

**EVALUATION AND ASSESSMENT METHODOLOGY, STANDARDS, AND PROCEDURES MANUAL OF THE UNITED STATES FEDERAL RADIOLOGICAL MONITORING AND ASSESSMENT CENTER**

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**Abstract**

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In the event of a major radiological emergency, the U.S. Federal Radiological Emergency Response Plan authorises the creation of the Federal Radiological Monitoring and Assessment Center (FRMAC). The FRMAC is established to co-ordinate the Federal off-site monitoring and assessment activities, and is comprised of representatives from several Federal agencies and Department of Energy contractors who provide assistance to the state(s) and Lead Federal Agency.

The Evaluation and Assessment (E&A) Division of the FRMAC is responsible for receiving, storing, and interpreting environmental surveillance data to estimate the potential health consequences to the population in the vicinity of the accident site. The E&A Division has commissioned the preparation of a methodology and procedures manual which will result in a consistent approach by Division members in carrying out their duties. The first edition of this manual is nearing completion. In this paper, a brief review of the structure of the FRMAC is presented, with emphasis on the E&A Division. The contents of the E&A manual are briefly described, as are future plans for its expansion.

**1. INTRODUCTION**

The Federal Radiological Emergency Response Plan (FRERP) was developed in response to the Three Mile Island Nuclear Power Generating Station accident on March 29, 1979. The Federal response to that accident pointed out the need for a co-ordinated response plan. The FRERP was formalised on November 8, 1985, and was signed by those Federal Agencies having responsibilities during a radiological emergency. The FRERP establishes the Federal Radiological Monitoring and Assessment Center (FRMAC) as the technical operations centre for all Federal off-site monitoring and assessment activities. The FRMAC is comprised of representatives from several Federal agencies and Department of Energy (DOE) contractors, which assemble to co-operatively provide assistance to the state(s) and the Lead Federal Agency (LFA) during a significant radiological emergency.

## 2. FEDERAL RADIOLOGICAL MONITORING AND ASSESSMENT CENTER (FRMAC)

The primary objective of the FRMAC is to provide to the state(s) and the LFA radiological monitoring and assessment support, data interpretation, dose projections, and to maintain a common set of quality assured environmental data. The size of the FRMAC response will depend on the size and nature of the emergency. A FRMAC may be as large as 300 or more personnel.

The FRMAC organizational structure consists of the FRMAC management and five divisions: Liaison, Support, Health and Safety, Monitoring and Analysis, and Evaluation and Assessment.

The Liaison Division co-ordinates all FRMAC liaisons assigned to the various state, local, facility, and LFA emergency operations centres. The Liaison Division also co-ordinates all the FRMAC representatives from other organizations. The Support Division provides all the necessary support to sustain a fully operational FRMAC including communications, electrical work, transportation, video and photography, logistics, security, and administrative services. The Health and Safety Division provides for the safety and well-being of FRMAC workers. Health and Safety personnel evaluate the working environment and provides guidance in the areas of health physics, industrial hygiene, occupational safety, and medical care. The Monitoring and Analysis (M&A) Division co-ordinates all the FRMAC assets involved in environmental radiological monitoring, sampling, radioanalysis, and quality assurance. The monitoring and sampling data are subjected to a cursory quality assurance check then provided to the Evaluation and Assessment group and distributed within the FRMAC.

## 3. EVALUATION AND ASSESSMENT DIVISION

The Evaluation and Assessment (E&A) Division within the FRMAC is responsible for establishing a comprehensive and accountable data base for accident-related environmental surveillance data, evaluating this data, and assessing the potential significance and impact of the emergency on public health using this information. To accomplish these objectives, the Division is organised into five functional groups:

*The Predictions Group* prepares predictions of plume concentrations, ground deposition, and potential doses to individuals and populations resulting from the release of radioactive materials. These predictions are particularly useful during the period before substantial measured environmental data are available upon which to base assessments.

*The Data Management Group* reviews all incoming data from the FRMAC M&A Division, as well as all available non FRMAC-generated radiological monitoring data. After the data sheets are screened for consistency and completeness, they are copied and widely distributed within the FRMAC. The original data sheets are maintained in an archive and are closely controlled. The data are entered into a comprehensive, computerised database and displayed on a Geographical Information System (GIS).

*The Assessment Group* uses measured environmental data and dose calculation models to estimate potential doses to the public in the impacted area. The group uses these data projections to estimate geographical areas where various protective actions should be considered to mitigate potential doses and to support decisions related to the initiation of recovery actions.

*The Overview Group* provides input to the Assessment and Data Management Groups relative to output format, graphics, and overall assessment perspectives. The final

FRMAC products are generated by the Overview Group and, after an internal review, are released to the state(s) and the LFA by the FRMAC Director.

*The Meteorology Group* provides weather information for FRMAC operations, field monitoring, sample collection, and aerial surveys.

When measured environmental radiological data are available, a wide variety of issues are considered by the staff in the E&A Division to estimate doses. These include plume characterisation, estimation of ground deposition and ground shine external doses, external immersion doses, inhalation from a passing cloud and/or resuspension, ingestion pathway transfer factors, consumption rates and doses, occupancy rates, etc. The E&A dose projections will be as realistic as possible, using reasonable assumptions and parameter values which are judged to be appropriate after consideration of the uncertainties involved in the data and the computational models. The assumption and parameter values will be documented, and their sources referenced and included in the assessment.

#### 4. EVALUATION AND ASSESSMENT MANUAL

The E&A Division has drafted a manual which specifies the procedures, standards, and calculational methodology which will be applied in fulfilling the Division role in the FRMAC. The draft has been used at four major FRMAC exercises and revisions have been made based on these experiences.

The manual is oriented toward estimates for short-term (acute) exposures which might be encountered during the initial phase of an accidental release. The models are simple and intended to be used in hand calculations. However, it is planned that the methodology will be expanded in the future for personal computer (PC) applications.

The E&A Division manual will be used to: 1) Facilitate the assessment, by E&A Division members, of the consequences of accidental radionuclide releases, including comparing projected doses to pre-established protective action guidelines (PAGs); 2) Document procedures used in assessments by E&A Division members, 3) Provide consistency in assessments performed by different E&A Division members during around-the-clock FRMAC operations; 4) Serve as a training document for E&A Division members, as well as other members of FRMAC and interested participants from Federal and state agencies; 5) Provide a sound technical base for assessments agreed to and accepted by the technical community before the accident; and 6) Facilitate the possible adoption of the manual by other emergency response groups, including those outside the United States. If the manual is used by international emergency response personnel, this will help to assure the consistent interpretation of dose assessment data for international incidents.

Emphasis is placed on making the manual clear and easy to use, especially under emergency conditions when there will be pressure to produce answers quickly. The manual is divided into a main body of material, which will be used most frequently, and several appendices, containing supporting information and models used less frequently.

#### BODY OF MANUAL

The body of the document contains models for direct determination of radiation doses based on measured environmental radiation, a brief summary of the Environmental Protection Agency (EPA) and Food and Drug Administration (FDA) Protective Action Guides (PAGs), and information on the effectiveness of dose mitigation techniques.

### *Exposure Pathway Models*

**Cloud Passage** For an airborne release, techniques for making inhalation and air submersion dose estimates based upon measured air concentrations during cloud passage.

**Ground Contamination** Information necessary to predict widespread isotopic distributions using external gamma-ray measurements based on the relationship between the gamma-ray intensity and isotopic distributions determined at a few locations. The techniques will only be valid in cases in which the radionuclide ratios on the ground remain relatively constant between geographically separated locations.

**Resuspension** Estimation of inhalation and external air submersion doses, based upon measured ground or airborne radionuclide concentrations, for both near-field and far-field locations.

**Liquid Pathways** Estimation of doses due to the ingestion of contaminated drinking water using methods based upon measured radionuclide concentrations in water.

**Fresh Food Products** Methods to estimate doses due to the ingestion of contaminated leafy vegetables, cows' milk, and goats' milk. The leafy vegetable methodology is based on having measured radionuclide concentrations in vegetation. The cows' milk and goats' milk methodology is based on having measured radionuclide concentrations in milk, or in animal forage and drinking water. Special models are provided for tritium, strontium-89/90, iodine-131/133, and cesium-134/137 in milk.

### *Protective Action Guides (PAGs)*

EPA and FDA have established PAGs for the early phase of an atmospheric release, food and water during the intermediate phase, deposited radioactive materials during the intermediate phase, and emergency worker exposure.

At the present time the manual is being revised to include more information on rapid procedures in comparing projected doses to the EPA and FDA PAGs.

### *Dose Mitigation Measures*

This section provides information on the effectiveness of various dose reduction methodologies that have a sound technical basis and that can be applied to the basic dose calculations described in previous sections of the manual.

## 5. APPENDICES

The appendices discuss dose coefficients, information on the removal of radionuclides by water treatment and during food preparation, airborne transport of radionuclides using atmospheric dispersion modelling, transport of radionuclides in surface waters, environmental transport and dose calculations for the fresh food pathways based on source term data and airborne dispersion, half-lives and decay constants of principal radionuclides, and example dose calculations.

## 6. FUTURE PLANS

The manual has undergone two major reviews and has been tested at four major exercises by members of the FRMAC E&A Division. A major revision is underway which will be completed by the fall of 1994. After this draft is reviewed by E&A Division members and their comments are incorporated, the document will be released to other Federal and state agencies for external review. Following the completion of all reviews, and incorporation of

comments, the manual will be published in final form, subject to review and revision biennially.

#### REFERENCES

- [1] Manual of Protective Action Guides and Protective Actions for Nuclear Incidents, EPA 400-R-92-001. U. S. Environmental Protection Agency, Office of Radiation and Indoor Air, Washington, D.C. (1992).
- [2] FRMAC Operations Plan, Emergency Phase (Working Draft #1), FRMAC-11-93. U.S. Department of Energy, Nevada Operations Office, Las Vegas, Nevada (1993).