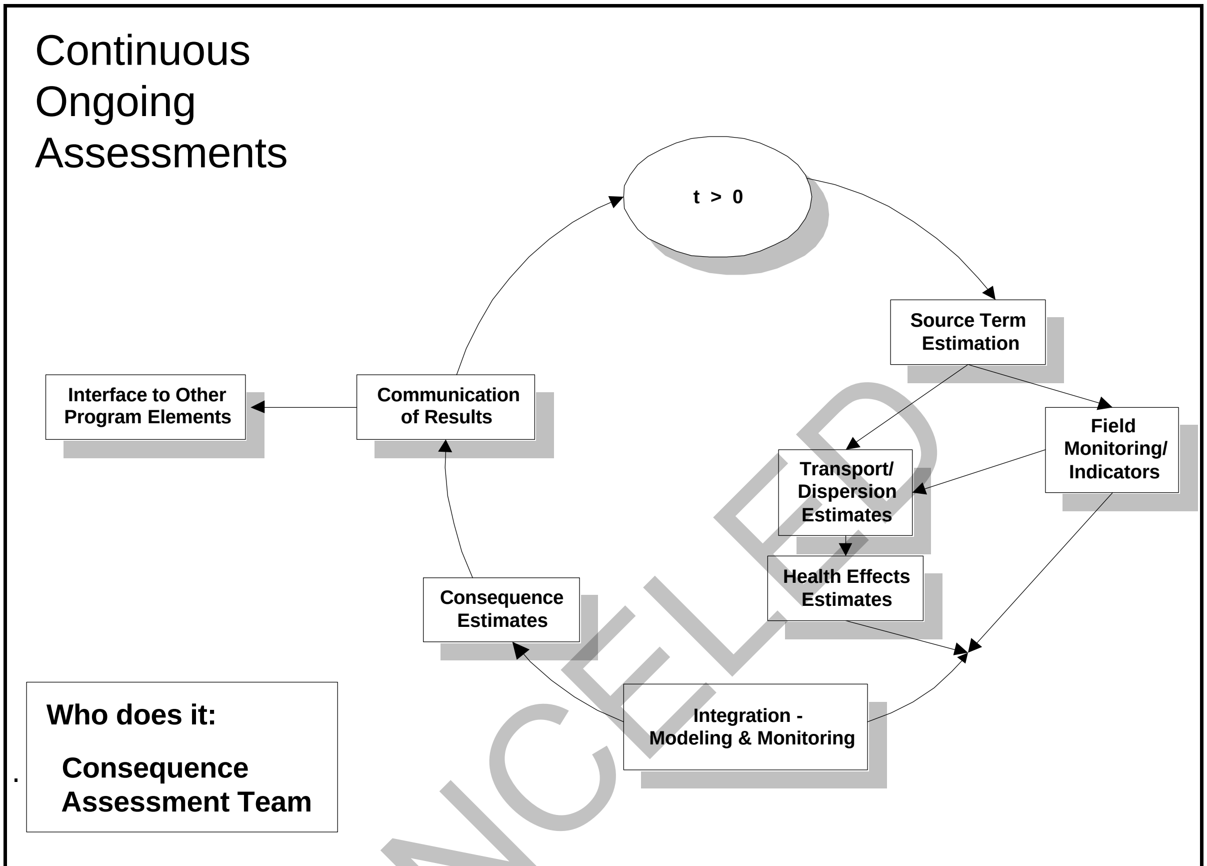

Figure 2. The process of continuous assessment.

1.3 Consequence Assessment Process

The process of consequence assessment for both TIA and continuous assessments consists of three elements: (1) the identification of input data/information, (2) the calculation of consequences, and (3) the interpretation and communication of the results.

1.3.1 Identification of Input Data/Information

"Inputs" are the information that "feed" the consequence assessment process. Information needs fall into three categories: source term, meteorology, and receptor locations. Source term information indicates how much hazardous material has been released into the environment. Meteorological information is used to determine how the material will be transported through the atmosphere to the receptors, and how rapidly the receptors will be affected. Receptor information identifies the specific locations and distances at which consequence estimates are needed.

Source Term. A “source term” represents the amount of material released to the environment or the rate at which it is released. The information needed to characterize the source term includes the following.

- Total quantity of material present.
- Quantity of material released from primary barrier.
- Quantity of material released to environs.
- Properties of the material.
- Duration of release.
- Rate of release.
- Height of release.
- Vertical velocity/buoyancy of release.

Not all of the information listed above may be necessary to adequately define the release source term. The information necessary will depend on the material of interest and the model or calculational technique used. Some of this information may be determined by real-time measurements and used directly in models (e.g., volume in tank, stack monitor reading). Others may be known only theoretically (such as gas density) or may have to be assumed, based on limited empirical evidence, in order to arrive at a release estimate that can be used in consequence calculations (e.g., particle size distribution). A generic formula for determining a source term is discussed in Volume II, Section 3.5.

The following are some recommendations for emergency planners on preparation for determining source terms during emergency response.

- Gather and present information on source terms for a range of events/conditions. This information should have been developed as a part of the Hazards Survey or Assessment process. The key information should be extracted from the Hazards Survey or Assessment (and other references) and placed into a format that can be used as a quick reference by response personnel (see Appendix A for an example).

- Correlate the predetermined source terms with observed conditions (i.e., personnel observations, instrument readings, monitoring results, etc.). Users of the documentation should be able to rapidly compare available information to the predetermined source terms to select the one that is most appropriate for the event at hand or to apply the best modifying factors. In the absence of any other information, the user may simply identify the affected building and use the most conservative source term listed.

- Identify technical experts within the local organization who have experience with the hazardous materials and their associated physical and chemical phenomena. Ensure they are a part of the ERO consequence assessment team or arrange for them to be available for consultation.

Meteorology. Information about meteorological conditions is necessary to predict how and where hazardous materials released to the atmosphere will be transported and deposited. The types of meteorological data used in consequence assessments include default, real-time, and regional forecasts. Default information (usually worst case) is used in generating the precalculated consequence estimates that are part of the tools used to support TIA. Real-time information is gathered in the vicinity of the release to characterize the region of transport.

For complex meteorological conditions, additional real-time data from the region of transport may be necessary to adequately characterize transport and dispersion. Real-time data should be used to replace default values as soon as practical. Regional forecast information is used in parallel with real-time meteorology to semiquantitatively determine temporal changes in parameters that could affect consequence assessment calculations.

The most important real-time meteorological parameters for emergency response are related to the wind. The mean wind direction and speed provide the basis for determining *where* and *when* consequences will occur. The wind speed (dilution) coupled with atmospheric turbulence intensity (dispersion) provides the basis for determining *how much* hazardous material will arrive at the receptor. Other factors that have an effect on the transport, dispersion, and deposition of material include inversion layer height, precipitation, gravitational settling, temperature, and humidity.

The minimum data necessary to drive intermediate or advanced atmospheric dispersion models are wind speed, wind direction, and an indicator of atmospheric stability. The following describes how each meteorological parameter operates on a source term.

- Wind Direction.
  - Identifies plume trajectory and the downwind receptors.
  - Has little or no effect on concentration of effluents (except when terrain effects are included in the modeling).
  - Wind is *from* the direction reported.

- Wind Speed.
  - Establishes plume arrival time at a particular receptor.

  - Dilutes source material (i.e., inversely proportional).
  - Determines transport times to establish radioactive decay and plume depletion.

- Indicator of Atmospheric Stability.

  - Determines plume concentration at a particular receptor.
  - Disperses source material (Gaussian approximation often used).

Methods to acquire and use meteorological and other environmental data in consequence assessments should be commensurate with quantities of hazardous materials present in the facility and the need to accurately characterize the transport and dispersion of materials during a release. The environmental monitoring program required for consequence assessment should be based on an extension of the general environmental protection program required by DOE O 231.1 for each facility.

If the facility Hazards Assessment indicates that no potential emergencies and releases of material will be classified higher than Alert, no real-time meteorological monitoring capability is necessary beyond that required by other applicable DOE Orders. Access to representative meteorological information from non-facility resources, such as a local airport or the National Weather Service, will suffice.

If the facility Hazards Assessment indicates that no potential emergencies and releases of material will be classified higher than Site Area Emergency, use the following criteria for the geographic area within the site boundary.

- Sufficient continuous real-time meteorological information should be available to characterize atmospheric dispersion within the confines of the site. This capability should include a means to determine wind speed, wind direction, and atmospheric stability via instrumentation or trained observation.

- Generally, the measuring station providing meteorological input should be located within approximately 2 km of the potential release point(s). The number and location of meteorological monitoring stations necessary to characterize transport and dispersion conditions depend on the number and location of potential release points and the size and meteorological complexity in the region of transport.

- Calculational models used for consequence assessment should be appropriate for dispersion conditions specific to the facility and vicinity. Facility-specific characteristics addressed should include height of release point (i.e., elevated, ground-level, or mixed-mode), effluent temperature and velocity, building wake effects, and stack aerodynamic effects (i.e., plume rise). Local meteorological factors to be considered include lake breeze, urban heat island, mountain/valley winds, and other terrain effect.

If the facility Hazards Assessment indicates a potential General Emergency classification based on a postulated emergency release scenario, the following additional criteria apply in the region of transport.

- Sufficient continuous real-time meteorological data sources should be available to accurately characterize atmospheric dispersion for *offsite* areas potentially affected by a maximum release. The number of monitoring stations, and the sophistication of monitoring equipment necessary, will depend on terrain complexity and dispersion conditions.

- The increased distance and area involved in accurate characterization of atmospheric dispersion to the limits of potentially impacted offsite locations will likely require more sophisticated dispersion models. Models available should be able to provide estimates for any location of interest within and slightly beyond the limits of the EPZ.

The number of monitoring stations necessary to provide adequate real-time data is influenced by the complexity of the local terrain. Simple terrain is generally flat or relatively flat with no complex airflow patterns. Complex terrain airflow patterns are induced by either mountain-valley (complex-land) terrain features or by land-water (complex-water) interfaces.

Temporal variability of meteorological parameters occurs concurrently with terrain influences and is addressed by regional forecast information regardless of terrain complexity. Comprehensive treatment of transport considerations associated with Complex-Land and Complex-Water locations is *only* needed if the Hazards Assessment indicates significant impacts in the region of transport.

Receptors. As used in this guidance, a receptor is defined as "a point or location at which consequence estimates are performed for the purpose of determining event severity by estimating impacts on safety or human health." For facilities with hazardous materials programs, human health effects are the primary concern. The calculation of consequences at specific receptors helps answer the following.

- Who will be affected.
- Who will be notified.
- Who will have to respond.

- Where and when consequences will occur.
- Where consequences will be above classification or protective action thresholds.

Estimating consequences at specific receptors provides information that is used in event classification, protective action decisions, notification, reentry planning, termination of emergency response, and recovery planning/activities. Onsite receptors of interest include site facilities, facility and site boundaries, collocated workers, assembly areas, evacuation routes, and emergency response facilities. Offsite receptors of interest include population centers, special populations (e.g., hospitals, schools, nursing homes, day care centers, prisons), evacuation routes, relocation centers, environmental monitoring stations, and ingestion related locations (e.g., water supply intakes, farms, dairies, food processing plants).

It is recommended that all receptors of interest be identified and documented for each facility requiring a Hazards Assessment. This listing should be made part of the documentation provided to the ERO consequence assessment staff.

Information for each receptor should identify the wind direction that would affect the receptor, the name of the receptor, distance from facility, and plume travel time for a wind speed of 1 m/s. (It should be noted that this wind direction-receptor relationship is only valid for straight-line airflows over essentially flat terrain.) (See Appendix A for example.)

1.3.2 Calculation of Consequences

Calculational methods and resources should provide for projecting the quantitative impact of an actual or potential release of hazardous materials within the EPZ. Most standard methods/models for calculating consequences focus on airborne release assessments; however, other credible dispersion pathways may need to be addressed depending on the hazardous materials present and results of facility Hazards Assessment. The airborne release pathway typically represents the most time-urgent situation, requiring a rapid, coordinated response. Releases to aquatic and ground pathways may not have the same time-urgency, and calculational models for these pathways should be developed on a case-by-case basis if applicable to the individual facility.

The level of sophistication of calculational methods and models should be commensurate with facility-specific source terms, atmospheric transport and dispersion considerations, and potential severity of the consequences of a release. The following general guidelines should be applied.

- If the facility Hazards Assessment indicates that potential emergencies and releases of material will not be classified more severely than Alert, then consequence assessments should make use of simple calculational methods for post-event analysis. Sophisticated calculational methodology/models for consequence projections are usually not needed. Plans and procedures should identify protective actions to be implemented for the protection of personnel within the facility boundary or near the event scene.

- If the facility Hazards Assessment indicates that no accident scenario analyzed will result in an event classification higher than Site Area Emergency, then protective actions may be required beyond the facility boundary and throughout the site only.

The calculational methods and models should yield a quantitative prediction of the impact in a time that is short with respect to the time needed to carry out personnel protective actions. The calculation would typically involve the modeling of the release on a personal computer or use of well-designed manual calculations (e.g., nomograms, overlays, graphs, tables, etc.) Actual source term and environmental data input to a computer model may be provided by on-line systems or manual entry. The method/model used should be customized, as necessary, to address each major type of release scenario. For example, for an event resulting in an instantaneous release, such as an explosion, when the time period for calculations must be short, consequence assessment may be based on nomograms only. In contrast, consequence assessment may be based on complex computer calculations for a slower-paced event sequence. Advanced capabilities, such as the ability to perform rapid recalculations to consider changing conditions or information (including back-calculating a source term from field monitoring data), or analyze a range of hypothetical situations, may be desirable.

- If the facility Hazards Assessment indicates a potential for an emergency classification of General Emergency, then a release may require personnel protective actions beyond the site boundary and the consequence assessment methods should be capable of producing estimates to or beyond the limits of the EPZ. In addition to those capabilities discussed above under Site Area Emergency, the projection methods/models provided should yield a quantitative prediction of the offsite impact sufficient to allow timely (approximately 15 minutes) offsite protective action recommendations. Advanced features, such as on-line data entry, may be necessary to meet the time requirements for notification.

Three tiers of calculational methods have been identified to address consequence requirements.

1. **Elementary.** Pre-calculated consequences, such as tabulated hazards assessment or SAR results or ready reference graphs/figures. The accuracy is limited; they

usually provide plume centerline results at a single receptor; and they are easy and quick to use.

2. **Intermediate.** Simplified consequence calculations such as hand calculations, nomograms, overlays, and simplified PC-based computer models. Accuracy is limited; and they provide a simple plume footprint, centerline and off centerline estimates, results at several receptors, and are relatively easy and quick to use.

3. **Advanced.** Advanced computerized methods capable of more realistically modeling atmospheric transport and dispersion when operated by a subject matter expert. These are recommended for continuing assessments at high hazard facilities/sites with complex meteorological flows in the region of transport. They more accurately depict plume trajectories and provide complex plume footprints. Although they are generally slow and more difficult to use, recent advances in computer technology are reducing the run times.

Consequences are calculated for the purpose of comparing the results with criteria that relate to human health effects. The relevant criteria for radioactive materials are the Environmental Protection Agency (EPA) Protective Action Guides (PAGs), which are expressed in units of radiation dose (total effective dose equivalent [TEDE]). For an atmospheric release, TEDE is directly proportional to the total amount of the radioactive material released during the period of exposure. Therefore, when calculating how much of a radioactive material is released during a particular event, there is not much concern with the variation of the release rate over time, but only with the total quantity released during the period of assumed exposure. For releases that could go on for a long time, the assumed period of exposure is usually taken into account when determining the emergency class or protective action that is warranted. For example, if it is reasonable to assume that protective actions could be decided and implemented for a particular population within 2 hours of the start of a release, it will be useful to know the relationship between the quantity released (and the resulting dose) during that first 2 hours and the expected total release. (See also Volume II, Appendix B.)

The relevant criteria for most non-radiological hazardous materials of concern are the American Industrial Hygiene Association (AIHA) ERPG-2, or approved alternative values, expressed as "peak concentrations in air below which it is believed that nearly all persons could be exposed for up to 1 hour" without experiencing some level of health effect. The key difference is that exposure to some materials at a concentration exceeding the ERPG-2 value for a short period of time may be enough to produce the health detriment. As a result, it is recommended that these concentration criteria be compared to a calculated maximum 15-minute average concentration for purposes of deciding on protective actions. This indicates that assessment tools should determine non-radiological release rates as a function of time that will permit the calculation of maximum 15-minute average concentration at receptors of interest. For exposure periods less than 15 minutes, concentrations may be calculated over a shorter time period (e.g., the exposure duration). If the material is one for which short exposure to very high concentrations can produce severe health effects, it will be important to determine what kind of short-duration or near-instantaneous releases are possible, because these scenarios produce the highest instantaneous concentrations. (See Volume II, Appendix B.)

The basis for selection of methods and models should be well documented and include the results of any verification and validation. Consistency among models used by DOE Headquarters, offsite State/local agencies, and other site facilities that are likely to provide assistance during an emergency should be considered in model selection. It is a good idea to model a series of representative release scenarios using the site calculational methods and models. The results can then be compared to those from methods and models used by local, State, and other Federal agencies for the same scenarios. Significant differences should be identified, explained, and documented, which will help in reconciling results during an actual response. Calculational methods and models used in preparing facility Hazards Assessments and developing scenarios for drills/exercises should be identical or similar to those used in the consequence assessment process.

1.3.3 Interpretation and Communication of Results

The results of the consequence assessment process will be used by several different response elements: emergency managers; other response organizations; and local, State, and Federal agencies. They are used to verify or alter the event classification. Emergency managers rely on the results to verify and formulate protective actions for onsite personnel and protective action recommendations to offsite authorities. Notification forms carry the information to other response organizations. It is provided to local, State, and other Federal agencies for use in verifying or performing their own consequence assessments. The health and safety personnel use the results to advise and protect response personnel. Public information personnel use it to inform the media and public. Each potential user of the results has a specific set of needs and requirements. Assessment personnel should consider the needs of the end users when preparing and communicating results. Use of a standard form for presenting and summarizing inputs and corresponding assessment results is often helpful for clearly communicating results. (See Appendix B for example.) Supplemental information such as source term calculations, graphs, plume footprints, etc., can be attached to meet the needs of specific users. *Communicating information effectively to the different end users is of equal importance to technical accuracy.*

Transport and Dispersion. The end product of transport and dispersion calculations is the atmospheric concentration (and sometimes ground contamination concentrations) as a function of time and distance from the release point. Timely conversion of these concentrations to units of consequence (i.e., radiation dose or dose rate, chemical concentrations or exposures, etc.) is necessary for emergency managers to make effective use of the information.

Classification and Protective Actions. The following questions should be considered when preparing results to support event classification and protective action decision making.

- Will hazardous material(s) transport beyond the facility/site boundaries?
- When will the transport begin?
- What are the applicable protective action criteria for the material involved in the emergency?
- Will onsite/offsite impacts exceed applicable protective action criteria?
- When will impacts exceeding applicable protective action criteria begin and end?
- What are the boundaries of the areas where protective action criteria will be exceeded?
- What "evacuation" or predetermined protective action zones are impacted?
- Should the protective action or recommendation be shelter in place or evacuation?
- Will protective actions result in dose savings?

Reconciliation of Results. Consequence assessment staff should reconcile calculated results with measurements. Calculation results will, in general, *not* match measurement results because of uncertainties in *both* sets of numbers. Neither is necessarily wrong; both contain useful information for assessing an emergency and supporting the objectives of consequence assessment. But, both are also *always* uncertain to varying degrees.

- The degree to which calculation results match measurements will vary depending on the degree of match between the locations, times, and parameters; the sophistication of the modeling and data measurement techniques; and the complexity of the source, release, transport, dispersion, and deposition associated with the event. (Note: A number of studies have shown that more sophisticated systems do not always produce more accurate results.)

- The observed mismatch will be a combination of errors in measuring and modeling and include area and shape of the plume footprint, placement of the plume footprint, placement of the location of maximum impact within the plume footprint, and timing of plume passage.

- It will often not be possible to differentiate among the effects of the different errors in the overall process. The differences between calculation and measurement results will help to define the overall "envelope of uncertainty" around the estimates of consequences. The consequence assessment team should combine the results into the best overall representation of the event. Consideration of the level of confidence for each data point or group of data should be factored into the evaluation, assessment, and communication of results.

- Understanding and communicating the uncertainties associated with the consequence assessment process is very difficult and often ignored. However, it can be very important to proper decision making.

Public Information. The results to be communicated for Public Information will be determined by the Emergency Director, the Public Information Officer, or other authority within the ERO. The types of information to be communicated should be predetermined as part of the emergency management plans and implementing procedures. Consequence assessment personnel should have no direct contact with the media or public unless authorized and properly trained. Results prepared for public information may include the following types of information.

- Identification of the hazard.
- Description of the consequences.
- Locations where the consequences might occur.
- Locations where consequences might exceed protective action criteria.
- Who might be affected.
- When the effect might occur.
- The indicated protective actions.
- When protective actions should begin and/or end.
- Meteorological conditions and forecast information.

Public information should be specially formatted, worded, and graphically displayed for effective communication to a non-technical audience. This may be substantially different from the communication formats used for the ERO staff. If members of the consequence assessment staff act as "subject matter experts" for public information briefings, a simple, well-designed worksheet would provide a means for recording and transmitting textual discussion points and summaries of assessment results.

1.4 Timely Initial Assessment

1.4.1 Inputs

The three inputs required to perform a consequence assessment are source term, meteorology, and receptors. For TIA, emergency planners should do the following.

- Develop assumptions/default inputs to support rapid estimates.
- Organize assumptions/default inputs and key them to recognizable event conditions.
- Identify expected sources of real-time information to replace assumptions/default inputs.
- Make provisions for incorporating real-time information into analysis, if available.
- Identify receptor locations of interest based on initial real-time meteorological conditions.

The information listed above can be organized into a series of tools to aid personnel in making a rapid estimate of consequences based on the limited information available in the first few minutes of response. An example of how to organize the material into an easily used tool is provided in Appendix A.

Source Term. In order to meet *timely* assessment requirements, source terms should be pre-determined and documented for the full range of events and conditions expected to be encountered in the response mode. Calculation methods and resources should provide for estimating the quantitative impact of a release of hazardous materials within the EPZ. The time necessary to complete calculations should be short compared to time required to implement protective actions. Many standard methods/models for calculating consequences focus on airborne release assessments; however, other credible dispersion pathways may need to be addressed depending on the hazardous materials present and results of the facility Hazards Assessment.

Meteorology. Initial assessments are often performed by on-duty personnel prior to the activation of the emergency response consequence assessment staff. As a result, default or worst case meteorology is usually incorporated into precalculated results and TIA tools. The first pieces of real-time information that are likely to be available to responders are wind direction and speed. With minimal effort, this information can be used to modify the precalculated results to determine who is at risk and when consequences will occur. If an indicator of stability class is available, the TIA tools can be developed to allow the user to rapidly scale the dose or exposure results.

Receptors. Default and predetermined calculations used as a basis for facility-specific EALs and TIA tools incorporate worst case distances to specific receptors (e.g., nearest facility and site boundaries). Estimated consequences at these receptors support event classification and protective action decisions. Well-designed TIA tools provide the ability to extrapolate results at other receptors (see Appendix A for example). Knowledge of real-time wind direction is used to identify critical downwind receptors.

1.4.2 Calculations

During the first minutes of response, there is no time and little information or resources available to perform lengthy or complex transport calculations. Response personnel should be provided with precalculated results and/or simplified calculational methodologies.

Each facility's Hazards Assessment identifies a range of initiating events and scenarios that could lead to the release of hazardous materials. Potential consequences of each scenario are estimated and summarized in tabular form. These precalculated consequences, in conjunction with the results of other types of analyses, serve as the bases for the development of initial assessment tools. To produce an effective initial assessment tool, the assessment results should be gathered together, tabulated, and indexed for quick reference. To help the user quickly identify the most applicable precalculated result, they should also be keyed to observable conditions and EALs. Presentation of results in tabular and/or graphic format will allow the user to interpolate or more closely approximate actual conditions. The source terms on which the precalculated results are based should be briefly described so that it is possible, under emergency conditions, to select the one that is most representative of the event at hand or to apply the best modifying factors.

When simplified calculation models (e.g., hand calculations, nomograms, overlays, simple PC-based models) are developed, assumptions and default inputs to the models should be used to support rapid estimates of consequences. The data should include inputs for release rate/magnitude (source term) and atmospheric transport and dispersion conditions. Default input sets should be organized and keyed to recognizable conditions to aid users in quickly selecting the most appropriate inputs. Consequence assessment personnel should be sensitive to changes in input parameter values and be able to explain and qualify results to decision-makers.

The expected sources of real-time information that replace assumptions and default values should be identified. Provisions should be made for incorporating real-time information (e.g., instrumentation readings and sample results) into analyses as soon as it is available. Whenever possible, back-up sources of information should be identified.

All of the tools (e.g., precalculated results and simplified calculational methods) developed to support TIA should be combined into a single reference. The design of the reference should provide for easy and rapid use with minimal chance of error. For an example, see Appendix A.

1.4.3 Results

TIA results will be used in two related endeavors: (1) event classification and (2) protective action recommendations.

Event Classification. TIA supports the emergency classification decision process by providing for a direct comparison of projected consequences with the initial event categorization/classification. Facilities should ensure that TIA results are communicated in a clear, concise, and timely manner to the person with the responsibility to perform subsequent event categorization/classification.

Protective Actions. TIA results are used to determine applicable protective actions, if onsite/offsite impacts are likely to exceed applicable PAC, and when and where impacts are likely to occur. A clear and straightforward format should be developed and used for communicating results. The results should be easily and clearly connected to the specific protective actions to be implemented. A map or graphic display may also be considered, since a "picture" of the affected areas may lend clarity.

1.5 Continuous Assessment

As the consequence assessment staff is activated and TIA activities are completed, the continuous assessment process begins. The goal is to use all currently available information and data to continuously refine the assessment to improve accuracy, reduce uncertainty, and improve understanding by using better input information, more sophisticated models, and the expertise of subject matter experts. Tasks include (1) re-evaluating event classification; (2) re-evaluating protective actions/recommendations; (3) initiating and confirming health and safety decisions for responders; (4) coordinating results with offsite consequence assessment teams; and (5) performing "what if" estimates in anticipation of changing conditions. In the later stages of response, the continuous assessment process can provide information to support a termination decision and initial recovery planning. Continuous assessment is performed in a cyclic fashion (see

Figure 1.2), incorporating the most current data and information into each cycle. During planning and preparedness activities, emergency planners should do the following.

- Establish procedures for incorporating event-specific data into analyses as it becomes available.
- Identify alternative methods for gathering input information.
- Develop a method for verifying the accuracy of data and information received by the consequence assessment team.
- Establish a standard communication protocol for communication of data/information and results to minimize the propagation of errors.
- Include a process to perform a quality assurance check on assessment results and establish degree of uncertainty prior to distribution.
- Establish a method to compare results and resolve differences between response organizations.
- Understand the capabilities of DOE radiological emergency response assets and plan for incorporation into the assessment process (see Volume VIII.
- Work with the public information staff to identify the format, content, and level of detail of information required to support public information activities.
- Identify and train technical personnel to present results to the media and public.

1.5.1 Inputs

As with the TIA, procedures need to be established for incorporating event-specific data into analyses as such data becomes available. Methods and instrumentation should be identified to determine the status of affected systems, release parameters, and environmental conditions. The methods and instrumentation should be specific to the point of release, pathway, and material of concern. Methods and equipment should be referenced and incorporated into consequence assessment procedures, considering the following.

- Identify and reference in procedures any methods or documents that could be used to determine potential source-term (hazardous material) inventories.

- Establish correlations between monitoring instrument readings and concentrations, cumulative exposure/dose, and/or exposure/dose rate at specific receptors.

- Identify instrumentation that estimates but does not directly measure quantity or concentration of released or stored material (e.g., building air monitors, pressure indicators on storage tanks); document correlations between instrument readings and quantities of interest.

- For identified instrumentation, provide all necessary conversion factors or techniques.

- Develop methods to acquire and use real-time meteorological parameters and meteorological forecast conditions.

1.5.2 Calculations

During continuous assessment, the consequence assessment team should use models or methods to improve the quantitative accuracy of consequence estimates. The methods may be the same as those used during initial assessment.

Depending on the hazard level, the methods used may not need to be more sophisticated then those used during TIA. However, during continuous assessment, real-time information is used as available in the calculational methods.

For moderate- to high-hazard facilities, computer-based modeling systems are used to increase the accuracy of the estimates. Typical computer-based modeling systems have more features; are the only means available to characterize wind fields in complex regions of transport; use more sophisticated, flexible, detailed, or accurate input information; and produce more sophisticated, detailed, or accurate output products. However, they require more time, knowledge, skill, and training to use effectively.

In general, a site/facility should design and employ the simplest consequence assessment system (manual or computer-based) that will meet its goals for accurately characterizing transport and dispersion conditions in support of emergency response.

Advanced models/methods should have the ability to estimate consequences at a large number of receptors, including those selected by the user.

1.5.3 Results

During the continuous assessment process, the assessment team should use its judgment to combine the calculated and measurement results into the best possible overall picture of the consequences. To effectively communicate and utilize the results, the types and format of information needed by each response element should be pre-determined as part of the emergency plan and implementing procedures.

1.6 Integration, Coordination, and Quality Assurance

1.6.1 Integration with Emergency Classification and Protective Actions

Calculation models and methods should provide estimates of concentrations, integrated exposures, and exposure rates from released materials at selected receptor points. Estimates of consequences should be in units or terms that correspond to those used in EALs and for determining protective actions. For example, calculated consequences at distances corresponding to facility and site boundary receptors should be compared to protective action thresholds. The distance at which a protective action level would be exceeded should be determined and reported to ERO management. For determining appropriate protective action, models and methods should project integrated consequences based on current and predicted conditions of release duration, source term, and dispersion.

The facility-specific EAL set should include criteria which are stated in terms of consequence assessment results. Normally, EALs based on consequence assessment results should not be considered the primary classification criteria, but they will serve as supplements to more directly observable event indicators.

1.6.2 Coordination of Information

Plans and procedures should address a protocol for sharing and transmitting information among response organizations. This protocol should address the units of measure for quantities or parameters of interest including concentration, cumulative exposure/dose, and exposure/dose rate. The units of measurement used in communication and documentation should be the same as those commonly used in the emergency management community. To avoid confusion and misinterpretation in the process or results of consequence assessment, coordination of units and measurements should be proceduralized and agreed upon with interfacing onsite and offsite organizations in advance.

Plans and procedures should address recording the parameter values and information used in a consequence assessment calculation. These values should be posted as current status and transmitted to other response organizations. The means for logging, displaying, and analyzing the trend of data relevant to consequence assessment should support the decision-making process for both onsite and offsite organizations.

At least annually, DOE emergency planners should meet with all planning partners to discuss items that affect consequence assessment, such as the following.

- Changes to site/facility hazards.
- Notification.
- Calculation models and methods.
- Communication methods.
- Terminology.
- Presentation of results.
- Changes in monitoring systems, techniques, or capabilities.

1.6.3 Quality Assurance

Quality control of the tools used in consequence assessment, such as the meteorological monitoring system hardware and software, dose modeling hardware and software, etc., should be employed in a manner similar to the control exercised over the procedures used in consequence assessment activities. The reasons for a quality program are many; for example, consequence assessment results and personnel protection may be impacted by faulty modeling or meteorological data, real-time systems demand a high percentage of data availability, etc. A planned and systematic pattern should be employed that provides adequate confidence that consequence assessment tools conform to established operational, functional, and technical requirements. The sophistication of the quality assurance program for consequence assessment tools should be commensurate with facility-specific hazards. Several references are provided regarding meteorological systems, computer systems, and quality programs.

Contractors subject to DOE rule 10 CFR 830.120 and DOE 5700.6C should add their quality assurance requirements associated with the emergency management system into their existing quality assurance program and implementing procedures.

Operational considerations relate to reliability and survivability and should include such features as uninterruptable power supplies, back-up components or methods, and rapid response maintenance. The consequence assessment, computer-based modeling, or meteorological systems need to be available and functional during an emergency. Adverse conditions affecting power continuity, ventilation, etc., are most likely to occur during the time of emergency; thus, adequate planning for contingencies is necessary.

A systematic approach based on needs analysis should be employed in the development, operation, maintenance, and retirement of software and hardware to ensure that functional requirements are met. Consistency with models used by other facilities that are likely to provide assistance during an emergency, DOE Headquarters, and offsite State/local agencies should be considered in model selection.

Technical requirements should be established that provide for documentation of software code, maintenance of hardware, verification/validation of the consequence assessment system, and configuration control of the system after inauguration. Methods and models used in consequence assessment should be documented in such a manner that the analyses and results can be critically reviewed, understood, and, if necessary, reconstructed by independent experts. Detailed descriptions of the assumptions, methods, and models should be documented in a form that may be referenced (e.g., published technical reports or vendor manual).

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APPENDIX A
EXAMPLE TIMELY INITIAL ASSESSMENT TOOL

A.1 Introduction

The purpose of this appendix is to illustrate the use of the example Hazards Assessment results, presented in Volume II, Appendix D, to produce a tool to aid in performing timely initial consequence assessment.

Section 1.4 of this chapter on Consequence Assessment discusses the concept of timely initial assessment. Several pre-calculated and simplified calculational techniques are described. Each is discussed briefly and in sufficiently general language to be applied to a broad variety of facility types. It is believed that the intent of the guidance can be made much clearer by use of an example. This example utilizes the results of the example Hazards Assessment, presented in Volume II, to create a TIA tool.

This appendix is presented in the form of a document titled an "Emergency Assessment Resource Manual" (EARM). For the hypothetical DOE site Erlenmeyer, the EARM represents a sitewide TIA tool consisting of multiple sections, one for each facility that required a Hazards Assessment. To make the reference easy to use, each section would be tabbed or labeled for easy access and would contain the same type of information presented in the same format. The example presented here represents the section from the EARM which has been prepared for the hypothetical Mixed-Waste Universal Plastic Process Pilot Plant (MWUPPPP) housed in the ABC Facility on the Erlenmeyer site. [The complete example EARM can be found in the course material for the Workshop on Consequence Assessment for Emergency Response, sponsored by NN-60.]

A.2 Example Emergency Assessment Resource Manual (EARM)

The format and content of the example, presented in the following pages, should be viewed as one of many possible methods for utilizing the results of the Hazards Assessment process and other relevant analyses to create an aide for performing TIA.

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Mixed-Waste Universal Plastic Process Pilot Plant
Emergency Assessment Resource Manual

1. First Responder Information

1.1 Current Operations

The MWUPPPP receives mixed transuranic waste from decontamination and decommissioning (D&D) operations on the Erlenmeyer site, processes it to reduce its volume and destroy certain organic contaminants, and incorporates it into a durable plastic matrix for storage and disposal. The waste contains plutonium-238, heavy metals, and residues of various chemical munitions agents.

1.2 Nearest Site Boundary

The nearest site boundary is the near bank of the Big Lazy River, 300 m east and southeast of the ABC Building.

1.3 Summary of Radioactive Materials

The radioactive material inventory of the MWUPPPP is essentially all (~99 percent) Pu-238 as contamination in bulk waste being processed and in the stabilized (product) form. The Pu-238 is in the form of a very insoluble (Class Y) oxide, with particle size ranging from sub-micron to more than 75 micron AMAD. Table 1.1 presents a summary of the consequences of analyzed events and conditions involving radioactive materials.

1.4 Summary of Nonradioactive Hazardous Materials

The only nonradioactive hazardous material found in the MWUPPPP in quantities exceeding the screening threshold is toluene-2,4-diisocyanate (TDI). TDI is received in drums and used in the formulation of a plastic matrix to stabilize and contain the hazardous waste residue. Table 1.2 presents a summary of the consequences of analyzed events and conditions involving TDI.

Table 1.1. Radiological Accident Consequences.

Event/Condition	Facility Boundary[1] Dose[2] (rem)[3]	Site Boundary[4] Dose[2] (rem)[3]	Distance to 1 rem PAC[2] (km)	Emergency Class
Product Extrusions (4) Burn, Unfiltered Ground Level Release	730	51	1.5	General Emergency
Product Extrusion (1) Burns, Unfiltered Ground Level Release	180	13	0.85	General Emergency
Incinerator Explosion, Unfiltered Ground Level Release	3.7	0.25	0.22	Site Area Emergency
Spill of Waste Drum Outside	2.7	0.19	0.2	Site Area Emergency
Breach of Process Enclosure, Unfiltered Ground Level Release	0.15	0.01	<0.1	Alert[5]

1: For analysis purposes, defined 100 m radius from release point.
2: PAC=protective action criterion; at 1 m/s and Pascal F stability.
3: Total Effective Dose Equivalent (TEDE)=Effective Dose Equivalent + Committed Effective Dose Equivalent (EDE+CEDE).
4: At nearest site boundary (300 m east).
5: Based on exceeding 1/10 of protective action criterion at facility boundary (100 m).

Table 1.2. Nonradiological Accident Consequences.

Event/Condition	Facility Boundary[1] Concentration[2] (ppm)	Site Boundary[3] Concentration[2] (ppm)	Distance to 0.02 ppm PAC[2] (km)	Emergency Class
TDI leak/spill outside with fire that engulfs drum	3.0	2.7	9.1	General Emergency
TDI leak/spill outside with fire, drum not involved in fire	0.60	0.54	2.7	General Emergency
TDI leak/spill outside, no fire	0.51	0.12	0.93	General Emergency

1: For analysis purposes, defined as 100 m from release point.
2: PAC=protective action criteria; at 1 m/s and Pascal F stability.
3: At nearest site boundary, 300 m east.

2. Receptor Locations

Table 2.1 lists the distances to significant receptors in each direction (sector) from the ABC Facility and the travel time for an airborne plume to reach that receptor at a wind speed of 1 m/s.

Table 2.1. Distances to Receptors From ABC Facility.

Wind From	Downwind Sector	Threatened Receptor	Distance (km)	Plume Travel Time (min) at 1 m/s
N	S	Site Boundary	0.7	12
	S	Happy Cow Dairy	2.4	40
	S	Anytown School	6.5	108
NNE	SSW	Visitor Center	0.43	7
	SSW	Site Boundary	0.8	13
	SSW	Industrial Park	4.6	77
	SSW	Anytown Town Center	12.5	208
NE	SW	Site Boundary	0.95	16
	SW	Broken Arrow Scout Camp	2.0	33
	SW	Any Town Center	12.0	200
ENE	WSW	Highway 99	0.98	16
	WSW	Site Boundary	1.1	18
	WSW	Broken Arrow Scout Camp	2.1	35
	WSW	Gotham City Limit	18.5	308
E	W	Highway 99	0.93	15
	W	Site Boundary	1.6	27
	W	Site EOC	10.1	168
	W	Gotham City Limit	17.7	295
ESE	WNW	123 Area EOC	1.2	20
	WNW	G Area Tank Farms	5.2	87

Table 2.1. Distances to Receptors From ABC Facility (continued).

Wind From	Downwind Sector	Threatened Receptor	Distance (km)	Plume Travel Time (min) at 1 m/s
ESE (cont'd)	WNW	Site Boundary	12.6	210
	WNW	Fort Phosgene Admin Area	13.2	220
SE	NW	D Area	7.9	131
	NW	Site Boundary	12.4	207
	NW	Fort Phosgene Admin Area	13.2	220
	NW	Tribe Town	16.1	268
SSE	NNW	F Area	4.3	71
	NNW	Site Boundary	7.9	131
	NNW	A Area	13.4	224
S	N	Labs Facility	0.4	7
	N	Site Boundary	4.9	82
	N	Stunted Pines Park Ranger Station	13.4	224
SSW	NNE	Labs Facility	0.4	7
	NNE	Site Boundary	4.2	70
	NNE	West Podunk City Limit	11.3	188
SW	NE	Labs Facility	0.5	8
	NE	Site Boundary	0.6	10
	NE	Highway 99	5.2	87
	NE	East Podunk City Limit	13.1	218
WSW	ENE	Site Boundary	0.37	6
	ENE	C Facility	2.0	33
	ENE	Rutabaga County Line	6.9	114
W	E	Site Boundary	0.3	5

Table 2.1. Distances to Receptors From ABC Facility (continued).

W (cont'd)	E	C Facility	2.0	33
	E	Rutabaga County Line	6.6	
WNW	ESE	Site Boundary	0.3	5
	ESE	State Fish Hatchery	2.9	
NW	SE	Site Boundary	0.35	6
	SE	Second Nearest Residence	3.1	52
	SE	Wheresville State Home for Dweebs	15.2	253
NNW	SSE	Building 999	0.35	6
	SSE	Site Boundary	0.45	8
	SSE	Nearest Residence/Lazy River Dairy	2.4	40

3. Accident Scenarios

This section provides radiological and/or hazardous material consequences for seven scenarios, as follows.

3.1 TDI Spill Outside

3.2 TDI Spill/Fire Outside

3.3 TDI Spill/Fire Engulfs Drum, Outside

3.4 Waste Drum Spill Outside

3.5 Breach of Process Enclosure (HVAC Lost)

3.6 Incinerator Explosion (HVAC Lost)

3.7 Fire Involving Product Extrusions (HVAC Lost)

[Note: For the purposes of this appendix only information for scenarios 3.1 and 3.7 will be presented. For each accident scenario identified the following subsections present the same type of information in a standard format.]

3.1 TDI Spill Outside

Once leaked from the drum, the vaporization rate will be directly proportional to the wetted area. Analysis of a range of different leak sizes and locations indicates that wetted area from a single drum that is punctured outside the ABC Building could theoretically exceed 750 m^2, with the most probable maximum being about 300 m^2.

3.1.1 Source Term

The rate of vaporization of TDI from a spill is a function of ambient temperature, the temperature (and type) of the surface on which it is spilled (the pavement), the temperature of the TDI when it is spilled, and the air velocity moving over the spill. Of these, the TDI temperature and the surface temperature are the most significant. The conservative case selected for the source term calculation is typical of summer conditions, i.e., high ambient and surface temperatures. Conditions typical of other seasons were also analyzed and the vaporization rates are presented in Table 3.1 below. If the actual conditions at the time of a release correspond more closely to one of the other reference conditions, the multiplier in the last column can be used to scale down the consequence estimates presented in this section.

Table 3.1. Source Term Estimates For TDI Spill Outside.

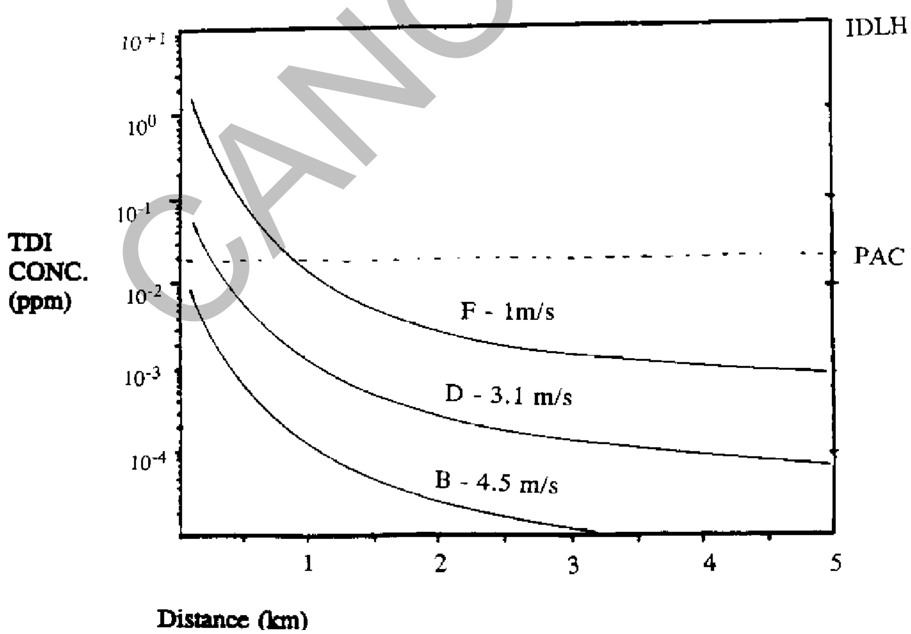
TDI Vaporization			
Case	**Conditions**	**Rate (kg/s)**	**Multiplier**
Hot - Summer (conservative)	TDI Temp = 90°F Air Temp = 90°F Surface Temp = 130°F	0.00018	1
Warm - Spring/Autumn	TDI Temp = 65°F Air Temp = 65°F Surface Temp = 85°F	0.00011	0.6
Cool - Spring/Autumn	TDI Temp = 45°F Air Temp = 45°F Surface Temp = 45°F	0.000032	0.2
Cold - Winter	TDI Temp = 40°F Air Temp = 25°F Surface Temp = 20°F	0.000011	0.06

3.1.2 Protective Action Criteria Distances

Table 3.2. Protective Action Criteria Distances for Different Meteorological Conditions Based on the Conservative Vaporization Rate.

Stability Class	Assumed Wind Speed (m/s)	Dist. at Which Protective Action Criteria (0.02 ppm) Exceeded (km)	Dist. at Which IDLH (10 ppm) Exceeded (km)
A	4.5	<0.1	<0.1
B	4.5	<0.1	<0.1
C	3.1	0.12	<0.1
D	3.1	0.17	<0.1
E	1.0	0.48	<0.1
F	1.0	0.93	<0.1

3.1.3 Concentration versus Distance for Different Meteorological Conditions



Information for accident scenarios 3.2-3.6 would be presented here.

3.7 Fire Involving Product Extrusions With Loss of HVAC

The plastic product will burn if subjected to temperatures above 205°C in the presence of air. Burning of the plastic with its included Pu aerosol is expected to cause about 25 percent of the aerosol to become airborne.

3.7.1 Source Term

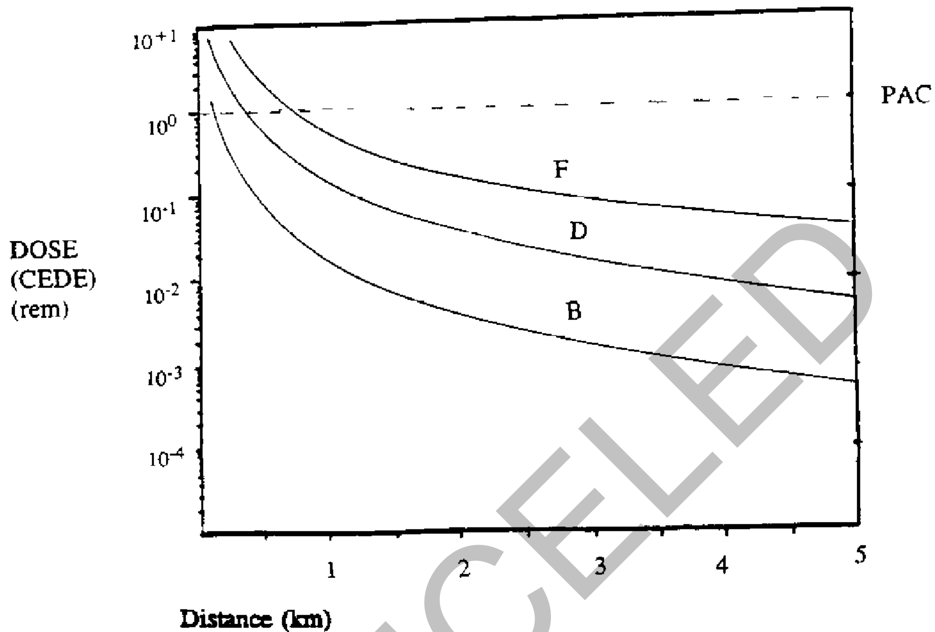
Burning a single product extrusion will release 2.5E+5 µCi Pu to the room atmosphere, of which 30 percent (7.5E+4 µCi) ultimately could be released to the atmosphere at ground level through doors, seals, and building penetrations if the HVAC exhaust is not functioning. Burning of the maximum inventory (in any single bay) of four product extrusions could release 3E+5µCi over a period of 2 hours.

3.7.2 Protective Action Criteria Distances

Table 3.8. Protective Action Criteria Distances for Different Meteorological Conditions Based on Release of 3E+5 µCi Pu-238 at Ground Level.

Stability Class	Assumed Wind Speed (m/s)	Dist. at Which 1 Rem Protective Action Criteria Exceeded (km)	Dist. to Early Lethality Threshold (km)
A	4.5	0.27	<0.1
B	4.5	0.40	<0.1
C	3.1	0.71	<0.1
D	3.1	1.15	<0.1
E	1.0	1.40	0.2
F	1.0	1.50	0.2

3.7.3 Dose Versus Distance for Different Meteorological Conditions (Four Product Extrusions Burned)



APPENDIX B
EXAMPLE FORMS AND CHECKLIST

CONSEQUENCE ASSESSMENT RESULTS FORM

Consequence Assessment Team No.

Time: _____ Initialed by Assessment Manager ________

Hazards Evaluation Results				
Projected Consequences:				
#	Location	Downwind Distance (miles/Km)	ETA	Exposure Level
1				
2				
3				
4				
5				

Protective action criteria exceeded out to _____ (miles/Km).

Bases/Assumptions used for the above estimates:

[Note: If available, the following types of information might be included: type of material released, quantity of material estimated, release point, release height, wind speed, wind direction, stability class, and applicable protective action criteria.]

RECOMMENDATIONS

Event Classification

☐ Alert ☐ Site Area Emergency ☐ General Emergency ☐ Termination

Recommended Protective Actions

Area/Site:

Offsite:

ERLENMEYER SITE ERO
CONSEQUENCE ASSESSMENT - CHECKLIST

1. Obtain a copy of the initial Event Notification Form from the occurrence notification communicator.

2. From the Data Display Terminal located in the Assessment Team work area, obtain current meteorological data from the monitoring tower nearest to the reported event location. If the information is not available from the Data Display Terminal, contact the D Facility control room on 5-2121 and request current data. Record data in Section 1 of Attachment 1.

3. Obtain the section of the Emergency Assessment Resource Manual (EARM) appropriate for the facility involved in the event.

   a. Identify the accident scenario which most closely resembles the event description from the initial notification information.

   b. From the appropriate table, obtain the site boundary concentration/dose, distance to protective action criteria, and event classification for the worst case conditions. Record this information in Section 2 of Attachment 1.

   c. Using the concentration/dose curves provided in the EARM and the current stability class, estimate the concentration/dose at the facility boundary and the nearest downwind site boundary. If the initial notification contained information on source term, create a scaling factor to modify your estimate. Record information in Section 3 of Attachment 1.

4. If the Emergency Director has arrived, provide an initial briefing using information collected on Attachment 1.

5. As soon as the Incident Command Post (ICP) has been activated, establish communications with the Health and Safety Representative. Begin data entry and updating of Status Boards.

6. Using the results from step 3.c. above, identify the affected area. Plot the affected area on the status board map. Compare these results with protective actions that may have already been ordered by the Incident Commander. Bring any urgent need for additional protective actions/recommendations to the immediate attention of the Emergency Director.

7. Compare the emergency class determined in Step #3 with any emergency classification decision that may have been reached by the Incident Commander. Bring any differences to the attention of the Emergency Director.

8. Using the appropriate computerized atmospheric dispersion model (e.g., Chemical Model or Radiological Model) and the most current meteorological and source term data, perform a comprehensive concentration/dose projection. Use these results to re-evaluate protective action and event classification recommendation. Update Attachment 1, attach computer output, and brief Emergency Director as necessary.

9. Establish communications with the Erlenmeyer site, county, and State EOCs, if activated. Provide them with current information/data, results of analyses, and technical assistance as requested.

10. If it has been determined that field monitoring is necessary:

    a. Direct the Environmental Surveillance Coordinator to form two field teams and report when they are ready to be briefed and dispatched.

    b. In coordination with any other organizations that will be dispatching field teams, develop a monitoring strategy.

    c. Establish communications with and control over site teams. Begin team tracking and data transmission, logging and display.

    d. Establish necessary communications with other organizations to acquire data from their teams. Process data as necessary (e.g., conversion, correction factors, etc.) and integrate with site team data.

    e. Obtain and interpret analysis results from any field samples sent to the analytical lab.

11. Compare field sample/measurement results with concentration/dose estimates. Revise and/or refine projections as possible. Prepare and distribute updated Attachment 1 as necessary.

12. If the release is projected to last longer than 2 hours, obtain forecast meteorological information and perform a plume projection. Identify the potentially affected areas and appropriate protective actions.

13. In response to significant changes in meteorological conditions, updated source term information, field monitoring/sampling results, and requests for specific projections,

perform periodic concentration/dose calculations. Develop associated protective actions and classification. Repeat this process as necessary.

14. As requested, assist State and local agencies in assessing impacts due to other exposure pathways (e.g. drinking water, food supply, outdoor activities, etc.).

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ATTACHMENT 1
CONSEQUENCE ASSESSMENT SUMMARY

Time:_____

1. Current Meteorology:

   a. Event location ______________________________
   b. Wind speed (m/s)______________________________
   c. Wind direction (from) ______________________________
   d. Stability class ______________________________

2. EARM Consequence Estimate (worst case source term, severe meteorology)

   a. Event/scenario type ______________________________
   b. Nearest site boundary (direction and distance) ______________________________
   c. Maximum consequence at site boundary ______________________________
   d. Distance at which Protective Action Criterion exceeded ______________________________
   e. Emergency class ______________________________
   f. Remarks______________________________
   ____

3. EARM Consequence Estimate (best estimate source term, current meteorology)

   a. BEST ESTIMATE of source term ______________________________
   b. DOWNWIND site boundary (direction and distance) ______________________________
   c. Consequence at DOWNWIND facility boundary ______________________________
   d. Consequence at DOWNWIND site boundary ______________________________
   e. Distance to Protective Action Criterion under CURRENT CONDITIONS ______________
   f. Emergency class based on consequence and distance ______________________________
   g. Remarks ______________________________
   ____

4. Consequence Estimate (from computer model).

   a. BEST ESTIMATE of source term ______________________________
   b. DOWNWIND site boundary (direction and distance) ______________________________
   c. Consequence at DOWNWIND facility boundary ______________________________
   d. Consequence at DOWNWIND site boundary ______________________________
   e. Distance to Protective Action Criterion under CURRENT CONDITIONS ______________
   f. Emergency class based on consequence and distance ______________________________
   g. Remarks ______________________________
   ____

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