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**Compilation of Demographic
Data for the Chemical Stockpile
Emergency Preparedness Program**

**Barbara Vogt
John Sorensen
Cynthia Coomer**

Oak Ridge National Laboratory

**Barry Shumpert
Harriet Hardee**

University of Tennessee

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**Barbara Vogt
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University of Tennessee

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**Prepared for the
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by

**OAK RIDGE NATIONAL LABORATORY
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TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS	iv
1. DESCRIPTION OF THE REFERENCE DOCUMENTS	1
1.1 INTRODUCTION	1
1.2 PURPOSE	2
1.3 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) FIGURES	2
1.4 EVACUATION TIME ESTIMATES (ETE) FIGURES	3
1.5 OVERLAYS	3
1.6 EVACUATION PLANNING GUIDES (EPG) FIGURES	4
1.7 STATE PLANNERS	4
1.8 CONCLUSIONS	5
2. SOURCE DOCUMENTS FOR DEMOGRAPHIC TABLE	9

ABBREVIATIONS AND ACRONYMS

APBRG	Accident Planning Base Review Group
APG	Aberdeen Proving Ground
ANC	Anniston Chemical Activity, formerly Anniston Army Depot (ANAD)
BGCA	Blue Grass Chemical Activity, formerly Blue Grass Army Depot (BGDA)
CSDP	Chemical Stockpile Disposal Program
CSEPP	Chemical Stockpile Emergency Preparedness Program
DCD	Desert Chemical Depot, formerly Tooele Army Depot (TEAD)
DOD	Department of Defense
DYNEV	DYNamic EVacuation model
EIS	Environmental Impact Statement
EPG	Emergency Planning Guides
EPZ	emergency planning zone
ERCP	Emergency Response Concept Plan
ETE	evacuation time estimates
FEMA	Federal Emergency Management Agency
GIS	geographical information system
IEM	Innovative Emergency Management
IRZ	immediate response zone
km	kilometer
MEOWS	Maximum Envelopes of Water
NECD	Newport Chemical Depot, formerly Newport Army Ammunition Plant (NAAP)
NEPA	National Environmental Policy Act
ORNL	Oak Ridge National Laboratory
PAZ	protective action zone
PBCA	Pine Bluff Chemical Activity, formerly Pine Bluff Arsenal (PBA)
PCD	Pueblo Chemical Depot, formerly Pueblo Depot Activity (PUDA)
PC-DYNEV	DYNamic EVacuation model for the personal computer
PZ	precautionary zone
TIGER	Topologically Integrated Geographic Encoding and Referencing
UMCD	Umatilla Chemical Depot, formerly Umatilla Depot Activity (UMDA)

1. DESCRIPTION OF THE REFERENCE DOCUMENTS

1.1 INTRODUCTION

There are eight installations in the continental United States where lethal unitary chemical agents and munitions have been stored since the late 1950's. In December, 1985, Congress directed the Department of Defense (DOD) to destroy these stockpiles of aging chemical warfare weapons. The destruction was to take place in such a manner as to provide:

- (1) maximum protection of the environment, the general public, and the personnel involved in the destruction,
- (2) adequate and safe facilities designed solely for the destruction of the stockpile, and
- (3) clean-up, dismantling, and disposal of the facilities when the disposal program was complete (Title 14, Part B, Section 1412 of Public Law 99-145).

As with all proposed expenditures of money for federal projects, Army compliance with the National Environmental Policy Act (NEPA) involved preparing a programmatic environmental impact statement (EIS) for the proposed action—the Chemical Stockpile Disposal Program (CSDP). After selecting on-site disposal as the preferred alternative, the Army initiated site-specific NEPA documents for each of the proposed disposal sites (Carnes 1989). Included in the NEPA analysis are individual health impact risk assessments based on the number and type of munitions stored at each site. Oak Ridge National Laboratory (ORNL) was tasked to develop the NEPA documents.

The principal impacts identified in the programmatic EIS were those associated with accidents. The average maximum number of fatalities under conservative meteorological conditions exceeded 500 deaths and ranged from a low of 1 to a high of 1400 within 20 km (12 miles) of the facilities. Because of the potential for catastrophic consequences from the release of agent during the continued storage, the foremost mitigation identified in the Final Programmatic EIS was emergency planning (Rogers et al. 1989). To help communities develop emergency response capabilities, the Army established the Chemical Stockpile Emergency Preparedness Program or CSEPP based on principals established in the Emergency Response Concept Plan (ERCP) (U.S. Dept. Of Army 1987). The Army and the Federal Emergency Management Agency (FEMA) jointly oversee the CSEPP.

An important part of the ERCP guidance was establishing cooperative interaction between local, state, and federal agencies and the development of emergency planning zones (EPZs) to support the emergency response concept. Conceptually, the EPZs consist of three subzones, the immediate response zone (IRZ), the protective action zone (PAZ), and a precautionary zone (PZ). The EPZs reflect different response requirements associated with a fast-moving cloud of agent during an accidental release. The IRZ is the closest area to the stockpile and extends approximately 10 km (6 miles) from the storage/disposal site. The PAZ is based on a 35 km (21 miles) distance and defines an area in which the primary emergency response is evacuation although other options are considered (Rogers et al. 1989). The PZ is based on the usual no-deaths distance of approximately 35 km (21 miles) for worst-case accidents involving nerve agent releases. Protective actions in the PZ are limited to precautionary measures. With local input, the EPZs were established along political and

geographical boundaries and thus may not accurately reflect the conceptual distances. The EPZs have also been modified through negotiations between the various agencies.

1.2 PURPOSE

The purpose of this document is to describe how the population figures (Table 1) were derived for the population estimates for both the CSDP and the CSEPP analyses. Most of the data is derived from the U.S. Census 1990 population figures. The U.S. Census is the most complete enumeration of the U.S. population and is the most reliable except where communities undertake their own special census. However, the Census only counts residential populations and does not attempt to document daytime populations within commercial or residential facilities. Thus the population counts most accurately reflect nighttime residential populations. The Census Bureau and the Department of Labor provide periodic updates for county level populations but do not attempt to determine exactly where new residents are located or where population loss occurs. Thus the information does not provide the geographic details needed to update populations at risk.

The two types of geographical areas used to estimate the populations will affect the outcomes of the estimates. The analysis that focuses on emergency preparedness involves populations within the IRZ, the PAZ or both, regardless of the probable direction of an accidental plume release. Since the PZ is a conceptual tool used to enhance preparedness planning and will vary as to planning needs, no population figures are needed.

The use of zones is not a new approach to emergency planning. Both floodplains and floodways are defined in the National Flood Insurance Program as zones for flood-proofing or land regulation. For hurricanes, Maximum Envelopes of Water (MEOWS) determine zones for evacuation planning. The CSEPP IRZs and PAZs are defined by physical and geographical characteristics as well as political boundaries and are based on population distribution and local meteorological and topographical conditions.

The population figures for the NEPA documents were measured within concentric circular zones with the center point determined by the location of the proposed disposal facilities. These zones were based on potential human health impacts and not dependent on physical or political features. The analysis estimate the populations that could be affected by a release of chemical warfare agent during disposal operations and are based only on geographical distances, generally to the point of human health no-effects. On average, the risks of being harmed from an accidental release will decrease with increasing distance from the source term.

1.3 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) FIGURES

Passed in 1969, NEPA requires all federal agencies to address environmental impacts when federal funds are used in planning or implementing actions. Part of the documentation includes a human health effects analysis and a social justice analysis. The social justice analysis is included in NEPA documents as a result of the Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (February 11, 1994). Executive Order 12898 requires all federal agencies to identify and address, as

appropriate, disproportionately high and adverse human health conditions or environmental effects of their programs, policies, and activities on minority and low-income groups.

To examine the health impacts, the NEPA documents produced for Deseret Chemical Depot (DCD), formerly Tooele Army Depot (TEAD), Anniston Chemical Activity (ANC), formerly Anniston Army Depot (ANAD), Umatilla Chemical Depot (UMCD), formerly Umatilla Depot Activity (UMDA), and Pine Bluff Chemical Activity (PBCA), formerly Pine Bluff Arsenal (PBA), used concentric radii to determine populations at various distances from the proposed sites of the disposal facilities on the installations. Data were imported from the Census Bureau's automated geographic data base, the Topologically Integrated Geographic Encoding and Referencing (TIGER) system. The most recent analyses used the 1990 Census TIGER files available on CD-ROM, especially the Summary Tape File 1-A and Summary Tape File 3-A database files.

In addition, the PL94-171 database files from the Census were used to calculate the approximate numbers of minority persons proximate to the installations for the social justice impact analysis. The program used for the graphic analysis was developed at ORNL and uses the block level census data. Because the census is based on centroids of block units, the resulting population numbers may differ depending on the proposed location of the facility as well as the density of population. Generally, the higher the population density, the greater the number of centroids in an area and the more definitive the population figures.

1.4 EVACUATION TIME ESTIMATES (ETE) FIGURES

The Evacuation Time Estimates (ETEs) were developed by transportation engineers at ORNL. The data for measuring the populations in the IRZs and the PAZs were drawn from a variety of sources to estimate the number of vehicles that would potentially be evacuating during an emergency under different times of day, weather conditions, or different assumed response rates. Thus, some estimates also include daytime populations. To establish consistency with Census population data the nighttime populations used in the ETEs are reported in this document.

The demographic data used in the ETEs were obtained from a wide variety of sources, including the U.S. Census, regional and local governmental agencies, school boards and institutions, or from data supplied by other local public and private agencies in the counties of interest. Oftentimes telephone inquiries were made to identify populations at special facilities (such as hospitals and shopping malls) that were not available from other sources. Comprehensive procedures were then developed to distribute the population across various points in the network representation of the PC-DYNEV (for DYNamic EVacuation) model. DYNEV's development has been supported by FEMA and seen repeated and reported applications over the years. PC-DYNEV is an updated microcomputer version of the model.

1.5 OVERLAYS

Overlays are population counts developed for some of the IRZ and PAZ where digitized boundary files were available. This approach utilized the Census TIGER files that are overlaid on maps depicting the IRZ and PAZ boundaries. The overlays were created by using a geographical information system (GIS) computer program called MapInfo™—a commercial GIS

product available that correlates points on a map with specific characteristics, in this case population characteristics associated with the Census centroids. MapInfo™ was chosen for cost, functionality, and ease of use; however, other GIS packages are available which could be used to conduct the analyses.

Census data used for the analysis came from two sources: the Summary Tape File 1-A and PL94-171 files available on CD-ROM. The Summary Tape File 1-A contains basic demographic data including population, households, age groups, race/ethnicity, and housing characteristics. The PL94-171 contains population, race, and ethnicity data. The greatest difference between the two sources is in the spatial aggregation of data. The Summary Tape File 1-A breaks data out by state, county, census tract, and block groups. The PL94-171 also contains data at the block level—the smallest geographic unit in the census files.

Geographic data is taken from the Census Bureau's TIGER files which contain all the physical and political boundaries needed to define census blocks, block groups, tracts and counties. The files also have information on highways, streets, waterways, rail lines and utility lines and thus can be used to accurately identify the IRZ and PAZ with respect to the community infrastructure as well as to display the thematic distribution of population attributes.

1.6 EVACUATION PLANNING GUIDES (EPG) FIGURES

In December 1992, the Planning Subcommittee of CSEPP established a working group called the Accident Planning Base Review Group (APBRG) to update the accident planning base for CSEPP communities. The EPGs present site-specific data and instructions for developing protective actions and replace the Emergency Response Concept Plans (ERCPs) developed in 1988. Among the information that may have changed since the original ERCPs were issued are population figures and meteorological data.

Data for the Emergency Planning Guides (EPGs) were developed by Argonne National Laboratory, ORNL, and IEM (Innovative Emergency Management) in conjunction with local and state planning agencies. Unlike the NEPA documents that focused on the risk during the proposed disposal, the EPGs were developed to ensure that local communities could protect their residents in an emergency involving an accidental release of chemical agent while the stockpile remained in storage. The EPGs generally use the ETE database but on occasion will use a special survey or census of the IRZ or PAZ areas under investigation.

1.7 STATE PLANNERS

Planners from the states with CSEPP communities were also queried about the number of people located in the IRZ and the PAZ. State planners may have relied on data obtained from the U.S. Census, the Evacuation Time Estimates, or data from consultants hired to develop population counts. Some state planners may rely on special surveys or a census of the area of interest to verify or update population figures. One state has rezoned the IRZ and PAZ communities into one EPZ and developed data to determine the number of people in the area. Other states have also developed daytime population estimates to supplement the residential population figures.

1.8 CONCLUSIONS

At this point in time we have only two sets of comparable population estimates for all 8 sites. The first set includes the estimates for concentric radii developed from the 1990 Census data in support of NEPA documentation. The second is from the ORNL ETE studies which drew on a variety of data sources. In addition we have overlays of the IRZ boundaries on the 1990 Census data for IRZs at 4 sites and for PAZs at 3 sites. Two sites have conducted special surveys, one site did an independent estimate, and one site has estimates from a more recent ETE.

First, in comparing the concentric circle populations with those in the IRZs we find that in every case the population of the IRZ exceeds the estimate of the 10 km (6 miles) radius population. If we compare the estimate of the 20 km (12 miles) populations with the IRZ estimates, we find that in all but one case the population estimate for 20 km (12 miles) is greater than that of the IRZ. The larger 10 km (6 miles) populations may be attributed to the conservative IRZ boundaries developed by local agencies that used estimated distances at least as great or greater than the 10 km (6 miles) radii.

Second, there are indicators that populations have likely increased at several of the sites. This would be expected as the Census used population data collected during 1990 and 1989. The special survey at Tooele, UT, for the Tooele Army Depot (now called the Desert Chemical Depot) shows a population increase as do estimates at the Bluegrass Army Depot (now called the Bluegrass Chemical Activity) in Richmond, KY, and for the Pine Bluff Arsenal (now called the Pine Bluff Chemical Activity) at Pine Bluff, AR. The community survey conducted in Pueblo, Colorado, shows about the same level of population as was estimated in the original Pueblo ETE for the Pueblo Depot Activity (now called the Pueblo Chemical Depot).

Third, this review shows there is a need for better and more consistent population data in the EPGs. Some of the EPGs provided no data, others repeated the ETE estimate, while still others used other estimates without a discussion of the methodology or sources of data involved.

Finally, there is a distinct indication that more up-to-date and systematic estimations are needed for all sites. A consistent approach to doing so would be to estimate the population for all sites using a overlay method with the 1990 census data and then updating the zone wide estimates using the 1997 census updates. This then could be spatially allocated to census blocks or block groups using other types of data such as building permits, utility connections or other address specific information. This could then be adjusted if and when special censuses are conducted or when the 2000 census data is available.

Table 1. Population Estimates at CSEPP Sites

Site	NEPA		ORNLETE		Overlays		EPG		State Planners		Other Estimates
	0 - 10 km	0 - 20 km	IRZ	PAZ	IRZ	IRZ/PAZ Total	IRZ	PAZ	IRZ	PAZ	
APG ¹	55,790	257,860	67,200	292,700			67,200		55,000 (Total for EPZ, a combination of IRZ/PAZ)		
	Based on personal communication with G. Zimmerman, 1-29-98		Source: Southworth et al. 1990				Source: CSEPP Accident Planning Base Review Group et al. 1995		Based on personal communication G. Krock and D. Richmond, 1-5-98.		
ANCA ²	10,890	97,197	83,000	99,372							
	Source: Terry et al 1997		Source: Metzger et al. 1991								
BGCA ³	27,943	61,391	29,400	59,600			43,950		84,519 (Day) 32,675 (Night)	23,746 (Day) 32,641 (Night)	IRZ: 32,658 PAZ: 42,369
	Based on personal communication with G. Zimmerman, 1-29-98		Source: Rathi, Metzger et al. 1991				Source: CSEPP Accident Planning Base Review Group et al. Vol. 3, (Draft)		Based on KLD and SSI 1997; personal communication with Harry James 1-5-98		Source: KLD and SSI 1997
NECD ⁴	3,952	18,809	7,300	52,200	6,105	57,362	7,300	52,200			
	Based on personal communication with G. Zimmerman 1-29-98		Source: Rathi, Southworth et al. 1991		Based on 1990 Census PL94-171: personal communication Harriet Hardee, 1-5-98		Source: CSEPP Accident Planning Base Review Group et al.				

Table 1. (continued)

Site	NEPA		ORNL ETE		Overlays		EPG		State Planners		Other Estimates
	0 - 10 km	0 - 20 km	IRZ	PAZ	IRZ	IRZ/PAZ Total	IRZ	PAZ	IRZ	PAZ	
PBCA ⁵	6,504	70,369	69,585	87,250			69,585	87,254	99,063	74,871	
	Source: U.S. Army 1997		Source: Venigalla et al. 1992				CSEPP Accident Planning Base Review Group et al. (Draft) 1994		Based on personal communication Tammy Raymon 1-5-98		
PCD ⁶	152	5,455	1,703	6,442	1,672	8,474	1,800	6,210	1,725	6,261	
	Based on personal communication with G. Zimmerman, 1-28-98		Source: Rathi et al. 1990		Based on 1990 Census PL 94-171 personal communication Harriet Hardee 1-5-98		CSEPP Accident Planning Base Review Group et al. (Draft) Vol. 6, 1996		Based on Community Needs Survey-1995 personal communication Carl Ballinger 1-5-98		
DCD ⁷	13	600	1,200	23,800	1,147	23,554			1,371	22,983	
	Source: Gant & Zimmerman 1997		Source: Rathi et al. 1990		Based on 1990 Census PL 94-171 personal communication Harriet Hardee 1-5-98				2,100	27,580	
									Tooele County Survey	Tooele County Survey	
									Based on 1990 Census Data in FEMIS-personal communication Ron Goshen 1-5-98		

Table 1. (continued)

Site	NEPA		ORNL ETE		Overlays		EPG		State Planners		Other Estimates
	0 - 10 km	0 - 20 km	IRZ	PAZ	IRZ	IRZ/PAZ Total	IRZ	PAZ	IRZ	PAZ	
UMCD ⁸	11,201	25,553	19,900	5,800	OR: 20,864 WA: 256		19,900	5,800			
	Source: U.S. Army 1996		Source: Rathi et al. 1991		Based on 1990 Census PL94 171 personal communication Harriet Hardee 1-5-98		CSEPP Accident Plan Base Review Group et al. Vol. 8 (Draft) 1995				

¹APG-Aberdeen Proving Ground.

²ANC-Anniston Chemical Activity, formerly Anniston Army Depot (ANAD).

³BGCA-Blue Grass Chemical Activity, formerly Blue Grass Army Depot (BGDA).

⁴NECD-Newport Chemical Depot, formerly Newport Army Ammunition Plant (NAAP).

⁵PBCA-Pine Bluff Chemical Activity, formerly Pine Bluff Arsenal (PBA).

⁶PCD-Pueblo Chemical Depot, formerly Pueblo Depot Activity (PUDA).

⁷DCD-Desert Chemical Depot, formerly Tooele Army Depot (TEAD).

⁸UMCD-Umatilla Chemical Depot, formerly Umatilla Depot Activity (UMDA).

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PCD - Personal communication with Carl Ballinger, State of Colorado, to Cynthia Coomer, Oak Ridge National Laboratory, Oak Ridge, Tn., January 5, 1998.

BGCA - Personal communication with Harry James, State of Kentucky, to Cynthia Coomer, Oak Ridge National Laboratory, Oak Ridge, Tn., January 5, 1998.

BGCA - Personal communication with G. Zimmerman to Barbara Vogt, Oak Ridge National Laboratory, Oak Ridge, Tenn., Jan. 28, 1998.

APG - Personal communication with George Krock and Doug Richmond, State of Maryland, to Cynthia Coomer, Oak Ridge National Laboratory, Oak Ridge, Tn., January 5, 1998.

APG - Personal communication with G. Zimmerman to Barbara Vogt, Oak Ridge National Laboratory, Oak Ridge, Tenn., Jan. 28, 1998.

DCD - Personal communication with Ron Gloschen, State of Utah, to Cynthia Coomer, Oak Ridge National Laboratory, Oak Ridge, Tn., January 5, 1998.

NECD - Personal communication with G. Zimmerman to Barbara Vogt, Oak Ridge National Laboratory, Oak Ridge, Tenn., Jan. 29, 1998.

Overlays - Personal communication with Harriet Hardee, University of Tennessee, to John Sorensen, Oak Ridge National Laboratory, Oak Ridge, Tn., January 5, 1998.

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67. Don Alvic, Pellissippi Research Institute, 10521 Research Drive, Suite 100, Knoxville, TN 37932
68. Thomas E. Drabek, Professor, Department of Sociology, University of Denver, Denver, CO 80208-0209
69. P. Richard Rittelmann, FAIA, Executive Vice President, Burt Hill Kosar Rittelmann Associates, 400 Morgan Center, Butler, PA 16001-5977
70. Susan F. Tierney, The Economic Resource Group, Inc., One Mifflin Place, Cambridge, MA 02138
71. C. Michael Walton, Ernest H. Cockrell Centennial Chair In Engineering and Chairman, Department of Civil Engineering, University of Texas at Austin, Austin, Texas 78712-1076
- 72-73. Office of Assistant Manager of Energy & Development. P.O. Box 2001, Oak Ridge, TN 37831-6269
74. Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831
75. ORNL Site Manager, U.S. Department of Energy, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge, TN 37831-6269