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**CIA HISTORICAL REVIEW PROGRAM  
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**Soviet Civil Defense: Objectives,  
Pace, and Effectiveness**

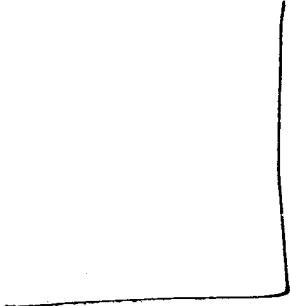
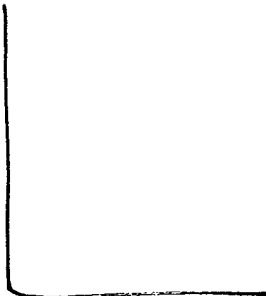
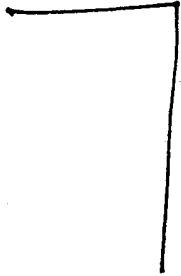
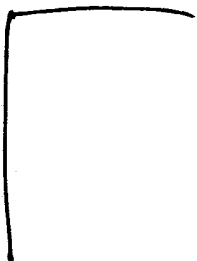
Interagency Intelligence Memorandum  
Memorandum to Holders

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July 1981

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MEMORANDUM TO HOLDERS  
OF NI IIM 77-029

SOVIET CIVIL DEFENSE: OBJECTIVES,  
PACE, AND EFFECTIVENESS

Information as of December 1980 was  
used in the preparation of this Memorandum.

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## SCOPE NOTE

This Memorandum to Holders is an update of the Interagency Intelligence Memorandum *Soviet Civil Defense: Objectives, Pace, and Effectiveness*, which was issued in December 1977.<sup>1</sup> It supersedes the key findings and summary and conclusions sections of the 1977 IIM. Three major aspects of that study require revision on the basis of recent collection and analysis of data—the Soviet civil defense shelter program, the plans for urban evacuation, and the assessment of the effects of civil defense. Updates of our analysis on these topics are the feature of the main text of this Memorandum to Holders. The technical details of our analyses are in the annexes.

This Memorandum to Holders was prepared under the auspices of the National Intelligence Officer for Strategic Programs, National Intelligence Council. Its preparation was a joint undertaking of the Central Intelligence Agency; the Defense Intelligence Agency; the National Security Agency; the Bureau of Intelligence and Research, Department of State; and the offices of the Assistant Chief of Staff for Intelligence, Department of the Army; of the Director of Naval Intelligence, Department of the Navy; and of the Assistant Chief of Staff, Intelligence, Department of the Air Force. The Memorandum, based on research conducted by the participating intelligence agencies, was drafted by [ ] Central Intelligence Agency and was coordinated by the Interagency Intelligence Working Group on Soviet Civil Defense, chaired by [ ] The Working Group was assisted by the Command and Control Technical Center, Defense Communications Agency, in conducting computer simulations to analyze the effects of civil defense on Soviet casualties and fatalities. Representatives of the Federal Emergency Management Agency; the Defense Nuclear Agency; the Organization of the Joint Chiefs of Staff, Studies, Analysis, and Gaming Agency; and the Arms Control and Disarmament Agency participated in the preparation of this Memorandum. Imagery exploitation was a cooperative effort of imagery analysts from the Central Intelligence Agency, the Defense Intelligence Agency, the Army, the Air Force, [ ]

<sup>1</sup> NI IIM 77-029.

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## KEY FINDINGS

1. *Scope.* Soviet civil defense is a nationwide program under military control. It is viewed by the Soviet leadership as part of the USSR's military strategy and strategic posture. Its objectives are to protect people—the leadership, the work force of key economic facilities,<sup>1</sup> and the general population, in that order; facilitate the continuity of economic activity in wartime; and enhance the capability for recovery from the effects of war.

2. *Pace.* It is difficult to measure the pace of the many preparations called for under the Soviet civil defense program. One part of the program—blast shelter construction—showed an increase in the late 1960s, although the rate of construction has varied from area to area and year to year. We are uncertain about the pace of shelter construction since the mid-1970s, but we believe the rate has leveled off. The creation of military civil defense units, begun in 1966, reached a peak in the late 1960s and early 1970s. We have not identified any units established after 1976. Some aspects of civil defense activity have been marked by bureaucratic difficulties and public apathy, which appear to have resulted in uneven implementation of stated goals. On the whole, however, there has been a general trend of improvement in almost all facets of the civil defense program over the past decade.

3. *Cost.* Total civil defense costs are unknown, but cost estimates have been made of four major elements of the Soviet program—pay and allowances of about 115,000 full-time civil defense personnel, operation of specialized military civil defense units, construction and maintenance of facilities at these units, and blast shelter construction. We estimate that in 1979 the ruble cost of these elements was about 9 percent of the cost for Soviet strategic defense forces, or less than 1 percent of the total Soviet defense expenditures. If these elements were to have been duplicated in the United States, they would have cost about \$2.3 billion with about three-fourths representing manpower costs. (These estimates should be considered rough approximations because they are affected by uncertainties both in the quantitative data on civil defense programs and in estimates of prices.)

<sup>1</sup> Economic facilities include industrial installations and military production plants.

4. *Protection of the Economy.* Plans for protecting the Soviet economy include wartime sheltering, evacuation and dispersal of the work force, emergency relocation of the essential equipment of certain installations, geographic dispersal of new installations, hardening, and rapid shutdown of equipment. We have evidence that a small number of high-priority installations plan to relocate equipment to low-risk areas, where production will resume. However, among the various measures to protect the economy, the Soviets have focused primarily on sheltering, evacuation, and dispersal of the work force. Those installations located in what the Soviets consider probable risk areas and considered by them to be of low priority to wartime production will cease operations and the work force will be evacuated to low-risk areas during the crisis. Installations whose continued operation is essential to support the war effort and to enhance the Soviet capability for postattack recovery will disperse their off-duty work force to close-in exurban areas. From there these workers will commute to their urban installations to continue work around the clock.

5. *Protection of the Leadership.* We assess the leadership in the USSR to include the top national leaders, party and government officials from national and republic levels down to urban rayon levels, managers of key economic installations, and members of civil defense staffs—about 110,000 people in all. There are extensive facilities in the Moscow area for protection of the top national military and civilian leaders in wartime, that are provided independently of the civil defense program. Preparations to protect the remainder of the civilian leadership are the responsibility of Soviet civil defense officials. We estimate that the Soviets have sufficient shelter space for virtually all leadership elements.

6. *Protection of the Population.* On the basis of our new evaluation of occupancy factors and available shelter space, we estimate that about 11 percent of the total population in urban areas could be accommodated in blast shelters. This figure would rise to about 13 percent by 1988, assuming a continuation of the present rate of shelter construction and taking into account expected population growth in urban areas. Thus, large-scale evacuation away from target areas is the key to a marked reduction in the number of casualties from a nuclear attack on the USSR. Our study also shows that, in general, large cities can shelter a higher percentage of their populations than small cities—about 22 percent as compared to 6 percent.

7. The location of civil defense shelters indicates a Soviet emphasis on protection of the industrial work force. About 48 percent of the shelters we have identified were associated with industrial installations,

23 percent with residential buildings, 22 percent with government, administrative or institutional buildings, and 7 percent with other or unidentified facilities. In all, 70 percent of the blast shelters identified in the survey were located at places of work.

8. During the past year we have acquired new information that has given us a better understanding of Soviet planning for evacuation of urban areas. Formerly we had postulated on the basis of limited information that 75 percent of the population of all cities with more than 25,000 people would evacuate—a total of about 100 million evacuees from some 900 cities. On the basis of a recently completed analysis of data on Soviet evacuation planning, we currently estimate that about 90 percent of the population in some 300 cities would evacuate—a total of about 85 million evacuees. There is an alternative view that the evidence available is too tenuous to allow a confident assessment of the number of cities the Soviets plan to evacuate.<sup>2</sup>

9. We estimate that the evacuation and sheltering of the bulk of the population from urban areas could be accomplished in two to three days, with as much as a week required for full evacuation of the largest cities. These times could be extended and the evacuation process complicated by shortages in transportation, adverse weather conditions, or other problems.

10. *Effects of Civil Defense.* During the past year we reassessed the effects of Soviet civil defense in reducing casualties from a large-scale retaliatory US nuclear strike. (Estimated casualties were those resulting from prompt weapon effects and fallout during the period of some six weeks following the attack.) The reassessment was based on updated findings on the availability of civil defense shelters in urban areas and more detailed simulations of Soviet evacuation plans. It also differed from our previous assessment in some of the assumptions made about US forces. Taking these several differences into account, we conclude that the findings of our current analysis are consistent with our previous assessment: the effectiveness of Soviet civil defense in reducing casualties would depend primarily on the extent to which civil defense measures were implemented; complete implementation of civil defense plans could reduce Soviet casualties by some 80 million to 100 million; and civil defense could not prevent massive damage to the economy. Our current findings show, however, that Soviet casualties and fatalities could be somewhat higher than our previous estimate.

<sup>2</sup> The holders of this view are the Director, Defense Intelligence Agency, and the Senior Intelligence Officers of the military services.



11. The key features of our reassessment of Soviet civil defense are:

- For 1979 and 1988, US retaliatory attacks were postulated against various Soviet military and economic targets following a Soviet attack against US strategic forces on generated alert and day-to-day alert.
- Soviet and US forces for 1979 and 1988 were drawn from National Intelligence Estimates and Department of Defense program and planning data which assumed that SALT II limits would extend through 1989.
- Actual US targeting plans were not used in simulating the hypothetical attacks. [

[

- For comparison, a second analysis was made [

- [
- In the US retaliatory attacks, the Soviet population was neither specifically targeted nor avoided.
  - Three different levels of Soviet civil defense preparation were assumed—little or no preparation; implementation of the shelter program; and full implementation of civil defense plans for protecting the population, including sheltering and evacuation of urban areas.

12. The key findings of our assessment of the effects of a hypothetical US retaliatory attack on the USSR by 1979 US forces on generated alert were:

- **Protection of the leadership:** With as little as a few hours' warning, a large percentage of the Soviet leadership at all levels would probably survive.
- **Protection of the essential work force:** With sufficient time to implement the shelter program, most of the work force that the Soviets regard as essential during wartime and for postwar recovery would probably survive.
- **Protection of the general population:** Soviet population casualties and fatalities would vary greatly depending on the extent to which civil defense measures were implemented as shown in

Table I  
Estimated Soviet Casualties and Fatalities  
From a Hypothetical US Retaliatory Attack  
(in millions)

Civil Defense Preparations	Casualties/Fatalities <sup>a</sup>	
	US Forces on Generated Alert	US Forces on Day-to-Day Alert
Little or none .....	125/105	115/75
Shelters and best protective structures occupied .....	115/85	95/55
Full sheltering; evacuation of 90 percent of 300 cities.	45/30	35/14 <sup>b</sup>

<sup>a</sup> Casualty totals include fatalities.

<sup>b</sup> In the 1977 IIM, assuming full sheltering and evacuation of 75 percent of 900 cities, we estimated that a retaliatory attack by US forces on day-to-day alert could result in casualties in excess of 20 million, including 5 million to 10 million fatalities. Using this same assumption for purposes of comparison, we estimate in our present analysis that Soviet casualties would be about 30 million, including 11 million fatalities.

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table 1. From an attack by US forces on generated alert Soviet casualties could range from about 125 million with little or no implementation to about 45 million with full implementation, including evacuation of 90 percent of some 300 cities. An attack by US forces on day-to-day alert could result in slightly less casualties, ranging from 115 to 35 million.

— Protection of economic facilities: The hypothetical US attack on the USSR destroyed nearly 80 percent of the value of the economic targets [

13. These findings were generally consistent with estimated Soviet casualties and fatalities from the alternative hypothetical US attack [

This second simulation indicated that casualties would be:

- About 150 million (including 100 million fatalities) in the case of little or no implementation of civil defense plans.
- About 100 million (including 65 million fatalities), if urban blast shelters and the best available protective structures were occupied.
- About 50 million (including 27 million fatalities), if the Soviets implemented both the shelter program and evacuation.

14. Our assessment of the effects of Soviet civil defense measures in protecting leadership and essential personnel and the economy from an attack by 1979 US forces on day-to-day alert is about the same as from an attack by generated US forces.

15. Our assessment indicates that in 1988 a hypothetical retaliatory attack by US forces on generated alert would result in an even larger number of Soviet casualties among the general population than in 1979. The projected increase in the number of Soviet shelters during the next 10 years would be more than offset by expected increases in Soviet urban population and planned net increases in the number and yield of US weapons. Expected improvements in Soviet civil defense preparations would, however, increase the likelihood of survival of a large percentage of the leadership and essential personnel. We do not foresee any significant improvement in the ability of the Soviets to protect their economic facilities from a US nuclear strike directed against them.

16. Full implementation of civil defense preparations would greatly reduce the level of Soviet casualties that would result without such preparations. We do not have high confidence, however, in the absolute values shown by our analysis for the number of Soviet casualties and fatalities resulting from the prompt effects and fallout from a large-scale US nuclear attack on the USSR. We believe that Soviet civil defenses would be most effective in coping with the effects of a limited nuclear attack, such as an attack on Soviet military targets only. But we are unable to assess the longer term effects of an attack involving many thousands of nuclear weapons on the survival of the Soviet population or on the prospects for Soviet economic recovery.

17. In view of their belief that all aspects of society contribute to a nation's military capabilities, the Soviet leaders probably view civil defense as contributing to their strength in the US-USSR strategic balance. They probably expect civil defense to contribute to their ability to conduct military operations and to enhance the ability of the nation to survive and recover from a nuclear exchange. However, in light of the uncertainties they would have about their ability to implement civil defense plans and about the immediate and longer term effects of a massive nuclear exchange, the Soviet leaders cannot have confidence in the degree of protection that their civil defenses would afford at present or in the late 1980s. There are alternative views about the strategic implications of the Soviet civil defense program:

- According to one view, it is doubtful that Soviet leaders would have sufficient confidence in civil defense in a crisis for it to contribute more than marginally to decisionmaking. New analy-

sis in this Memorandum to Holders of the 1977 IIM on Soviet civil defense shows the program to be less effective today than shown in our estimate of three years ago: there would be fewer people evacuated and greater numbers of casualties. The holder of this view also notes that civil defense projections suggest that current major shortcomings will not be overcome.<sup>3</sup>

- There is another view that the continuing Soviet investment of major resources in the civil defense program clearly demonstrates the confidence the Soviet leaders have in its value. This confidence could contribute to Soviet resolve in a future crisis.<sup>4</sup>

Our assessment of the impact of the Soviets' capabilities for strategic nuclear conflict, including civil defenses, on their policies and conduct toward the United States is contained in National Intelligence Estimates.

<sup>3</sup> The holder of this view is the Director, Bureau of Intelligence and Research, Department of State.

<sup>4</sup> The holders of this view are the Director, Defense Intelligence Agency; and the Senior Intelligence Officers of the military services.

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## SUMMARY AND CONCLUSIONS

1. During the past two years our efforts have been largely devoted to assessments of three major areas: the Soviet civil defense shelter program, plans for urban evacuation, and the effects of Soviet civil defense in reducing damage from a US retaliatory strike. Our latest findings on these subjects are detailed in the main text of the Memorandum to Holders and are summarized in this section. The other subjects covered in the Summary and Conclusions of the 1977 IIM have been revised and updated as required by new evidence and analysis.

2. Our study of the Soviet civil defense program has focused on those factors most likely to affect perceptions of the strategic balance between the Soviet Union and the United States: the Soviets' ability to ensure the survival of their leadership, their ability to protect centers of production, and their ability to protect the population. Because we do not know much about the long-term consequences of a large-scale attack on the functioning of a modern, industrialized society, our study deals with the nuclear weapons effects during a relatively brief period following a large-scale attack. It does not assess the Soviets' post-nuclear-attack capabilities to conduct military operations or their longer term prospects for national survival, political cohesion, and reconstitution of the economy.

3. We have attempted to describe the Soviet program in a way that would allow for an assessment of the confidence that the Soviet leaders place in the program—the degree to which their civil defense makes them feel more able to withstand the consequences of a strategic nuclear exchange. Consequently, we have examined all intelligence describing the civil defense organization, priorities, plans, training, and propaganda efforts from which inferences might be drawn.

### Organization, Priorities, and Pace

4. Soviet strategic writings integrate civil defense into military strategy, which takes into consideration

Note: This Summary and Conclusions supersedes the Summary and Conclusions of the Interagency Intelligence Memorandum, *Soviet Civil Defense: Objectives, Pace, and Effectiveness*, dated December 1977.

the likely origins, course, and consequences of nuclear war. The Soviets' experience in World War II, together with their traditional concern for homeland defense, reinforce their interest in civil defense. By developing an extensive civil defense program, in conjunction with their other defensive and offensive strategic forces, the Soviets seek to ensure the survival of the USSR and to be in a stronger postwar position than their adversaries. Soviet civil defense is intended to contribute to the maintenance of a functioning logistics base for operations by regular armed forces to win the war, to limit human and materiel losses, and to enable the country to speed recovery.

5. Soviet leaders use civil defense to foster favorable popular attitudes toward the Soviet system, to demonstrate concern for the people, and to lend credibility to calls for vigilance against potential enemies. Nearly every Soviet citizen receives civil defense instruction in school, in premilitary training, or through training courses, lectures, and exercises at places of work. Public attitudes about surviving a nuclear war are skeptical, however, and there is evidence that many people do not take the program seriously. Nevertheless, we believe that Soviet people would respond to directions from civil defense authorities.

6. Civil defense organizations exist at all levels of the Communist Party, government, and economy. Full-time civil defense staffs exist at each echelon of the Soviet administrative structure, as well as at all significant economic institutions and enterprises. Since 1972 the national organization has been led by General of the Army A. T. Altunin, a Deputy Minister of Defense.

7. In wartime, the civil defense administrative structure would be converted into a chain of command subordinate to the deputy commander for civil defense of each military district. The operating elements that would carry out postattack recovery consist of civilian civil defense formations and about 60 military civil defense units, of which 47 have been confirmed. (See table D-2 in annex D.) To carry out Soviet civil defense measures in peacetime there are about 115,000 full-time civilian and military personnel (see

annex D). According to guidelines issued by General Altunin in 1975, the total number of civilians in the program would be upwards of 16 million—a number that includes many perfunctory participants. Recent information indicates that the total number of participants could be about 25 million.

8. The effectiveness of the civil defense organization in carrying out its responsibilities in peacetime suffers at times from the reluctance of industrial managers to spare labor and other resources for civil defense and from misunderstandings between civil defense officers and civilian officials. In wartime, increased centralization of authority would probably reduce many of the bureaucratic inefficiencies inherent in this large organization during peacetime. On the whole, the Soviets' view of their civil defense organization structure and the progress it is making probably is a favorable one—overall, better than it was before the military assumed control nearly 10 years ago.

9. In terms of its objectives the Soviet program appears to hew fairly close to what its organizers have declared their intentions to be (see table 2). The first priority is to protect people—the leadership, other essential personnel, and the rest of the population, in that order. In support of this, they have built shelters, established relocation sites, and developed evacuation plans. The second priority is to maintain the continuity of economic activity in wartime. Much of the effort to satisfy this objective appears to have been directed toward providing protection for the essential work force. The third priority, elimination of the consequences of an enemy attack, has involved the training of a broad spectrum of the Soviet population in postattack operations such as administering first aid, clearing rubble, decontamination, and emergency repair and restoration of electric power.

10. The pace of the Soviet civil defense program is affected, on the one hand, by commitments of the leadership to realize progress in peacetime preparations and, on the other, by reluctance of some officials to dedicate scarce resources to what they regard as a secondary requirement. Measures of the pace of Soviet civil defense preparations are difficult to quantify:

- A rigorous examination of one such measure—blast shelter construction—has shown varied levels of activity from area to area and year to year, but appears generally to have increased until the mid-1970s. Judgments about the rate

Table 2

Objectives of Soviet Civil Defense	
Objectives	Tasks
Protection of human resources	<ul style="list-style-type: none"> <li>Sheltering and relocation of the leadership</li> <li>Sheltering and dispersal of essential workers</li> <li>Sheltering and evacuation of the urban population</li> <li>Stockpiling food and medical supplies</li> </ul>
Continuity of economic activity in wartime	<ul style="list-style-type: none"> <li>Integration of civil defense and economic mobilization plans</li> <li>Rapid shutdown of industrial facilities</li> <li>Permanent and hasty hardening of installations and equipment</li> <li>Crisis relocation of economic enterprises</li> <li>Stockpiling reserves of materials</li> <li>Geographic dispersal of industry</li> </ul>
Elimination of consequences of enemy attack	<ul style="list-style-type: none"> <li>Preparation of military and civil defense formations</li> <li>Training in rescue and recovery</li> <li>Preparations for distribution of food and essential supplies</li> </ul>

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of construction since that time are tenuous, but we believe the rate has continued at about the mid-1970s level.

- An examination of the creation of military civil defense units shows that the first units were established about 1966. We have not identified any units established after 1976. The majority of the units were established in the late 1960s and early 1970s.
- There is little evidence of Soviet progress in protecting industry by hardening and geographic dispersal, but a study is under way to investigate as yet unconfirmed reports of Soviet implementation of those measures.

Bureaucratic difficulties and public apathy, which have marked some aspects of civil defense activity, appear to have resulted in uneven implementation of stated goals. On the whole, however, there has been a general trend of improvement in almost all facets of the civil defense program over the past decade.

Table 3

Cost of Key Soviet Civil Defense Elements, 1979		
	Billion 1970 Rubles	Billion 1979 Dollars
Manpower—Military and Civilian.....	0.17	1.72
Military Units:		
Operation of military units.....	0.04	0.12
Construction and maintenance of facilities at these units.....	0.01	0.04
Shelter construction.....	0.14	0.44
<b>Total</b> .....	<b>0.36</b>	<b>2.32</b>

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11. Although total civil defense costs are unknown, cost estimates have been made of four major elements of the Soviet program: pay and allowances for about 115,000 full-time civil defense personnel, operation of specialized military civil defense units, construction and maintenance of facilities for these units, and shelter construction (see table 3). The cost of these elements in 1979 amounted to about 360 million rubles, which is some 9 percent of the estimated cost for Soviet strategic defensive forces or less than 1 percent of the estimated Soviet defense budget. If these elements of the Soviet program would have been duplicated in the United States, they would have cost about \$2.3 billion in 1979, with about three-fourths of this representing manpower costs. (These estimates should be considered rough approximations because they are affected by uncertainties both in the quantitative data on civil defense programs and in estimates of prices.)

### Protection of the Leadership

12. We assess the leadership in the USSR to include the top national leaders, party and government officials from national and republic levels down to the urban rayon levels,<sup>1</sup> managers at key economic installations, and members of civil defense staffs—about 110,000 people in all. Facilities to protect the top national military and civilian leaders in wartime are provided independently of the civil defense program. We estimate that the Soviets have sufficient shelter space for virtually all leadership elements.

13. Throughout the Soviet Union there are facilities for protecting the leaders—hardened underground

<sup>1</sup> Rayons are administrative subdivisions of oblasts and cities.

facilities in urban areas and relocation sites outside the cities. The exurban sites include both standard command posts and those health and recreational facilities that have been adapted for use as command posts in wartime. These facilities are usually provided with communications equipment and are located near or on transportation routes. Relocation sites range, at one extreme, from government control centers equipped with personnel bunkers and extensive communications support to aboveground housing facilities without hardened personnel shelters at the other. The pattern for local shelters and relocation sites extends from the national level, including ministries, to party, government, and economic headquarters at republic, oblast, and city levels.<sup>2</sup>

⌋ We estimate that the Soviets have sufficient command post space for virtually all the leadership elements as defined in this paper.

14. The resistance of these facilities to blast varies, depending on their location and prospective occupants. Technical assessments show that at some of the relocation sites for the top national leadership, the hardness of shelters, when defined as a 50-percent probability of achieving severe structural damage, ranges from ⌋

⌋ The range of hardness for shelters for other national leaders is ⌋

⌋ Judging from analysis of Soviet designs, the remaining leadership shelters are estimated to be less hard—about the same hardness as average shelters in industrial and urban areas. We believe that most command posts have communications facilities and some stockpiles of food, medicine, protective equipment, and other supplies for their prospective occupants.

### Protection of the Economy

15. Plans for protecting the Soviet economy include a number of complementary measures, not all of which are necessarily to be taken at any individual site

<sup>2</sup> Oblasts are administrative subdivisions of republics.

but which could apply selectively depending on a site's importance to a wartime economy. These measures include:

- Sheltering personnel at installations in the event of attack.
- Dispersal of a portion of the work force during a crisis.
- Emergency relocation of certain installations.
- Geographic dispersal of new installations.
- Hardening of physical structures.
- Hasty hardening measures when an attack is imminent, such as sandbagging of equipment and earth mounding around structures.
- Rapid shutdown of equipment.

16. The location of civil defense blast shelters indicates a Soviet emphasis on protection of the industrial work force. About 48 percent of the shelters identified in our survey (see paragraphs 26-31) were associated with industrial installations, 23 percent with residential buildings, 22 percent with government, administrative, or institutional buildings, and 7 percent with other or unidentified facilities. The number of shelters detected under construction in each category in our current study indicates that the Soviets are maintaining these relative priorities. In all, 70 percent of the shelters identified in the survey were located at places of work.

17. For the 1977 Interagency Intelligence Memorandum, we surveyed some 150 economic facilities distributed among 17 key industrial categories that we believe are important for Soviet recovery from a nuclear attack. The primary civil defense preparations that we were able to identify at these installations were those related to sheltering personnel. We found that shelters had been built or were under construction at the time of the survey at some 65 percent of the plants. More than two-thirds of the shelters identified had been built since 1968.

18. We also performed various statistical tests on the sample to extrapolate our findings to the rest of the Soviet economic facilities within these categories. For this purpose we used the industrial categories on which our information was most complete. Assuming that our sample is roughly representative of key Soviet industries and recognizing that our confidence bounds are

large owing to our small sample and the variability of the data, some conclusions can be drawn:

— The increased level of shelter construction since 1968 indicates progress in implementation of Soviet planning. The rate of increase in construction was not uniform throughout industry, but was concentrated among large enterprises, new installations, and those undergoing expansion.

— The Soviets could shelter 24 percent of the estimated total labor force in these key industrial categories. This estimate was based on a shelter occupancy factor of 0.5 square meter per person. Based on our most recent analysis of shelter occupancy factors, the figure would have been somewhat less. The Soviets' plans, however, do not call for sheltering the entire labor force. They plan to close nonessential industries and to evacuate nonessential workers from those industries that are to continue production. The remaining essential work force at each plant is to be divided into two or three shifts, one to continue work, the others to be dispersed to locations within commuting distance of the enterprise. We believe the shelters at economic facilities are intended for that portion of the essential labor force at work.

— In a recent reanalysis of two of the 150 plants, we discovered that additional shelter space was available at both plants. Although we cannot confidently make extrapolations of these findings to the other 148 plants initially surveyed, the results of this limited sample suggest that the 1977 figures on shelter capacity are low.

19. In addition to the survey of 17 key recovery industries on which the above conclusions were based, in the 1977 IIM we studied 113 plants from five military industrial categories. We found that shelters had been built or were under construction at 70 percent of the 113 plants. This compared with 65 percent of the 150 facilities at the 17 key recovery industries at which shelters had been built or were under construction.

20. The Soviet program for geographic dispersal of industry is, as far as we can tell, not being implemented to a significant extent:

- New plants have often been built adjacent to major existing plants.
- Existing plants and complexes have been expanded in place.



- No effort has been made to expand the distance between buildings or to locate additions to minimize fire and other hazards in the event of a nuclear attack.
- Previously open spaces in fuel storage sites have been filled with new storage tanks and processing units.

The value of overall productive capacity has been increased proportionately more at the old industrial sites, providing richer target areas, and raising the total vulnerability of industry to attack even more.

21. Previous analysis leads us to believe that there is not a comprehensive program for hardening economic installations. In some cases construction guidelines for the physical hardening of industrial sites appear to have been ignored. Published Soviet civil defense guidelines acknowledge the high cost of such measures and explicitly state that they are to be carried out only when economically feasible. A study is now under way to determine the scope of industrial hardening.

22. There are only a few human-source reports of training exercises in which hasty hardening techniques have been employed. The Soviets appear to have given greater emphasis to rapid shutdown of equipment than to hasty hardening. The emphasis in this scheme seems to be on protecting vital equipment and installations from secondary damage triggered by prompt effects of a nuclear attack, such as ignition of combustibles, and on facilitating longer term recovery of installations after an attack.

23. A recent review of all-source reporting on 268 economic installations that were reported to have civil defense plans revealed that 63 percent would cease operations and evacuate their work forces. Twenty-four percent were described as critical war industries which would shelter and disperse their work forces and would continue operations. The remaining 13 percent, also critical industries, would relocate equipment and work forces and continue operations. Of the 268 economic installations, 87 percent would remain in place.

24. Overall, we estimate that the measures to protect the USSR's economy would not prevent massive damage from a US attack designed to destroy Soviet economic facilities. At best, Soviet leaders and civil defense planners are probably confident that, through rapid shutdown and emergency repairs by the surviv-

ing work force, limited production at slightly or moderately damaged sites could be restored soon after an attack. We have not assessed the Soviets' long-term ability to reconstruct their economy.

### Protection of the Population

25. Soviet civil defense plans for the protection of people call for shelters, evacuation from possible target areas, and individual protective gear. During the past two years we have improved our understanding of the shelter program and the scheme for urban evacuation.

26. *The Shelter Program.* In the IIM of December 1977 the estimate of the percentage of the urban population that could be sheltered was based on the study of a nonrandom sample of 15 Soviet cities. The potential for biases inherent in the limited sample lessened our confidence that the sample was representative of a national pattern. Thus, in 1978 we developed a stratified random sample of 57 Soviet cities [ ] for making more reliable assessments of the Soviet blast shelter program. The data collected from this sample have been combined with results of studies of the shelter programs in Leningrad and Kiev to provide a reliable basis for assessments of the shelter program nationwide. Our latest assessment of shelter capacity was also based on a new evaluation of the variation in shelter occupancy factors throughout the Soviet Union. (See paragraphs 7 and 8 of the discussion for details.)

27. This study indicates that the Soviets have the capability to shelter about 15 million people, or about 11 percent of the urban population in cities of 25,000 or more. We are 95-percent confident that the true percentage is between 8.9 and 13.3. This range allows only for errors in the sampling process due to the size of the sample and the number of observed shelters for which we can get reliable measurements. In addition to the possibility of errors inherent in the sampling process, several other factors contribute to some overall uncertainty:

- Incomplete evidence concerning actual occupancy factors.

- Uncertainty about the total space available for people in the shelters.

28. The survey indicates that large cities have shelters for a higher percentage of their population than smaller cities: cities with a population of 1 million or more have shelters for about 22 percent of their population; cities of from 100,000 to 1 million people have shelters for about 9 percent; and cities of from between 25,000 and 100,000 have shelters for about 6 percent.

29. The capacity for sheltering people in large cities is even greater if the space in subway systems is included. Of the 13 Soviet cities with a 1976 population of 1 million or more, seven have operating subway systems. These facilities could add about 2.6 million square meters of shelter space to our estimate if both subway platforms and tunnels were used as shelters. Only some 0.4 million square meters of area would be provided by the platforms alone. Thus the average percentage of population in cities of 1 million or more that could be sheltered in blast shelters and subways would be 23.4 percent if only the area on subway platforms were included, or 31.4 percent if the area in both tunnels and platforms were counted. We are uncertain about how to account for space in subways in our estimate of total national shelter capacity. We do not know whether all the subways have life-support systems or how much space would be allocated per person, but in the absence of specific Soviet data on the actual space allotment in subways, we have assumed one square meter. Also, we do not know to what extent the subways would be used for evacuation, thus possibly precluding the use of some tunnel area for shelter space at least temporarily.

30. Our best estimate is that most Soviet civil defense shelters for the general population are designed for loads of 100 to 300 kPa (14 to 43 psi). Design loads can usually be considered to describe "sure safe" conditions for vulnerability analysis. According to our analysis of a typical shelter, designed for a 200-kilopascal load, there would be a 50-percent probability of severe damage at an overpressure of 620 kPa (90 psi) from a 1 Mt weapon.

31. We estimate that about 80 percent of the people in urban blast shelters would be adequately protected from the blast and other prompt effects of a nuclear attack that was intended to maximize damage to industrial and military targets. Given the large percentage of the urban population that cannot be accommodated in blast shelters, however, evacuation of the bulk of the urban population would be nec-

essary in order to achieve a marked reduction in the number of casualties.

32. *Urban Evacuation.* During the past year we have acquired new information that has given us a better understanding of Soviet planning for evacuation of urban areas. Formerly we had postulated on the basis of limited information that 75 percent of the population of all cities with more than 25,000 people would evacuate—a total of about 100 million evacuees from some 900 cities. On the basis of a recently completed analysis of more detailed data on Soviet evacuation, we currently estimate that some 300 cities would evacuate, but that about 90 percent of the population in those cities would be involved—a total of about 85 million evacuees. This analysis was based on data from a variety of sources on Soviet evacuation planning for 148 cities. There is an alternative view that the evidence available is too tenuous to be confident about the number of cities the Soviets plan to evacuate.<sup>3</sup>

33. Soviet writings state that the order to evacuate cities would be given during the "special period"—a period of high tension and increased risk of war. The order to evacuate would be issued through dedicated civil defense communications networks and disseminated to the public via the mass media. Individual installations would use available means to notify personnel of the time and place for staging their evacuation. Factories, offices, schools, or bus and train stations would serve as embarkation points. According to Soviet planners the population would have only a few hours to prepare for an evacuation following the order. On their arrival at assembly points people would board buses or trains, or begin walking toward their previously assigned relocation areas. Those persons destined for remote areas would be evacuated first to intermediate points, where they would rest and be fed by local authorities.

34. Urban evacuation has a central role in Soviet civil defense plans, although evacuation exercises involving the entire population of cities are not part of Soviet civil defense training. We have evidence that Soviet civil defense leaders view large-scale evacuation exercises as excessively disruptive and are concerned that a citywide exercise might precipitate panic.

<sup>3</sup> The holders of this view are the representatives of the Defense Intelligence Agency and the intelligence organizations of the military services.

35. Soviet plans call for evacuation of urban areas within three days. Our studies indicate a range of times necessary to accomplish evacuation, depending primarily on the availability of transportation. For evacuation employing motorized transport—buses, trucks, trains, and cars—one to four days would be required for the last group of evacuees to reach their relocation area. If the evacuation were carried out on foot, a week or more would be required to evacuate the larger cities. Some combination of motorized and foot transport would reduce the required time to less than a week. Unusually severe weather conditions could slow the pace of evacuation and affect a local decision to evacuate. On balance, an average of two or three days would probably be required to evacuate the major portion of the Soviet urban population.

36. Soviet planning recognizes that the evacuated population must be provided fallout protection. Plans and some materials exist for upgrading existing structures and constructing hasty shelters in rural and exurban areas. Soviet civil defense publications state a preference for adaptation of existing structures. We estimate that, given time to complete preparations, the bulk of the evacuated population would have about the level of protection afforded by basements and expedient shelters.

#### The Effects of Soviet Civil Defense

37. During the past year we reassessed the effects of Soviet civil defense in reducing casualties from a large-scale retaliatory US nuclear strike. (Estimated casualties were those resulting from prompt weapon effects and fallout during some six weeks following the attack.) The reassessment was based on updated findings on the availability of civil defense shelters in urban areas and more detailed simulations of Soviet evacuation plans. The reassessment also differed from our previous assessment in some of the assumptions made about US forces. Taking these several differences into account, we conclude that the findings of our current analysis are consistent with our previous assessment: the effectiveness of Soviet civil defense in reducing casualties would depend primarily on the extent to which civil defense measures were implemented; complete implementation of civil defense plans could reduce Soviet casualties by some 80-100 million; and civil defense could not prevent massive damage to the economy. Our current findings show, however, that Soviet casualties and fatalities could be somewhat higher than our previous estimate.

38. The key features of our current analysis of the effects of Soviet civil defense are:

- For 1979 and 1988 US retaliatory attacks were postulated against various Soviet military and economic targets following a Soviet attack against US strategic forces on generated alert and day-to-day alert.
- Soviet and US forces for 1979 and 1988 were drawn from National Intelligence Estimates and Department of Defense program and planning data which assumed that SALT II limits would extend through 1989.
- Actual US targeting plans were not used in simulating the hypothetical attacks. ]

- For comparison we replicated our analysis employing a second hypothetical US attack. ]

- In the US retaliatory attacks, the Soviet population was neither specifically targeted nor avoided.

- Three different levels of Soviet civil defense preparation were assumed: little or no preparation, implementation of the shelter program, and full implementation of civil defense plans to protect the population, including sheltering and evacuation of urban areas.

39. The key findings of our assessment of the effects of a US retaliatory attack on the USSR by 1979 US forces on generated alert were:

- **Protection of the leadership:** With as little as a few hours' warning, a large percentage of the Soviet leadership at all levels would probably survive.
- **Protection of the essential work force:** With time to implement the shelter program, a large percentage of the essential work force would probably survive.
- **Protection of the general population:** Soviet population casualties would vary greatly, depending on the extent to which civil defense

measures were implemented. Casualties would be about 125 million (including 105 million fatalities) in the case of little or no implementation, about 115 million (85 million fatalities) if urban blast shelters and the best available protective structures were occupied, and about 45 million (30 million fatalities) if full sheltering and evacuation had been implemented.

- Protection of economic facilities: The hypothetical US retaliatory attack on the USSR destroyed nearly 80 percent of the value of the economic targets [

40. Our assessment of the effects on the Soviet population from a hypothetical retaliatory attack by US forces on day-to-day alert indicates that casualties would be:

- About 115 million (including 75 million fatalities) in the case of little or no implementation of civil defense plans.
- About 95 million (including 55 million fatalities), if urban blast shelters and the best available protective structures were occupied.
- About 35 million (including 14 million fatalities), if the Soviets completed implementation of both the shelter program and evacuation.

[ 41. For comparison, a second analysis was made

assessment of the effects of this hypothetical US retaliatory strike with forces on generated alert showed that casualties would be:

- About 150 million (including 100 million fatalities) in the case of little or no implementation of civil defense plans.
- About 100 million (including 65 million fatalities), if urban blast shelters and the best available protective structures were occupied.
- About 50 million (including 27 million fatalities), if the Soviets completed implementation of both the shelter program and evacuation.

42. With US forces on day-to-day alert, this second analysis indicated that casualties would be:

- About 105 million (including 65 million fatalities) in the case of little or no implementation.

- About 80 million (including 50 million fatalities), if urban blast shelters and the best available protective structures were occupied.

- About 35 million (including 17 million fatalities), if the Soviets completed implementation of both the shelter program and evacuation.

43. Those government control centers and leadership relocation sites that we have identified and located would be vulnerable to US attack. [

] We estimate that, with several hours to make final preparations, a large percentage of leaders and communications facilities would survive.

44. Those measures we have described for protection of the economy could not prevent massive damage. The hypothetical attack used in our analysis destroyed nearly 80 percent of the value of the economic targets [ ] The specific damage levels shown by our analysis are subject to some uncertainty because of the uncertainty in structural damage criteria used for assessing economic loss. Even with a week or so of preparations, there would be little reduction in the amount of prompt damage to facilities resulting from blast. Our analysis of the hardness of shelters at industrial installations and shelter locations relative to likely weapon aim points indicates that a large percentage of the essential personnel would survive a US attack designed to maximize damage to economic facilities. The Soviet measures for protecting the work force, critical equipment and supplies, and for limiting damage from secondary effects could contribute to maintaining and restoring production after an attack. We have not, however, analyzed the Soviet potential for economic recovery.

45. We estimate that the Soviets will continue to emphasize the construction of shelters for the urban population, especially at places of work. If the current pace of shelter construction is continued, the number of people who can be sheltered will increase from about 15 million at present to about 22 million in 1988. Taking into account the estimated growth in the urban population, we calculate that the percentage of city dwellers that could be sheltered would grow from the current 11 percent to about 13 percent in 1988. Nevertheless, because of the growth of the Soviet urban

population, the number of urban dwellers who could not be sheltered in the cities would increase by about 30 million, from about 115 million in 1979 to 145 million in 1988. Thus, protection of the general population would continue to require large-scale urban evacuation.

46. Our assessment of the results of a hypothetical retaliatory attack by US forces on generated alert in 1988 indicates that the total number of Soviet casualties among the general population would be even greater than in 1979, if the improvements in US strategic forces proceed as we assumed in the projections used in our analysis. The projected increase in the number of Soviet shelters during the next 10 years would be more than offset by expected increases in Soviet urban population and in the number and yield of US weapons. Thus, large-scale evacuation away from target areas remains the key to a marked reduction in the number of casualties.

47. Programs for protection of the leadership are solidly established and well advanced. We are confident that this aspect of the program will continue to receive attention, thereby providing better protection for leaders at all levels. The continued growth in the numbers of leadership facilities—many of which we may not be able to locate precisely—will increase prospects of survival of a large number of Soviet leaders.

48. Prospects for improvement in measures to protect the economy against attack are mixed. Continued construction of shelters at places of work will enable a larger proportion of the work force to be sheltered. The continuation of current trends, especially the concentration of economic investment in previously existing plant sites, the lack of dispersal of industry, and an absence of construction-hardening techniques, would mean that a US countereconomic attack would remain highly destructive. We do not believe that the protective measures the Soviets are likely to undertake during the next 10 years would reduce significantly the level of damage likely to result from a large-scale US attack designed to maximize destruction of economic targets.

#### Implications

49. Full implementation of civil defense preparations would greatly reduce the level of casualties. The results of our analyses support our previous conclusion that the most critical decision to be made by Soviet

leaders in terms of saving their population is whether or not to evacuate. The benefit of complete implementation of sheltering and evacuation would be the reduction of casualties by about 80-100 million people, including some 75 million fatalities. We do not have high confidence, however, in the absolute values shown by our analysis for the number of Soviet casualties and fatalities.

50. We are unable to make a confident assessment of how effective Soviet civil defense would be in rescue and recovery operations following an attack. Our tentative estimate is that, under the most favorable circumstances, stocks of essential supplies would be adequate to sustain the surviving population for weeks and perhaps longer, but the distribution of these supplies would be a critical problem. Under the worst conditions, we believe the chances would be poor that the Soviets could effectively support the surviving population with supplies and services.

51. Soviet civil defenses would be most effective in coping with the effects of a limited nuclear attack, such as an attack on selected military targets. But the longer term effects of an attack on the USSR involving many thousands of weapons are matters of great uncertainty. Subject to speculation, for example, are the effects of radioactive contamination, ultraviolet burning, climatic changes, loss of housing, and shortage of medical personnel on the survival of the Soviet population and on the prospects for Soviet economic recovery.

52. In view of their belief that all aspects of society contribute to a nation's military capabilities, the Soviet leaders probably view civil defense as contributing to their strength in the US-USSR strategic balance. They probably expect civil defense to contribute to their ability to conduct military operations and to enhance the ability of the nation to survive and recover from a nuclear exchange. However, in light of the uncertainties they would have about their ability to implement civil defense plans and about the immediate and longer term effects of a massive nuclear exchange, the Soviet leaders cannot have confidence in the degree of protection that their civil defenses would afford at present or in the late 1980s. There are alternative views about the strategic implications of the Soviet civil defense program:

— According to one view, it is doubtful that Soviet leaders would have sufficient confidence in civil defense in a crisis for it to contribute more than marginally to decisionmaking. New analysis in

this Memorandum to Holders of the 1977 IIM on Soviet civil defense shows the program to be less effective today than shown in our estimate of three years ago: there would be fewer people evacuated and greater numbers of casualties. The holder of this view also notes that civil defense projections suggest that current major shortcomings will not be overcome.<sup>4</sup>

— There is another view that the continuing Soviet investment of major resources in the civil defense

<sup>4</sup> *The holder of this view is the Director, Bureau of Intelligence and Research, Department of State.*

program clearly demonstrates the confidence the Soviet leaders have in its value. This confidence could contribute to Soviet resolve in a future crisis.<sup>5</sup>

Our assessment of the impact of the Soviets' capabilities for strategic nuclear conflict, including civil defenses, on their policies and conduct toward the United States is contained in National Intelligence Estimates.

<sup>5</sup> *The holders of this view are the Director, Defense Intelligence Agency; and the Senior Intelligence Officers of the military services.*

## DISCUSSION

### NATIONWIDE SHELTER CAPACITY

1. The Interagency Intelligence Memorandum *Soviet Civil Defense: Objectives, Pace, and Effectiveness*,<sup>1</sup> published in December 1977, included an estimate of the percentage of the Soviet urban population that could be accommodated in civil defense blast shelters. At that time, we estimated that a minimum of 10 or 20 percent, depending on whether the occupancy factor used was 1.0 or 0.5 square meter per person, of the Soviet urban population in cities of 100,000 or more could be sheltered. For that study, photography of 15 Soviet cities was searched for civil defense shelters. The cities that were searched were not selected at random [

]The biases inherent in that limited sample, therefore, lessened our confidence that the sample was representative of a national pattern.

2. In 1978 we developed a stratified random sample which includes 57 of the 891 Soviet cities that had a population in 1976 greater than 25,000 but less than 2 million. The cities were selected without regard to their military significance [

]Using metropolitan area boundaries provided by the Defense Intelligence Agency, we partitioned each of the sampled cities into sectors of 2 miles square. (See figure 1.)

3. We excluded the three Soviet cities with populations greater than 2 million—Moscow, Leningrad, and Kiev—from the list from which the sample was selected. We already had data on Leningrad and Kiev (from work done for the 1977 IIM) that could be combined with the results from the random sample survey. The results of the studies of Leningrad and Kiev have been updated [ ] Moscow was not searched because the time required to search

Note: This text supersedes those portions of the 1977 IIM dealing with the blast shelter program, urban evacuation, and the effectiveness of Soviet civil defense.

<sup>1</sup> NI IIM 77-029.

the entire city would have been prohibitive. To incorporate Moscow into an estimate of the total Soviet shelter program, we assumed the shelter capacity there to be proportional to the capacity found in the studies of Leningrad and Kiev.

4. Our assessment of the nationwide Soviet shelter program is based on extrapolations of the findings from the 57-city random sample and the data on Leningrad and Kiev. Our analysis indicates that the Soviets have the capability to shelter about 15 million people, or about 11 percent of the urban population in cities of 25,000 or more. This assessment includes the impact of a new evaluation of the variation in shelter occupancy rates used throughout the Soviet Union. Allowing only for errors in the sampling process and uncertainties about shelter dimensions, we are 95 percent confident that the true percentage is between 8.9 and 13.3. This confidence interval could be affected by our: [

]uncertainty about the total space available for people in the shelters; and incomplete evidence concerning planned shelter occupancy factors.

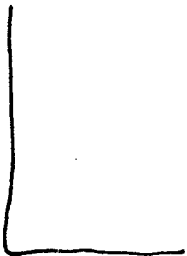
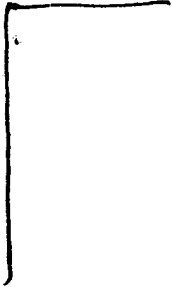
5. *Identification of Shelters.* Our count of the number of Soviet blast shelters nationwide has been adjusted to deal statistically with the possibility that we have not identified all shelters in a given search area. [

]even with the corrections—the shelter count and the resulting estimate of shelter space should be considered minimums. On the other hand, our estimate of shelter space would be driven downward if some of the tentatively identified shelters were eliminated. [

6 [

]

]



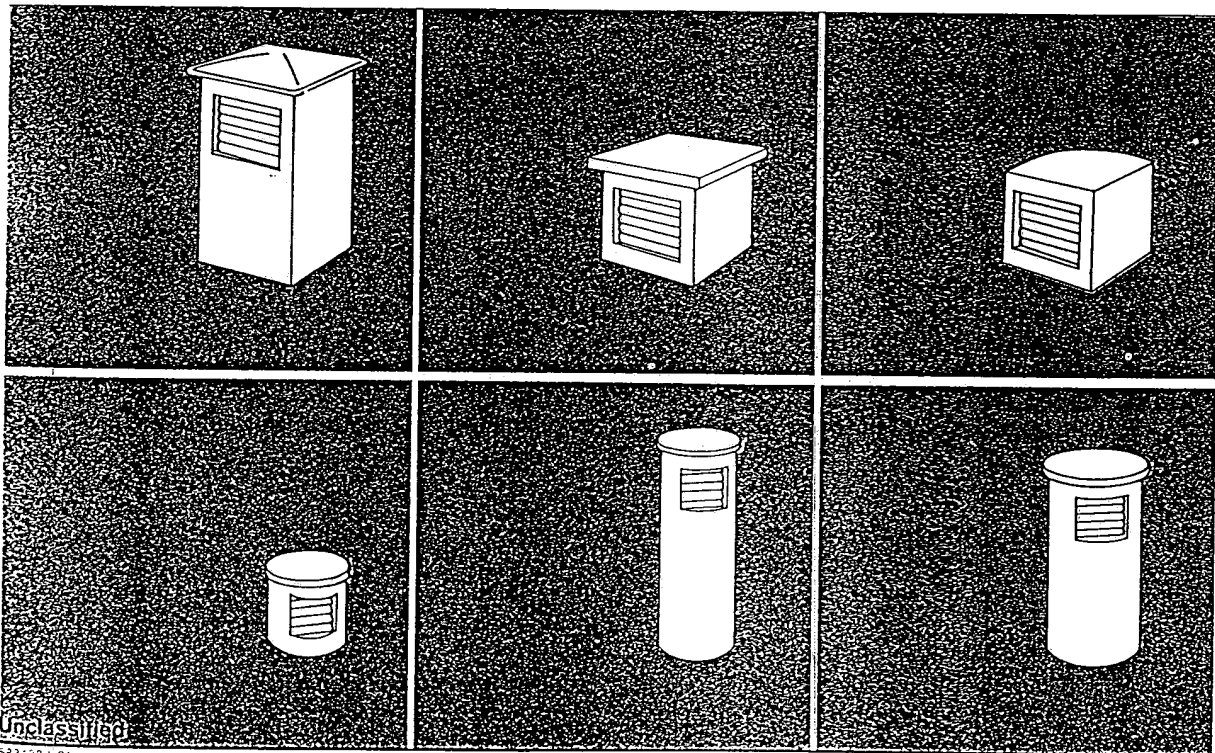


Indicates that the percent of the total shelter floorspace available for people ranges from 40 to 60 percent for shelters with utility corridors along outside walls to 75 to 83 percent for shelters without such corridors. We do not know what percent of Soviet shelters are built of each of these two types of designs. We are, therefore, unsure about the degree to which our characterizations of the availability of two-thirds of the space is representative of Soviet practice. The sensitivity of estimates of Soviet shelter capacity to various assumptions about occupancy factors and the percent of space available for occupancy is demonstrated in figure 4.

7. *Available Space.* We have employed a general rule that two-thirds of the total floorspace in shelters is available for people and the other third is for support services, equipment, and supplies. This conclusion (our best estimate) has evolved from a review of Soviet shelter designs

8. *Occupancy Factors.* Soviet planned occupancy factors are based on midsummer climatic conditions. Soviet civil defense publications cite 0.5m<sup>2</sup> as the minimum space allocation per person. Some of these publications, as well as reporting from human sources, indicate that this figure may vary with region, season of

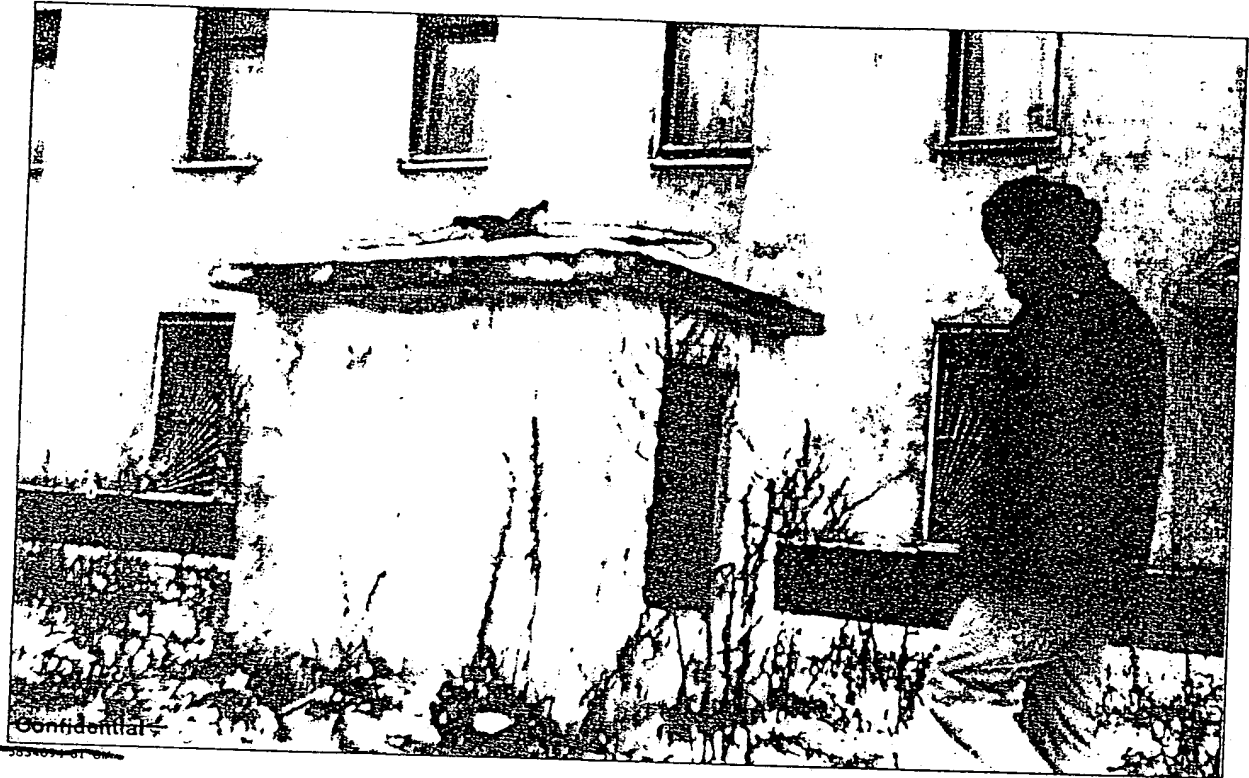
Figure 2  
Typical Designs of Air Vents/Emergency Exits Used  
With Soviet Civil Defense Blast Shelters



Unclassified  
533-881 81

Figure 3

Air Vent/Emergency Exit for a Civil Defense Shelter in Leningrad



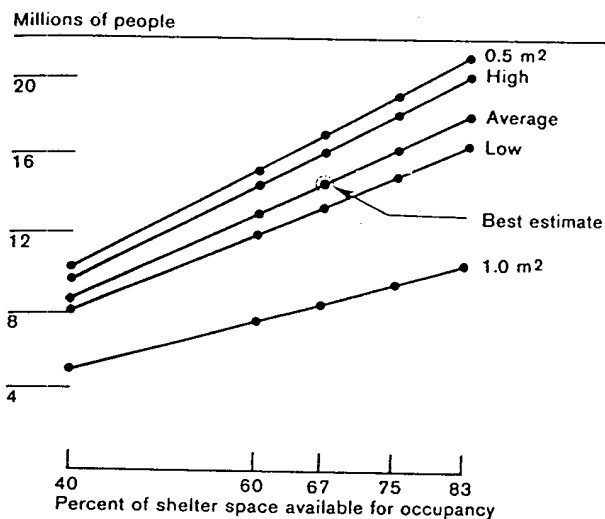
the year, the effective shelter temperature or the performance of the ventilation and filtration equipment used. Under certain conditions, for example, the standard may be as high as 2.5 square meters per person. One manual, published in 1971, indicates that the Soviet Union is divided into three climatic zones, affecting allocations of shelter floorspace, ranging from 0.5 to 1.0 square meter per person. For each zone, the occupancy factor is given for two types of construction—(a) poured concrete and (b) prefabricated concrete, stone, or masonry parts. (See figure 5.)

9. Our estimates of the capacity of Soviet shelters are made by applying the occupancy factors given in Soviet publications to the shelters located in each of the three climatic zones, using one of three assumptions about the type of shelter construction. Assuming Soviet blast shelters were constructed in the fashion most favorable for high-occupancy rates, 12.3 percent of the Soviet urban population could be sheltered. If

we assumed all shelters were built of the less favorable type for high-occupancy rates, 10.2 percent could be sheltered. Our current best estimate of the capacity of Soviet shelters assumes an even mix of these types of construction and indicates that 11.1 percent of the urban population could be sheltered. If we were to use occupancy factors of 0.5 or 1.0 square meter per person as in the 1977 IIM, our latest shelter survey would imply that some 13.0 or 6.5 percent of the total urban population could be sheltered.

10. *Shelter Capacity by City Size.* The data collected in the study show that, in general, large cities can shelter a higher percentage of their population than small cities. Our estimates are summarized in table 4. Assuming that Soviet blast shelters were of an equal mix of construction types and using Soviet occupancy factors for shelters in each climatic zone, we estimate that the percentage of the population that could be sheltered would range from an average of

**Figure 4**  
**Sensitivity of Shelter Capacity Estimates to Assumptions About Occupancy Factors and the Percent of the Shelter Available for Occupancy**



about 22 percent in the largest cities surveyed to about 6 percent in the smallest. This range would be 24 to 7 percent if the occupancy factor for all shelters were 0.5 square meter per person, or 12 to 3.5 percent if the occupancy factor were 1.0 square meter per person. There is greater variance in the percent of the population that can be sheltered in those large cities surveyed than among the smaller cities. Kiev and Minsk are estimated to be able to shelter about 40 percent of their populations, whereas Leningrad, Sverdlovsk, and Tbilisi are estimated to be able to shelter about 14, 13, and 4 percent respectively (see table 5).

11. The Soviets' capability to shelter people in large cities would be even greater if the space in subway systems were included. Of the 13 cities in the Soviet Union with a 1976 population of 1 million or more, seven have operating subway systems. Subways are under construction in six additional cities and are planned for eight more (see table 6). Existing subway facilities could add about 2.6 million square meters of shelter space to our estimate if subway platforms and tunnels were utilized as shelters. Only some 0.4 million square meters of area would be provided by the platforms. Our best estimate of the average percentage of

population in cities of 1 million or more that could be protected would increase from about 22 percent as shown in table 2 to about 24 percent, if only subway platforms were added, or about 32 percent if the area in both tunnels and platforms were counted. The capacity of subway platforms and tunnels to serve as shelters raises from 11 to 13 our best estimate of the percent of the total urban population that can be sheltered. We do not yet know how much of the subway system will be allocated for sheltering or the amount of space that will be allotted per person (we assume 1 square meter per person), and we have some uncertainty about the presence of life-support equipment in all of the systems.

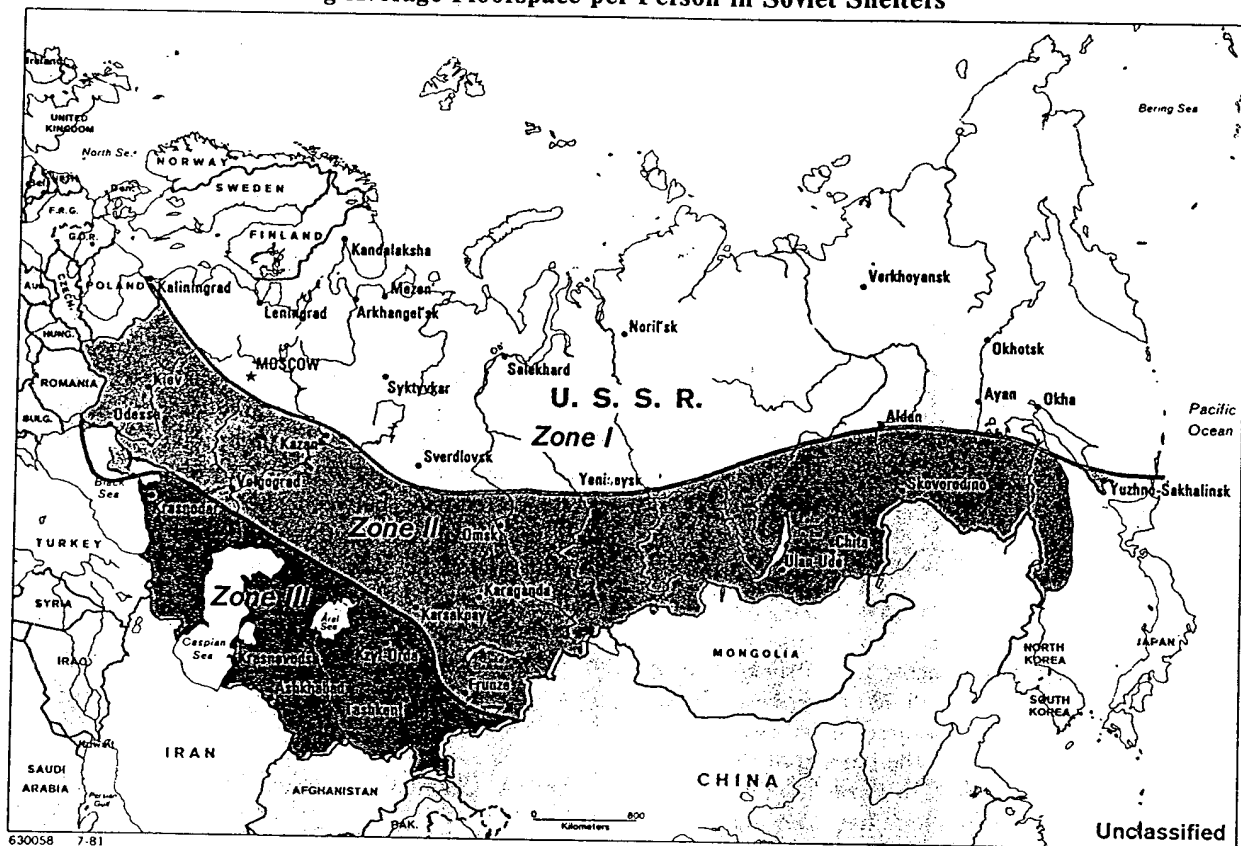
12. *Shelter Capacity—Other Variables.* In addition to comparing shelter capacity to city size, we attempted to correlate civil defense blast shelter capacity with other variables pertinent to the 57 Soviet cities selected in our sample survey. We analyzed the economic, geographic, political, military, and land-use factors shown in table 7. The preliminary conclusions from our analysis of these factors are that there are no strong correlations between the variables examined and the percentage of the population that can be accommodated in blast shelters. Land use and geographic factors, however, appear to be the best determinants of the percentage of a city's population that can be sheltered. Economic and political factors appear to be less important as determinants; military variables were found to have little predictive value.

#### Shelter Capacity at Industries

13. The location of civil defense shelters indicates a Soviet emphasis on protection of the industrial work force. About 48 percent of the shelters identified in our survey were associated with industrial installations, 23 percent with residential buildings, 22 percent with government, administrative, or institutional buildings, and 7 percent with other or unidentified facilities. The number of shelters detected under construction in each category in our current study indicates that the Soviets are maintaining these relative priorities. In all, 70 percent of the shelters identified are at places of work.

14. According to Soviet civil defense plans, the essential work force at key economic facilities would work around the clock on two or three shifts per day during crises. The work force on duty would be pro-

**Figure 5**  
**Climatic Zones Affecting Average Floorspace per Person in Soviet Shelters**



**Soviet Norms for the Average Floorspace per Person in Shelters**

Type of Construction	Floor Area per Person		
	Zone I	Zone II	Zone III
Prefabricated Concrete, Stone, or Masonry Parts	0.5	0.65-0.7	1.0
Poured Concrete	0.5	0.5-0.6	0.75

Table 4  
Soviet Urban Shelters, by City Size<sup>a</sup>

	Number of Cities	Total Population (thousands)	Available Area <sup>b</sup> (thousand sq meters)	Percent of Population Protected
Over 1 million.....	13	27,223	3,300.9	21.8
100,000-1 million	240	72,016	4,042.5	9.3
25,000-100,000.....	658	32,580	1,135.4	5.9
<b>Total .....</b>	<b>911</b>	<b>131,819</b>	<b>8,478.8</b>	<b>11.1</b>

<sup>a</sup> Based on estimated 1978 populations.

<sup>b</sup> Estimated at two-thirds of the exterior shelter area.

Table 5  
Estimated Shelter Capacity for 57 Sampled Cities,  
Plus Leningrad and Kiev

City Population Strata	City	Percent of Population Sheltered	City Population Strata	City	Percent of Population Sheltered
2,000,000 or more	Kiev	40		Kzyl-Orda	1
	Leningrad	14		Margilan	7
1,000,000-1,999,999	Minsk	39		Nevinnomyssk	8
	Sverdlovsk	13		Orsk	24
	Tbilisi	4		Rovno	7
				Sumy	2
500,000-999,999	Alma Ata	11	50,000-99,999	Syktyvkar	5
	Baku	4		Balashov	1
	Dnepropetrovsk	14		Bugulma	7
	Tula	12		Gubkin	7
	Vladivostok	5		Ishimbay	<sup>a</sup>
	Voronezh	10		Iskitim	23
	Yerevan	5		Kzyl	10
250,000-499,999	Astrakhan	7	25,000-49,999	Navoi	<sup>b</sup>
	Ivanovo	13		Novoaltaysk	<sup>a</sup>
	Kemerovo	8		Ramenskoye	6
	Kurgan	12		Tobolsk	2
	Nizhniy Tagil	19		Vyborg	<sup>b</sup>
	Vilnius	<sup>a</sup>		Birsk	5
	Vitebsk	5		Domodedovo	14
	Vladimir	16		Kirovskiy	3
Voroshilovgrad	7	Kizel	<sup>a</sup>		
100,000-249,999	Achinsk	9		Novokazalinsk	<sup>a</sup>
	Belovo	<sup>a</sup>		Omutninsk	18
	Beltsy	5		Pervomaysk	8
	Berdiansk	11		Slobodskoy	3
	Chardzhou	3		Stepan Razin	2
	Elektrostal	15		Velsk	22
	Kiselevsk	<sup>a</sup>		Vladimir Volynskiy	2
	Kutaisi	6		Vyazma	12

<sup>a</sup> Not available.

<sup>b</sup> Less than 0.5 percent.

**Table 6**  
**Subway Systems in Soviet Cities, June 1980**  
(tunnel length in kilometers)

	Complete	Under Construction	Planned
<b>Systems in operation</b>			
Moscow.....	184.9	29.8	136.2
Leningrad.....	55.5	11.5	132.8
Kiev.....	16.0	15.8	14.0
Tbilisi.....	15.8	—	14.0
Baku.....	19.3	10.7	14.0
Kharkov.....	18.0	—	40.0
Tashkent.....	10.7	4.5	40.0
<b>Systems under construction</b>			
Chelyabinsk.....	—	one tunnel	Unknown
Yerevan.....	—	12.0	19.0
Gorkiy.....	—	10.0	Unknown
Minsk.....	—	17.0	33.0
Novosibirsk.....	—	13.0	Unknown
Volgograd.....	—	1.5	Unknown
<b>Projected</b>			
Dnepropetrovsk.....	—	—	(surveyed)
Krivoy Rog.....	—	—	30.0
Khabarovsk.....	—	—	(surveyed)
Kuybyshev.....	—	—	17.5
Riga.....	—	—	31.0
Omsk.....	—	—	(surveyed)
Rostov-on-Don.....	—	—	(surveyed)
Sverdlovsk.....	—	—	11.0

~~Secret~~

ected by shelters at their place of work. The off-duty personnel would be dispersed outside the city to zones within commuting distance. Although the actual distance has not been specified, Soviet regulations state that commuting time should not exceed 2.5 hours one way. In 1977 we conducted a survey of 150 industrial plants selected from what we judge to be key recovery industries.<sup>2</sup> We estimate that the blast shelters identified at these installations had sufficient floor space to protect 24 percent of the estimated total labor force—assuming shelter occupancy at 0.5 square meter per person. If one-half of the total work force were dispersed, 48 percent of the remainder could be sheltered.<sup>3</sup> In a recent reanalysis of two of the 150 plants, we discovered shelter space in excess of what we found

<sup>2</sup> Aluminum, bearings, cement, chemicals, communications and electrical equipment, electric power, engines, iron and steel machine tools, motor vehicles, nonferrous metals, pharmaceuticals, petroleum, and synthetic rubber.

<sup>3</sup> These percentages would have been less, if our most recent analysis of shelter occupancy factors were used.

during the initial search. Although we cannot confidently make extrapolations of these findings to the other 148 plants initially surveyed, the results of this limited sample suggest that the 1977 figures are low.

### Types of Shelters

15. Protective structures of Soviet civil defense are divided into two types: blast shelters (*ubezhishcha*) and radiation or fallout shelters (*protivoradiatsionnye ukrytiya*). Blast shelters are designed to withstand all effects of nuclear weapons and chemical and biological agents as well as to control temperature and humidity, whereas fallout shelters are designed with emphasis on protection from prompt radiation and fallout. Nonetheless, fallout shelters provide some protection from blast effects. The 57-city survey and the resulting estimates of the shelter program nationwide address only blast shelters.

16. *Blast Shelters.* Our best estimate is that Soviet civil defense shelters at economic installations are de-

Table 7

**Factors Examined for Each City To Establish  
a Rationale and Predictive Function for  
the Percentage of the Population  
That Can Be Sheltered**

---

<b>Economic</b>
Weighted value of capital stock and output
Weighted value of capital stock and output of machine building and metal working
Number of economic facilities
Number of processing facilities
Number of equipment manufacturing facilities
Number of basic services facilities
Number of civilian end-product facilities
Number of military materiel facilities
<b>Geographic</b>
Distance to international borders
Congestion of possible evacuation routes
Climatic conditions
Factors affecting underground construction
<b>Political</b>
Position of city in the administrative hierarchy
Estimated Communist Party membership
Number of delegates from the local oblast to the Party Congress
Number of members in the Central Committee and Central Auditing Commission residing in that city
Number of key political figures affiliated with the city
<b>Military</b>
Number of military installations
Number of surface-to-air missile facilities
Number of ground installations
Number of naval installations
Number of air and air defense installations
<b>Land Use</b>
Area of the city
Percentage of residential land use
Percentage of industrial land use
Percentage of military land use
Percentage of open areas
Number of civil defense training sites
Size of clusters of industrial facilities

---

signed for loads of 100 to 300 kilopascals (14 to 43 pounds per square inch). Our analysis indicates that a typical Soviet shelter located at economic enterprises was designed for 200 kPa (28 psi). Design loads can usually be considered as providing a high probability of "sure safe" survival under sustained overpressure. The characteristic durations of the pulse or overpressure of different weapons are significant factors in the assessment of structural damage.

17. Soviet regulations classify blast shelters according to strength, capacity, location, availability of filters

and ventilation equipment and in terms of the time of construction:

- **Strength.** Shelters are divided into five blast design load categories, although we do not know the design strength for each category. Our best estimate is that industrial and residential shelters are designed for 100 to 300 kPa (14 to 43 psi) and that higher design loads are reserved for shelters intended for the leadership.
- **Capacity.** Shelters are classified as small (up to 150 people), medium (150 to 450), and large (over 450).
- **Location.** Shelters are described as either basement or detached.
- **Filtration and Ventilation Equipment.** Equipment can be either factory-made or simplified equipment made from available materials.
- **Time of Construction.** Blast shelters are either of the permanent type, built during peacetime, or expedient shelters built rapidly under threat of attack.

18. We have identified four types of blast shelters—basement, detached, semidetached, and garage. Analysis of data collected in the 57-city photographic survey indicates that the Soviets have roughly equal numbers of basement and detached shelters. Basement shelters made up 51.4 percent of the shelters identified, detached shelters (including semidetached) made up 47.4 percent, and garage shelters were 1.2 percent. Through extrapolations of the data collected in the stratified random sample, we estimate basement shelters make up about 54 percent of all Soviet blast shelters, detached shelters account for about 46 percent, and garage shelters are less than 1 percent.

19. **Fallout Shelters.** Radiation or fallout shelters are classified by the Soviets into groups according to the time of construction and degree of attenuation of radiation. They can be permanent structures built during peacetime, temporary structures hastily built from local materials under threat of an attack, basements and cellars adapted as fallout shelters under threat of attack, or existing buildings used without modification.

20. The degree of attenuation of radiation is the extent to which a protective structure reduces the dose of radiation over time. The Soviets assess the attenuation of radiation of a one-story wooden house as a

protective factor (PF) of 2, of an open trench as 3, a production building or basement of a wooden home as 7, a stone house as 10, and a covered trench or basement of a stone home as 40 to 100. These figures are generally consistent with US assessments of the PFs for similar buildings.

21. Soviet documentary sources indicate a preference for adapting structures as radiation shelters rather than the construction of new fallout shelters. Adaptation takes less time and reduces the effect of such problems as the shortage of construction materials and complications of weather or hydrological conditions. Soviet sources cite the following structures as suitable for adaptation as fallout shelters: basements, root cellars, cellars, housing, mines and mine works, subway sections, and other underground excavations. In addition, there is an extensive body of Soviet literature and human source reporting that confirms the existence of Soviet plans for the rapid construction of expedient fallout shelters.

#### Pace of Shelter Construction

22. The information collected in the [ ] 57 cities allows us to make a rough estimate of the current pace of the Soviet shelter construction program. If the current pace of construction is continued, the number of people who can be sheltered will increase from about 15 million at present to about 22 million in 1988. Taking into account the estimated growth in the urban population, we calculate that the percentage of city dwellers that could be sheltered would grow from the current 11 percent to about 13 percent in 1988. Nevertheless, because of the projected growth of the Soviet urban population, the number of urban dwellers who could not be sheltered in the cities would increase by about 30 million, from about 115 million in 1979 to 145 million in 1988. Thus, effective protection of the general population would still require large-scale urban evacuation, both now and in the future.

#### URBAN EVACUATION

23. During the past year we have acquired information that has given us a better understanding of Soviet planning for evacuation of urban areas. We now estimate Soviet planning for urban evacuation is less extensive but more intensive than we had previously hypothesized. We had postulated on the basis of

limited information that 75 percent of the population of all cities with more than 25,000 people would evacuate—a total of about 100 million evacuees from some 900 cities. On the basis of a recently completed analysis of more detailed data on Soviet evacuation, we currently estimate that some 300 cities would evacuate, but that 90 percent of the population in those cities would be involved—a total of about 85 million evacuees. There is an alternative view that the evidence available is too tenuous to allow a confident assessment of the number of cities the Soviets plan to evacuate.<sup>4</sup>

24. Soviet planning for protecting urban residents against weapons of mass destruction<sup>5</sup> include dispersal and evacuation in conjunction with the use of shelters and individual protective devices. The Soviets define dispersal of workers as “the organized removal and quartering in the exurban zone of the employees of those enterprises and organizations which continue to operate in the cities and of important installations located outside these cities.”<sup>6</sup> Dispersed workers commute back to their jobs in the city where operations continue around the clock in continuous shifts. Dispersal is to take place within a distance requiring no more than 2.5 hours travel time one way. Facilities that would continue operation include those important for mobilization of the economy to a wartime basis, as well as those needed to support the vital activities of cities (for example, utilities). While on duty the work force would be afforded protection by shelters at or near the place of work.

25. The Soviets define evacuation as “organized removal of employees of enterprises, organizations, and institutions that have halted operations or are to shift their operations to the exurban zone, as well as the population that is disabled or not employed in production, from the zones of possible heavy destruction in the cities and major installations located outside these cities.”<sup>7</sup> In addition, the Soviet concept of evacuation includes relocation, that is, movement of

<sup>4</sup> The holders of this view are the Director, Defense Intelligence Agency; and the Senior Intelligence Officers of the military services.

<sup>5</sup> The Soviets use the term “weapons of mass destruction” to refer to nuclear, chemical, and biological weapons.

<sup>6</sup> Yegorov, P. T., Shlyakov, I. A., and Alabin, N. I., *Civil Defense*, Third Edition, (Moscow, 1977).

<sup>7</sup> Yegorov, P. T., Shlyakov, I. A., and Alabin, N. I., *Civil Defense*, Third Edition, (Moscow, 1977).



both equipment and personnel of some facilities. For the purpose of this study, however, we use the term evacuation to include all three types of Soviet civil defense measures—dispersal, evacuation, and relocation.

26. *The New Analysis.* During the past year we have collected data on Soviet evacuation plans from human sources and supplemented it with information on Soviet civil defense exercises. Data gathered on 148 Soviet cities indicated whether or not the general population of the city was to evacuate during implementation of the national civil defense plan. We have analyzed these data in an attempt to identify the rationale behind the Soviet selection of cities to be evacuated. We developed a classification rule that could be applied to all Soviet cities and applied this rule to determine which urban areas are slated for evacuation. For a discussion of the data base and the methodology used in this analysis see annex B.

27. The analysis indicates that population is the most significant factor in determining which cities will be evacuated. A city with a population greater than 85,500 will probably be evacuated. Using this technique, we correctly classified 91.2 percent of the cities for which we knew the evacuation status. Other important factors selected in the analysis were the presence of facilities engaged in basic processing and production of military materiel. The importance of these factors is supported by reporting from human sources and the 1961 Soviet Civil Defense Statute, which categorizes large administrative centers and industrial cities as priority areas for civil defense.

28. The most valid indicators for the classification rule proved to be city size and the presence of facilities engaged in production of military materiel. This rule correctly matched 93.9 percent of the 148 cities for which we had evidence of evacuation status. The rule was used to identify which of the 900 Soviet cities with populations greater than 25,000 would be evacuated. This classification indicated that some 300 cities would be evacuated and that some 600 would not. Collectively, the 300 cities to be evacuated have a population of about 95 million people—nearly 40 percent of the total Soviet population and about 75 percent of the urban population.

29. Not all people in a city slated for evacuation would evacuate upon the initiation of Soviet civil defense plans. Those assigned to remain in the cities would include one work shift at key industrial facili-

ties, employees of installations which support vital activities of the city, such as utility workers, and perhaps some party, government, and civil defense officials. Recent evidence indicates that personnel remaining in cities at the time of evacuation would comprise about 10 percent of the urban population. In the IIM issued in 1977, 25 percent of a city's population was assumed to remain in the city. Thus, we had formerly postulated that 75 percent of the population of all Soviet cities with more than 25,000 people would evacuate—a total of about 100 million evacuees from some 900 cities. Our latest analysis indicates that about 90 percent of the population would evacuate from only some 300 cities—a total of about 85 million evacuees.

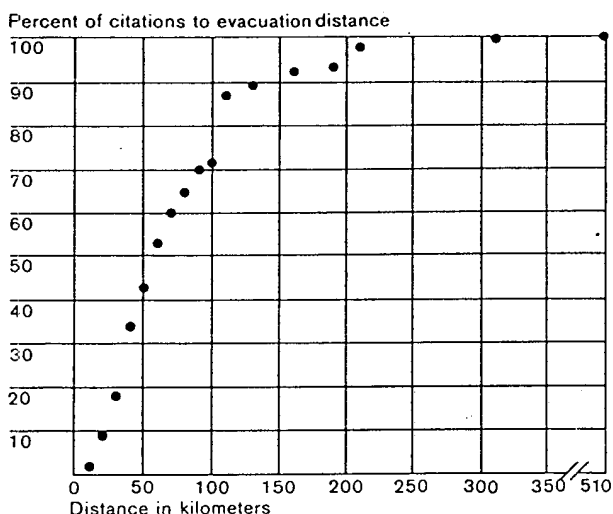
30. A review of human source reporting on evacuation plans also provides a good insight to the distances evacuees would travel. Of evacuation distances cited 50 percent were to places within 60 km of the city and 85 percent were within 100 km (see figure 6). The frequency of citations for the distance evacuees would travel is plotted in figure 7. The 100-km radii around those cities estimated to evacuate in accordance with Soviet civil defense plans are shown on the map, figure 8. This plot represents the area in which we believe the bulk of the evacuated Soviet population would be located. This evidence gives additional support for our previous estimate that an evacuation of the bulk of population from urban areas could be accomplished in two to three days. As much as a week would be required for full evacuation of the largest cities. These times could be extended in some areas by transportation shortages and adverse weather conditions.

31. Although urban evacuation has a central role in Soviet civil defense plans, evacuation exercises involving the entire population of cities are not part of Soviet civil defense training. We have evidence that Soviet civil defense leaders view large-scale evacuation exercises as excessively disruptive and are concerned that a major exercise might precipitate panic.

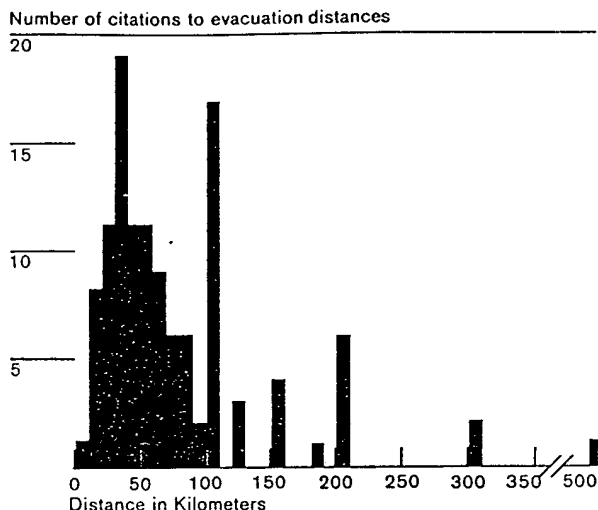
## EFFECTS OF SOVIET CIVIL DEFENSE

32. We recently assessed the effects of Soviet civil defense, utilizing computer models to simulate a large-scale US retaliatory attack on the USSR following a Soviet first strike on US strategic forces. The surviving elements of US strategic forces responded with a massive attack against Soviet military and economic tar-

**Figure 6**  
**Pattern of Evacuation Distances for Urban Populations in Soviet Civil Defense Plans**



**Figure 7**  
**Reported Distances That Soviet Civil Defense Evacuees Would Travel**



gets. The Soviet population was neither specifically targeted nor avoided. Details of the simulation and its results are included in annex C. Assessments of the effects of the retaliatory strike were made under three different assumptions about the preparation and implementation of Soviet civil defense: little or no preparation, implementation of the sheltering program only, and complete implementation of both sheltering and urban evacuation.

33. For the base case analysis, US forces in 1979 and those projected for 1988 were assumed to be on generated alert. In addition, similar analyses were made assuming US forces were on day-to-day alert.

34. The Soviet forces used in the analysis were those projected in National Intelligence Estimates in 1978 under the assumption that SALT II limits extended through 1989. The US forces used were in accordance with Department of Defense planning.

35. Several improvements were made in our analysis of the effects of Soviet civil defense compared to the one done for the 1977 Interagency Intelligence Memorandum. The improvements include better data

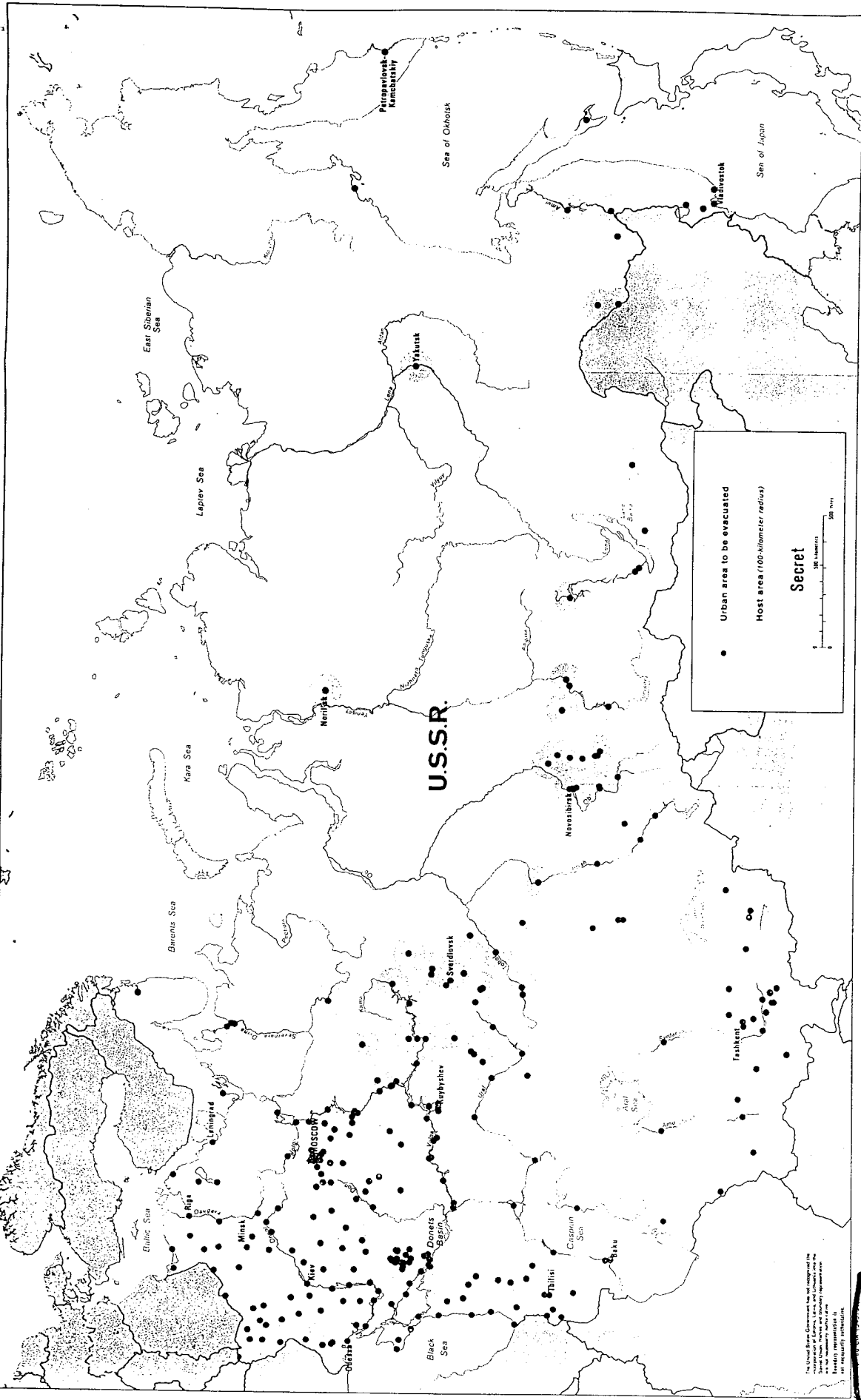
bases, improved computer modeling techniques, and an enhanced understanding of the Soviet civil defense program. In general, we have more confidence in our findings and a better understanding of the sensitivity of the results of our analysis to variations in the input data and the assumptions used.

36. In simulating the US attack for our base case, we used the number and characteristics of US weapons operational in 1979 and the US systems programed or planned for 1988. Actual US targeting plans were not used, [

] To evaluate the results of our simulation we replicated our analysis using an alternative hypothetical US attack [

] The results were consistent with the findings of our base case. We therefore believe our analysis provides a realistic appreciation of the effects of Soviet civil defense measures in reducing the level of Soviet casualties.

Likely Host Areas for Urban Evacuees



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37. The key findings of our assessment of the effects of a retaliatory attack on the USSR by present US forces on generated alert are:

- Protection of the leadership. With as little as a few hours' warning a large percentage of the Soviet leadership at all levels would probably survive.
- Protection of the essential work force. With sufficient time to implement the shelter program, a large percentage of the essential work force would probably survive.
- Protection of the general population. Casualties (fatalities and incapacitating injuries) to the Soviet population would vary greatly depending on the extent to which civil defense measures were implemented (see figure 9). Casualties would be about 125 million (including 105 million fatalities) in the case of little or no implementation and about 115 million (85 million fatalities) if urban blast shelters and the best available protective structures were occupied. Casualties would be about 45 million (30 million fatalities), if full sheltering had been implemented, and 90 percent of 300 Soviet cities had been evacuated, according to current Soviet planning. In the 1977 IIM we hypothesized that the Soviets would evacuate 75 percent of the population of all cities over 25,000. If the Soviets completed such an evacuation, casualties from the hypothetical retaliatory attack by US forces on generated alert would be 35 million, including 25 million fatalities.
- Protection of economic facilities. The hypothetical US retaliatory attack on the USSR destroyed nearly 80 percent of the value of the economic targets [ ]

38. Soviet casualties would be fewer if US forces were on day-to-day alert at the time of the Soviet first strike (see figure 9). Casualties would be about 115 million (including 75 million fatalities), in the case of little or no implementation, and about 95 million (55 million fatalities), if urban blast shelters and the best available protective structures were occupied. Casualties would be about 35 million (14 million fatalities), if full sheltering had been implemented and 90 percent of the population of 300 Soviet cities had been evacuated.

39. The most critical decision to be made by Soviet leaders in terms of saving their population would be whether or not to evacuate. The cost of not evacuating could approach 70 million casualties, including 55 million fatalities. The potential benefit of complete implementation of sheltering and evacuation of 300 cities would be the reduction of Soviet casualties by some 80 million, including some 70 million fatalities. The Soviets' best prospect for further reducing casualties and fatalities would be to evacuate more cities. For example, if the Soviets were able to evacuate 90 percent of the population of all cities of 25,000 or more people—over 900 cities compared to the 300 evacuated in our base case analysis—the number of casualties from an attack by US forces on generated alert could be reduced from some 45 million to 25 million; fatalities from about 30 million to 15 million.

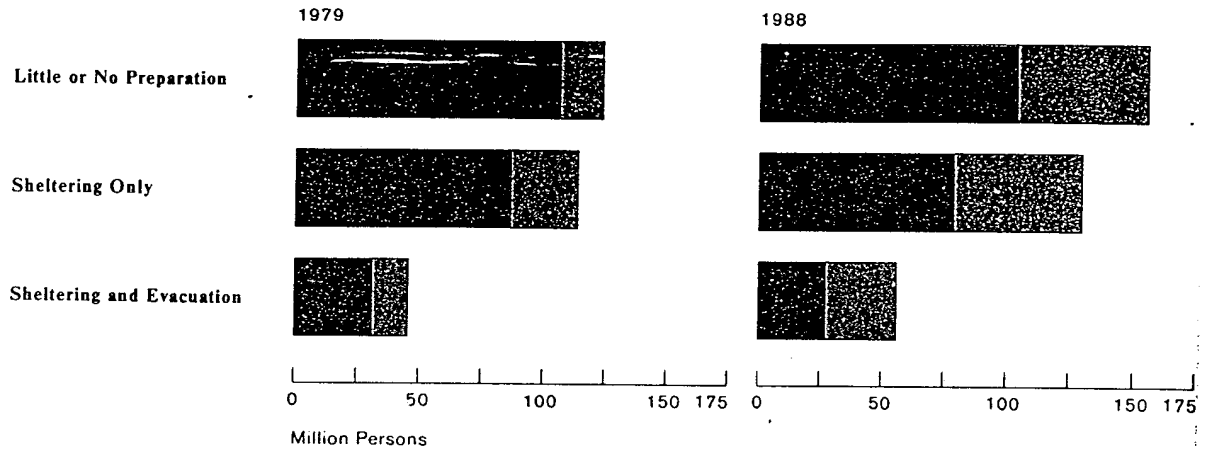
40. Our assessment indicates that in 1988 a hypothetical retaliatory attack by US forces on generated and day-to-day alert would result in an even larger number of Soviet casualties among the general population than in 1979 (see figure 9). In making this calculation, we have estimated the overall change in the urban and rural population for the decade and extrapolated these rates uniformly for all urban and rural areas. The projected increase in the number of Soviet shelters during the next 10 years would be more than offset by expected increases in Soviet urban population and planned net increases in the number and yield of US weapons. Expected improvements in Soviet civil defense preparations would, however, increase the likelihood of survival of a large percentage of the leadership and essential personnel. We do not foresee any significant improvement in the ability of the Soviets to protect their economic facilities from a US nuclear strike directed against them.

41. There are great uncertainties in the results of attack simulations and damage assessments like those used in our analysis of the effects of civil defense. We are also uncertain about several aspects of the Soviet civil defense program. We therefore do not have high confidence in our single-value estimates of the numbers of Soviet casualties and fatalities for any of the assumed situations. We have much greater confidence in the relationship between the numbers of casualties estimated for the three levels of civil defense preparations.

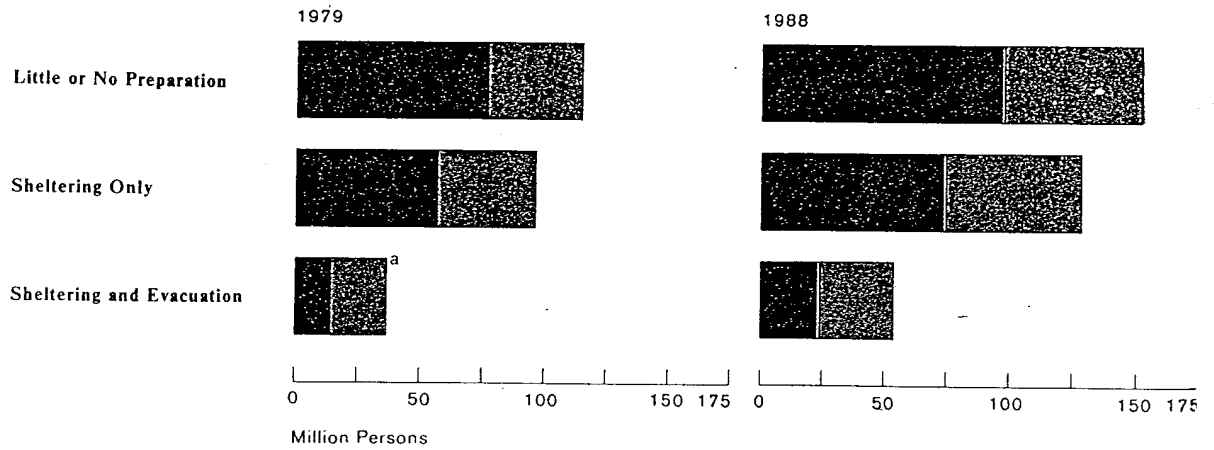
Figure 9

Estimated Effects of Soviet Civil Defense Preparations on Casualties

Retaliatory Attack by US Forces on Generated Alert



Retaliatory Attack by US Forces on Day-to-Day Alert



<sup>a</sup>In the 1977 IIM, assuming full sheltering and evacuation of 75 percent of 900 cities, we estimated that a retaliatory attack by US forces on day-to-day alert could result in casualties in excess of 20 million, including 5 million to 10 million fatalities. Using this same assumption for purposes of comparison, we estimate in our present analysis that Soviet casualties would be about 30 million, including 11 million fatalities.

Casualties  
Fatalities  
Incapacitated people

## Annex A

### The Soviet Civil Defense Shelter Program

1. *The Statistical Sample.* In the Interagency Intelligence Memorandum of December 1977,<sup>1</sup> the estimate of the percentage of the urban population that could be sheltered was based on the study of a nonrandom sample of 15 Soviet cities. The potential for biases inherent in the limited sample lessened our confidence that the sample was representative of a national pattern. Thus, in 1978 we developed a stratified random sample of 57 Soviet cities to be imaged and analyzed for making more reliable assessments of the Soviet shelter program. The use of a random sampling technique:

- Increases the reliability of estimates of the shelter program.
- Provides a basis for assessing the uncertainty of the estimates.
- Provides an effective and efficient use of intelligence resources.

2. The sampling plan called for the randomly selected Soviet cities to be searched [ ] The cities to be searched were selected from the 894 cities with a population of 25,000 or more in 1976. These 894 cities were grouped into seven strata based on their population (see table A-1). The sampling plan specified the total number of

<sup>1</sup> *Soviet Civil Defense: Objectives, Pace, and Effectiveness*, NI IIM 77-029, December 1977.

Table A-1

Stratification of Soviet Cities by Population <sup>a</sup>		
City Population Strata	Number of Cities	Total Stratum Population
2,000,000 or more <sup>b</sup> ..	3	13,421,000
1,000,000-1,999,000..	10	12,085,000
500,000-999,000.....	29	21,221,300
250,000-499,000.....	58	20,094,800
100,000-249,000.....	153	23,416,000
50,000-99,000.....	218	14,776,200
25,000-49,000.....	423	14,530,500
Total .....	894	119,544,800

<sup>a</sup> Population data are estimates for 1976.

<sup>b</sup> Not used in the statistical sample.

cities to be sampled and the number of cities to be selected from six of seven strata grouped by city size. The stratum of largest cities, containing Moscow, Leningrad, and Kiev, was not used because the latter two cities had been extensively searched in 1977. The results of the studies of Leningrad and Kiev have been updated [ ] Moscow was not searched because of its great size.

3. The original intention in stratification was to group the sampled cities into homogeneous strata relative to factors that might affect civil defense plans of the cities. Successful stratification reduces the sampling variability and provides more precise estimates of shelter capacity. In addition to population other criteria for stratification were considered, including geographic location, military importance, and economic activity. These criteria were not used to stratify the sample because the total number of cities in the sample was limited by the total man-hours available for the search effort. A large number of strata would have resulted in a small number of cities in each. This would decrease the precision of shelter capacity estimates, thus defeating the main purpose of stratification. Stratification on the basis of population alone was a compromise between the alternative criteria, because population is related to many other factors.

4. [ ]

5. The sampling plan took into consideration the total available search effort, the number of cities in each stratum, the estimated search time for a typical city in each stratum, and the expected variability of total city shelter capacities within each stratum. This latter factor was based on estimates obtained from the search in 1977 of 15 Soviet cities. A sample size of 57 cities was selected to maximize the precision of an estimator of the total Soviet shelter capacity. The allocation of the sample to the six strata was also distributed to optimize

Table A-2

Fifty-Seven Soviet Cities Searched for Civil Defense Shelters

City Population Strata	Cities Searched	Coordinates		City Population Strata	Cities Searched	Coordinates	
		° 'N	° 'E			° 'N	° 'E
1. 1,000,000-1,999,999	Minsk	53 54	27 34	5. 50,000-99,999	Nevinnomyssk	44 38	41 57
	Sverdlovsk	56 51	60 36		Orsk *	51 12	58 34
	Tbilisi *	41 42	44 45		Rovno	50 37	26 15
2. 500,000-999,999	Alma Ata *	43 15	76 57		Sumy	50 54	34 48
	Baku	40 23	49 51		Svktyvkar	61 40	50 48
	Dnepropetrovsk	48 27	34 59		Balashov	51 33	43 09
	Tula	54 12	37 37		Bugul'ma *	54 33	52 48
	Vladivostok	43 08	131 54		Gubkin *	51 17	37 32
3. 250,000-499,999	Voronezh	51 38	39 12		Ishimbay	53 29	56 02
	Yerevan *	40 11	44 30		Iskitim *	54 38	83 18
	Astrakhan'	46 21	48 03		Kyzyl	51 42	94 27
	Ivanovo *	57 00	40 59		Navoi	40 09	65 21
	Kemerovo	55 20	86 05		Novoaltaysk	53 24	83 55
	Kurgan *	55 26	65 18		Ramenskoye	55 34	38 14
	Nizhniy Tagil	57 55	59 57		Tobol'sk	58 12	68 16
	Vilnius	54 41	25 19	Vyborg *	60 42	28 45	
4. 100,000-249,999	Vitebsk	55 12	30 11	6. 25,000-49,999	Birsk	55 25	55 32
	Vladimir *	56 10	40 25		Domodedovo *	55 28	37 46
	Voroshilovgrad	48 34	39 20		Kirovskiy	40 26	49 51
	Achinsk	56 17	90 20		Kizel	59 03	57 40
	Bel'tsy	47 46	27 56		Novokazalinsk	45 50	62 10
	Belovo	54 25	86 18		Omutninsk	58 40	52 12
	Berdiansk *	46 45	36 47		Pervomaysk	48 38	39 33
	Chardzhou *	39 06	63 34		Slobodskoy *	58 42	50 12
	Elektrostal'	55 47	38 28		Stepan Razin	40 25	49 58
	Kiselevsk	53 59	86 39		Vel'sk *	61 05	42 08
	Kutaisi *	42 15	42 40	Vladimir-Volynskiy	50 51	24 20	
	Kzyl-Orda *	44 48	65 28	Vyaz'ma *	55 13	34 18	
	Margilan	40 27	71 44				

\* Selected in the subsample of 19 cities.

the precision of the estimate. The 57 cities were then randomly selected from each of the six strata. Table A-2 lists the 57 cities selected to be searched according to this plan.

6. To obtain preliminary estimates by the fall of 1978 for use in a National Intelligence Estimate, a subsample of the 57 cities was selected. The objective of this plan was to ensure that reasonably valid preliminary results of the sampled cities would be available at a time before all 57 cities are completely searched. Based on this plan, a subsample of 19 of the 57 cities was selected. These cities are indicated by an (a) in table A-2. The results of the survey of 18 of these cities (excluding Vladimir) formed the basis for the preliminary estimates and conclusions presented in a National Intelligence Estimate.

10. Imagery Exploitation. Imagery exploitation was done as a cooperative effort of imagery analysts

from the Central Intelligence Agency, the Defense Intelligence Agency, the Army, the Air Force

The results indicate a net increase of about 20 percent in the number of shelters.

11. *Methods of Estimation.* The information from the exploitation of each sector was stored in a computer data base. The sequence of statistical techniques used to estimate Soviet urban shelter capacity is quite simple. The process involves five steps. First, shelter count adjustment factors are derived for each type of shelter in each stratum. Then, these factors are applied to the observed number of shelters and the area of their floorspace in each of the sampled cities. This provides an estimate of the number of shelters and their capacity in each of the sampled cities. Next, the findings of the shelter survey for all cities in each stratum is used to generate a ratio estimator. This estimator allows the extrapolation of estimates for the sampled cities in a stratum to be used to estimate the shelter counts for all cities in that stratum. Calculations are then made of total shelter capacity in each stratum by multiplying the shelter count estimates of each type of shelter by estimates of the average size for each type. Finally, these estimates are used to estimate the percent of the population that could be accommodated.

15. *The Ratio Estimator.* The ratio estimator is defined using the following variables:

- $Y_h$  = the total number of shelters of a given type in stratum h
- $P_h$  = the total population of all cities in stratum h
- $y_{hi}$  = the estimated total shelter count of a given type in sampled city i from stratum h
- $p_{hi}$  = the population of city i in stratum h
- $n_h$  = the number of sampled cities from stratum h

Then an estimator of  $Y_h$  is

$$\hat{Y}_h = \frac{\sum y_{hi}}{\sum p_{hi}} P_h$$

where the sums are over i from 1 to  $n_h$ .

12. The precision of the resulting estimates of the number of shelters is derived from the estimates of the variances of the shelter count estimators. Similarly, confidence bounds for estimates of shelter area are based on estimates of the variance of shelter area estimators. Mathematical formulas of each of these steps are presented below.

16. *Projections of Shelter Capacity in 1988.* Although we have no direct evidence of Soviet plans for shelter construction over the next decade, our projections of the capacity of Soviet shelters in 1988 are made on the assumption that the current rate of construction will be maintained. The rate of shelter construction in the Soviet Union

shows an increase beginning in the late 1960s. The rate has varied from area to area and year to year, but appears generally to have increased until the mid-1970s. Judgments about the rate of construction since that time are tenuous, but we believe the rate has continued at about the same level. Our estimates of the current rate of construction are based on two types of studies. First, detailed studies of the shelter programs in Kiev, Leningrad, and Minsk provide a reasonably good time series of the addition of new shelters. Second, the 57-city sample survey provided a count of the number of shelters observed under construction. These studies indicate that the Soviets are currently adding about 5-6 percent to their shelter capacity. In our projections we assume this amount will continue to be added each year through 1988. On this basis we estimate that the shelter capacity in 1988 will be about 55 percent greater than that of 1978-79.

13.

14. *Shelter Count Adjustment Factors.*

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## Annex B

### Soviet Urban Evacuation

1. *The Data Base.* During the past year analysis of recently acquired information has given us a better understanding of Soviet planning for evacuation of urban areas. Indications that a city has or does not have an evacuation plan were collected from human sources and Soviet civil defense exercises. The human sources ranged from employees who had learned of evacuation plans during civil defense training to civil defense employees responsible for the development and implementation of civil defense plans. Of the 148 cities in the data base, the intelligence sources indicated that 69 had evacuation plans for their populations, 69 were host areas for evacuees, and 10 were simply known not to evacuate. We cannot be sure how representative these cities are; 38 percent of the cities reported to have evacuation plans were cited by two or more sources. Nevertheless, we are confident that the information available is a reliable basis from which to assess the extensiveness of Soviet urban evacuation. There is an alternative view that the evidence available is too tenuous to be confident about the number of cities the Soviets plan to evacuate.<sup>1</sup>

2. *Methodology.* The statistical procedure used in the analysis is called stepwise multiple discriminate analysis. This analytical technique examines a set of attributes of the 148 cities and selects the subset of those attributes that best discriminates between "evacuation" and "nonevacuation" cities. The resulting discrimination rule weights each of the selected factors according to its importance in discriminating between evacuation and nonevacuation cities. The validity of the discrimination rule is judged by the percentage of cities correctly classified when the rule is applied to the original data base. Once a rule is developed and selected, it is applied to the other cities in the Soviet Union by substituting the values of the selected factors of each city into the discrimination function. The resulting value of the function indicates into which of the two groups the city should be classified.

<sup>1</sup> The holders of this view are the representatives of the Defense Intelligence Agency and the intelligence organizations of the military services.

3. The attributes that were examined included economic, population, and military characteristics of the cities. [

] All installations within 20 kilometers of the center of a city were attributed to that city. Thus it was possible to count the number of installations that have a specific functional or product classification for each city.

4. Preliminary calculations were made using the weighted value of manufacturing value added and capital stock. These values, however, were found to be highly correlated with the number of installations. They were determined to never be significant for discriminating between evacuation and nonevacuation cities once the number of installations were included in the discrimination rules. For this reason, manufacturing value was not considered in the analyses.

5. The factors used in the analyses are shown in table B-1. These data were collected on each of the 148 cities and all other Soviet cities with populations greater than 25,000. Several discrimination rules were developed and compared.

6. Table B-2 presents a list of those cities used in the analysis for which evidence indicated the general population was slated for evacuation. Table B-3 includes those cities indicated not slated for evacuation (most of which are known host areas). Table B-4 provides a composite listing of all cities estimated to be slated for evacuation, including those listed in table B-2 for which reporting exists. Table B-5 provides a composite listing of all cities estimated not to be slated for evacuation, including those reported in table B-3.

Table B-1  
Factors Used in the Analysis

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**I. Population**

**II. Economic**

**A. Basic processing**

1. POL and related products production
2. Iron and steel production
3. Chemicals production
4. Other basic processing

**B. Basic equipment**

1. Metalworking machinery manufacturing
2. Electrical equipment manufacturing
3. Other basic equipment manufacturing

**C. Basic services, research, and utilities**

1. Research and development facilities
2. Telecommunication
3. Electric power plants
4. Railroad transportation
5. Other basic services, research, and utilities

**D. Civilian end products**

**E. Military end products**

1. Atomic energy facilities
2. Aircraft and component production
3. Ammunition production
4. Armament production
5. Motor vehicle production
6. Military engineering equipment production
7. Chemical and biological warfare production
8. Ship construction
9. Missile and space system production
10. Explosives production

**III. Military installations**

**A. Air and missile installations and joint commands**

1. Airfields
2. Air defense headquarters
3. Missile installations
4. Other air and missile installations

**B. Military troop installations—Army and Navy**

1. Ground forces installations
  2. Naval installations
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Table B-2

Cities Reported To Be Slated For Evacuation

	Population (thousands)	Coordinates			Population (thousands)	Coordinates	
		° 'N	° 'E			° 'N	° 'E
Akademgorodok.....	50	54 52	83 04	Magnitogorsk.....	400	53 27	59 04
Aktyubinsk.....	187	50 17	57 10	Margilan.....	126	40 27	71 44
Alma Ata.....	921	43 15	76 57	Minsk.....	1,283	53 54	27 34
Arkhangelsk.....	396	64 34	40 32	Moskva.....	7,820	55 45	37 35
Artemovsk.....	92	48 27	38 42	Murmansk.....	416	68 58	33 05
Astrakhan.....	480	46 21	48 03	Nikolayev.....	479	46 58	32 01
Baku.....	1,199	40 23	49 51	Norilsk.....	163	69 20	88 06
Bendery.....	113	46 49	29 29	Novokuznetsk.....	547	53 45	87 06
Chelyabinsk.....	1,088	55 10	61 24	Novosibirsk.....	1,364	55 02	82 55
Chernigov.....	258	51 30	31 18	Odessa.....	1,106	46 28	30 44
Chernovtsy.....	224	48 18	25 56	Omsk.....	1,055	55 01	73 24
Dnepropetrovsk.....	1,064	48 27	34 59	Penza.....	512	53 21	45 01
Donetsk.....	1,026	48 01	37 48	Petropavlovsk-Kamchatskiy.....	221	53 01	158 39
Dushanbe.....	541	38 35	68 48	Petrozavodsk.....	237	61 81	34 33
Fergana.....	160	40 23	71 46	Riga.....	830	56 57	24 06
Frunze.....	553	42 54	74 36	Rostov na Donu.....	935	47 14	39 42
Gorkiy.....	1,346	56 18	43 55	Rubezhnoye.....	69	49 01	38 23
Irkutsk.....	539	52 16	104 20	Saratov.....	881	51 34	46 02
Issyk.....	23	43 22	77 28	Sevastopol.....	323	44 36	33 32
Kaluga.....	297	54 31	36 16	Sumy.....	223	50 54	34 48
Karaganda.....	612	49 51	73 10	Sverdlovsk.....	1,203	56 51	60 36
Kemerovo.....	480	55 20	86 05	Tallin.....	451	59 24	24 43
Khabarovsk.....	553	48 30	135 06	Tashkent.....	1,982	41 20	69 18
Kharkov.....	1,470	50 01	36 15	Tbilisi.....	1,099	41 42	44 45
Kherson.....	355	46 38	32 36	Tiraspol.....	246	46 51	29 37
Kishinev.....	534	47 01	28 51	Tula.....	584	54 12	37 37
Kiev.....	2,157	50 26	30 31	Vilnius.....	489	54 41	25 19
Kommunarsk.....	129	48 30	38 47	Vinnitsa.....	330	49 15	28 29
Komsomolsk na Amure.....	255	50 35	137 02	Vitebsk.....	298	55 12	30 11
Krivoy Rog.....	676	47 55	33 21	Vladivostok.....	559	43 08	131 54
Kstovo.....	57	56 11	44 11	Volgograd.....	982	48 45	44 26
Kuybyshev.....	1,243	53 12	50 09	Voroshilovgrad.....	475	48 34	39 20
Leningrad.....	4,095	59 55	30 15	Yerevan.....	1,014	40 18	44 51
Lisichansk.....	143	48 55	38 26	Zaporozhye.....	784	47 49	35 11
Lvov.....	667	49 51	24 01				

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Table B-3

## Cities Reported Not Slated For Evacuation

	Population (thousands)	Coordinates			Population (thousands)	Coordinates	
		° 'N	° 'E			° 'N	° 'E
Aleksandrov.....	58	56 24	38 43	Madona Rayon.....	7	56 51	26 13
Alekseyevka.....	27	51 08	34 53	Maloyaroslavets.....	22	55 01	36 28
Ananyey.....	18	47 43	29 58	Merefa.....	31	49 48	36 03
Bakhchisaray.....	20	44 45	33 52	Mga village.....	6	59 76	31 06
Belgorod-Dnestrovskiy.....	39	46 12	30 21	Mozhaysk.....	23	55 30	36 01
Berezino.....	6	53 51	29 01	Mytishchi.....	140	55 55	37 46
Berezna.....	6	51 34	31 47	Nemenchine.....	5	54 51	25 29
Berezovka.....	10	47 12	30 55	Novgorod.....	187	58 31	31 17
Blagoyevo.....	3	46 56	30 39	Obukhov.....	1	48 47	27 45
Boguslav.....	12	49 33	30 53	Ola.....	6	59 35	151 17
Borispol.....	39	50 21	30 56	Orgeyev.....	35	47 22	28 49
Boyarka.....	32	50 19	30 19	Ovidiopol.....	7	46 16	30 26
Buguruslan.....	55	53 39	52 26	Panfilov.....	19	44 10	80 01
Chernobil.....	10	51 16	30 14	Paplaka.....	1	56 26	21 27
Cherven.....	10	53 42	28 26	Podolsk.....	228	55 26	37 33
Chuguyev.....	32	49 51	36 39	Radekov.....	5	50 17	24 39
Dergachi.....	24	50 07	36 08	Razdelnaya.....	14	46 51	30 05
Dneprodzerzhinsk.....	265	48 30	34 37	Sambor.....	32	49 31	23 12
Dobele.....	11	56 37	23 16	Sebesh.....	10	56 17	28 29
Dolinskoye.....	9	47 32	29 54	Shebekino.....	45	50 26	36 53
Gatchina.....	78	59 34	30 08	Shilute.....	14	55 21	21 29
Gdov.....	4	58 46	27 48	Sinyavino.....	7	59 51	31 07
Glubokiy.....	27	48 31	40 19	Sioni.....	4	41 59	45 02
Griva.....	3	55 51	26 30	Sloki.....	10	56 57	23 36
Ilichevsk.....	61	46 23	30 39	Soroki.....	27	48 09	28 18
Ivangorod.....	14	59 22	28 13	Toksovo.....	3	60 09	30 31
Ivankov.....	6	50 56	29 54	Tolmachevo.....	6	58 52	29 51
Ivanovka.....	4	46 58	30 28	Tripole.....	4	50 07	30 46
Izmail.....	89	45 21	28 51	Ukmerge.....	26	55 14	24 45
Kalinovskaya.....	5	43 34	45 31	Varena.....	2	54 13	24 34
Kargat.....	13	55 12	80 17	Vasilkov.....	33	50 11	30 19
Kehra.....	3	25 12	59 12	Verbovka.....	3	49 29	36 51
Kikerino.....	7	59 28	29 38	Vishennoye.....	2	45 08	34 36
Kiliya.....	28	45 27	29 16	Vologda.....	236	59 13	39 54
Kirovobad.....	216	40 41	46 22	Volosovskiy Rayon.....	5	59 26	29 29
Klin.....	92	56 20	36 44	Vsevolozhskiy.....	27	60 01	30 40
Kominternovo.....	4	46 49	30 56	Yekabpils.....	25	56 31	25 53
Kostroma.....	276	57 46	40 55	Zarasy.....	5	55 44	26 15
Kotovsk.....	43	47 45	29 32	Zelenogorsk.....	16	60 12	29 42
Luga.....	39	58 44	29 52				

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Table B-4

Cities Estimated To Be Slated For Evacuation

	Population (thousands)	Coordinates			Population (thousands)	Coordinates	
		° 'N	° 'E			° 'N	° 'E
Abakan.....	131	53 44	91 27	Donetsk.....	1,026	48 01	37 48
Achinsk.....	122	56 16	90 29	Dushanbe.....	541	38 35	68 48
Akademgorodok.....	50	54 52	83 04	Dzerzhinsk.....	268	56 15	43 30
Aktyubinsk.....	187	50 17	57 10	Dzhambul.....	273	42 54	71 23
Aleksin.....	73	54 30	37 03	Elektrostal.....	138	55 48	38 27
Alma Ata.....	921	43 15	76 57	Engels.....	169	51 29	46 08
Andizhan.....	300	40 47	72 21	Feodosiya.....	85	45 03	35 23
Angarsk.....	247	52 32	103 56	Fergana.....	160	40 23	71 46
Angren.....	113	41 02	70 08	Frunze.....	553	42 54	74 36
Anzhero Sudzhensk.....	111	56 06	86 02	Gomel.....	375	52 26	31 01
Arkhangelsk.....	396	64 34	40 32	Gorkiy.....	1,346	56 18	43 55
Armavir.....	164	44 60	41 07	Corlovka.....	371	48 20	38 05
Artemovsk.....	92	48 27	38 42	Grodno.....	205	53 41	23 51
Ashkhabad.....	313	37 57	58 23	Groznyy.....	425	43 18	45 41
Astrakhan.....	480	46 21	48 03	Guryev.....	171	47 06	51 56
Baku.....	1,199	40 23	49 51	Irkutsk.....	539	52 16	104 20
Balakovo.....	149	52 01	47 48	Iskitim.....	59	54 38	83 18
Balashikha.....	111	55 49	37 57	Issyk.....	23	43 22	77 28
Baranovichi.....	134	53 08	26 02	Ivano Frankovsk.....	162	48 55	24 44
Barnaul.....	554	53 21	83 45	Ivanovo.....	510	56 60	40 59
Bataysk.....	103	47 08	39 44	Izhevsk.....	558	56 51	53 14
Batumi.....	134	41 39	41 39	Kalinin.....	421	56 51	35 53
Belaya Tserkov.....	150	49 48	30 08	Kaliningrad.....	362	54 43	20 31
Belgorod.....	274	50 36	36 34	Kaliningrad.....	203	55 56	37 53
Beltsy.....	132	47 46	27 54	Kaluga.....	297	54 31	36 16
Bendery.....	113	46 49	29 29	Kamensk Uralskiy.....	213	56 24	61 55
Berdsk.....	68	54 46	83 05	Kamyshin.....	113	50 06	45 25
Berdyansk.....	121	46 47	36 47	Karaganda.....	612	49 51	73 10
Berezniki.....	196	59 26	56 49	Kaunas.....	368	54 55	23 56
Birobidzhan.....	68	48 48	132 56	Kazan.....	1,046	55 49	49 06
Biysk.....	215	52 32	85 11	Kemerovo.....	480	55 20	86 05
Blagoveshchensk.....	184	50 17	127 33	Kerch.....	181	45 22	36 29
Bobruysk.....	202	53 09	29 14	Khabarovsk.....	553	48 30	135 06
Bor.....	66	56 21	44 06	Kharkov.....	1,470	50 01	36 15
Borisoglebsk.....	71	51 22	42 06	Kherson.....	355	46 38	32 36
Borisov.....	112	54 14	28 32	Khimki.....	123	55 54	37 27
Bratsk.....	233	56 14	101 41	Khmelnitskiy.....	180	49 26	27 01
Brest.....	175	52 06	23 42	Kineshma.....	127	57 27	42 10
Bryansk.....	394	53 17	34 22	Kirov.....	386	58 37	49 39
Bukhara.....	161	39 47	64 26	Kirovabad.....	226	40 42	46 23
Chapayevsk.....	90	52 59	49 43	Kirovakan.....	165	40 50	44 29
Chardzhou.....	150	39 06	63 35	Kirovograd.....	230	48 31	32 17
Cheboksary.....	328	56 09	47 15	Kiselevsk.....	123	54 01	86 42
Chelyabinsk.....	1,088	55 10	61 24	Kishinev.....	534	47 01	28 51
Cherepovets.....	265	59 09	37 56	Kiev.....	2,157	50 26	30 31
Cherkassy.....	271	49 26	32 06	Klaypeda.....	184	55 43	21 07
Chernigov.....	258	51 30	31 18	Klimovsk.....	54	55 23	37 32
Chernovtsy.....	224	48 18	25 56	Kokand.....	181	40 33	70 56
Chimkent.....	330	42 19	69 37	Kolomna.....	144	55 05	38 48
Chirchik.....	155	41 29	69 35	Kommunarsk.....	129	48 30	38 47
Chita.....	305	52 03	113 30	Komsomolsk na Amure.....	255	50 35	137 02
Daugavpils.....	122	55 53	26 32	Konstantinovka.....	128	48 32	37 42
Dnepropetrovsk.....	1,064	48 27	34 59	Kopeysk.....	166	55 06	61 39
Dodonovo.....	83	56 15	93 29	Kovrov.....	140	56 23	41 20

Table B-4

Cities Estimated To Be Slated For Evacuation (Continued)

	Population (thousands)	Coordinates			Population (thousands)	Coordinates	
		° 'N	° 'E			° 'N	° 'E
Kramatorsk.....	275	48 44	37 34	Novosibirsk.....	1,364	55 02	82 55
Krasnodar.....	606	45 02	39 01	Nukus.....	114	42 28	59 36
Krasnoyarsk.....	799	56 01	92 56	Odessa.....	1,106	46 28	30 44
Krasnyy Luch.....	120	48 09	38 56	Omsk.....	1,055	55 01	73 24
Kremenchug.....	256	49 03	33 27	Ordzhonikidze.....	366	43 03	44 41
Krivoy Rog.....	676	47 55	33 21	Orekhovo Zuyevø.....	123	55 49	38 59
Kstovo.....	57	56 11	44 11	Orel.....	312	52 58	36 04
Kumertau.....	55	52 47	55 49	Orenburg.....	494	51 49	55 07
Kurgan.....	321	55 27	65 20	Orsha.....	135	54 32	30 26
Kursk.....	396	51 44	36 11	Orsk.....	248	51 14	58 31
Kustanay.....	189	53 14	63 38	Osh.....	168	40 32	72 48
Kutaisi.....	185	42 16	42 41	Pavlodar.....	266	52 17	76 58
Kuybyshev.....	1,243	53 12	50 09	Pavlovo.....	77	55 59	43 05
Kzyl Orda.....	160	44 51	65 30	Pavlovskiy Posad.....	69	55 47	38 40
Leninabad.....	201	40 17	69 38	Penza.....	512	53 21	45 01
Leninakan.....	193	40 48	43 51	Perm.....	1,036	58 01	56 15
Leningrad.....	4,095	59 55	30 15	Pervomayskiy.....	50	64 26	40 48
Leninsk Kuznetskiy.....	135	54 41	86 12	Pervouralsk.....	143	56 53	59 57
Lipetsk.....	391	52 36	39 37	Petropavlovsk.....	202	54 53	69 09
Lisichansk.....	143	48 55	38 26	Petropavlovsk-Kamchatskiy.....	221	53 01	158 39
Lutsk.....	144	50 45	25 20	Petrozavodsk.....	237	61 81	34 33
Lvov.....	667	49 51	24 01	Podkamen.....	183	49 57	25 20
Lyubertsy.....	195	55 41	37 56	Poltava.....	314	49 36	34 33
Magadan.....	116	59 34	150 48	Priluki.....	70	50 36	32 23
Magnitogorsk.....	400	53 27	59 04	Prokopyevsk.....	269	53 52	86 47
Makeyevka.....	454	48 04	37 58	Pskov.....	168	57 49	28 21
Makhaichkala.....	247	42 59	47 29	Pushkino.....	150	56 01	37 51
Margilan.....	126	40 27	71 44	Pyatigorsk.....	160	44 03	43 03
Mary.....	96	37 36	61 51	Ramenskoye.....	115	55 35	38 12
Maykop.....	136	44 36	40 06	Riga.....	830	56 57	24 06
Melitopol.....	185	46 51	35 23	Rostov na Donu.....	935	47 14	39 42
Miass.....	150	55 02	60 08	Rovno.....	174	50 38	26 15
Michurinsk.....	112	52 54	40 30	Rubezhnoye.....	69	49 01	38 23
Minsk.....	1,283	53 54	27 34	Rubtsovsk.....	179	51 32	81 12
Mogilev.....	290	53 54	30 21	Rudnyy.....	114	52 59	63 08
Moskva.....	7,820	55 45	37 35	Rustavi.....	161	41 33	45 02
Murmansk.....	416	68 58	33 05	Ryazan.....	480	54 38	39 44
Murom.....	144	55 35	42 04	Rybinsk.....	241	58 04	38 48
Nakhodka.....	131	42 50	132 54	Salavat.....	134	53 25	55 56
Nalchik.....	233	43 30	43 38	Samarkand.....	469	39 40	66 58
Namangan.....	277	41 01	71 40	Saransk.....	327	54 12	45 10
Nebit Dag.....	71	39 31	54 23	Sarapul.....	112	56 29	53 47
Neftekamsk.....	69	56 06	54 16	Saratov.....	881	51 34	46 02
Nikolayev.....	479	46 58	32 01	Semipalatinsk.....	303	50 25	80 14
Nikopol.....	150	47 35	34 23	Serov.....	120	59 37	60 35
Nizhnecamsk.....	152	55 37	51 47	Serpukhov.....	144	54 56	37 25
Nizhniy Tagil.....	400	57 56	60 02	Sevastopol.....	323	44 36	33 32
Norilsk.....	163	69 20	88 06	Severodonetsk.....	114	48 57	38 29
Novoaltaysk.....	53	53 26	83 56	Severodvinsk.....	197	64 35	39 50
Novoherkassk.....	209	47 27	40 05	Shakhty.....	253	47 42	40 15
Novokuybyshevsk.....	119	53 06	49 56	Shchelkovo.....	115	55 55	38 02
Novokuznetsk.....	547	53 45	87 06	Shevchenko.....	124	43 39	51 11
Novorossiysk.....	155	44 44	37 48	Shostka.....	70	51 53	33 30
Novoshakhtinsk.....	113	47 47	39 56	Shyauliyay.....	118	55 57	23 20

Table B-4

## Cities Estimated To Be Slated For Evacuation (Continued)

	Population (thousands)	Coordinates			Population (thousands)	Coordinates	
		° 'N	° 'E			° 'N	° 'E
Simferopol .....	297	44 57	34 04	Ulan Ude .....	332	51 50	107 36
Slavyansk .....	172	48 51	37 30	Ulyanovsk .....	464	54 20	48 24
Smolensk .....	276	54 48	32 05	Uman .....	83	48 45	30 14
Sochi .....	169	43 35	39 45	Uralsk .....	167	51 14	51 26
Spassk Dalniy .....	52	44 36	132 48	Ussuriysk .....	161	43 49	131 58
Stavropol .....	254	45 03	41 59	Ust Kamenogorsk .....	272	49 59	82 36
Sterlitamak .....	213	53 39	55 58	Uzhgorod .....	82	48 38	22 18
Stryi .....	62	49 15	23 51	Verkhnyaya Salda .....	51	58 03	60 34
Sukhumi .....	130	43 01	41 01	Vilnius .....	489	54 41	25 19
Sumgait .....	204	40 36	49 38	Vinnitsa .....	330	49 15	28 29
Sumy .....	223	50 54	34 48	Vitebsk .....	298	55 12	30 11
Sverdlovsk .....	1,203	56 51	60 36	Vladimir .....	295	56 09	40 26
Svobodnyy .....	71	51 23	128 09	Vladivostok .....	559	43 08	131 54
Syktyvkar .....	188	61 40	50 50	Volgograd .....	982	48 45	44 26
Syzran .....	195	53 11	48 28	Volsk .....	73	52 03	47 24
Taganrog .....	303	47 14	38 54	Volzhsk .....	54	55 52	48 23
Taldy Kurgan .....	86	45 01	78 23	Volzhskiy .....	210	48 50	44 44
Tallin .....	451	59 24	24 43	Voronezh .....	858	51 41	39 15
Tambov .....	289	52 44	41 27	Voroshilovgrad .....	475	48 34	39 20
Tartu .....	101	58 23	26 44	Yakutsk .....	157	62 02	129 45
Tashkent .....	1,982	41 20	69 18	Yaroslavl .....	630	57 39	39 53
Tbilisi .....	1,099	41 42	44 45	Yelets .....	132	52 37	38 33
Temirtau .....	206	50 04	72 59	Yenakiyevo .....	262	48 14	38 13
Ternopol .....	149	49 34	25 36	Yerevan .....	1,014	40 18	44 51
Tiraspol .....	246	46 51	29 37	Yoshkar Ola .....	268	56 38	47 53
Tolyatti .....	529	53 31	49 20	Yuzhno Sakhalinsk .....	147	46 58	142 44
Tomsk .....	442	56 30	84 59	Zagorsk .....	115	56 19	38 09
Torez .....	132	48 02	38 38	Zaporozhye .....	784	47 49	35 11
Tselinograd .....	225	51 11	71 26	Zelenodolsk .....	89	55 51	48 32
Tula .....	584	54 12	37 37	Zhdanov .....	504	47 07	37 35
Tyumen .....	375	57 11	65 34	Zheleznodorozhnyy .....	121	55 45	38 02
Ufa .....	977	54 49	56 03	Zhitomir .....	252	50 16	28 41

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Table B-5

Cities Estimated Not Slated For Evacuation

	Population (thousands)	Coordinates			Population (thousands)	Coordinates	
		° 'N	° 'E			° 'N	° 'E
Abay.....	49	49 38	72 52	Belebey.....	46	54 07	54 08
Abdulino.....	26	53 42	53 39	Belgorod-Dnestrovskiy.....	39	46 12	30 21
Abinsk.....	29	44 53	38 10	Belogorsk.....	66	50 55	128 30
Abovyan.....	42	40 17	44 38	Belorechensk.....	40	44 46	39 53
Akhangaran.....	30	40 54	69 39	Beloretsk.....	73	53 59	58 24
Akhtubinsk.....	44	48 17	46 11	Belovo.....	110	54 26	86 18
Akhtyrka.....	44	50 19	34 54	Berdichev.....	85	49 54	28 36
Aksay.....	27	47 16	39 53	Beregovo.....	27	48 13	22 39
Alapayevsk.....	52	57 51	61 42	Berezino.....	6	53 51	29 01
Alatyr.....	47	54 51	46 34	Berezna.....	6	51 34	31 47
Aleksandriya.....	88	48 41	33 06	Berezovka.....	10	47 12	30 55
Aleksandrov.....	58	56 24	38 43	Berezovskiy.....	40	55 38	86 16
Alekseyevka.....	27	51 08	34 53	Berezovskiy.....	44	56 56	60 50
Aleysk.....	41	52 29	82 46	Beslan.....	28	43 12	44 33
Ali Bayramly.....	44	39 57	48 56	Bezhetsk.....	31	57 48	36 42
Alitus.....	56	54 24	24 03	Birsk.....	32	55 26	55 33
Almalyk.....	99	40 51	69 36	Biruni.....	28	41 42	60 46
Almetyevsk.....	110	54 54	52 20	Blagoyevo.....	3	46 56	30 39
Alushta.....	27	44 41	34 25	Bogdanovich.....	31	56 47	62 03
Amursk.....	43	50 14	136 54	Bogoroditsk.....	33	53 47	38 08
Amvrosiyevka.....	25	47 48	38 29	Bogorodsk.....	38	56 07	43 31
Ananyev.....	18	47 43	29 58	Bogotol.....	29	56 13	89 32
Anapa.....	30	44 54	37 20	Boguslav.....	12	49 33	30 53
Ance.....	a	57 31	22 01	Bol'shoye Mokroye.....	a	56 06	44 05
Antratsit.....	59	48 08	39 06	Bologoye.....	36	57 53	34 05
Apatity.....	58	67 36	33 24	Bolshoy Kamen.....	33	43 07	132 21
Apsheronsk.....	34	44 28	39 43	Borislav.....	37	49 18	23 25
Aralsk.....	42	46 48	61 41	Borispol.....	39	50 21	30 56
Arkalyk.....	47	50 15	66 55	Borovichi.....	67	58 24	33 56
Arsenyev.....	60	44 09	133 17	Borzya.....	30	50 24	116 32
Artem.....	84	43 22	132 12	Boyarka.....	32	50 19	30 19
Artemovskiy.....	39	57 21	61 54	Brovary.....	51	50 31	30 48
Arys.....	28	42 26	68 48	Bryanka.....	69	48 30	38 41
Arzamas.....	91	55 24	43 46	Budennovsk.....	41	44 47	44 10
Asbest.....	82	57 01	61 29	Bugulma.....	82	54 33	52 48
Asha.....	37	54 60	57 15	Buguruslan.....	55	53 39	52 26
Asino.....	33	56 60	86 09	Buturlinovka.....	26	50 50	40 38
Atbasar.....	41	51 49	68 22	Buy.....	29	58 29	41 33
Atkarsk.....	31	51 53	45 01	Buynaksk.....	44	42 50	47 08
Avdeyevka.....	38	48 09	37 46	Buzuluk.....	77	52 47	52 16
Ayaguz.....	44	47 58	80 26	Cesis.....	a	57 18	25 15
Aznakayevo.....	33	54 52	53 05	Charentsavan.....	27	40 25	44 39
Azov.....	79	47 06	39 26	Chaykovskiy.....	79	56 47	54 07
Bakal.....	27	54 57	58 48	Chebarkul.....	46	54 59	60 23
Bakhchisaray.....	20	44 45	33 52	Chekhov.....	49	55 09	37 29
Balakhna.....	37	56 30	43 36	Cheremkhovo.....	88	53 09	103 07
Balakleya.....	31	49 29	36 51	Cherkessk.....	104	44 14	42 03
Balashov.....	92	51 33	43 11	Chernobil.....	10	51 16	30 14
Baley.....	27	51 35	116 39	Chernogorsk.....	83	53 50	91 17
Balkhash.....	78	46 51	74 59	Chernushka.....	28	56 31	56 05
Barabinsk.....	38	55 22	78 21	Chernyakhovsk.....	35	54 39	21 50
Bayram Ali.....	39	37 37	62 11	Cherven.....	10	53 42	28 26
Bekabad.....	61	40 13	69 15	Chervonograd.....	54	50 24	24 14
Belaya Kalitva.....	37	48 11	40 48	Chervonopartizansk.....	26	48 05	39 48



Table B-5

Cities Estimated Not Slated For Evacuation (Continued)

	Population (thousands)	Coordinates			Population (thousands)	Coordinates	
		° 'N	° 'E			° 'N	° 'E
Chiatura.....	26	42 18	43 17	Gaysin.....	26	48 49	29 24
Chistopol.....	70	55 22	50 39	Gdov.....	4	58 46	27 48
Chkalovsk.....	30	40 12	69 50	Gelendzhik.....	33	44 34	38 05
Chu.....	35	43 37	73 46	Geokchay.....	34	40 39	47 45
Chuguyev.....	32	49 51	36 39	Georgiu Dezh.....	52	50 59	39 33
Chusovoy.....	58	58 18	57 49	Georgiyevsk.....	51	44 09	43 29
Chust.....	36	41 01	71 14	Glazov.....	80	58 09	52 40
Dalnegorsk.....	50	44 33	135 35	Glubokiy.....	27	48 31	40 19
Dalnerechensk.....	36	45 56	133 45	Glukhov.....	33	51 41	33 56
Debaltsevo.....	38	48 21	38 26	Gori.....	60	41 60	44 06
Dedovsk.....	31	55 52	37 08	Gorki.....	26	54 17	30 60
Denau.....	31	38 17	67 54	Gorno Altaysk.....	42	51 57	85 58
Derbent.....	68	42 04	48 18	Gornyatkiy.....	28	67 32	64 03
Dergachi.....	24	50 07	36 08	Gorodets.....	35	56 39	43 29
Dimitrov.....	56	48 18	37 17	Gremyachinsk.....	27	58 33	57 51
Dimitrovgrad.....	101	54 14	49 36	Griva.....	3	55 51	26 30
Divnogorsk.....	28	55 58	92 22	Gryazi.....	42	52 30	39 57
Dmitrov.....	50	56 21	37 32	Gubakha.....	33	58 53	57 35
Dneprodzerzhinsk.....	265	48 30	34 37	Gubkin.....	69	51 17	37 33
Dnestrovsk.....	50	46 39	29 53	Gudermes.....	35	43 21	46 06
Dobele.....	11	56 37	23 16	Gukovo.....	72	48 03	39 56
Dobropolye.....	31	48 29	37 05	Gulistan.....	43	40 30	68 47
Dokuchayevsk.....	25	47 45	37 41	Guryevsk.....	27	54 18	85 58
Dolgoprudny.....	108	55 56	37 32	Gus Khrustalnyy.....	68	55 38	40 41
Dolinskoye.....	9	47 32	29 54	Ilich.....	25	40 50	68 27
Domodedovo.....	40	55 27	37 46	Ilichevsk.....	61	46 23	30 39
Donetsk.....	46	48 21	40 02	Ingulets.....	40	47 42	33 12
Donskoy.....	34	53 59	38 20	Inta.....	50	66 03	60 09
Dorofeyevka.....	*	53 03	70 05	Irbit.....	54	57 41	63 04
Drogobych.....	70	49 21	23 32	Irpen.....	32	50 32	30 15
Druzhkovka.....	62	48 38	37 32	Isfara.....	27	40 08	70 39
Dubna.....	52	56 45	37 12	Ishim.....	65	56 07	69 29
Dubno.....	30	50 26	25 44	Ishimbay.....	58	53 28	56 02
Durbye.....	*	56 35	21 21	Isilkul.....	25	54 55	71 17
Dyatkovo.....	32	53 36	34 21	Ivangorod.....	14	59 22	28 13
Dzerzhinsk.....	47	48 24	37 51	Ivankov.....	6	50 56	29 54
Dzerzhinskiy.....	28	55 38	37 51	Ivanovka.....	4	46 58	30 28
Dzhalal Abad.....	62	40 57	73 01	Ivanteyevka.....	39	55 59	37 56
Dzhankoy.....	49	45 43	34 24	Izmail.....	89	45 21	28 51
Dzhetygara.....	47	52 12	61 13	Izobilnyy.....	32	45 23	41 43
Dzhezkazgan.....	93	47 48	67 43	Izum.....	58	49 12	37 18
Dzhezkazgan.....	36	47 53	67 27	Kachkanar.....	44	58 42	59 30
Dzhizak.....	38	40 08	67 50	Kadiyevka.....	37	48 35	38 38
Dzhusaly.....	27	45 30	64 06	Kafan.....	32	39 12	46 25
Echmiadzin.....	42	40 11	44 18	Kagan.....	39	39 44	64 33
Ekibastuz.....	56	51 44	75 20	Kagul.....	37	45 54	28 12
Elista.....	64	46 19	44 15	Kakhovka.....	42	46 49	33 30
Fastov.....	44	50 05	29 55	Kalinkovichi.....	32	52 08	29 20
Frolovo.....	42	49 47	43 39	Kalinovskaya.....	5	43 34	45 31
Fryazino.....	34	55 59	38 05	Kaltan.....	28	53 32	87 17
Furmanov.....	40	57 16	41 07	Kalush.....	57	49 02	24 22
Gardabani.....	9	41 28	45 05	Kamen na Obi.....	44	53 48	81 20
Gatchina.....	78	59 34	30 08	Kamenets Podolskiy.....	106	48 42	26 35
Gay.....	31	51 29	58 28	Kamenka.....	33	53 11	44 01

Table B-5

Cities Estimated Not Slated For Evacuation (Continued)

	Population (thousands)	Coordinates			Population (thousands)	Coordinates	
		° 'N	° 'E			° 'N	° 'E
Kamensk Shakhtinskiy.....	76	48 20	40 15	Klin.....	92	56 20	36 44
Kamyshlov.....	32	56 51	62 43	Klintsy.....	67	52 46	32 15
Kanash.....	50	55 32	47 30	Kobrin.....	33	52 14	24 21
Kandalaksha.....	44	67 11	32 26	Kokchetav.....	100	53 17	69 30
Kanibadam.....	34	40 18	70 26	Kokhtla Yarve.....	71	59 24	27 16
Kansk.....	97	56 14	95 44	Kolchugino.....	44	56 18	39 23
Kant.....	28	42 53	74 51	Kolkhoz Frunze.....	a	46 16	34 58
Kapchagay.....	31	43 53	77 04	Kolomyya.....	55	48 32	25 03
Kapsukas.....	36	54 33	23 22	Kolpashevo.....	29	58 20	82 55
Kara Balty.....	54	42 50	73 53	Kolpino.....	120	59 45	30 36
Karabulak.....	30	44 55	78 29	Kominternovo.....	4	46 49	30 56
Karasuk.....	26	53 44	78 03	Komrat.....	27	46 18	28 40
Karatau.....	26	43 11	70 29	Komsomolsk.....	39	49 01	33 40
Kargat.....	13	55 12	80 17	Konakovo.....	36	56 42	36 47
Karpinsk.....	38	59 46	60 01	Kondopoga.....	35	62 12	34 16
Karshi.....	107	38 51	65 48	Konotop.....	91	51 15	33 11
Kartaly.....	45	53 03	60 39	Korenovsk.....	27	45 29	39 28
Kashira.....	44	54 52	38 12	Korkino.....	88	54 56	61 24
Kasimov.....	34	54 57	41 24	Korosten.....	72	50 58	28 37
Kaskelen.....	32	43 12	76 38	Korsakov.....	42	46 38	142 47
Kaspiysk.....	44	42 53	47 38	Koryazhma.....	49	61 19	47 08
Kattakurgan.....	51	39 54	66 16	Kostroma.....	276	57 46	40 55
Kazatin.....	28	49 44	28 51	Kotelnich.....	32	58 19	48 21
Kedaynyay.....	29	55 19	23 59	Kotlas.....	66	61 14	46 38
Kehra.....	3	25 12	59 12	Kotovo.....	27	50 20	44 48
Kentau.....	64	43 32	68 31	Kotovsk.....	43	47 45	29 32
Khachmas.....	26	41 28	48 48	Kotovsk.....	37	52 37	41 32
Khanty Mansiysk.....	26	61 02	69 02	Kovel.....	46	51 14	24 43
Khartsyzsk.....	60	48 03	38 09	Krasnoarmeysk.....	60	48 17	37 11
Khasavyurt.....	69	43 15	46 36	Krasnodon.....	46	48 18	39 44
Khashuri.....	30	42 01	43 37	Krasnogorsk.....	107	55 50	37 20
Khiva.....	29	41 23	60 22	Krasnograd.....	28	49 23	35 27
Khodzheyli.....	43	42 25	59 27	Krasnokamensk.....	41	50 06	118 03
Kholmisk.....	51	47 03	142 03	Krasnokamsk.....	57	58 05	55 45
Khust.....	27	48 11	23 18	Krasnoturinsk.....	57	59 47	60 12
Kikerino.....	7	59 28	29 38	Krasnoufimsk.....	39	56 37	57 47
Kiliya.....	28	45 27	29 16	Krasnouralsk.....	41	58 21	60 04
Kimovsk.....	45	53 59	38 33	Krasnovodsk.....	55	40 01	52 59
Kimry.....	66	56 53	37 22	Krasnoye Selo.....	27	59 44	30 11
Kinel.....	40	53 14	50 38	Krasnozavodsk.....	42	56 27	38 15
Kingisepp.....	34	59 23	28 36	Krasnyy Liman.....	33	48 60	37 49
Kireyevsk.....	27	53 56	37 56	Krasnyy Sulin.....	44	47 54	40 05
Kirgili.....	37	40 27	71 47	Kremennaya.....	25	49 03	38 14
Kirishi.....	41	59 29	32 03	Krichev.....	29	53 42	31 44
Kirov.....	30	54 05	34 20	Krikovo.....	a	47 08	28 52
Kirovo Chepetsk.....	67	58 33	50 02	Kronshtadt.....	40	59 60	29 47
Kirovobad.....	216	40 41	46 22	Kropotkin.....	90	45 27	40 35
Kirovsk.....	40	48 39	38 39	Krymsk.....	48	44 56	37 60
Kirovsk.....	43	67 37	33 41	Kryukovo.....	52	55 59	37 11
Kirovskiy.....	23	40 26	49 51	Kudymkar.....	28	59 01	54 39
Kirsanov.....	29	52 39	42 44	Kulebaki.....	47	55 26	42 32
Kislovodsk.....	101	43 55	42 44	Kulyab.....	54	37 55	69 47
Kizel.....	42	59 03	57 39	Kungur.....	88	57 26	56 59
Kizlyar.....	35	43 51	46 44	Kupyansk.....	37	49 43	37 37

Table B-5

Cities Estimated Not Slated For Evacuation (Continued)

	Population (thousands)	Coordinates			Population (thousands)	Coordinates	
		° 'N	° 'E			° 'N	° 'E
Kurgan Tyube.....	45	37 51	68 47	Mogilev Podolskiy.....	30	48 27	27 48
Kurganinsk.....	41	44 54	40 36	Molodechno.....	68	54 20	26 52
Kurinka.....	39	50 14	32 45	Molodogvardeysk.....	27	48 21	39 39
Kushva.....	44	58 18	59 45	Monchegorsk.....	46	67 57	32 55
Kuybyshev.....	49	55 27	78 19	Morozovsk.....	27	48 21	41 50
Kuznetsk.....	97	53 08	46 37	Morshansk.....	52	53 27	41 48
Kyshtym.....	42	55 44	60 33	Mozdok.....	33	43 45	44 39
Kyzyl.....	57	51 42	94 27	Mozhaysk.....	23	55 30	36 01
Kyzyl Kiya.....	32	40 16	72 08	Mozhga.....	43	56 27	52 14
Labinsk.....	56	44 38	40 44	Mozyr.....	78	52 04	29 15
Lebedin.....	28	50 35	34 30	Mtsensk.....	41	53 17	36 35
Leninogorsk.....	76	50 21	83 31	Mukachevo.....	75	48 27	22 43
Leninogorsk.....	50	54 36	52 27	Myski.....	40	53 43	87 49
Leninsk.....	35	40 39	72 14	Mytishchi.....	140	55 91	37 76
Leninsk.....	60	45 38	63 20	Nakhichevan.....	41	39 13	45 24
Lenkoran.....	40	38 46	48 51	Naro Fominsk.....	54	55 24	36 44
Lesozavodsk.....	41	45 29	133 25	Narva.....	73	59 23	28 12
Lgov.....	31	51 42	35 16	Naryn.....	29	41 26	76 01
Lida.....	59	53 54	25 19	Navoi.....	109	40 05	65 22
Ligatne.....	2	57 11	25 02	Nazarovo.....	55	56 01	90 24
Likino Dulevo.....	31	55 44	38 58	Nefteyugansk.....	39	61 06	72 36
Lisakovsk.....	31	52 39	62 47	Nelidovo.....	31	56 14	32 47
Livny.....	47	52 26	37 37	Nemenchine.....	5	54 51	25 29
Liyepaya.....	109	56 32	21 02	Nerekhta.....	28	57 28	40 35
Lobnya.....	45	56 01	37 29	Nevelsk.....	30	46 41	141 53
Lode.....	a	57 23	25 26	Nevinnomyssk.....	101	44 38	41 57
Lomonosov.....	47	59 55	29 47	Nevyansk.....	31	57 30	60 13
Lozovaya.....	47	48 53	36 19	Nezhin.....	73	51 03	31 53
Lubny.....	50	50 01	33 01	Nikolayevsk na			
Luga.....	39	58 44	29 52	Amure.....	35	53 09	140 44
Lysva.....	76	58 06	57 48	Nikolskiy.....	44	47 54	67 33
Lytkarino.....	45	55 35	37 55	Nikolskoye.....	a	59 13	38 30
Lyubotin.....	33	49 57	35 55	Nizhneudinsk.....	43	54 54	99 03
Lyubuchany.....	35	55 14	37 32	Nizhnevartovsk.....	76	60 56	76 35
Lyudinovo.....	38	53 53	34 28	Noginsk.....	110	55 53	38 27
Madona Rayon.....	7	56 51	26 13	Novaya Kakhovka.....	49	46 46	33 22
Malakhovka.....	40	55 38	38 02	Novgorod.....	187	58 31	31 17
Maloyaroslavets.....	22	55 01	36 28	Novocheboksarsk.....	80	56 08	47 30
Marganets.....	49	47 39	34 38	Novoekonomicheskoye.....	31	48 18	37 15
Mariinsk.....	40	56 14	87 44	Novograd Volynskiy.....	45	50 36	27 38
Mayli Say.....	31	41 16	72 27	Novokazalinsk.....	43	45 51	62 09
Mednogorsk.....	36	51 25	57 35	Novomoskovsk.....	84	48 39	35 14
Meleuz.....	32	52 58	55 56	Novomoskovsk.....	160	54 06	38 14
Merefa.....	31	49 48	36 03	Novopolotsk.....	68	55 32	28 36
Mezhdurechensk.....	89	53 41	88 04	Novotroitsk.....	97	51 12	58 20
Mga village.....	6	59 76	31 06	Novotul'skiy.....	35	54 11	37 44
Mikha Tskhakaya.....	27	42 17	42 04	Novovolynsk.....	46	50 44	24 11
Mikhaylovka.....	57	50 05	43 14	Novovyatsk.....	32	58 30	49 44
Millerovo.....	38	48 56	40 24	Novozybkov.....	44	52 32	31 57
Mineralnyye Vody.....	69	44 14	43 08	Novyy uzen.....	36	43 20	52 53
Mingechaur.....	56	40 47	47 03	Obninsk.....	88	55 06	36 36
Minusinsk.....	47	53 42	91 42	Obukhov.....	1	48 47	27 45
Mirgorod.....	33	49 59	33 37	Odintsovo.....	93	55 41	37 18
Mirnyy.....	31	62 32	113 59	Okha.....	31	53 35	142 57

Table B-5

## Cities Estimated Not Slated For Evacuation (Continued)

	Population (thousands)	Coordinates			Population (thousands)	Coordinates	
		° 'N	° 'E			° 'N	° 'E
Oktemberyan .....	28	40 09	44 02	Pustomyty.....	4	49 43	23 55
Oktyabrsk .....	34	53 11	48 47	Pyarnu .....	52	58 23	24 32
Oktyabrskiy .....	89	54 30	53 29	Radekhov.....	a	49 59	33 48
Ola.....	6	59 35	151 17	Radekov.....	5	50 17	24 39
Olenegorsk.....	28	68 09	33 15	Rasskazovo.....	41	52 40	41 53
Omutninsk.....	29	58 41	52 11	Raychikhinsk.....	28	49 47	129 26
Onega.....	25	63 55	38 06	Razdan.....	39	40 30	44 46
Ordzhonikidze.....	45	47 41	34 04	Razdelnaya.....	14	46 51	30 05
Ordzhonikidzeabad.....	37	38 33	69 01	Rechitsa.....	61	52 22	30 24
Orgeyev.....	35	47 22	28 49	Reutov.....	60	55 46	37 53
Osinniki.....	66	53 38	87 23	Revda.....	62	56 49	59 56
Osipovichy.....	26	53 18	28 39	Rezekne.....	35	56 31	27 21
Ostashkov.....	25	57 09	33 07	Rezh.....	41	57 23	61 24
Ostrogzhsk.....	33	50 52	39 05	Rodniki.....	30	57 07	41 44
Ostrov.....	31	57 21	28 21	Romny.....	54	50 45	33 29
Otradnyy.....	50	53 23	51 21	Roschino.....	a	60 15	29 37
Ovidiopol.....	7	46 16	30 26	Roshal.....	26	55 40	39 53
Ozery.....	26	54 52	38 34	Roslavl.....	57	53 57	32 52
Paide/Turi.....	a	58 54	25 33	Rossosh.....	39	50 12	39 35
Panevezhis.....	104	55 45	24 21	Rostov.....	32	57 12	39 26
Panfilov.....	19	44 10	80 01	Rovenki.....	64	48 06	39 23
Paplaka.....	1	56 26	21 27	Rtishchevo.....	44	52 16	43 48
Pargolovo.....	25	60 05	30 18	Ruzayevka.....	48	54 03	44 56
Parkent.....	a	41 18	69 40	Ryazhsk.....	25	53 43	40 05
Partizansk.....	48	43 08	133 09	Rybachye.....	37	42 28	76 11
Pashkovskiy.....	81	45 02	39 06	Rybnitsa.....	46	47 47	29 01
Pavlograd.....	110	48 33	35 52	Rzhev.....	68	56 16	34 20
Pechora.....	46	65 09	57 12	Sabunchi.....	45	40 26	49 57
Pereslavl Zaleskiy.....	34	56 45	38 51	Safonovo.....	54	55 07	33 15
Perevalsk.....	32	48 27	38 50	Saki.....	33	45 09	33 35
Pershotravensk.....	27	48 21	36 24	Salekhard.....	26	66 33	66 35
Pervomaysk.....	46	48 38	38 33	Salsk.....	61	46 29	41 32
Pervomaysk.....	95	48 03	30 51	Salyany.....	28	39 35	48 59
Petrodvorets.....	64	59 52	29 57	Sambor.....	32	49 31	23 12
Petrovsk.....	38	52 19	45 24	Saran.....	64	49 47	72 52
Pikoleva.....	a	59 34	34 04	Sarova.....	52	54 56	43 20
Pinsk.....	90	52 08	26 08	Sasovo.....	31	54 21	41 56
Plesetsk.....	30	62 44	40 17	Satka.....	45	55 03	59 01
Podolsk.....	228	55 26	37 33	Sebesh.....	10	56 17	28 29
Pokhvistnevo.....	26	53 39	52 08	Segezha.....	37	63 44	34 20
Pokrovskoye Zafskin.....	a	55 39	36 40	Selidovo.....	26	48 09	37 18
Polevskoy.....	62	56 29	60 13	Semenov.....	25	56 48	44 30
Polotsk.....	77	55 30	28 48	Semet.....	a	56 04	44 03
Polysayeyo.....	35	54 36	86 16	Serdobsk.....	41	52 28	44 13
Popasnaya.....	31	48 39	38 23	Sergach.....	25	55 32	45 30
Poronaysk.....	25	49 14	143 06	Sestroretsk.....	36	60 05	29 59
Poti.....	56	42 09	41 41	Severomorsk.....	49	69 05	33 26
Pravdinsk.....	35	56 32	43 33	Severouralsk.....	31	60 11	59 58
Primorsko				Shadrinsk.....	92	56 05	63 41
Akhtarsk.....	28	46 03	38 11	Shakhrisabz.....	32	39 04	66 50
Prokhladnyy.....	47	43 46	44 02	Shakhtersk.....	71	48 04	38 27
Przhevalsk.....	49	42 30	78 24	Shakhtinsk.....	54	49 43	72 36
Pugachev.....	34	52 01	48 48	Shamalgan.....	a	43 11	76 31
Pushkin.....	120	59 43	30 24	Sharya.....	25	58 22	45 31

Table B-5

Cities Estimated Not Slated For Evacuation (Continued)

	Population (thousands)	Coordinates			Population (thousands)	Coordinates	
		° 'N	° 'E			° 'N	° 'E
Shatura.....	32	55 35	39 33	Talgar.....	39	43 19	77 15
Shchekino.....	71	54 01	37 32	Tara.....	26	56 54	74 23
Shchuchinsk.....	56	52 56	70 12	Tashauz.....	87	41 51	59 58
Shebekino.....	45	50 26	36 53	Tatarbunarskiy Rayon.....	9	45 51	29 37
Sheki.....	44	41 12	47 11	Tatarsk.....	32	55 14	75 59
Shelekhov.....	43	52 12	104 06	Tavda.....	47	58 03	65 17
Shepetovka.....	44	50 12	27 04	Tayga.....	26	56 04	85 38
Shilute.....	14	55 21	21 29	Tayschet.....	36	55 57	98 01
Shumerlya.....	35	55 30	46 25	Tedzhen.....	32	37 23	60 30
Shuya.....	72	56 51	41 23	Tekeli.....	30	44 52	78 48
Sibay.....	42	52 44	58 41	Telsiai.....	27	55 59	22 15
Sinelnikovo.....	34	48 20	35 31	Temryuk.....	29	45 17	37 23
Sinyavino.....	7	59 51	31 07	Termez.....	61	37 14	67 18
Sioni.....	4	41 59	45 02	Teykovo.....	42	56 52	40 32
Skopin.....	29	53 50	39 34	Tikhoretsk.....	63	45 51	40 08
Slantsy.....	44	59 06	28 08	Tikhvin.....	60	59 39	33 32
Slavgorod.....	31	53 01	78 39	Timashevsk.....	32	45 37	38 57
Slavuta.....	32	50 18	26 52	Tkvarcheli.....	26	42 51	41 41
Slavyansk Kubani.....	65	45 16	38 08	Tobolsk.....	48	58 12	68 16
Slobodskoy.....	37	58 44	50 12	Tokmak.....	59	42 50	75 18
Sloki.....	10	56 57	23 36	Tokmak.....	44	47 15	35 44
Slonim.....	34	53 06	25 21	Toksovo.....	3	60 09	30 31
Slutsk.....	44	53 02	27 35	Tolmachevo.....	6	58 52	29 51
Smela.....	60	49 13	31 53	Tomilino.....	26	55 39	37 57
Snezhnoye.....	74	48 03	38 45	Topki.....	31	55 17	85 38
Sokol.....	48	59 28	40 06	Torzhok.....	53	57 03	34 59
Soligorsk.....	58	52 48	27 33	Tripole.....	4	50 07	30 46
Solikamsk.....	100	59 40	56 44	Troitsk.....	92	54 05	61 36
Solnechnogorsk.....	38	56 11	36 59	Trudovoye.....	29	43 17	132 05
Solntsevo.....	53	55 39	37 24	Tskhinvali.....	36	42 14	43 59
Sorochinsk.....	26	52 26	53 09	Tuapse.....	61	44 07	39 05
Soroki.....	27	48 09	28 18	Tulun.....	52	54 35	100 36
Sosnogorsk.....	31	63 36	53 56	Turkestan.....	61	43 18	68 15
Sosново.....	a	60 33	30 17	Tuymazy.....	48	54 37	53 43
Sosnovyy Bor.....	28	59 54	29 06	Tynda.....	30	55 11	124 44
Sovetsk.....	41	55 05	21 53	Uchaly.....	29	54 18	59 27
Sovetskaya Gavan.....	36	48 60	140 15	Ugleurskiy.....	29	58 57	57 36
Sovkhoz Avangard.....	a	48 06	35 46	Uglich.....	38	57 32	38 20
Stantsiya Razdel'ya.....	a	46 51	30 05	Ukhta.....	82	63 34	53 44
Staraya Russa.....	40	57 60	31 21	Ukmerge.....	26	55 14	24 45
Staryy Oskol.....	90	51 19	37 51	Ulyanovka.....	a	59 38	30 46
Staryy Saltov.....	2	50 04	36 48	Unecha.....	26	52 51	32 41
Stepan Razin.....	45	40 26	49 59	Ura Tyube.....	40	39 55	69 01
Stepanakert.....	33	39 50	46 45	Urgench.....	95	41 33	60 39
Stupino.....	63	54 54	38 05	Urus Martan.....	25	43 08	45 32
Sukhodolsk.....	27	48 21	39 44	Uryupinsk.....	39	50 48	42 01
Sukhoy Log.....	32	56 56	62 01	Ushtobe.....	28	45 16	77 59
Surgut.....	83	61 15	73 26	Ust Barga.....	48	56 08	94 36
Svencionel'iai.....	a	55 10	26 01	Ust Ilimsk.....	42	58 01	102 41
Sverdlovsk.....	73	48 05	39 41	Ust Kut.....	41	56 47	105 40
Svetlogorsk.....	63	52 38	29 45	Ust Labinsk.....	39	45 14	39 42
Svetlograd.....	34	45 21	42 51	Utyansk.....	a	55 30	25 36
Svetlovodsk.....	49	49 03	33 13	Uvarovo.....	33	51 59	42 16
Svyatoshino.....	a	50 27	30 22	Uzgen.....	26	40 47	73 18

Table B-5

Cities Estimated Not Slated For Evacuation (Continued)

	Population (thousands)	Coordinates			Population (thousands)	Coordinates	
		° 'N	° 'E			° 'N	° 'E
Uzlovaya.....	74	53 59	38 11	Yartsevo.....	42	55 04	32 43
Vainode.....	a	56 26	21 52	Yasinovataya.....	41	48 08	37 53
Valuyki.....	30	50 12	38 07	Yefremov.....	53	53 09	38 07
Varena.....	2	54 13	24 34	Yegoryevsk.....	71	55 23	39 03
Vasilkov.....	33	50 11	30 19	Yekabpils.....	25	56 31	25 53
Vasilsursk.....	26	56 08	46 02	Yelabuga.....	38	55 46	52 04
Velikiy Ustyug.....	38	60 46	46 18	Yelgava.....	68	56 39	23 44
Velikiye Luki.....	103	56 21	30 33	Yelizovo.....	35	53 11	158 23
Velsk.....	29	61 06	42 08	Yemanzhelinsk.....	33	54 45	61 20
Ventspils.....	49	57 24	21 31	Yeremeyevka.....	1	46 48	30 23
Verbovka.....	3	49 29	36 51	Yermak.....	57	52 03	76 56
Vereshchagino.....	25	58 05	54 40	Yessentuki.....	77	44 03	42 52
Vereya.....	9	55 21	36 11	Yevlakh.....	33	40 37	47 09
Verkhniy Ufaley.....	38	56 03	60 15	Yevpatoriya.....	96	45 12	33 22
Verkhnyaya Pyshma.....	57	56 56	60 38	Yeysk.....	75	46 43	38 17
Vichuga.....	52	57 13	41 56	Yurga.....	81	55 44	84 56
Vidnoye.....	45	55 33	37 46	Yurmala.....	61	56 58	23 45
Vishennoye.....	2	45 08	34 36	Yuzhno Uralsk.....	39	54 27	61 15
Vladimir Volynskiy.....	30	50 51	24 20	Zaozernyy.....	27	55 58	94 43
Volchansk.....	25	50 18	36 56	Zarasy.....	5	55 44	26 15
Volgodonsk.....	41	47 32	42 09	Zaraysk.....	25	54 47	38 53
Volkhov.....	48	59 56	32 21	Zavolzhye.....	43	56 39	43 24
Volkovysk.....	26	53 09	24 27	Zelenogorsk.....	16	60 12	29 42
Volnovakha.....	25	47 36	37 29	Zelenograd.....	132	56 01	37 12
Vologda.....	236	59 13	39 54	Zelenokumsk.....	30	44 25	43 53
Volosovskiy Rayon.....	5	59 26	29 29	Zeya.....	33	53 44	127 16
Vorkuta.....	100	67 30	64 03	Zheleznogorsk.....	69	52 21	35 24
Voskresensk.....	75	55 20	38 41	Zheltyye Vody.....	56	48 21	33 30
Vostochnoye.....	a	42 56	75 15	Zhigulevsk.....	49	53 24	49 31
Votkinsk.....	92	57 03	53 59	Zhlobin.....	32	52 54	30 01
Voznesensk.....	40	47 35	31 20	Zhmerinka.....	42	49 03	28 06
Vsevolozhskiy.....	27	60 01	30 40	Zhodino.....	29	54 06	28 21
Vyatskiye Polyany.....	36	56 14	51 03	Zhovtnevoye.....	38	46 53	32 01
Vyazma.....	49	55 13	34 18	Zhukovskiy.....	170	55 38	38 06
Vyazniki.....	43	56 15	42 09	Zima.....	54	53 56	102 03
Vyborg.....	71	60 43	28 45	Zlatoust.....	203	55 11	59 42
Vyksa.....	47	55 20	42 10	Znamenka.....	29	48 43	32 41
Vyshniy Volochek.....	75	57 36	34 33	Zolotonosha.....	27	49 41	32 03
Yalta.....	82	44 30	34 10	Zolotoye.....	25	48 43	38 30
Yalutorovsk.....	32	56 39	66 18	Zugdidi.....	41	42 31	41 52
Yangiyul.....	72	41 07	69 03	Zyryanovsk.....	54	49 44	84 17

\* Estimates of the population of these cities are not available. They are, however, less than 25,000 in population.

## Annex C

### Effects of Civil Defense

1. The effects of Soviet civil defense in reducing casualties from a large-scale US retaliatory strike are assessed through the use of computer models. These models allow us to test the sensitivity of the results to changes in intelligence judgments and assumptions. The results of this process do not represent an assessment of the overall effectiveness of the Soviet civil defense program. They do, however, provide a valid indicator of the differences between the level of casualties the Soviets might incur under different levels of civil defense preparation.

2. Several improvements have recently been made in the process used to assess the effects of Soviet civil defense. These include better data bases, improved computer modeling techniques, and an enhanced understanding of the Soviet civil defense program. As a result of these improvements, we have more confidence in our assessments and a better understanding of the sensitivities of the results to changes in the inputs and assumptions used.

#### The Soviet Population Data Base

3. The population data base for the Soviet Union has been expanded and improved. The population data base used for the analysis in the IIM of 1977 was made up of less than 15,000 discrete population locations. These included both P-95 data<sup>1</sup> for the urban population and for the rural population cells measuring 20 minutes by 30 minutes. The new population data base used in this analysis includes over 60,000 discrete locations. The data base is the aggregation of four components:

- The urban P-95 data used formerly.
- Urban non-P-95 data generated by the Rand Corporation.

<sup>1</sup> P-95s are circles [ ] to denote concentrations of population. To qualify as a P-95, a population concentration must have a population of at least 3,000 people and the unpopulated area should not exceed 20 percent of the circle. P-95 circles [ ] have radii from 0.3 to 1.0 nautical mile. P-95 circles are configured such that overlap between circles does not exceed 5 percent of the area of the smaller circle.

— Rural Ukraine data in cells 5 minutes by 7 minutes.

— A modification of a rural cell data base generated by the Rand Corporation.

4. The "coarse" data base used for the 1977 IIM was adequate for rough estimates of casualties from a massive attack. The more refined data base, however, allows much more realistic calculations. Most importantly, it is more sensitive to the effects of blast and fallout and key assumptions about evacuation schemes and hosting ratios.

#### Improved Understanding of Soviet Evacuation

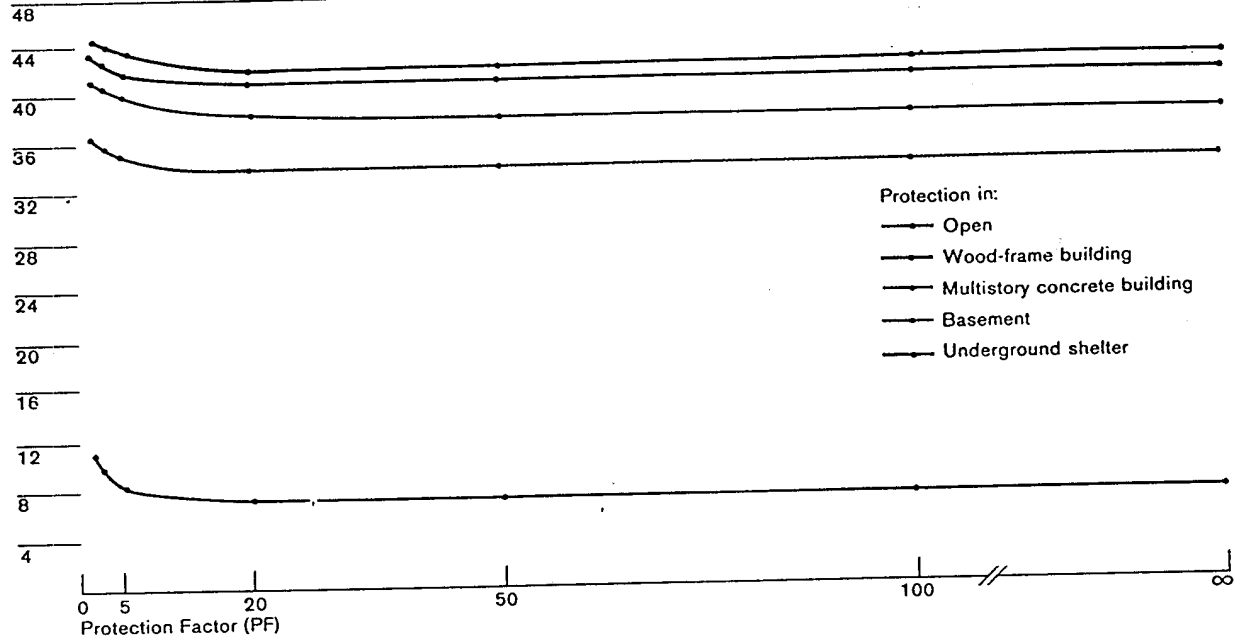
5. Our improved understanding of Soviet urban evacuation was discussed in detail in section II of the discussion and annex B.

#### Improved Model of Evacuation

6. In this study, several alternative schemes of modeling evacuation were employed. The "preferred" model, hereafter called the evacuation model, was designed for and used for the first time in this study. The most notable feature of this evacuation model is that it incorporates our recently improved understanding of the Soviet evacuation process and the distances to which evacuees travel. Whereas formerly evacuation was modeled by the Intelligence Community to be a uniform distribution of evacuees to inhabited rural areas, the new evacuation model allows people to evacuate within a grid of 5 by 5 degrees formed along existing latitude and longitude lines. Evacuation within the model is done in a concentric fashion extending out from the city to be evacuated. Evacuees are first moved to designated host areas within the 1-by-1-degree cell in which the city is located. This process is carried out within the constraint of a specified evacuee-to-host ratio. Ratios of both 2:1 and 5:1 were used in this study. Once the available host centers are filled, evacuees are allowed to move out to the ring of eight cells surrounding the center cell. There they may be hosted up to the specified ratio. If any

**Figure C-1**  
**Sensitivity of Fatality Estimates to Various Combinations of Protection From Blast and Fallout**

**Nonevacuated Population**  
Fatalities (Percent of Soviet Population)



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evacuees cannot be hosted in this ring of cells, they are allowed to go one ring farther out from their original city.

### Improved Understanding of the Soviet Civil Defense Shelter Program

7. Our improved understanding of the Soviet civil defense shelter program was used in the assessment of the effects of civil defense. It is documented in section I of the discussion.

### Improved Modeling for Damage Assessment

8. Damage assessment calculations were performed by the Command and Control Technical Center (CCTC), Defense Communications Agency. Its calculations involved several computer programs and codes many of which have been updated since the 1977 IIM. In addition, two new capabilities introduced by CCTC during this time have given us the capability

for the type of analysis done in this report. They are the development of an evacuation code and postprocessor for the answer file of the single integrated damage analysis capability (SIDAC).

9. The evacuation code permits the user to designate alternative definitions of who is to be evacuated and who is eligible to host evacuees. The SIDAC postprocessor generates damage matrices for casualties and fatalities. These matrices allow the user to select the combination of protection factors from prompt effects and fallout for different segments of the population. Collectively, these two new developments have improved the efficiency of the examination of a large number of alternative assumptions about the status of the Soviet population.

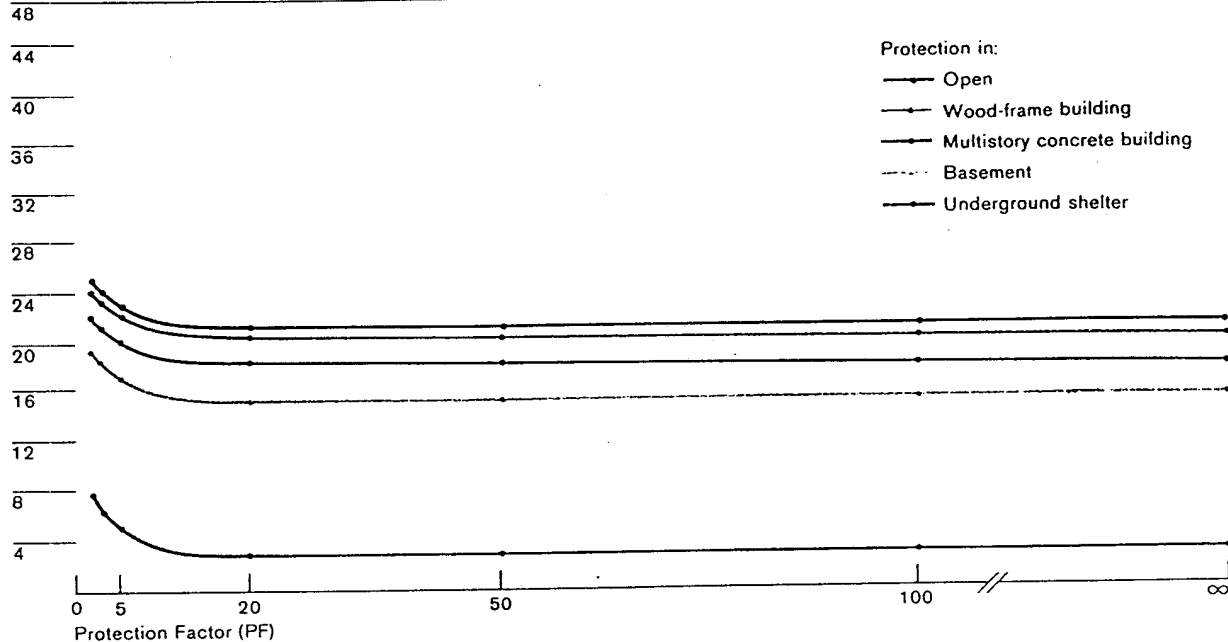
### SENSITIVITIES

10. Several alternative calculations were made to test the sensitivity of estimates of casualties and fatalities.



**Figure C-2**  
**Sensitivity of Fatality Estimates to Various Combinations**  
**of Protection From Blast and Fallout**

**Evacuated Population**  
Fatalities (Percent of Soviet Population)



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ties to changes in inputs and assumptions. Factors for which sensitivity calculations were made include the degree of protection from the effects of blast and radiation, the areas from which people are evacuated, the percentage of the population evacuated from those areas, the extent of civil defense preparation, the amount of space allocated per person in blast shelters, the ratio for hosting evacuees, the readiness posture of US forces at the time of the Soviet attack, and an alternative US retaliatory attack. These analyses are discussed below.

#### Sensitivity to the Degree of Protection From Blast and Radiation

11. Two types of alternative calculations were made to test the sensitivity of casualty and fatality estimates to assumptions about the degree of protection from blast and radiation. In the first type of cal-

ulation, a simplifying assumption is made that all people in the Soviet Union are located and remain in the same type of location. The types of protective structures for which this assumption was applied are wooden buildings, multistory concrete buildings, basements, underground shelters, and none (that is, people were assumed to be in the open). For each structure, this type of calculation was done both with the "best" assessment of the protection factor (PF)<sup>2</sup> from fallout and with alternative values of PF from 2 up to infinite protection from fallout. The PFs used in our analysis for each structure type are shown in table C-1.

12. Estimates of fatalities from the base case attack under these alternative population postures are shown in figure C-1 for a nonevacuated Soviet population and figure C-2 for an evacuated Soviet population.

<sup>2</sup> The protection factor (PF) is the ratio of the dose rate of radiation outside of the structure to the dose rate inside the structure.

**Table C-1**

**Protection Factor for Persons Located in Various Types of Structures**

Structure Type	Protection Factor <sup>a</sup>
Open .....	2
Wooden building .....	3
Multistory concrete building .....	5
Basement .....	20
Underground shelter .....	100

<sup>a</sup> The protection factor (PF) is the ratio of the dose rate of radiation outside of the structure to the dose rate inside the structure.

13. In addition, calculations were done to assess the impact of different levels of protection from prompt effects on estimated fatalities. As before, everyone in the USSR was assumed to be in the same type of protective structure. The types of protective structures for which this assumption was applied are wooden buildings, multistory concrete buildings, basements, blast shelters, command posts, and none. Estimates of fatalities from the base case attack under these alternative postures are in figure C-3 for a nonevacuated Soviet population and for an evacuated population.

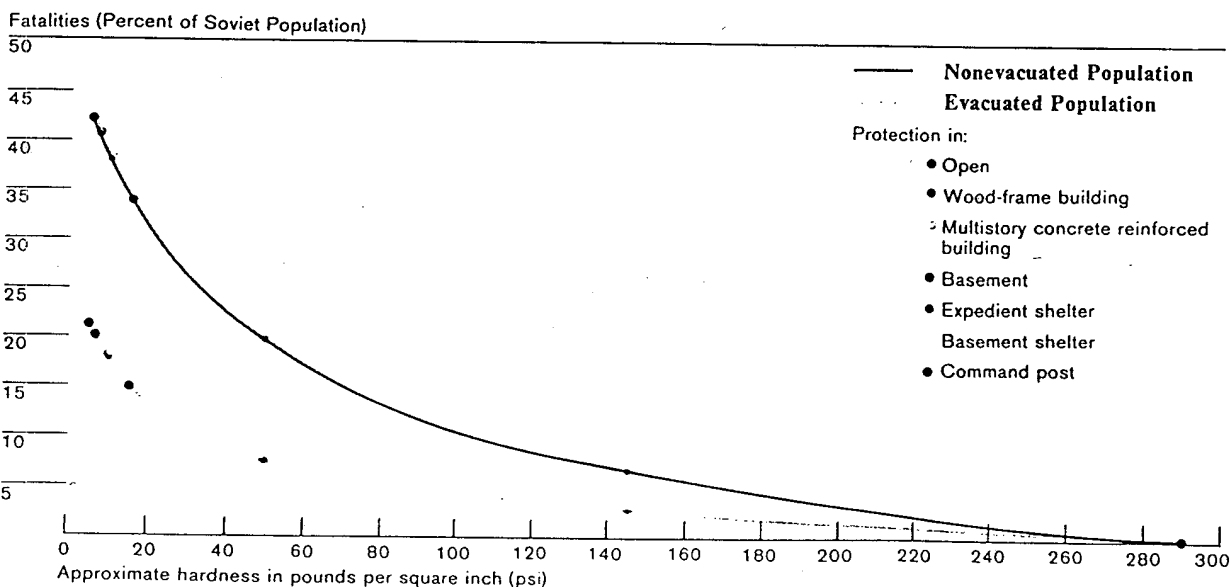
14. The calculations underlying figures C-1 to C-3 lead to the conclusions that for an attack such as the one hypothesized in our base case:

- Acquisition of a PF of 20 is adequate protection for reducing fatalities. Few additional lives are saved by acquiring greater protection from fallout.
- Estimates of fatalities are more sensitive to changes in the assessed hardness of protective in the range of 0 to 50 pounds per square inch than in the range of 50 to 300 pounds per square inch. Our calculations indicate that the probability of survival of Soviets in blast shelters would be about 92 percent, if the shelters have a hardness of about 50 psi, or about 97 percent, if the hardness is about 150 psi.

15. The second type of calculation made to test the sensitivity of casualty and fatality estimates to assumptions about the protection from blast and radiation involved the examination of alternative mixes of protective structures for the Soviet population. In the case of a nonevacuated Soviet population the main line es-

**Figure C-3**

**Impact of Protection From Prompt Effects on Estimated Fatalities**



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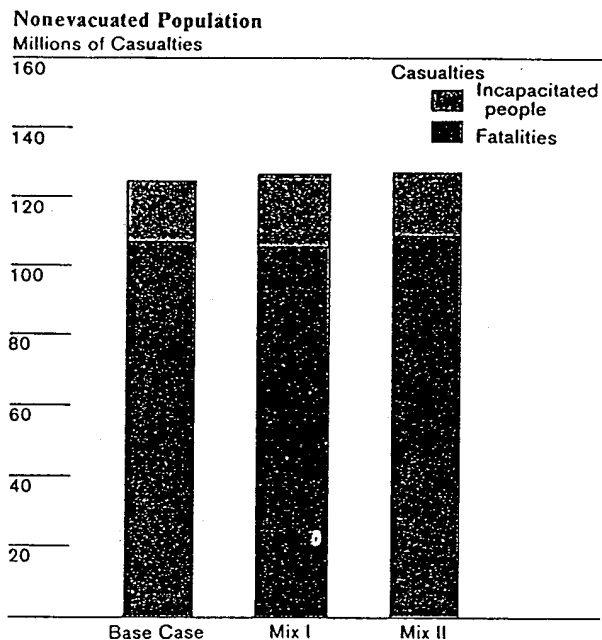
timate was made with the assumption that the urban population was proportionately located in building types of the dominant type of residence found in Soviet urban areas and that 5 percent of the urban population was in the open. The rural population was assumed to be in single-story wooden houses.

16. In the case of implementation of sheltering only, the base case estimate assumed that existing urban blast shelters were fully utilized. This allowed approximately 15 million people (11 percent of the urban population of cities of over 25,000 people) to be sheltered. Again, 5 percent of the urban population was assumed to be in the open at the time of attack. Among those who were in the open, survivors of the immediate effects of nuclear weapons were assumed to acquire a protection factor of 20 (the equivalent of protection in a basement) from fallout effects. The remaining urban population was assumed to be equally distributed between basements and multistory concrete reinforced buildings. The rural population was assumed to be in basements.

17. In the case of full implementation of sheltering and evacuation, all people remaining in evacuated cities (10 percent of the population of those cities) were assumed in the base case to be sheltered in underground blast shelters. Residents of rural areas and people evacuated to rural areas were assumed to be equally distributed in basements and expedient shelters. People in urban areas that were not evacuated were assumed to use the capacity of existing blast shelters (11 percent of the original population); 5 percent were assumed to be in the open; and the remaining people were assumed to have acquired protection in equal numbers in basements and multistory concrete buildings.

18. One alternative assumption for the status of the Soviet population for the case of little or no implementation (Mix I) assumed that all urban residents were in multistory concrete reinforced buildings and the rural population was in single-story wooden buildings. Another alternative (Mix II) assumed that urban residents were evenly distributed between single-story wooden buildings and multistory concrete buildings. As before, the rural population was assumed to be in single-story wooden buildings. A comparison of the estimated casualties and fatalities resulting from these alternatives is shown in figure C-4. This figure illustrates that estimates of casualties are rather insensitive to the differences between these alternative postures.

Figure C-4  
Estimated Casualties Under Three Soviet Protective Postures for Urban Inhabitants



- Base case -Urban residents are assumed to be proportionately located in buildings of the dominant type of residence in Soviet urban areas, and 5 percent are in the open. Rural residents are assumed to be in single-story wood framed buildings.
- Mix I -All urban residents are assumed to be in multistory concrete buildings; rural residents are assumed to be in single-story wood framed buildings.
- Mix II -All urban residents are equally distributed between single-story wood framed buildings and multistory concrete buildings; rural residents are assumed to be in single-story wood framed buildings.

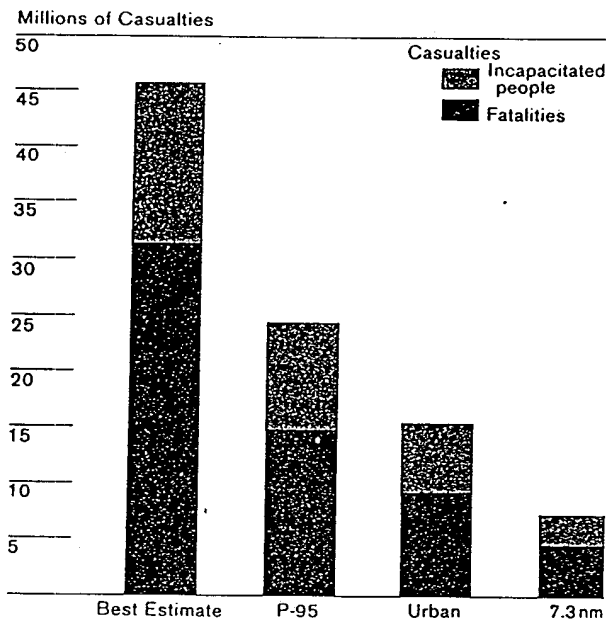
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### Areas From Which People Are Evacuated

19. A few alternative definitions of which areas are to be evacuated were examined to determine their impact on estimates of casualties and fatalities. Four definitions were examined, and the alternatives are shown in figure C-5.

- All urban P-95s (some 900 cities totaling about 130 million people).

**Figure C-5**  
**Estimates of Soviet Casualties Under Various Assumptions About Which Cities are Evacuated**



- Best estimate - This includes the some 300 cities that we believe would be evacuated.
- P-95 - Includes all of the urban P-95 population centers—involving the some 900 cities with populations of 25,000 or more.
- Urban - The same 900 cities mentioned above plus populations of surrounding urban areas.
- 7.3 nm - All populated areas within 7.3 nm of targets

**Percentage of the Population Evacuated From Risk Areas**

20. Using the four alternative definitions of areas to be evacuated, the effects of different assumptions about what percentage of the population would evacuate were calculated. Three percentages were examined: 90 percent (our best assessment of current Soviet operational plans), 75 percent (the percent hypothesized in the IIM of 1977), and 50 percent (a way of simulating only partial compliance with Soviet evacuation plans). The effects of these various combinations on estimates of casualties are portrayed in figure C-6.

**The Extent of Civil Defense Implementation**

21. As shown in figure 9, estimates of casualties and fatalities resulting from a massive nuclear attack against military and economic targets are most sensitive to the extent of civil defense implementation. Casualties from the hypothesized US retaliatory strike would be about 125 million (including 105 million fatalities) in the case of little or no preparation, about 115 million (85 million fatalities) if urban blast shelters and the best available protective structures were occupied, and about 45 million (30 million fatalities) if sheltering and evacuation had been completely implemented.

**The Amount of Space Allocated per Person in Blast Shelters**

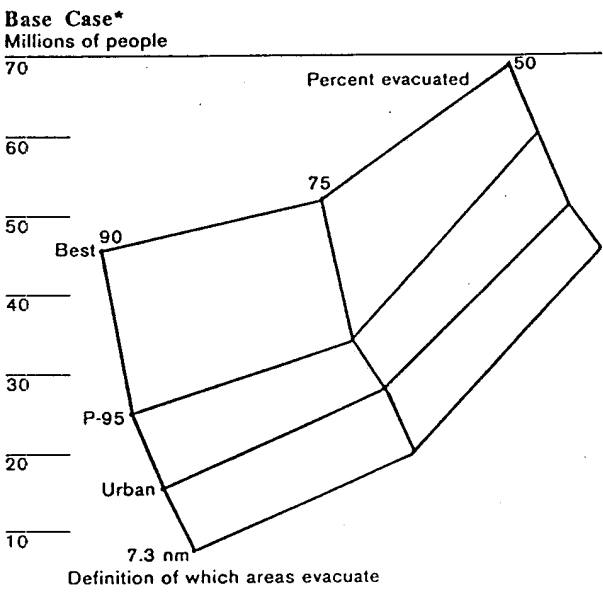
22. The base case estimates of casualties for scenarios involving the use of shelters are based on the assumption of shelter occupancy at rates consistent with our analysis of the variation of occupancy factors among Soviet climatic regions. This analysis implies a nationwide average occupancy factor of about 0.6 square meter per person. Alternative sets of calculations were made assuming occupancy rates of 0.5 and 1.0 square meter per person. In the case in which urban blast shelters and the best available protective structures were occupied but no evacuation was undertaken, the use of an occupancy factor of 1.0 square meter per person would increase by about 1 million the number of casualties that would be estimated if occupancy of 0.5 square meter per person were assumed (see figure C-7).

23. In the case in which sheltering and evacuation were completely implemented, use of the 1.0-square-

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- All urban P-95s and urban non-P-95s (some 900 cities and surrounding areas totaling about 160 million people).
- All areas within 7.3 nm of targets [ ] a total of about 180 million people).
- Our best estimate of which areas are to be evacuated (nearly 300 cities totaling about 95 million people).

**Figure C-6**  
Sensitivity of Casualty Estimates to Percentage of Population Evacuated and Definition of Which Areas Evacuate



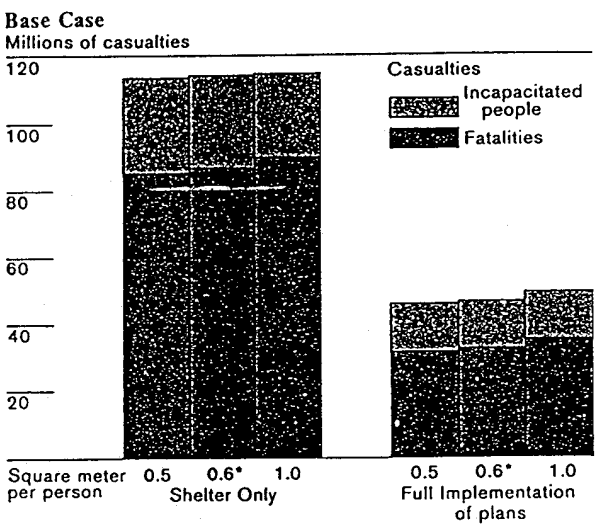
\*US forces on generated alert.

- Best - This includes some 300 cities that we believe would be evacuated
- P-95 - Includes all of the urban P-95 population centers—involving the some 900 cities with populations of 25,000 or more
- Urban - The same 900 cities mentioned above plus populations of surrounding urban areas
- 7.3 nm - All populated areas within 7.3 nm of targets

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meter factor would increase casualties by about 3 million. These results indicate that, although variations in the shelter occupancy factor proportionately affect the number of people that can be sheltered, the impact on estimates of casualties and fatalities is much less direct. This is due to the assumption that people who could not be sheltered in a blast shelter would acquire protection in basements and multistory concrete reinforced buildings.

**Figure C-7**  
Effects of Shelter Occupancy Factors on Estimates of Soviet Casualties



\*Our analysis of the variation of occupancy factors among climatic regions implies a nationwide average occupancy factor in Soviet blast shelters of about 0.6 square meters per person.

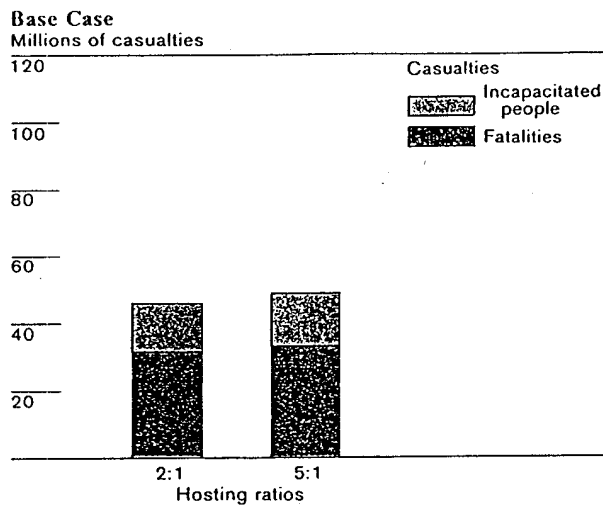
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**The Ratio for Hosting Evacuees**

24. The ratio used in the base case for hosting evacuees was 2 to 1. This figure is our best assessment of what the hosting ratio would be. The most authoritative statement from a Soviet source on hosting ratios is a training manual which states "for each local inhabitant, there may be one to two evacuees, or 2 to 3 square meters of living space for each person (that is, both local and evacuated)." The use of a 5-to-1 ratio could be plausible on the basis of 2 to 3 square meters of space allocated to each person. DIA has estimated that there are about 11.5 square meters of floorspace per person in buildings in Soviet rural areas. This could be interpreted to imply hosting ratios in the range of 4-6:1. Thus, an alternative calculation was

<sup>3</sup> Yegorov, P. T., Shlyakov, I. A., and Alabin, N. I., *Civil Defense* (Moscow, 1970), as translated by the US Air Force, p. 80.

**Figure C-8**  
**Effects of Hosting Ratios\* on Estimates**  
**of Soviet Casualties**



made assuming a hosting ratio of 5 to 1 to test the effect of a more densely packed evacuated population.

25. The effect on estimates of casualties and fatalities of a hosting ratio of 5 to 1 as compared to 2 to 1 is shown in figure C-8. With full implementation of Soviet civil defense plans and a hosting ratio of 2:1, casualties would be about 45 million, including 30 million fatalities. Assuming a hosting ratio of 5:1, we estimate that casualties would be 50 million, including 35 million fatalities.

#### The Readiness Posture of US Forces at the Time of the Soviet Attack

26. The base case assessments made in this study assumed that US forces were on a generated alert at the time of the Soviet strategic strike. Alternative calculations were made to determine the effect of US forces being on day-to-day alert. The major difference in the weapons systems available is due to an increased number of bombers put on increased readiness under a generated alert condition.

27. Our calculations showed that the number of casualties and fatalities resulting from a retaliatory attack by US forces on day-to-day alert would be somewhat less than those resulting from an attack by generated forces.

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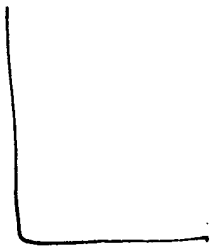
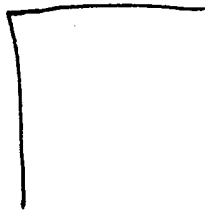
Annex D  
Tabular Data

Table D-1

Estimated Full-Time Soviet Civil Defense Personnel

	Military	Civilian	Total
<b>Staff organizations</b>			
National.....	250	50	300
Republic.....	2,250	450	2,700
Oblast.....	4,600	4,600	9,200
City.....	1,660	11,130	12,790
Rayon.....	1,080	15,100	16,180
<b>Total</b> .....	<b>9,840</b>	<b>31,330</b>	<b>41,170</b>
<b>Military units</b>			
Military districts.....	400	80	480
Civil defense troop units.....	25,000	—	25,000
Communications troops.....	900	—	900
Military academy.....	850	—	850
<b>Total</b> .....	<b>27,150</b>	<b>80</b>	<b>27,230</b>
<b>Nonmilitary organizations</b>			
Factories.....	—	33,500	33,500
Scientific institutes.....	—	2,700	2,700
Schools.....	3,000	2,700	5,700
Co-op and public organizations.....	—	2,100	2,100
Housing and public utilities.....	—	3,500	3,500
<b>Total</b> .....	<b>3,000</b>	<b>44,500</b>	<b>47,500</b>
<b>Total civil defense personnel</b> .....	<b>39,990</b>	<b>75,910</b>	<b>115,900</b>

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Table D-3

Military Civil Defense Units

Unit Location (alternate name)	Coordinates		Republic	Military District
	° ' "N	° ' "E		
Arkhangel'sk *			RSFSR	Leningrad
Artem	47 43 00	40 17 50	RSFSR	North Caucasus
Astrakhan	46 14 42	48 11 06	RSFSR	North Caucasus
Baku	40 23 50	49 49 10	Azerbaijan	Transcaucasus
Belovodskoye (Frunze)	42 49 20	74 08 10	Kirghiz	Central Asian
Biysk (Altaysky) *			RSFSR	Siberian
Chernovtsy *			Ukrainian	Carpathian
Chirchik	41 27 05	69 33 02	Uzbek	Turkestan
Dinskaya	45 11 55	39 13 15	Ukrainian	North Caucasus
Drogobych (Lvov)	49 20 32	23 31 46	Ukrainian	Carpathian
Dubossary (Kishniev, Kuchiyery)	47 18 40	29 06 35	Moldavian	Odessa
Dzerzhinsk *			RSFSR	Moscow
Feodosiya *			Ukrainian	Odessa
Geok Tepe (Ashkhabad)	38 08 35	57 56 40	Turkman	Turkestan
Gorbunovka	55 02 00	85 56 20	RSFSR	Siberian
Gorokhovets (Gorkiy, Zorino, Zolino)	56 17 58	43 03 15	RSFSR	Moscow
Ivanvka (Krasnoznamenka, Chervonoznamenka)	47 09 03	30 18 40	Ukrainian	Odessa
Johvi (Kohtla Jarve, Tallin)	59 21 00	27 25 00	Estonian	Baltic
Karaganda (Prishakhtinsk) *			Kazakh	Central Asian
Karatag (Dushanbe)	38 36 20	68 19 20	Tadzhik	Central Asian
Kazan	55 41 14	49 06 37	RSFSR	Volga
Khabarovsk	48 33 30	135 23 00	RSFSR	Far East
Kiev	50 25 12	30 27 19	Ukrainian	Kiev
Kochenevo (Novosibirsk)	55 02 30	82 10 00	RSFSR	Siberian
Kuybyshev	53 07 10	50 06 10	RSFSR	Volga
Leningrad/Kolpino	59 45 35	30 37 55	RSFSR	Leningrad

Table D-3  
Military Civil Defense Units (continued)

Unit Location (alternate name)	Coordinates		Republic	Military District
	° ' "N	° ' "E		
Leningrad/Murino (Medvezhiy Stan, Novo Devyatkino)	60 02 15	30 27 55	RSFSR	Leningrad
Lisichansk (Voroshilovgrad)	48 48 37	38 25 26	Ukrainian	Kiev
Makeyevka (Donetsk)	48 00 10	37 56 25	Ukrainian	Kiev
Melitopol (Zaporozhye, Mirnyy)	46 56 00	35 25 00	Ukrainian	Odesa
Merefa (Kharkov)	49 47 20	35 59 10	Ukrainian	Kiev
Minsk (Okolitsa)	54 02 30	27 46 55	Belorussian	Belorussian
Moskva <sup>a b</sup>			RSFSR	Moscow
Moskva/Balashika	55 47 20	37 58 30	RSFSR	Moscow
Moskva/Khimki (Novogorsk)	55 54 10	37 21 00	RSFSR	Moscow
Moskva/Noginsk	55 54 48	38 27 43	RSFSR	Moscow
Novogornyy (Chelyabinsk)	55 38 21	60 48 00	RSFSR	Ural
Pechi <sup>a</sup>			Ukrainian	Kiev
Penza (Russkiy Iyshim)	53 17 04	45 31 03	RSFSR	Volga
Perm			RSFSR	Ural
Pervouralsk (Sverdlovsk)	56 52 50	59 57 00	RSFSR	Ural
Pogorelovka (Krasnoyarsk)	56 18 18	92 55 25	RSFSR	Siberian
Riga (Suzhi)	57 01 00	24 12 00	Latvian	Baltic
Rostov (Kovolok, Voroshilovo)	47 20 18	39 50 10	RSFSR	North Caucasus
Saratov	51 47 40	45 46 20	RSFSR	Volga
Sarova	54 55 28	43 15 46	RSFSR	Moscow
Suchan (Vladivostok)	43 09 03	133 06 36	RSFSR	Far East
Taurage (Vilnyus)	55 15 32	22 16 37	Lithuanian	Baltic
Tavda <sup>a</sup>			RSFSR	Ural
Tbilisi	41 43 21	44 57 41	Georgian	Transcaucasus
Tula	54 04 30	37 11 55	RSFSR	Moscow
Usolye-Sibirskoye (Irkutsk, Angarsk)	52 43 57	103 35 05	RSFSR	Transbaikal
Uzunagach (Alma Ata)	43 13 55	76 18 40	Kazakh	Central Asian
Verkhovtsevo	48 28 10	34 13 01	Ukrainian	Kiev
(Dnepropetrovsk)				
Volgograd (Krasnoslobodsk, Akhtuba)	48 40 10	44 33 50	RSFSR	North Caucasus
Voronezh	51 33 40	39 08 09	RSFSR	Moscow
Vorsha (Vladimir) <sup>a</sup>			RSFSR	Moscow
Yerevan	40 21 20	44 35 50	Armenian	Transcaucasus
2 unidentified units <sup>a</sup>			RSFSR	Ural

<sup>a</sup> Not confirmed.

<sup>b</sup> Headquarters security detachment.

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