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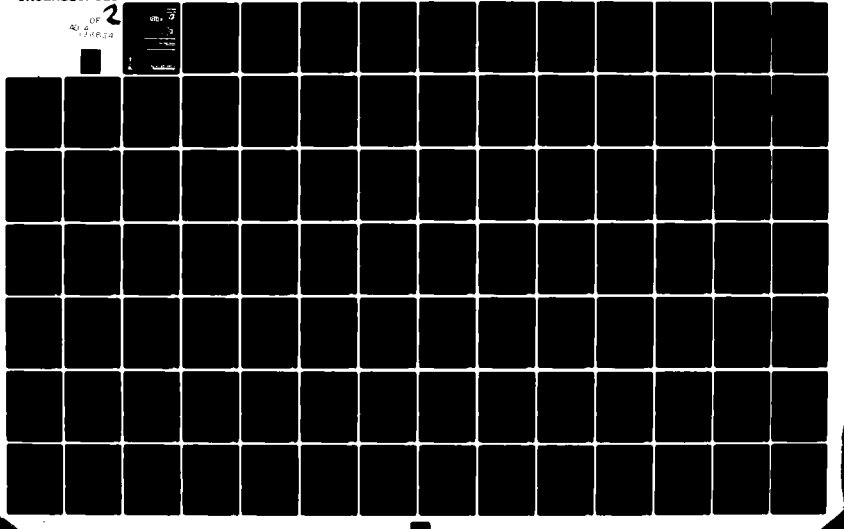

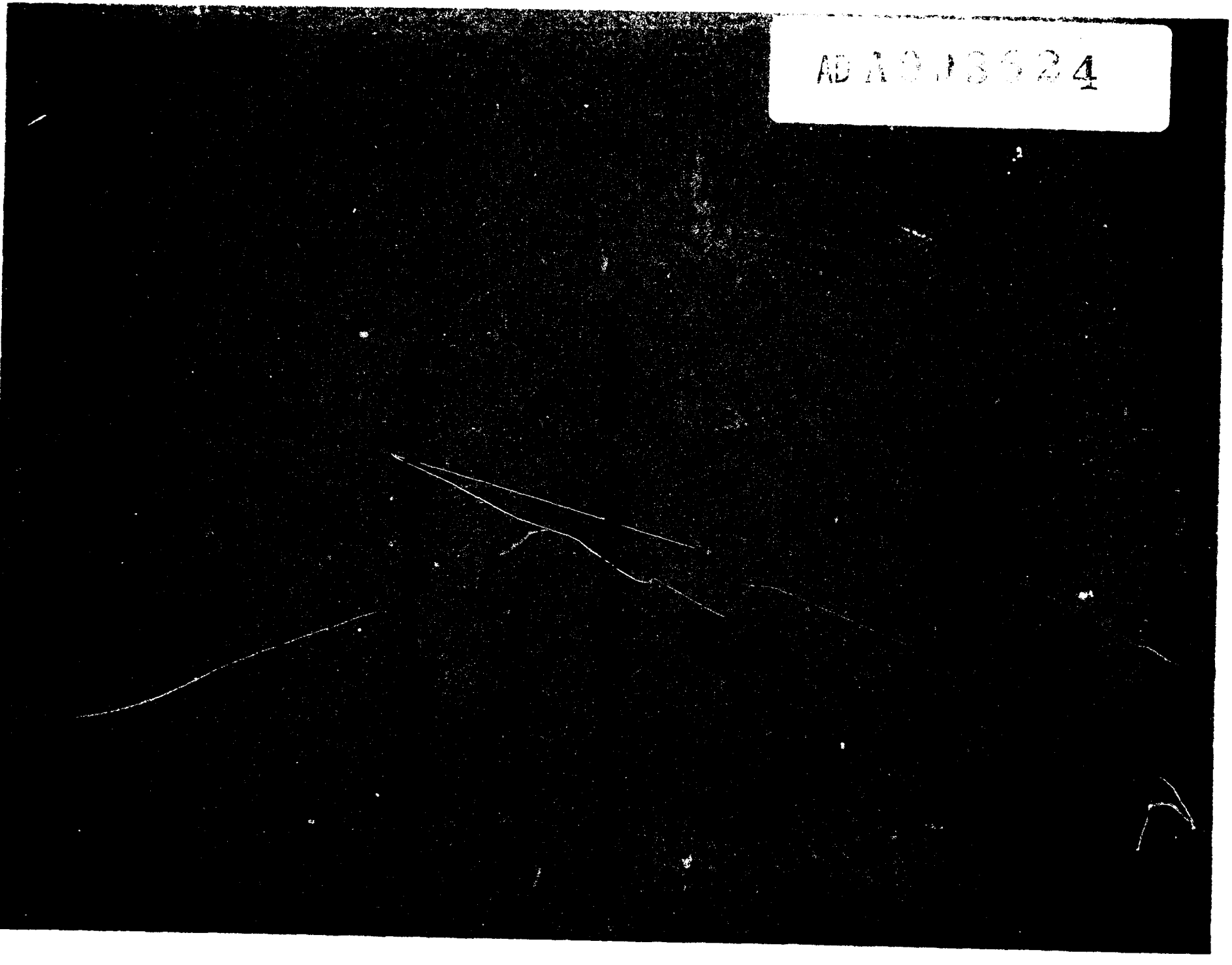

ERRATA

- Page vi - Change fifth statement to read "Establish a plan of action for house cleaning as a countermeasure for the protection of industry and government and other offices."

- Page 3-19, Program Sheet 4 - Change recommendation for next step from "no action" to "Research, Plan, Establish Program."

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The requirements of industry to contribute to the nation's recovery after a nuclear war is evaluated and a basic industrial preparedness program is recommended for implementation. This program evolved from a recommended national policy on industrial preparedness which is developed in the report. The program considers a set of six essential industries' and the applicability of fifteen countermeasures to augment industries post attack availability and usefulness. Recommended FEMA action is summarized.

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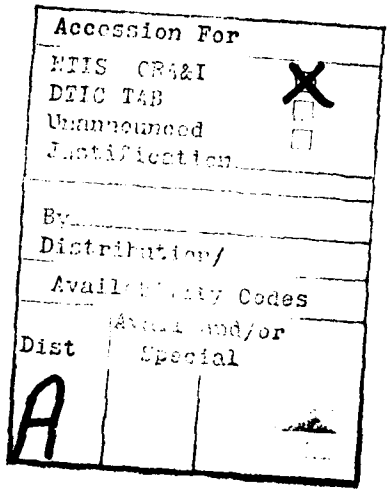

Candidate Industrial Preparedness Program

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SUMMARY

CANDIDATE INDUSTRIAL PREPAREDNESS PROGRAM
FEDERAL EMERGENCY MANAGEMENT AGENCY
WORK UNIT 4221C

by
ROGERS CANNELL AND EDWARD SCHUERT
WOODWARD - CLYDE CONSULTANTS
SAN FRANCISCO, CALIFORNIA
DECEMBER 1980

Research in the area of industrial preparedness was most active in the 1960s when numerous studies were completed on subjects directly related to the survival of industry during a nuclear war. However, during this period no national policy evolved on the role industry should play nor were the requirements for a comprehensive industrial preparedness program developed.

Industrial preparedness can be implemented either during peaceful times, or during a period of crisis at which time a nuclear attack appears to be imminent. The selected program should consist of those components necessary for survival of the population during the early post-attack period and for augmentation during the period of national recovery.

In order to establish the requirements of industry in the post-attack environment it was necessary to estimate the condition of the country after a large-scale nuclear exchange, especially the relationship between the surviving population and the capacity of the residual industry to produce goods. Thus those industries essential to national survival and eventual recovery were evaluated with respect to their capability to provide products. Where the capability was insufficient to support the post-attack population, those industries became prime candidates for assistance through an industrial preparedness program.

The problem of post-attack survival was evaluated, using the UNCLEX-73 scenarios, for conditions under which the national population was evacuated from prime target areas, Program D-Prime in which it was assumed that 80 percent of the population survived, and for no evacuation in which 45 percent of the population survived.

A consensus was found in the literature establishing the need for six basic industries, or their products, to provide the necessities for survival post-attack. These six basic industries are the following:

- Food and water
- Drugs
- Transportation
- Communications
- Electric Utilities
- Petroleum.

These industries were evaluated in relation to developed policy considerations and countermeasure availability for the development of a program to meet a minimum survival goal. Figure 1 describes the analysis.

Consideration of the recommended policies as developed, and the applicability of the fifteen countermeasures considered and their relationship to the FEMA Charter, produced a basic recommended industrial preparedness program incorporating those elements considered essential for survival. This basic program is summarized as follows:

- Quantify the interrelationships between a national crisis relocation program and the regional requirements for the six essential industries.

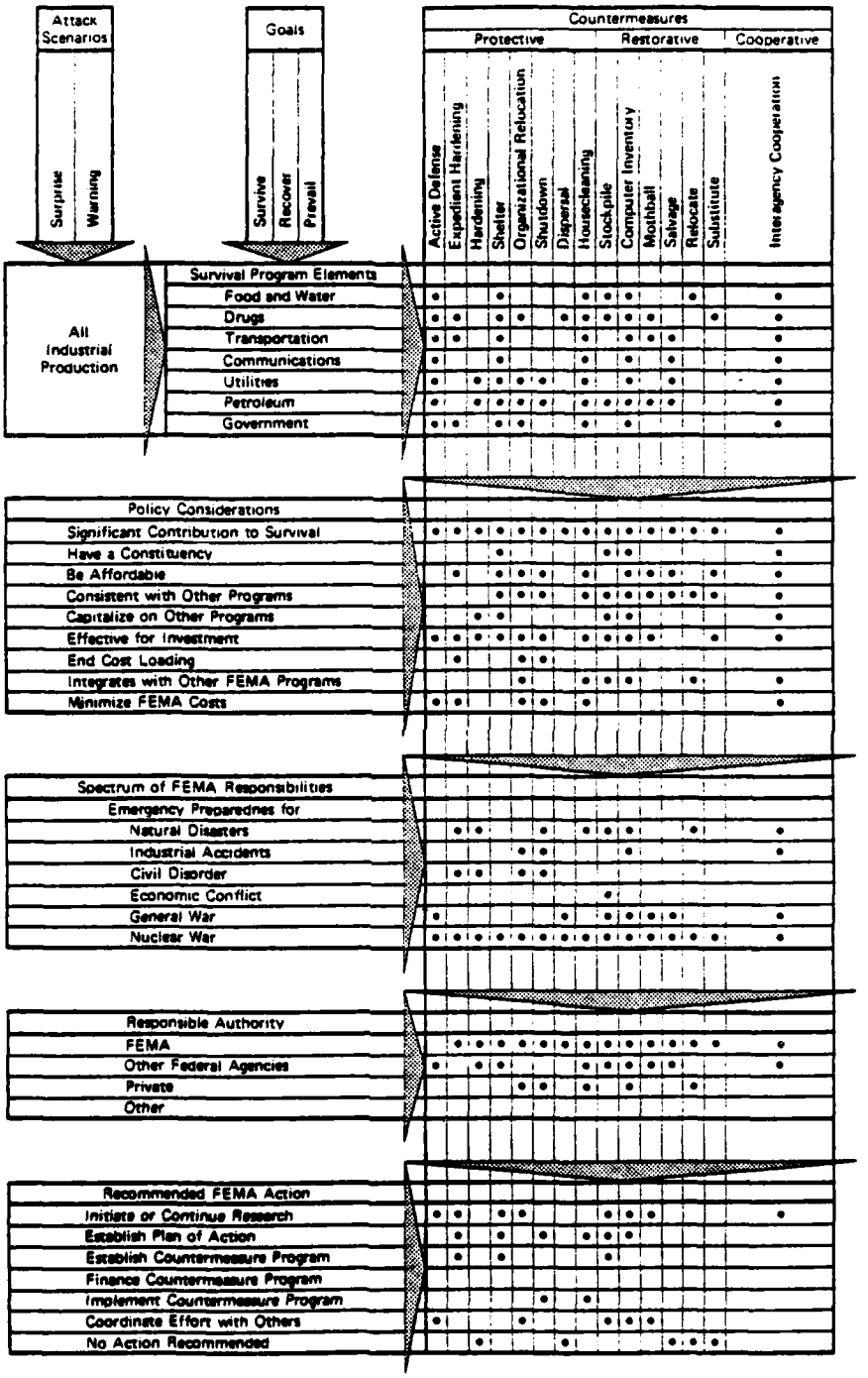

Figure 1. FEMA BASIC INDUSTRIAL PREPAREDNESS PROGRAM SUMMARY

- Coordinate FEMA activities with the Department of the Army program in active defense.

- Continue research, and establish a plan of action and a countermeasure program around the concept of expedient hardening for protection of the drug, transportation, and electric utility industries.

- Continue and coordinate work in crisis relocation research around the concept of organizational relocation and its application to the drug, electric utilities, and petroleum industries in addition to government.

- Establish a plan of action for the application of plant shutdown as a countermeasure.

- Establish a plan of action for housecleaning as a countermeasure for the protection of government and other offices.

- Initiate research, establish a plan of action and coordinate effort with others on the concept of stockpiling as a countermeasure for the protection of the food, drug, and petroleum industries.

- Initiate research, and coordinate effort with others on the concept of a computer inventory for tracking the locations and availability of goods relating to all of the six critical industries.

- Initiate research, on the concept of mothballing plants as a countermeasure for the drug, transporation, and petroleum industries.

- Initiate research, establish a plan of action and a countermeasure program, and coordinate effort within government on its concept of interagency cooperation as a countermeasure for the food, drug, transportations, communications, electric utilities and petroleum industries.

Augmentation of this basic program should evolve as further research within FEMA occurs and guidance for future programs is provided.

FOREWORD

On April 3 of this year, Mr. John Macy announced to Congress the goals and policies of the Federal Emergency Management Agency (FEMA). This new organization was designed to cope with the full spectrum of national physical disasters. Thus countermeasures to reduce the impact of destruction could be effectively directed at the problem whether the cause was nuclear war, natural disaster, or civil strife. It was believed that centralizing disaster functions would reduce redundancy, improve effectiveness, and lower costs.

This report on industrial preparedness, in which industrial preparedness policies are derived, critical resources are identified, and programs to protect critical resources are designed, was conducted independently of the organizational activities. The results of this technical study support the philosophical goals that lie at the foundation of FEMA.

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1.0
INTRODUCTION

The ability of industry to respond to the post-war needs of the nation has been recognized as an integral part of the U.S. Civil Defense program since its inception. Research on industrial preparedness was most active during the 1960s when numerous studies were completed in areas and on subjects directly related to the survival of industry after a nuclear war. However, a national policy did not evolve on the role industry should play, nor were the requirements for a comprehensive industrial preparedness program considered.

Civil defense in the United States has, over the past 30 years, been primarily directed toward those aspects of a nuclear crisis that directly relate to the impact on population and only secondarily to the post-attack requirements of the nation for an industrial base necessary for survival and recovery. Thus the limited national effort in this area has accomplished considerable research and put into practice, both for pre-attack preparedness and post-attack survival, many important concepts.

The present-day lack of a constituency in the area of civil defense has resulted in limited federal budgets that have proved sufficient only for a relatively small program limited largely to planning and research.

The national program is presently directed toward developing a pre-attack capability for evacuation of the population from high-risk areas to areas having a high probability of being untargeted should war occur. Crisis relocation, as it is known, emphases a program that would result in the survival of 80 percent of the population during a massive nuclear attack, and that would accomplish this survival rate at a very modest cost.

Survival of the population in a devastated post-attack environment has been addressed in a number of studies. It is generally concluded that recovery of the nation is possible, providing the basic necessities of life are available and the framework exists for reconstitution of the government and the national infrastructure. The ability of a nation to survive in a post-attack world can be augmented by the development of a program that would assist the residual industrial complex to provide those items critical during the post-attack period.

Much research (see bibliography) has been conducted to determine how to assist industry to survive a nuclear attack. A number of countermeasures that have been identified to ensure survival are:

- protection of industry by development of an active defense program
- expedient hardening of plants and components against blast and fire
- permanent hardening of plants and components against blast and fire
- providing shelters for key workers and critical resources
- establishment of organizational relocation programs for key workers and their families
- reduction of damage by development of plant shutdown procedures during periods of crisis
- dispersal of industries to reduce probability of being targeted
- development of good housecleaning practices to reduce degree and spread of damage
- stockpiling of critical items
- development of national inventory of existing critical items
- mothballing obsolescent industrial plants for post-attack reactivation
- development of post-attack salvage program
- establishment of relocation programs for critical resources
- development of techniques to utilize industrial facilities for critical output requirements by substitution of normal design considerations.
- development of national interagency cooperative program for augmentation of industrial preparedness

Thus the components of a national industrial preparedness program have in many instances been developed and tested.

The objective of this analysis is to assimilate these studies into an industrial preparedness program. Such a program requires consideration of the attitude of the nation toward its future, and thus considerable thought was given to the concept of the national policy as it relates to industrial preparedness.

In addition to a review of the literature (see bibliography) two industrial preparedness workshops were held at which the nation's experts in this field were brought together to discuss and debate the questions at hand. The workshops were most fruitful in that a broad cross-section of individuals with diverse viewpoints were brought together to discuss, perhaps for the first time, program alternatives rather than specific countermeasures.

2.0
POLICY DERIVATION

This section explores policy considerations for the FEMA industrial preparedness program. The purpose is to establish goals and selection criteria for use in evaluating and choosing an industrial preparedness program from a number of alternatives. The approach used is to direct the industrial preparedness program to effective measures that can be implemented by FEMA considering funding and policy constraints.

A program to reduce industrial vulnerability and enhance the capability of the United States to survive and recover from nuclear attack should meet the following broad set of criteria.

The program should work.

- The industry (or industries) selected for "protection" should be vital to post-attack needs.
- Proven techniques should be available to reliably assure the survivability of the productive capacity of the protected industry.
- The approach selected should offer significant advantages over other alternative measures.
- The approach selected should be effective over a wide range of potential disaster situations (spectrum of FEMA responsibilities).
- The program should be maintainable over its planned life.

The program should be believable.

- The risk should be perceived by the potential constituency.
- The effectiveness should be convincing.
- The implementation should appear feasible.

The program should be promotable.

- The concept should be acceptable to Congress.
- The program should not arouse public antagonism.
- A constituency benefiting from the program should exist.
- Public advisory groups should view the program as non-threatening.

The program should be affordable.

- It should compare favorably with other proposed measures in terms of national objectives.
- It should have a favorable benefit/cost ratio.
- All costs should be considered (direct and indirect, FEMA and non-FEMA).

The program should include an implementation plan.

- Countermeasures should be simple to explain and implement.
- A public information plan should be designed.
- A management/evaluation program should be included.
- Obsolescence and updating should be included in the operational planning.

The objective of drawing together a policy is to sort out those countermeasures that would reduce industrial destruction and relate them to specific industries (one countermeasure doesn't work for all industries) and then select programs that could be supported by a constituency and be funded. Thus the goal is not merely to design an effective industrial preparedness program but also to select one that has some chance of early implementation. The program described in this report can serve as the base; FEMA can then build on it, adding pieces when world hostility and the domestic political climate establish acceptance.

COMPONENTS OF POLICY

Considerations for developing an industrial preparedness policy are graphically shown in Figure 2-1. The components of the derivation are a constituency to support the program, a goal for the program, and constraints within which the program must operate.

A constituency is loosely defined as a group of people with sufficient power or influence to establish a program. The larger and more costly a program is, the stronger the constituency must be to establish the program. The more a program impinges on the public or requires its support, the more difficult it is to build a constituency. Constituency varies not only by generic category, like industry, military, special interests, and so on, but also within a generic category. For example, one might find a constituency to support a food stockpile program in farmers who thought it would be a way to help sustain prices. A constituency for a factory mothballing program might be found among rubber manufacturers whose plants were forced to close during a time of surplus production. Both of those constituencies would contribute toward meeting post-attack survival needs, and neither would be motivated by defense requirements. Neither would be a constituent for the other. Thus the first element of constituency is to identify a vested interest in the program under consideration.

To build a constituency total for a preparedness program the specific program contents should be tied together to gain support for a higher common, but less specific, interest. In this manner, many disinterested groups may support the overall need for a FEMA industrial preparedness program out of recognition that they cannot have the part they want unless the total program is a success.

The next consideration of testing for a constituency is that it must be broken down one level further than generic categories such as industry, military, etc., because none of these categories has a monolithic point of view. Certain industries would support a preparedness program if what they manufactured was something that went into the defense program and procedures existed whereby the self preparedness could be a tax write-off, or actions could be taken that

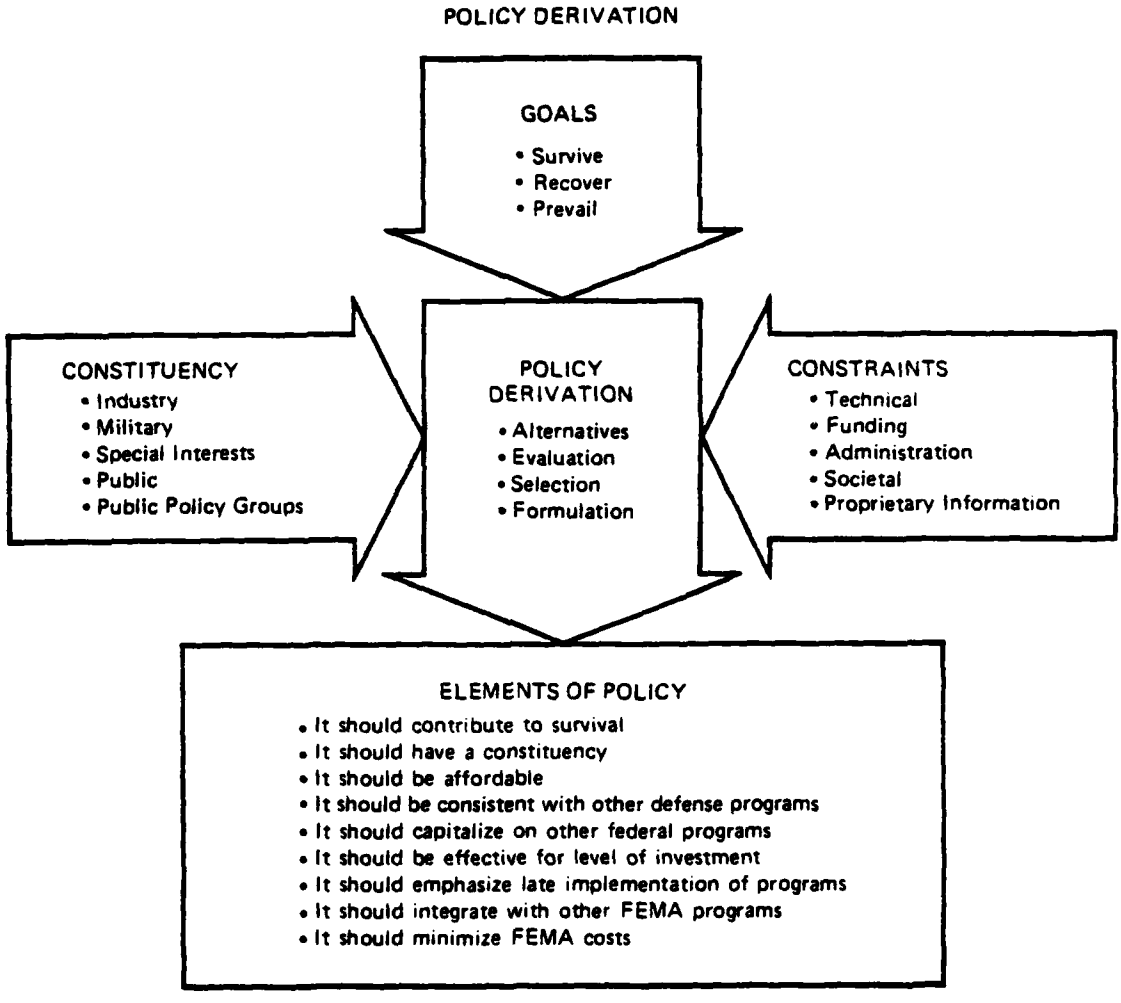

Figure 2-1. POLICY DERIVATION

would help to sell their products. Even the military branches could have divergent views. Some may feel that industrial preparedness supports their cause and others may feel that it is competitive with it--that it reduces their funds and implies an inability of the military to protect the nation. Some might maintain that if the military is successful in deterring war, then the ability to re-establish society is not necessary. Those that support industrial defense might claim that if recovery could be accomplished more quickly and more completely, deterrents to a total defense posture will have been enhanced.

The final consideration in building a constituency is recognizing that public information programs, changes in the military climate, support by the President, or any number of events or activities on the part of government or industry can build a constituency. Thus when a policy element is analyzed in terms of a potential constituency, consideration must be given not just in today's terms, but in terms of whether anything might happen in the future that would change that evaluation.

The second input to policy derivation is national goals. Of course, it would be preferable to attain the upper limit goal, such as "prevail" however; only a program that provides the most elemental goal like "increase the rate of survival" may be feasible. Thus a program should begin by serving lesser goals but be expandable to larger goals. At the level of minimum goals and basic programs, the amount of suffering would vary considerably according to how much pre-planning was done and how much was set aside in the way of resources, training, and so forth. Thus a minimum goal would not be to assure survival but to improve the probability. A study, then, of many attack scenarios that could occur found that there were many actions to make our rebuilding easier.

The final element which relates to policy derivation is constraints. Only funds and societal factors were considered limiting for the present time. The literature indicated that the kinds of protective programs under consideration were not limited by technical constraints. For example, the technology exists

for a hardening program, but the money does not. In addition considerable public anti-war opposition would be likely to occur. If it was a hasty hardening or expedient program, the cost would not preclude it; furthermore, action could be taken without much public attention.

Similarly, our studies did not discuss any serious technical constraints in any of the measures under consideration. If FEMA knows how to execute the technology, maybe the approach could be improved. More research could be conducted; more could be learned about cost and application. We could go ahead with quite a few programs without much limitation.

It is, however, important to recognize the relative readiness of each specific element of a given industry when a hardening plan is being formulated. For example, in a plant like Boeing, hardening might be well developed, and a further refinement of the hardening process would probably not encounter serious obstacles. On the other hand, an electronics firm, in which light frame buildings contain very high value equipment, could require major modifications before a hardening program could be planned. The principal problem is funding large-scale hardening programs in a political climate which does not tend to stress expenditures in this area. The best hope at present is that a hardening program can be embarked upon as a component of other efforts and that FEMA can establish some viable piggyback programs in alliance with other government and private programs.

Most of the preparedness programs that are implementable, affordable, and consistent with other defense actions tend to aim in the direction of large programs, with broad applicability, such as computer inventory, mothballing when plants go out of business, national interagency cooperative programs, and so on. However, since this situation is dynamic, there may be a time in the future when FEMA might wish to go ahead with a more effective but also more costly program like mass hardening. Consequently, research should be conducted on the whole program even though at this stage a smaller program that seems consistent with the present political environment would be developed.

Possibly further research should be conducted to accommodate late implementation planning. Then, if a few peak weeks of concern occured, these plans could be implemented. We could be consistent with the political climate with this approach. On the other hand, we have found several inexpensive programs, and we need to look at these in terms of their effectiveness against the level of investment. We should not be undertaking them just because they are cheap. We should also integrate with other FEMA programs, say a FEMA earthquake protection program built in one part of FEMA might have to have a spinoff program or follow-on that would interface with nuclear. In so integrating the two, we would capitalize on the investment. That's a plus in terms of the program; we'd like it to cover as much as it can of the FEMA scope. Capitalizing on other federal programs is also important; for instance, accessing an area like industrial recovery characteristics. Where our programs can be part of larger causes like energy self-sufficiency, etc., we should certainly make them so.

ELEMENTS OF POLICY

The combined inputs to policy--constituency, goals, and constraints-- yield the following policy elements.

- It should contribute to survival.
- It should have a constituency.
- It should be affordable.
- It should be consistent with other defense programs.
- It should capitalize on other federal programs.
- It should be effective for the level of investment.
- It should emphasize late implementation of programs.
- It should integrate with other FEMA programs.
- It should minimize FEMA costs.

3.0
PROGRAM DERIVATION

INTRODUCTION

In the evaluation of candidate industrial preparedness programs, it was necessary to view them not only from the standpoint of availability of program components, their applicability and costs, but most importantly, from their relationship to the policy thoughts developed earlier. Thus the approach to the development of an industrial preparedness program required consistency with today's national interests and attitudes toward civil defense. Other program concepts were evaluated on the assumption that this attitude could change.

Another variable which has an important impact on industrial preparedness program alternatives is the question of the scenario selected to represent the potential future conflict. The expectation that it is highly unlikely that a nuclear war would be initiated without warning, plays a critical role in the nation's civil defense posture. The emphasis on evacuation of the nation's urban population to low-risk areas as the primary program for saving lives infers, by definition, that several days warning would be available to take this action. Although a surprise attack is not considered probable, it is considered by some as a distinct possibility, and thus both the availability of time and its unavailability enter the equation as variables in the development of industrial preparedness programs.

Industrial preparedness can be implemented either during peaceful times or during a period of crisis at which time a nuclear attack appears to be imminent. The basic program should consist of those components necessary for population survival during the early post-attack period and secondarily to expedite the recovery period.

Past research and ongoing studies address a number of concepts which, if implemented, would provide a greater ability for specific industries to survive a nuclear attack and/or improve their ability to resume production.

THE PRE-ATTACK AND POST-ATTACK ENVIRONMENT

The Pre-Attack Environment

Whether a period of warning would exist through tension and conflict that would lead to a crisis and precipitate a nuclear exchange or that the Soviet Union would initiate a surprise attack is still being debated. Leon Goure', a noted authority on Soviet military philosophy and capabilities, and the authors of a recently published book, Soviet Strategy for Nuclear War, concur that an attack aided by the element of surprise could contribute enormously to the outcome of war and that the Soviets are improving their ability to initiate a successful surprise attack while protecting their country from the vulnerability of such an attack. As explained in Soviet Strategy, "Surprise is perhaps the single most important factor in Soviet military thought . . . In the event of war with the West, the Soviets place great importance on siezing the initiative and striking first, with surprise if at all possible." The authors further claim that although the Soviets may not be inclined to deliberately start a global war, they would not be hesitant under certain circumstances to strike first.

Few wars in history were begun without some degree of warning. The majority of people who have studied the motivations and effects associated with nuclear war believe that should a Soviet/U.S. confrontation occur, some degree of warning would precede an attack. This warning could be as little as a few hours, two to three days, a week, or possibly more. As Jack Greene explained at the 1967 symposium on Post Attack Recovery from Nuclear War, "the conditional probability of an 'out-of-the-blue' simultaneous attack on a major proportion of the large population centers is considered by most professionals . . . to be a very-low-probability event". Consequently, most planning and hypothetical attack scenarios have been predicated on some degree of warning.

The Soviet crisis relocation program is considered to play a major role in war-related strategy and has been estimated to require two to three days for

implementation in order to have a significant beneficial effect. It appears, however, that the Soviets are attempting to reduce even this minimal time requirement. Conversely, the U.S. civil defense program has played a minor role in war-related activities and defense budget appropriations. It has been estimated that without the ability for evacuation as efficient as that of the Soviet program, the U.S. could lose from 50 to 70 percent of its population while the Soviets would suffer fewer casualties than they incurred in World War II.

Acknowledging the discrepancies in Soviet/U.S. civil defense preparedness, FEMA has begun to implement program D-Prime to the extent allowed by its budget. Success of this program, once it is established, is also based on the assumption that a one- to two-week "surge" or warning period would be available. As long as the threat of nuclear war exists, future plans must include the possibility of an exchange under both circumstances--surprise and warning.

The Post-Attack Environment

In order to establish the requirements of industry in the post-attack environment, it was necessary to estimate the conditions of the country after a large-scale nuclear exchange, especially the relationship between the surviving population and the capacity of the residual industry to produce goods. Thus those industries critical to national survival and eventual recovery were evaluated with respect to their capability to provide products. When this capability was insufficient to support the post-attack population, those industries became prime candidates for assistance through an industrial preparedness program.

A number of scenarios can be found in the literature describing the post-attack condition of the country after a nuclear exchange. In this evaluation, the UNCLEX-73 study was used for input because it includes a comprehensive analysis of the impact of a large-scale attack on industry. The problem of post-attack survival was evaluated for conditions under which the national population was evacuated from prime target areas (Program D-Prime), in which it was assumed that 80 percent of the population survived, and for no evacuation in which 45 percent of the population survived.

*A summary of UNCLEX-73 can be found in Appendix A.

Industries selected as essential were defined as those required to permit the population to survive the post-attack period. Here it was assumed that if the basic necessities for survival were provided, and if a national infrastructure could be re-established, the nation would recover through the efforts of the people.

A consensus was found in the literature (see bibliography) establishing the need for the following six basic industries, or their products, to provide the necessities for survival.

- Food and Water. Basic subsistence of the post-attack population is fundamental to survival. Sufficient quantities of food and water as well as equitable distribution of these products is essential.
- Drugs. Sufficient drugs, especially antibiotics to prevent outbreak of disease and to provide reasonable health to the surviving population, is considered secondary only to the need for food.
- Transportation. A national transportation system is considered critical to survival in that the distribution of people and goods will be, in many cases, incompatible with each other. It will be essential to distribute critical items, especially food and drugs, over a period of many months.
- Communications. The ability to communicate, initially on a regional basis and shortly thereafter nationally, is essential to many aspects of post-attack survival, including the supply of critical products when and where needed.
- Electric Utilities. It is considered imperative that if the nation is to survive and recover, the residual industrial complex capable of producing goods will need a source of power as a basic prerequisite.
- Petroleum. Survival and recovery will be critically dependent upon a source of energy, primarily petroleum products. Fuel for agricultural and trucking industries is essential.

Any industrial preparedness program must consider the basic requirements for survival and recovery as briefly discussed above. Thus the ability of the six critical industries to provide for the population must be included in any analysis, and augmentation of these industries, where necessary, through an industrial preparedness program is considered essential.

These six essential industries were evaluated in relation to policy considerations and countermeasures available for the development of a program to meet a minimum survival goal.

POST-ATTACK ANALYSIS

The UNCLEX-1973 study was used to define the post-attack conditions assumed to exist for this study. This analysis permitted a semi-quantitative evaluation of the state of the nation during the first six months after a theoretical nuclear attack. The condition of the nation's industrial complex was tabulated, and those industries considered essential were given further evaluation. An industrial preparedness factor was developed to relate the capability of those essential industries to provide products for national survival during the first six months after an attack and for national recovery. Where any given industry was found to be unable to provide those products critical to survival, industrial preparedness countermeasures were evaluated and implementation of these required countermeasures was studied to assure that those industries could supply the goods and services required for survival and recovery.

Thus a basic industrial preparedness program was defined, upon which other applications of preparedness could be suggested and implemented. Depending upon policy, industrial preparedness program alternatives of increasing complexity and cost could be developed.

The UNCLEX-73 Attack Scenario

A summary of the make-up and outcome of Target System Charlie of UNCLEX-73 is shown in Figure 3-1. The results of this scenario were used in this study. (A summary of the study as taken from Volume II--National Survival After UNCLEX-73 can be found in Appendix A.)

TARGET SYSTEM CHARLIE

- Date of Attack — March 15, 1973
- Period of Attack — 7 Hours
- Evacuation of Cities — 10%-Voluntary
- Weapon Delivery Scenario

Delivery Mode	Yield (MT)	Number	Total MT
Missile	20	40	800
Missile	10	90	900
Missile	5	545	2725
Missile	3	455	1365
Aircraft	3	70	210
		1200	6000

- Target Categories

  Military Command and Control Centers
  Nuclear Retaliatory Capabiliy
  Centers of Government
  Concentrations of Manufacturing Industry
  Concentrations of Transportation Industry
  Concentrations of Military Support Industry
  Concentrations of Population

CHARLIE RESIDUAL

Population Survival	45%
Uninjured Producers	32%
Average Industrial Productivity During First 6 Months	14%

Figure 3-1. UNCLEX-73 Summary

Conclusions reached by the authors included the following:

"Holding the institutional fabric of the Nation together in the face of the extremely severe public service constraint will require the most heroic and persistent government effort. Extreme want and despair will threaten the stability of the government itself if these hardships are not accepted and finally surmounted.

"The surviving capacity balance comparisons reveal comparatively deep cuts in the following vital manufacturing sectors: drugs, petroleum refining, equipment production for communication, electronics, and electric power distribution, and major military equipment production. The threat of such shortages to national survival is suggested but remains conjectural or scenario-dependent.

"The overall post-attack transportation situation is extremely drastic, particularly in the Northeast and Middle West north of the Ohio and east of the Mississippi. All forms of surface transportation including water were brought to a virtual standstill in this area. Only the most heroic measures can be expected even partially to restore transportation operations in this part of the Nation that produced 59 percent of all pre-attack manufacturing. This makes most difficult the task of holding together the organized economy of this whole region which, in turn, poses a most grave threat to national survival.

"With so many respects in which the failure of national recovery is gravely threatened, it appears most unlikely that all of the pitfalls could be avoided and the national survival sustained."

Post-Attack Industrial Status

The survival of industry by category, at the national level, was determined after Target System Charlie. Survival was viewed as the percent of pre-attack production capability. The maximum productivity of industry by category during the first six months post-attack was then tabulated as calculated in the UNCLEX-73 study.

UNCLEX-73 data were used to define an industrial preparedness factor based upon a surprise attack (no crisis relocation planning, with 45 percent of the population surviving) and upon an attack after a period of warning (with CRP, and thus 80 percent of the population surviving). This factor measured the ratio of maximum productive capacity of individual industries during the first six months to the percent of surviving population.

Severe difficulties for any manufacturing sector were not considered unless the residual production capability was substantially below two-thirds of the population survival (45 percent) for a consumption support industry or below two-thirds of the uninjured survival (32 percent) for a production support industry. For the crisis relocation situation, 80 percent of the population survived and for the purpose of this analysis were considered uninjured.

Thus, if the IPF was greater than one for any given industry, it was assumed that production would be sufficient for survival. However, if the ratio was substantially less than one for any given industry, it was assumed that that industry would need help in the form of an industrial preparedness program.

This approach provided the ability to concentrate any selected industrial preparedness programs on those industries requiring help rather than developing a program which did not discriminate.

By ranking industries by priority of need (essential industries) during the post-attack period, and by determining which industrial preparedness countermeasure best applied to these industries, an efficient industrial preparedness program could be developed. Table 3-1 shows the relationship of industry class to its national survival and its maximum post-attack productivity.

From this analysis it was concluded that of the essential industries defined (food, drugs, transportation, communications, electric utilities, and petroleum), industrial preparedness programs are essential for drugs, electric utilities, and petroleum and that there is little difference in requirement for the two cases considered, where either 45 percent or 80 percent of the population survived.

In general, food, agriculture, and the residual highway network were found sufficient to provide and distribute food and other products during the post-attack survival period, although transportation in the northeast appears to require program assistance.

Table 3-1
RELATIONSHIP OF INDUSTRY TO NATIONAL SURVIVAL

Industry	I/O Class No.	National Survival %	Maxi Prod. (1st 6 mo)	Indus. Preparedness Factor W/O CRP	Indus. Preparedness Factor With CRP
MANUFACTURING					
All			14		
CONSUMPTION SUPPORT					
Alcoholic Beverages	1401	82	9	0.30	0.17
Paper Containers	2500	33	14	0.47	0.26
Printing & Publishing	2600	18	6	0.20	0.11
Drugs	2901	26	10	0.33	0.18
Cleaning Preparations	2902	8	3	0.10	0.05
Toilet Preparations	2903	24	7	0.23	0.13
Paints	3000	7	3	0.10	0.05
Tires	3201	33	14	0.47	0.26
Metal Containers	3900	15	7	0.23	0.13
Ammunition	1303	41	15	0.50	0.28
Ordnance and Accessories	1304	29	13	0.43	0.24
Typewriters and Office Machines	5102	12	6	0.20	0.11
Service Industry Machines	5202	16	6	0.20	0.11
Radio and TV Receivers	5601	25	10	0.33	0.18
Phonograph Records	5602	45	14	0.47	0.26
Motor Vehicles	5902	9	3	0.1	0.05
Aircraft	6001	12	5	0.17	0.09
Aircraft Engines	6002	11	4	0.13	0.07
Aircraft Parts	6003	23	8	0.27	0.10
Shipbuilding and Repair	6101	13	6	0.20	0.11
Guided Missiles	1301	6	2	0.06	0.04
Tanks	1302	18	6	0.27	0.11
Surgical and Dental Equipment	6202	30	13	0.43	0.24
Watches and Clocks	6203	27	12	0.40	0.22
Optical and Opthalmic Equipment	6301	23	11	0.37	0.07
Miscellaneous	6400	27	11	0.37	0.20

Table 3-1
RELATIONSHIP OF INDUSTRY TO NATIONAL SURVIVAL
(Continued)

Industry	I/O Class No.	National Survival %	Maxi Prod. (1st 6 mo)	Indus. Preparedness Factor W/O CRP	Indus. Preparedness Factor With CRP
PRODUCTION SUPPORT					
Synthetic Rubber	2802	22	6	0.29	0.11
Petroleum Refining	3100	25	10	0.48	0.18
Blast Furnaces and Steel	3701	13	5	0.24	0.09
Iron and Steel Forging	3703	10	4	0.19	0.07
Miscellaneous Iron & Steel	3704	18	8	0.38	0.15
Secondary Non-Ferrous	3805	10.5	4	0.19	0.07
Copper Rolling & Drawing	3806	22	9	0.43	0.17
Miscellaneous N-F Rolling and Drawing	3808	21	9	0.43	0.17
Non-Ferrous Wire	3812	27	9	0.43	0.17
Non-Ferrous Forgings	3813	0	0	0.00	0.00
Screw Machine Products	4101	16	6	0.29	0.11
Metal Stampings	4102	21	9	0.43	0.17
Engines and Turbines	4300	14	5	0.24	0.07
Metal Working Machines	4700	29	1	0.52	0.20
Ball and Roller Bearings	4902	20	9	0.43	0.17
Fans, Furnaces, General Machines	4903	25	10	0.48	0.18
Machine Shop Products	5000	29	11	0.52	0.20
Computers	5101	15	6	0.29	0.11
Electric Measuring Instruments	5301	27	11	0.52	0.20
Electric Transfer and Switch Gear	5302	16	11	0.52	0.20
Electric Wiring & Light	5500	26	11	0.52	0.20
Telephone and Telegraph Apparatus	5603	9	4	0.19	0.07
Radio and TV Communications Equipment	5604	16	5	0.25	0.09
Electronic Components	5700	27	11	0.52	0.20
Engine Electric Equipment	5801	12	6	0.29	0.11
Railroad Rolling Stock	6102	13	5	0.24	0.07
Scientific Instruments	6201	24	10	0.48	0.18

Table 3-1
RELATIONSHIP OF INDUSTRY TO NATIONAL SURVIVAL
(Concluded)

Industry	I/O Class No.	National Survival %	Maxi Prod. (1st 6 mo)	Indus. Preparedness Factor W/O CRP	Indus. Preparedness Factor With CRP
TRANSPORTATION AND STORAGE					
Rail Operations		29	12	0.27	0.15
Rail Shops (Repair)		41	17	0.38	0.21
Truck Terminals		25	9	0.20	0.11
Roadways		75		1.67	0.94
Warehousing		43	17	0.38	0.21
Food Storage		59		1.11	0.62
Strategic Stockpiling		77		2.34	1.39
Petroleum Products		30	13	0.29	0.16
COMMUNICATIONS AND UTILITIES					
Telephone and Telegraph		72	-	-	-
Radio Stations		86	-	-	-
Elec. Power Gen.		51	-	-	-
Substations		51	-	-	-
Nat. Gas Proc. Fac.		90	-	-	-
EXTRACTION					
Agricultural Crops		75	-	-	-
Livestock		61	-	-	-
Mineral Mining		100	-	-	-
Coal Mining		95	-	-	-
Oil Fields		90	-	-	-

PROGRAM DEVELOPMENT

The purpose of this section is to develop the FEMA program required to meet a minimum survival goal. The input for this section was taken from earlier sections of this report wherein all industrial production was subjected to the attack scenarios of UNCLEX-73. Those attack scenarios covered two conditions (1) the surprise condition as found in UNCLEX-73 (no warning) wherein the ratio of destruction to population and industry was roughly proportionate, and (2) the warning condition which was applied to the UNCLEX-73 scenario wherein ample time existed to implement the program D-Prime. The ratio of survivors to resources in both conditions indicated a need to harden or protect those resources essential to recovery. Thus the resources with disproportionate ratios were selected as candidates for inclusion in an industrial preparedness program.

The results of the UNCLEX-73 analysis suggested that of the six basic industries needed to provide framework for survival, the drug industry, some aspects of the transportation industry, the utilities, and the petroleum industry would require assistance in order to provide for survival. Thus a basic industrious preparedness program should assure that these components be able to provide necessary services or products during the first six months post attack.

Fifteen industrial preparedness countermeasures were evaluated for their effectiveness in improving the ability of a selected industry to provide required services and products during the post-attack crisis. These analyses are presented in Program Sheets 1 through 15, and summarized in Figure 3-2.

PROGRAM SHEET 1

COUNTERMEASURE	**ACTIVE DEFENSE** This program is the responsibility of the U.S. Army. It consists of anti-missile defense techniques. Such systems do not exist at the present time. If and when active defense systems are approved, FEMA programs must be planned to take advantage of the protection offered and to enhance the effectiveness of the active defense through cooperative planning.
RESPONSIBLE AUTHORITY	FEMA **Other Federal Agencies** Private Other Department of Army
SURVIVAL PROGRAM ELEMENTS	**Food & Water Drugs Transportation Communications Utilities Petroleum Government** All resources centered around urban areas will suffer less blast damage if there is an active defense. Fallout problems will probably not be significantly reduced by active defense.
POLICY CRITERIA	**Contributes** Constituency Affordable Consistent Cooperative **Effective** End Loading Integrates **Minimize Cost** Although not a FEMA responsibility, active defense fits several FEMA policy criteria.
SPECTRUM OF FEMA RESPONSIBILITY	Natural Disaster Industrial Accidents Civil Disorder Economic Conflict **General War Nuclear War** War oriented countermeasure.
NEXT STEP	**Research** Plan Establish Program Finance Implement **Coordinate** No Action FEMA should continue joint research programs with the DOA to devise and assess the effectiveness of various combined programs.

PROGRAM SHEET 2

COUNTERMEASURE	**EXPEDIENT HARDENING** An expedient hardening program consists of measures such as sandbagging equipment, burying vulnerable critical tools and records, equipment and supplies, and tying down and bracing equipment and facilities. The key requirement to make such a program effective is, (1) a rather high ratio of employees to production elements; (2) warning time; and (3) the availability of high cost items of hardening equipment and supplies as part of the normal production process. It is helpful if some measures can be pre-prepared without interfering with normal production. Measures are also more likely to be implemented during periods of equivocal warning if a minimum of effort is required to restore the production. The FEMA program for this measure consists of research, information manuals, a responsible staff to promote it and respond to questions. The program has been limited to research to date. Expedient hardening as defined and analyzed by the Boeing Co. is expensive but can be effective. The recent Boeing study contributes significantly to the techniques and credibility of such a program. Expedient hardening should be considered. Hardening for other types of industries remains to be studied and program costing for comparison needs additional work. Of more general use and broader application are the steps described by Scientific Services, Inc. to harden various parts of structures. The principal advantage to the SSI approach is the somewhat lower cost, somewhat less interference with ongoing production and somewhat broader application at the expense of less production. A manual has been written that describes the measures that would be necessary to reduce the costs of restoring post attack production for most industrial plants.
RESPONSIBLE AUTHORITY	**FEMA** Other Federal Agencies Private Other This is primarily a FEMA program--FEMA is responsible for developing the techniques and promoting their use by the private sector. This must include information on why, how, and when to carry out the program.
SURVIVAL PROGRAM ELEMENTS	Food & Water **Drugs** **Transportation** Communications Utilities Petroleum **Government** The expedient hardening program appears to have limited use in the critical resource area. Food availability can be improved only slightly by hardening processing plants. There will be virtually no contribution to food stockpile or production. Drug plants and supplies can be protected. Infrastructure is difficult to protect as a system although the vulnerability of some parts of the system can be reduced. Each case must be analyzed before proceeding with the hardening of components. Significant improvements can be made in the transportation and government sectors.
POLICY CRITERIA	**Contributes** Constituency **Affordable** Consistent Cooperative **Effective** **End Loading** Integrates **Minimize Cost** This program is effective for the investment required. It has a limited constituency which could improve during periods of tension, or if the measures are effective for natural disasters such as floods, fires or earthquakes. It is a very low cost program to the government, and usually a minor cost to private companies. Best of all, most of the costs appear late in the program. A few of the measures have the bonus value of meeting the total responsibility of FEMA.
SPECTRUM OF FEMA RESPONSIBILITY	**Natural Disaster** Industrial Accidents **Civil Disorder** Economic Conflict General War **Nuclear War** This program is limited to protecting production--equipment, facilities, supplies and manpower--for hazards occurring primarily from nuclear war, and from civil strikes, or natural disasters.
NEXT STEP	**Research** **Plan** **Establish Program** Finance Implement Coordinate No Action Expand research to cover a wider range of production activities. Establish a FEMA operational program and prepare information documents.

PROGRAM SHEET 3

COUNTERMEASURE	**PERMANENT HARDENING** This program consists of building facilities with design features that reduce the vulnerability of the production system. The most common approach is to completely bury the structure underground or to bury some of the structure and surround it with an earth berm. In some instances mines or caves can be adapted to this purpose. Above-ground hardening, by increasing the structural strength, or reducing the pressure on the walls by including blowout sections, is usually prohibitively expensive.
RESPONSIBLE AUTHORITY	**FEMA** **Other Federal Agencies** Private Other FEMA is responsible for any research conducted for this program. It is unlikely, however, that FEMA will have the funds for such a program. The best hope is through capitalizing on other programs in other departments of government, e.g., Department of Commerce, or what is called slanting in HUD or federally funded constructions.
SURVIVAL PROGRAM ELEMENTS	Food & Water Drugs Transportation Communications **Utilities** **Petroleum** Government This program has only limited application to the critical resource areas. Key components in energy and utilities sectors could be hardened. Transportation can probably survive without such an investment. The hardening of work areas for government is well worth the investment, but this could be considered an element in other programs. It will probably have broad application in other non-critical resource areas.
POLICY CRITERIA	**Contributes** Constituency Affordable Consistent **Cooperative** **Effective** End Loading Integrates Minimize Cost This approach can be one of the most effective techniques, but it has a very limited constituency. A program supported by FEMA would be extremely expensive, say $30-60 billion, and would be completely out of line with other current defense programs. One possibility is the piggyback program where a combination of DOE, HHS or HUD might encourage underground public buildings to save energy and reduce maintenance. For example, schools in tornado areas might be built underground. High attack risk and tornado risk are not often coinci[illegible]t.
SPECTRUM OF FEMA RESPONSIBILITY	**Natural Disaster** Industrial Accidents **Civil Disorder** Economic Conflict General War **Nuclear War** This program is largely limited to nuclear war with some additional bonus effects for earthquakes and tornadoes and civil strife.
NEXT STEP	Research Plan Establish Program Finance Implement Coordinate **No Action** This program is not promotable at the present time.

PROGRAM SHEET 4

COUNTERMEASURE	**SHELTER** An Industrial Shelter Program is intended to assure the survival of key workers. It consists of required fallout and/or blast protection usually located at or near production sites. It is planned to supplement permanent hardening, and host area shelter programs, as may be required to assure essential post attack production. The program has only limited application to sheltering resources from fallout since most resources are unaffected by fallout and it is less expensive to decontaminate than to shelter.
RESPONSIBLE AUTHORITY	**FEMA Other Federal Agencies** Private Other
	This program is primarily a FEMA program which may be implemented through various incentives by private industry. Other programs in DOE, HUD, and HEW may also provide a vehicle for encouraging resource shelter programs.
SURVIVAL PROGRAM ELEMENTS	**Food & Water Drugs Transportation Communications Utilities Petroleum Government**
	Key Workers in all critical resource categories are candidates for protection by the Industrial Shelter Program. In general, it is more important to post attack production to save the workers than plants which can be reconstructed more rapidly than workers can be trained.
POLICY CRITERIA	**Contributes Constituency Affordable Consistent Cooperative Effective** End Loading Integrates Minimize Cost
	The program (to save workers) can be effective in all sectors and could have a constituency in the corporate structure of the industries determined to be critical. It is consistent with crisis relocation and in many cases, it may be possible to utilize the protection inherent in other federal programs.
SPECTRUM OF FEMA RESPONSIBILITY	Natural Disaster Industrial Accidents Civil Disorder Economic Conflict General War **Nuclear War**
	This program is primarily designed for the nuclear end of the spectrum and can be effective for both the warning and no-warning case. If implemented, it will have use at the lower end of the scale, but would not be used there unless otherwise provided.
NEXT STEP	Research Plan Establish Program Finance Implement Coordinate **No Action**
	System studies are required to design a program that is complimentary to other Industrial Preparedness Programs. This will require pilot shelter plans for candidate industries to determine alternative methods and benefit cost studies to determine optimum program mix.

PROGRAM SHEET 5

COUNTERMEASURE	**ORGANIZATIONAL RELOCATION** This program consists of building a saving program around the employees and families of employees of the industries determined to be critical in the post attack period. It is a sensible program which adds no cost above current people saving programs. It is applicable for any industry in which the employees are centrally located in a limited number of work areas. It will function best when the majority of employees live fairly close to the work center, because it is then much easier to provide family protection and keep the employees and families together. Organizational relocation goes hand in hand with the overall CD policy of "Crisis Relocation" and because the concept is several decades old, a few of the nation's industrial concerns have relocation plans dating back to CD policy of the 1960's. A review of plans existing in 1970 did not find any to be currently operational though some of the "paper planning" was still applicable. More recently the Boeing Co. has prepared a Relocation Plan which was subsequently extended into a planning guidance manual for public distribution. The philosophy of these documents is universally applicable. Carried to its logical conclusion, this implies that all workers could be protected in this manner thus providing a framework in which crises relocation is planned. In summary the Policy and mechanism designed to initiate this program does not presently exist. Should the nation decide to focus on this program the technical guidance exists to implement it.
RESPONSIBLE AUTHORITY	**FEMA** Other Federal Agencies **Private** Other This is primarily a FEMA planned program implemented by private industry. Actual planning should be done as part of the people saving programs, but guidance as to specific industries should come from the industrial planning group of FEMA.
SURVIVAL PROGRAM ELEMENTS	Food & Water **Drugs** Transportation Communications **Utilities** **Petroleum** **Government** This program is appropriate for each sector of critical resources, but the food sector is limited in its usefulness to food production (which is not critical for survival). The measure will have only limited value to transportation as it is largely decentralized. It is especially appropriate for government. Maintenance and repair facilities for all infrastructure can profit from such a program.
POLICY CRITERIA	**Contributes** Constituency **Affordable** **Consistent** Cooperative **Effective** **End Loading** **Integrates** **Minimize Cost** This is an effective program at a minimum cost for saving the one element of production, people. Under current crisis relocation policies it does require warning to be effective. It adds no significant cost above crisis relocation program. The constituency is minimal, but it is affordable and consistent with other FEMA defense programs. Other government programs offer no advantages to it, but like crisis relocation, the costs are primarily late in the program. There are marginal advantages for certain civil disorders, and accidents such as that which occurred at Three Mile Island.
SPECTRUM OF FEMA RESPONSIBILITY	Natural Disaster **Industrial Accidents** **Civil Disorder** Economic Conflict General War **Nuclear War** This program is primarily designed for nuclear war under conditions of warning. It may have use under certain terrorism and blackmail situations. It is probably not useful for earthquakes and tornadoes, where warning times are short or nonexistent.
NEXT STEP	**Research** Plan Establish Program Finance Implement **Coordinate** No Action Establish an office to coordinate this program with crisis relocation.

PROGRAM SHEET 6

COUNTERMEASURE	**SHUTDOWN** Shutdown is designed to prevent self-destruction that might occur in unattended plants. The actions are specific to each industry and each plant. Common to all, however, is shutting off power and gas to prevent fires. Many plants with hazardous materials can remove these from the building to prevent contamination and/or fire. Other measures such as removing combustibles or fastening movable equipment are conceptually included in other programs.
RESPONSIBLE AUTHORITY	**FEMA** Other Federal Agencies **Private** Other This is primarily a FEMA program implemented by the private sector. FEMA is responsible for the research and publication of guidance information as well as for promoting the program. Industry is responsible for planning and promoting the program.
SURVIVAL PROGRAM ELEMENTS	Food & Water Drugs Transportation Communications **Utilities** **Petroleum** Government This program is primarily of value in the energy industry and the utility industry. It has virtually no value to food, drugs or water, except at process plants. It is not applicable to government.
POLICY CRITERIA	**Contributes** Constituency **Affordable** **Consistent** Cooperative **Effective** **End Loading** Integrates **Minimize Cost** The program is effective to the extent that a plant can self-destruct and that the countermeasure is implemented. It will probably have a constituency in plants in high risk areas as it is low cost and self serving. The program is affordable at approximately present FEMA budget levels. It is consistent with crisis relocation. The costs occur late--during an emergency.
SPECTRUM OF FEMA RESPONSIBILITY	**Natural Disaster** **Industrial Accidents** **Civil Disorder** Economic Conflict General War **Nuclear War** This program is designed largely for nuclear war under warning conditions. It has some added usefulness under conditions of civil disaster, natural disaster, and accidents.
NEXT STEP	Research Plan **Establish Program** Finance **Implement** Coordinate No Action Prepare and disseminate a program to enlist the support of industry.

PROGRAM SHEET 7

COUNTERMEASURE	**DISPERSAL** The purpose of this program is to reduce the value of the target by spreading productive sources over a large area. The program is of virtually no value to capital intensive industries of a critical nature, i.e., refineries, steel plants, or airplane companies, as these industries are targets in themselves. Also, critical producers are usually located to minimize the cost of either supply, production or distribution. Thus, ongoing costs of dispersal are usually prohibitive. On the other hand, when new plants are contemplated, sometimes their location can be influenced to reduce target value. For example, new synthetic fuel plants subsidized by DOE can often be located away from target areas and may not constitute a target area by themselves.
RESPONSIBLE AUTHORITY	**FEMA** Other Federal Agencies Private Other This program is a FEMA responsibility and consists of providing other departments of government and industries with guidance on effective locations from a defense standpoint. It is not likely nor even advisable to influence the location by regulation.
SURVIVAL PROGRAM ELEMENTS	Food & Water **Drugs** Transportation Communications Utilities Petroleum Government This program has limited capabilities for critical resources. Food, for example, is already widely dispersed. Drugs are frequently located in urban targets, and would involve a minimum cost to disperse. Energy refineries and oil storage are a target in themselves and dispersal is of minimum value. Synthetic fuels can be located to take advantage of dispersal. Transportation is already largely dispersed. Government has to be located where officials already are, and new programs would accomplish little.
POLICY CRITERIA	**Contributes** Constituency Affordable Consistent Cooperative Effective End Loading Integrates Minimize Cost This program is theoretically effective, but impractical to implement on a major scale because it runs counter to efficient production. There is no natural constituency unless it can be tied to some other issue like environment, employment of minorities and so forth. If limited to influencing the location of new construction, it is affordable and consistent with other defense programs. It may also be able to piggback on other programs in SBA, EPA, DOE and so forth.
SPECTRUM OF FEMA RESPONSIBILITY	Natural Disaster Industrial Accidents Civil Disorder Economic Conflict **General War Nuclear War** This program is limited to reducing vulnerability at the nuclear end of FEMA's responsibility. It would have little value in all of the lower areas of responsibility.
NEXT STEP	Research Plan Establish Program Finance Implement Coordinate **No Action** No action recommended.

PROGRAM SHEET 8

COUNTERMEASURE	**HOUSECLEANING** A housecleaning program consists of measures to reduce the degree and spread of damage from the effects of nuclear attack. Fire can be minimized by proper location, storage, and protection measures for combustible materials. Contamination is minimized by the design and placement of containers for hazardous materials. Control of fires and contamination is facilitated by the assurance of access to areas suffering destruction. The cleanup of fallout is facilitated by minimizing hard-to-reach areas which trap fallout. Most of the actions which reduce destruction can be established at minimum cost, while at the same time enhancing normal operations. The general approach requires specific planning for each type of facility.
RESPONSIBLE AUTHORITY	**FEMA** **Other Federal Agencies** **Private** Other
	This is primarily a FEMA program to be implemented by the private sector. FEMA is responsible for research, development and informational materials and encouraging the installation of the program in industry.
SURVIVAL PROGRAM ELEMENTS	**Food & Water** **Drugs** **Transportation** **Communications** **Utilities** **Petroleum** **Government**
	The housecleaning program can have application for each category of critical resource at processing and distribution stages, and offers opportunities to reduce losses to both production and stocks of food. Other critical resources also have functions where this technique can be effective.
POLICY CRITERIA	**Contributes** Constituency **Affordable** **Consistent** Cooperative **Effective** End Loading **Integrates** **Minimize Cost**
	This program is effective for the level of funds required. There is no present constituency, but there is no inherent objection to the program and the constituency can probably be built. It is a low cost program consistent with the crisis relocation program. It also has application at the natural disaster end of the spectrum of FEMA responsibility.
SPECTRUM OF FEMA RESPONSIBILITY	**Natural Disaster** Industrial Accidents Civil Disorder Economic Conflict General War **Nuclear War**
	This program, while designed to reduce damage from nuclear war, will also reduce destruction from natural disasters.
NEXT STEP	Research Plan **Establish Program** Finance **Implement** Coordinate No Action
	Assign the responsibility for this program; prepare "how to do it" pamphlets, and initiate an implementation program.

PROGRAM SHEET 9

COUNTERMEASURE	**STOCKPILE** The program consists of storing pre-attack surpluses for post-attack use. The cost is for the money tied up in the stored materials, deterioration and maintenance, but is recoverable at a future date when the stockpile is sold. Present stockpiles of drugs, rare metals, crude oil, and the like are designed for general war or economic conflict. Because of the composition, they have very little value for use after a nuclear attack. The exception is corn and wheat, which are stored to maintain prices, but are very valuable as a post-attack recovery resource.
RESPONSIBLE AUTHORITY	**FEMA** **Other Federal Agencies** **Private** Other The responsibility for the strategic stockpile and for research and planning of all stockpile needs is a FEMA responsibility. Active programs for crude and grain are the responsibilities of the DOE and the Department of Agriculture. Portions of the stockpile program can be privately implemented.
SURVIVAL PROGRAM ELEMENTS	**Food & Water** **Drugs** Transportation Communications Utilities **Petroleum** Government The program has application for food resources, critical drugs, and petroleum supplies. These areas are appropriate primarily because the FEMA program could capitalize on other ongoing programs with very little cost to FEMA.
POLICY CRITERIA	**Contributes** **Constituency** Affordable **Consistent** **Cooperative** **Effective** End Loading **Integrates** Minimize Cost The stockpile program meets all program objectives except for cost. It is highly effective, it has a constituency, and capitalizes on other federal programs. In the context of the present emphasis on non-military defense, it would overshadow other programs.
SPECTRUM OF FEMA RESPONSIBILITY	**Natural Disaster** Industrial Accidents Civil Disorder **Economic Conflict** **General War** **Nuclear War** The stockpile program can be designed to fulfill needs brought about by nuclear and general war and economic conflict. It would not be required to meet FEMA responsibilities at the low end of the scale.
NEXT STEP	**Research** **Plan** **Establish Program** Finance Implement **Coordinate** No Action Work with the Department of Agriculture to encourage minimum grain storage levels and the location of storage outside of potential blast areas. Modify the composition of the strategic stockpile to meet a broader range of situations. Encourage DOE to shift from storing crude which could not be processed when refineries were destroyed to storing products.

PROGRAM SHEET 10

COUNTERMEASURE	**COMPUTER INVENTORY** The computer inventory program is designed to provide the recovery features of a stockpile without the cost. It is designed to use resources normally in the industrial system by knowing where they are and to have legal access to them and to provide the logistics to move them to where they will be required in the post-attack environment. The system consists of one or more federally controlled computers which maintain a listing of companies controlling inventories of critical materials. Each of these companies in turn maintains current inventories of the type, quantity and location of resources under their control. In the post-attack period, the system operates by federal computer which accesses private computers to locate the required resources. The system has the advantage of having the dynamic stockpile dispersed to reduce vulnerability.
RESPONSIBLE AUTHORITY	**FEMA** **Other Federal Agencies** **Private** Other The program could easily be placed on presently owned FEMA computers. The program would probably require cooperation with the Bureau of Census and perhaps industry associations.
SURVIVAL PROGRAM ELEMENTS	**Food & Water** **Drugs** **Transportation** **Communications** **Utilities** **Petroleum** **Government** The system is theoretically effective for all resources. It may have only marginal utility for food or refineries since the storage and production locations are few in number and not difficult to keep track of, even without a computer system.
POLICY CRITERIA	**Contributes** **Constituency** **Affordable** **Consistent** **Cooperative** **Effective** End Loading **Integrates** Minimize Cost The computer inventory program meets most of the policy criteria. It is effective, it would have sufficient constituency, and is affordable even with present low FEMA budgets. It can capitalize on data that exists in other departments of government, and tends to cover all resources and much of the spectrum of FEMA responsibility.
SPECTRUM OF FEMA RESPONSIBILITY	**Natural Disaster** **Industrial Accidents** Civil Disorder Economic Conflict **General War** **Nuclear War** The program is primarily useful for nuclear war with a possible limited use in general war.
NEXT STEP	**Research** **Plan** Establish Program Finance Implement **Coordinate** No Action Conduct the research and planning required to design and implement this program.

PROGRAM SHEET 11

COUNTERMEASURE	**MOTHBALL** This program is intended to preserve the functioning of industrial facilities abandoned for reasons of economic or technological change. For example, when Youngstown Steel closes down because it is no longer competitive, the plant can be preserved for use in emergency. When U.S. tire companies close plants because of over-capacity, the abandoned plants can be preserved and re-established during the period of emergency. The recent study of the Rubber Industry during and after Nuclear Attack emphasizes both the the critical importance of tire manufacturing in the post attack period and recovery considerations for virtually any type of Nuclear Exchange. Tires will not only be a key component to trucking (to bring surviving resources to people) but also to tractors (for growing food) and mining and industrial equipment. The demand for tires will be high (nearly as great as before many of the attacks); production plants in industrial areas are vulnerable and are located in high risk areas. Survival and recovery could be severely jeopardized if provision is not made to sustain production. The "mothball" program offers one low-cost reasonably effective approach to filling this survival void. Many tire supply plants are being closed down as tire manufacturers retrench. Plants closed are predominantly in non-target areas (a typical example is Firestone in Solidad, California). A government Mothball program could maintain this production capacity at virtually the interest rate on the capital investment.
RESPONSIBLE AUTHORITY	**FEMA** **Other Federal Agencies** Private Other This program could be administered by FEMA or the Department of Commerce. The program would consist of paying private corporations to retain their plants in working order, rather than tearing them down and selling the equipment for scrap.
SURVIVAL PROGRAM ELEMENTS	Food & Water **Drugs** **Transportation** Communications Utilities **Petroleum** Government This program has limited application to the critical resource categories, but significant contributions to any expanded industrial program could be achieved. In the rare event that power generation plants are abandoned, and for the production of components in the transportation system, there should be application. Technological advances will operate to provide opportunities in the petroleum refining field.
POLICY CRITERIA	**Contributes** Constituency **Affordable** **Consistent** Cooperative **Effective** End Loading Integrates Minimize Cost This can be a highly effective program for which a constituency can be built. Although it is a low cost approach to ensuring post-attack production, it is still quite effective when compared with present budgets and other FEMA programs.
SPECTRUM OF FEMA RESPONSIBILITY	Natural Disaster Industrial Accidents Civil Disorder Economic Conflict **General War** **Nuclear War** The program is primarily limited to nuclear war where losses have been heavy or general war where requirements significantly increase.
NEXT STEP	**Research** Plan Establish Program Finance Implement **Coordinate** No Action Conduct research to determine candidate industries cost and administrative mechanisms. Coordinate effort with other agencies.

PROGRAM SHEET 12

COUNTERMEASURE	**SALVAGE** The salvage progam is designed to facilitate the restoration of equipment and facilities by the expedient transfer of parts. Cannibalizing occurs naturally in crisis situations, but the effectiveness of this approach can be enhanced by a cross-reference system of all the equipment using certain parts. Much of this information is available in the marketing department of manufacturers, but it has not yet been organized by FEMA into a restorative program.
RESPONSIBLE AUTHORITY	**FEMA** **Other Federal Agencies** Private Other
	This is primarily a FEMA program. Whether it can be built from other federal programs is not known at this time. The program consists of providing specific information to each industry on the transferability of parts.
SURVIVAL PROGRAM ELEMENTS	Food & Water Drugs **Transportation** **Communications** **Utilities** **Petroleum** Government
	This program is primarily useful to the transportation industry. It is not a critical program since the knowledge of how to substitute, salvage and cannibalize is already widely known. The program may also have a lesser contribution to make to the utilities industry.
POLICY CRITERIA	**Contributes** Constituency **Affordable** **Consistent** Cooperative Effective End Loading Integrates Minimize Cost
	The program is of limited effectiveness, but complies with most of the policy criteria. The constituency could be built, it is affordable, and is consistent with the crisis relocation program.
SPECTRUM OF FEMA RESPONSIBILITY	Natural Disaster Industrial Accidents Civil Disorder Economic Conflict **General War** **Nuclear War**
	The program is limited to contributing to the restoration at the nuclear end of FEMA's responsibilities.
NEXT STEP	Research Plan Establish Program Finance Implement Coordinate **No Action**
	This program is probably not important enough to implement at this time. Research and development should be held in abeyance until other programs are successfully underway.

PROGRAM SHEET 13

COUNTERMEASURE	**RELOCATE** This program consists of planned relocation of people or resources either to reduce post-attack nuclear hazards or to minimize logistics programs. The people relocation is part of the crisis relocation plan, and is designed to place people in an environment relatively free of fallout and in proximity to critical resources and production. Since this opportunity will not always exist, it may be expedient to relocate resources to serve human needs in environments where people are safe. This planning involves pre-planning of organization and logistics since specific relocation requirements are next to impossible to predict. Pre-planning would therefore consist of coordinating the process with private enterprises and assessing their capability to execute the plan.
RESPONSIBLE AUTHORITY	**FEMA** Other Federal Agencies **Private** Other
	This program would be a FEMA responsibility to plan, but it would require coordination with the private sector.
SURVIVAL PROGRAM ELEMENTS	**Food & Water** Drugs Transportation Communications Utilities Petroleum Government
	This program while theoretically contributing to all moveable resources and equipment will be most effective for food resources.
POLICY CRITERIA	**Contributes** Constituency Affordable **Consistent** Cooperative Effective End Loading **Integrates** Minimize Cost
	The relocation program meets most of the FEMA policy conditions. However, it only adds effectiveness to what could be successfully improvised in the time of need. It is therefore felt to add only marginal capability to survival goals.
SPECTRUM OF FEMA RESPONSIBILITY	**Natural Disaster** Industrial Accidents Civil Disorder Economic Conflict General War **Nuclear War**
	This program is largely applicable to the nuclear end of the scale, but would also have some application in natural disaster situations.
NEXT STEP	Research Plan Establish Program Finance Implement Coordinate **No Action**
	No action recommended.

PROGRAM SHEET 14

COUNTERMEASURE	**SUBSTITUTION** This program consists of pre-planning for alternative uses of resources and equipment. Little research has been conducted to develop either the requirements or the practicality of such a program. It is therefore premature to suggest where and how such a program would be designed and applied. The program would consist of identifying potential needs, alternative resources and equipment and modifications which would be required in the use process in order to adapt them to the substituted items. This program is an alternative to other restorative measures.
RESPONSIBLE AUTHORITY	**FEMA** Other Federal Agencies Private Other This program would be a FEMA responsibility to determine requirements for substitution. Technical alternatives can be determined from FEMA research and from other branches of government such as alternative energy sources from DOE; alternative metals from the Department of Commerce.
SURVIVAL PROGRAM ELEMENTS	Food & Water **Drugs** Transportation Communications Utilities Petroleum Government This program could be applicable to drugs and component parts of transportation. There are also some possibilities in alternative energy sources. Its principal use would come later in the event the FEMA Industrial Preparedness Program is to include the next level of vital industries.
POLICY CRITERIA	**Contributes** Constituency **Affordable Consistent** Cooperative **Effective** End Loading Integrates Minimize Cost This program meets most of the policy criteria. The cost would be low, but is as yet undetermined. It is the kind of program that could build a constituency, and to a certain extent, can use the work of other government agencies.
SPECTRUM OF FEMA RESPONSIBILITY	Natural Disaster Industrial Accidents Civil Disorder Economic Conflict General War **Nuclear War** The program would be designed to meet FEMA nuclear responsibilities. It could have application in economic conflict, but at that level, would probably not be a FEMA responsibility.
NEXT STEP	Research Plan Establish Program Finance Implement Coordinate **No Action** No action recommended.

PROGRAM SHEET 15

COUNTERMEASURE	**INTERAGENCY COOPERATION** This program is planned and coordinated by FEMA to use the ongoing programs of all departments of government related to industrial preparedness requirements. The requirements for applicable programs will be specified by FEMA, implemented by the collective departments, and managed by FEMA. If added budgets are required, they will be requested through the administration departments.
RESPONSIBLE AUTHORITY	**FEMA Other Federal Agencies** Private Other FEMA for policy planning and coordinating and appropriate departments of government for application. Application programs exist in nearly every department of government and it may be appropriate to set up a permanent coordinator between FEMA and the several departments of government.
SURVIVAL PROGRAM ELEMENTS	**Food & Water Drugs Transportation Communications Utilities Petroleum Government** Federal Programs exist for reducing the vulnerability or enhancing the recovery of each of the survival resources. Some programs such as cleanup of contaminated materials, stockpile, etc., are presently known. Others remain to be identified.
POLICY CRITERIA	**Contributes Constituency Affordable Consistant Cooperative Effective** End Loading **Integrates Minimize Cost** All policy criteria can be met with this program. The programs are limited only to the extent they are effective.
SPECTRUM OF FEMA RESPONSIBILITY	**Natural Disaster Industrial Accidents** Civil Disorder Economic Conflict **General War Nuclear War** This program has applications to any general national emergency.
NEXT STEP	**Research** Plan Establish Program Finance Implement Coordinate No Action Extensive study and research are required to identify applicable programs and to plan detailed cooperative programs. The identification of programs requires the establishment of a unit to form the program and carry it through its subsequent steps. This step is considered to be highly productive at a minimum cost.

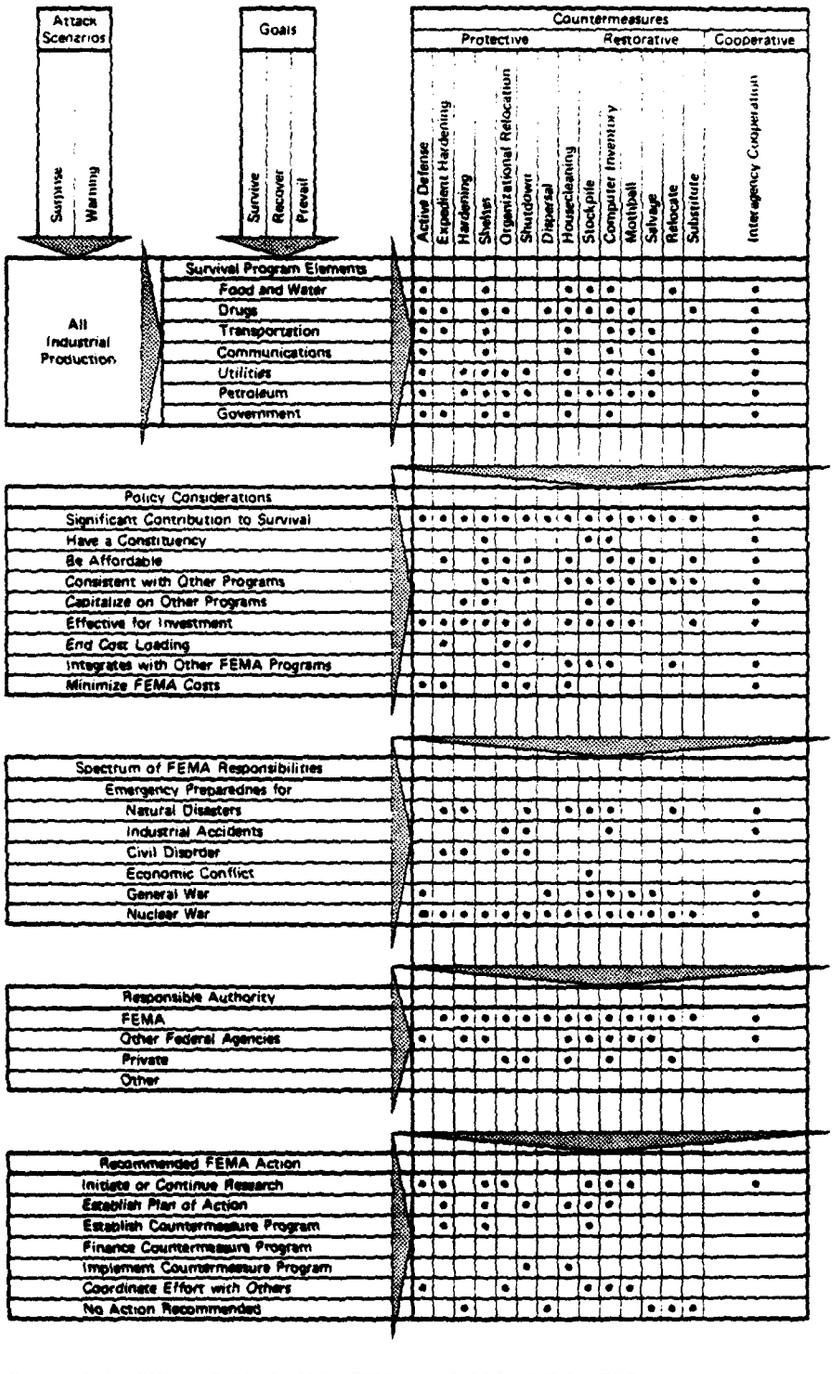

Figure 3-2. FEMA BASIC INDUSTRIAL PREPAREDNESS PROGRAM SUMMARY

Consideration of the recommended elements of policy, the requirements for essential industries and the application potential of countermeasures led to the recommendation of a basic industrial preparedness program.

The basic industrial preparedness program involves providing those resources that are essential for national survival as follows:

- Food and Water. The literature indicates that residual agricultural products will be sufficient to provide the basic caloric in-take of the population after an extensive nuclear attack. Since the areal distribution of people and foodstocks would be asymetric, the requirement for a transportation system to distribute these products appears to be essential.

  Augmentation of this requirement should be implemented through a program that inventories the relationship of the location of foodstock production to the propulation. Further preparedness could be implemented through a stockpiling program, a food shelter program, and a program of interagency cooperation.

- Drugs. The requirement for drugs is recognized in most studies of a post-attack situation. With survival rate, after UNCLEX-73, of 26 percent of the pharmaceutical production capability and a maximum post-attack production capability of 10 percent of normal, protection of this industry is paramount. Priority preparedness programs for the industry should include a computer inventory of the location, product and capacity of each facility, a hardening program for selected plants, and a stockpiling program for selected drugs.

- Transportation. The UNCLEX-73 analysis of the condition of the transportation system suggests, with exception of the northeast corridor, that the highway system would be usable after a major nuclear attack. Since this study suggests that an ability to move goods during the first six-months after attack is essential to survival, the requirement for vehicles and fuel becomes an essential item. The national distribution of vehicles at any given time suggests that an

adequate number of trucks would survive an attack. However, priority augmentation of the ability of the transportation industry to provide service could be accomplished by concentration on the trucking industry through an an expedient hardening program and computer inventory program for truck maintenance components and the mothballing of obscelescent truck related industries, especially tire manufacturing.

- Communications. Studies of the post-attack condition of the national communications network show good survivability. The UNCLEX-73 analysis shows a 70 to 90 percent availability for all types of systems. Thus it is assumed that no priority augmentation of this essential industry will be required and thus the recommended basic program need not provide preparedness countermeasures.

- Energy. National survival and recovery from a nuclear attack will be critically dependent upon a supply of energy. In this area two industries are selected for inclusion -- utilities for the production and distribution of electricity, and petroleum for the production and distribution of products. UNCLEX-73 suggests that both these industries will require augmentation through the development of pre-war preparedness programs. Recommended programs include stockpiling for petroleum products, and hardening of selected items such as sub-stations within the utility industry. A national inventory of locations and types of utilities and petroleum product stockpiles, including that set aside for the Strategic Petroleum Reserve would further augment the availability of these industries and their products.

Consideration of the recommended policies as developed in Chapter 2, and the applicability of the fifteen countermeasures considered and their relationship to the FEMA Charter, produced a basic recommended industrial preparedness program incorporating those elements considered essential for survival. This basic program is summarized as follows:

- quantify the interrelationship between a national crisis relocation program and the regional requirements for the six essential industries.

- Coordinate FEMA activities with the Department of the Army program in active defense.

- Continue research, and establish a plan of action and a countermeasure program around the concept of expedient hardening for protection of the drug, transportation, and electric utility industries.

- Continue and coordinate work in crisis relocation research around the concept of organizational relocation and its application to the drug, electric utilities, and petroleum industries in addition to government.

- Establish a plan of action for the application of of plant shutdown as a countermeasure.

- Establish a plan of action for housecleaning as a countermeasure for the protection of industry and government and other offices.

- Initiate research, establish a plan of action and coordinate effort with others on the concept of stockpiling as a countermeasure for the protection of the food, drug, and petroleum industries.

- Initiate research, and coordinate effort with others on the concept of a computer inventory for tracking the locations and availability of goods relating to all of the six critical industries.

- Initiate research on the concept of mothballing plants as a countermeasure for the drug, transportation and petroleum industries.

- Initiate research, establish a plan of action and a countermeasure program, and coordinate effort within government on its concept of interagency cooperation as a countermeasure for the food, drug transportations, communications, electric utilities and petroleum industries.

Augmentation of this program as desired should devolve as further research within FEMA occurs and guidance for future programs is provided.

COST AND FINANCING CONSIDERATIONS

It is said by many that industrial preparedness is not implemented as it should be because of an absence of executive mandate. Implicit in this is the assumption that given Presidental directive, funds for program implementation would be forthcoming and industry would welcome industrial preparedness programs with open arms.

Without such Presidential directive, or even with it, funds are limited. It is unlikely we will ever have all the funds we think we should have.

The absence of a FEMA budget sufficient for implementation of an industrial preparedness program as well as the absence of executive and congressional support require careful analysis of industrial preparedness and the development of creative ways of financing it. We believe this is possible.

First, we need to toss aside our single purpose viewpoint and identify the potential multiple purposes of our industrial preparedness measures. We know, for example, that schools have been buried as protection against tornadoes. We know that various industrial earthquake mitigation measures will also prevent damage given a nuclear strike. If we can identify other uses for our measures we have potentially broadened our financial base. For example, flood and fire insurance programs already exist and provide incentives for firms to adopt certain measures. Piggybacking off these existing programs is expedient, cost effective, and likely to be publicly acceptable.

Second, we must recognize that for many programs we have no good idea of what implementation would cost. Most importantly we have not identified all the relevant costs nor which ones are properly or reasonably borne by government. A case can be made that government should pay for research, development, testing and demonstration, but implementation is a cost that firms will bear. Just as firms buy insurance, or self-insure against earthquake damage, so can they be expected to prepare for the effects of a nuclear strike. What we

do not know is the level of response—which firms, of what size. Some inferences as to this response and the response to various incentives should be available from flood and fire insurance programs.

We might point out that it should not be our objective to get all firms in an industry to prepare to a level that would assure 100 percent survival. For one, that may be unnecessary. The post attack economy will not need the same bundle of goods and services it now has. One hundred percent protection and survival of the aircraft industry could result in a delay in turning those resources toward a use more appropriate to the post-attack economy. Or, we may have expended pre-attack resources preserving something we later abandon.

It has been said that industry has been uninterested and unresponsive when approached about various forms of industrial preparedness. Certainly this has been the case with some small firms, but not all. Boeing has invested much of its own resources in development of crisis relocation. Similarly, Goodyear Tire & Rubber and Ford Motor have been active participants on their own at FEMA workshops. We believe this demonstrates industry is interested and that the perceived benefits of an industrial preparedness program can exceed costs. Clearly our goal must be to bring benefits and costs into line for those segments of industry we need to protect.

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APPENDIX A

NATIONAL SURVIVAL AFTER UNCLEX-73

SUMMARY

"The purpose of this study of national survival after UNCLEX-73 is to provide analyses in a standard format of national survival following each of the unclassified simulated nuclear attacks generated in Volume I of UNCLEX-73. These were 1,200 weapon, 6,000 megaton general war attacks on the United States. The MIKE attack stressed military targets, while the CHARLIE attack emphasized civilian targets. These analyses are designed to serve for familiarization, exercise and program procedure development on the part of those who are responsible for national survival following a nuclear attack.

Each analysis undertakes to ascertain whether national survival would be possible in the light of the impact of the particular attack on the four vital elements of national strength: population identity, government continuity, military security and economic viability, the latter considered at both the local and national levels.

The estimated population residuals of 118 million (56 percent) in the MIKE case and 94 million (45 percent) in the CHARLIE case appear, in both cases, to be sufficient to preserve the national identity. However, the condition of the population is weakened and its distribution altered.

Neither case jeopardizes the maintenance of the legitimate Presidential succession which is vital to the continuity of the Nation-State. As for the

provision of the required three elements of executive direction, in both cases sufficient facilities and talent have survived to ensure the capacity (1) for the acquisition and analysis of vital information and (2) for the formulation and confirmation of essential plans. The survival in the MIKE case of one-third of the Federal Government forces - mostly in the field - is judged to be adequate with effective leadership to cope with the government responsibility for the third required element: program dissemination and implementation. Reduction to one-quarter CHARLIE case is judged to leave the government capacity to meet these drastic program requirements only marginal, at best.

No definitive assessment of the residual military strength would be worth making for either UNCLEX-73 attack because in order to avoid the necessity for a security classification, they were purposely designed not to be effectual against military forces. In any case, the measure of the military impact would be scenario-dependent with respect to post-attack hostilities. Specification of the latter was not required for the purposes of this study.

Local viability following these attacks is assessed for all Standard Metropolitan Statistical Areas (SMSA's). For this, use is made of a newly devised procedure based on the time-phased assessments of 15 revival conditioning factors for which data are available. From these are fashioned for each SMSA a time-phased revival rate schedule portraying the progressive reactivation of local production for the national economy. Where contiguous reviving SMSA's can effect mutual assistance, "Islands of Survival" occur in which the revival rates of all SMSA's involved are accelerated. Where a somewhat subjectively established threshold revival rate is not achieved, even after any Island of Survival upgrading, SMSA's are subject to triage. Such a finding reflects statistically what, in reality, would be the policy choices between assistance and evacuation for the most seriously damaged SMSA's.

In the MIKE case 219 (83 percent) of the 263 SMSA's avoided triage, while in the CHARLIE case the number was 191 (73 percent).

The application, category by category, of the final revival rates in all SMSA's to the undamaged production capacities in those SMSA's affords two aggregates bearing on national survival and recovery. First is the maximum cumulative national producton for the immediate post-attack 6 months. This is assumed to be the "survival period" in which requirements are met largely from inventories that survived the attack. The survival rate at the end of the first post-attack year is applied to surviving production capacity to reflect the average annual production rate for the first year of recovery. To initiate recovery and thus to sustain national survival, this must be enough to meet the bulk of current requirements. In the MIKE case the resulting maximum cumulative production for all manufacturing which is achievable in the first 6 months survival period amounts to an annual rate of 45 percent of pre-attack production. For the first recovery year 57 percent is achievable. In the CHARLIE case these rates are 37 percent and 49 percent, respectively.

The dependence of national survival on the national economy rests in two major constituents: its production capacity and institutional fabric. By comparison, the production capacity is more readily measurable, more durable and takes longer to develop, as it consists of the physical facilities and human skills with which production is performed. The institutional fabric, on the other hand, is largely unmeasurable, more fragile and quicker to construct as it consists of the intangible relationships among all members of society regarding their common effort to meet their wants. The most tangible elements of the institutional fabric by which the management and utilization of the economy is guided includes government, the financial institutions and the agencies engaged in trade. Of these,

most important to national survival is government as that is the fountainhead for the necessary re-creation or creation of all vital elements of the economy, whether for the institutional fabric or production capacity.

The principal classes of financial and trade institutions for which data are available survive better than manufacturing in both the MIKE and CHARLIE cases. However, these do not include the capital and commodity marketing arrangements or corporate headquarters, all of which are largely located in the largest cities and are presumed destroyed. Thus the burden of salvaging and reconstructing the essential institutional fabric falls to government. The enormity of this undertaking combines with the low level at which the program execution capacity of the government survived, particularly in CHARLIE. This combination places an extraordinarily high premium on the imaginativeness and force of leadership from government and on the responsiveness and cooperation of the surviving elements of the economy if even a provisional reconstruction of the essential economic fabric is to be achieved. Even if administered price and distribution controls were employed to obtain conformance, the ultimate acceptance and success would depend on the perception of competent and realistic decisions and the prospect of ultimate restoration of effectual free enterprise.

The adequacy of the surviving production capacity is measured in terms of balance and sufficiency.

Assaying the balance consists of the traditional damage assessment technique in which surviving operable production capacity rates, stated as percentages of pre-attack capacity, are compared among categories. This is done to reveal relative shortages suggesting possible bottlenecks or an Achilles' heel. The

comparison is made among the vital sectors for which data are available among six broad classes of production capacity: extraction and construction, manufacturing, transportation and storage, communication and utilities, trade, finance and services, and the work force.

Measuring the sufficiency is undertaken with the comparatively new technique involving a sector-by-sector comparison. Thus, the amount of total output is established which is associated in the applicable input-output table of the economy with the administered final demand required: (1) to sustain the surviving population, (2) to meet the minimal military security requirements, and (3) to provide the repair or new construction essential to initiate recovery. The feasibility of the final demand is tested by comparing the associated sector total output with the surviving sector capacities for total output constrained by local viability limits as revealed in the damage assessment. Any infeasibilities indicated in this comparison in sectors, for which the stated final demand cannot be reduced or for which substitute products or processes cannot be readily arranged, reflect true bottlenecks which, if severe enough, would prevent national survival. Thus, the threat of severe category denials revealed in the assessment of balance is more fully assessed in the comparison with their requirements afforded by the input-output analysis.

The surviving capacity balance comparisons for both the MIKE and CHARLIE cases reveal comparatively deep cuts in the following vital manufacturing sectors: drugs, petroleum refining, equipment production for communication, electronics, and electric power distribution, and major military equipment production. The threat of such shortages to national survival is suggested but remains conjectural or scenario-dependent.

The sufficiency analysis for the MIKE case reveals no infeasibility in the final demand formulated for the first 6-month survival period. For the first recovery year, nine sectors show infeasibilities, but only one is such that it could not be accommodated with tolerable reductions in final demand or available substitute processes for indirect demand. The one deficiency that could threaten national survival is the indicated deficit in the availability of drugs. This threat becomes even more grave when it is considered that the stated demand includes no allowance for the requirements that would be generated if an epidemic of latent lethal communicable disease or diseases should break out in the first year following the attack.

The sufficiency analysis for the CHARLIE case shows five sector deficiencies for the final demand in the survival period. The significance of two (guided missiles and aircraft engines) is scenario-dependent. One small sector deficit can be accommodated by substitution. However, the indicated shortages in the production of transformers and railroad rolling stock, if not direct threats to national survival, are at least serious constraints on the possible rate of national recovery. These same problems are amplified by the indicated sector deficiencies for the first recovery year in the CHARLIE case. For 7 of the 16 sectors found to be in deficit, and for 3 more if the scenario permitted, accommodations could be made that probably would not jeopardize survival. Thus, for guided missile and aircraft engine production and shipbuilding, the consequence of the necessary final demand reduction is scenario-dependent.

However, of the six remaining sectors that constitute a serious threat, five are extensions of those public service industry rebuilding categories found to be in jeopardy in the survival period. Thus, manufacturing deficiencies now appear in

engines and turbines as well as transformers and switching gear for electric power, in telephone and telegraph apparatus and radio and TV broadcast equipment for communication, and in railroad rolling stock for transportation. As in the MIKE case a deficiency develops during the first recovery year in drug production with the same threat to national survival.

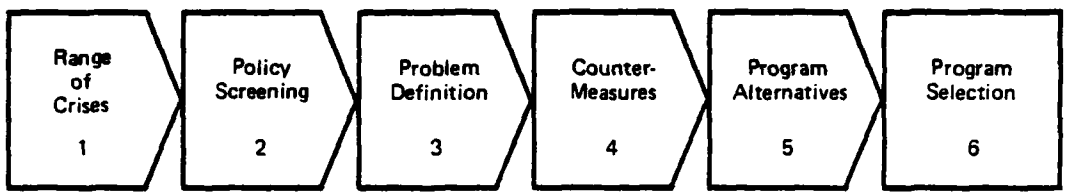
In summary, the most serious threat to national survival reflected in these two case studies probably lies in the tremendous institutional improvisation and reconstitution requirement which must be met by a very severely reduced governmental structure. The threat to national survival of two other demonstrably deficient vital elements are dependent on uncertainties external to the analysis. Thus, the losses in drug production could be fatal if serious communicable disease epidemics should materialize and the military support production losses could be fatal if military operations continued to threaten the Nation. Finally, the broad spectrum of denial to the sectors vital to rebuilding the public service industries would surely prolong recovery to a possible breaking point even if it did not precipitate an early failure of the public service functions.

The deficiencies indicated in these two case studies do not, in themselves, constitute justification for specific pre-attack programs, such as reinstating the stockpiling of drugs, designed to mitigate or ameliorate the indicated effects. For that purpose, hazard type studies that examine the full spectrum of probable attack situations are required. However, these case study findings certainly suggest program areas for evaluation. Also they exemplify analytical procedures that would be useful to such a purpose."

APPENDIX B

ORAL PRESENTATION TO FEMA STAFF

FEMA INDUSTRIAL PREPAREDNESS PROGRAM EVALUATION



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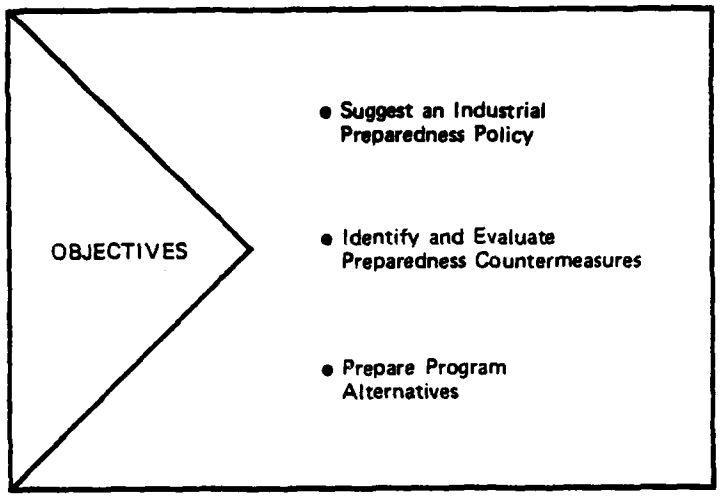
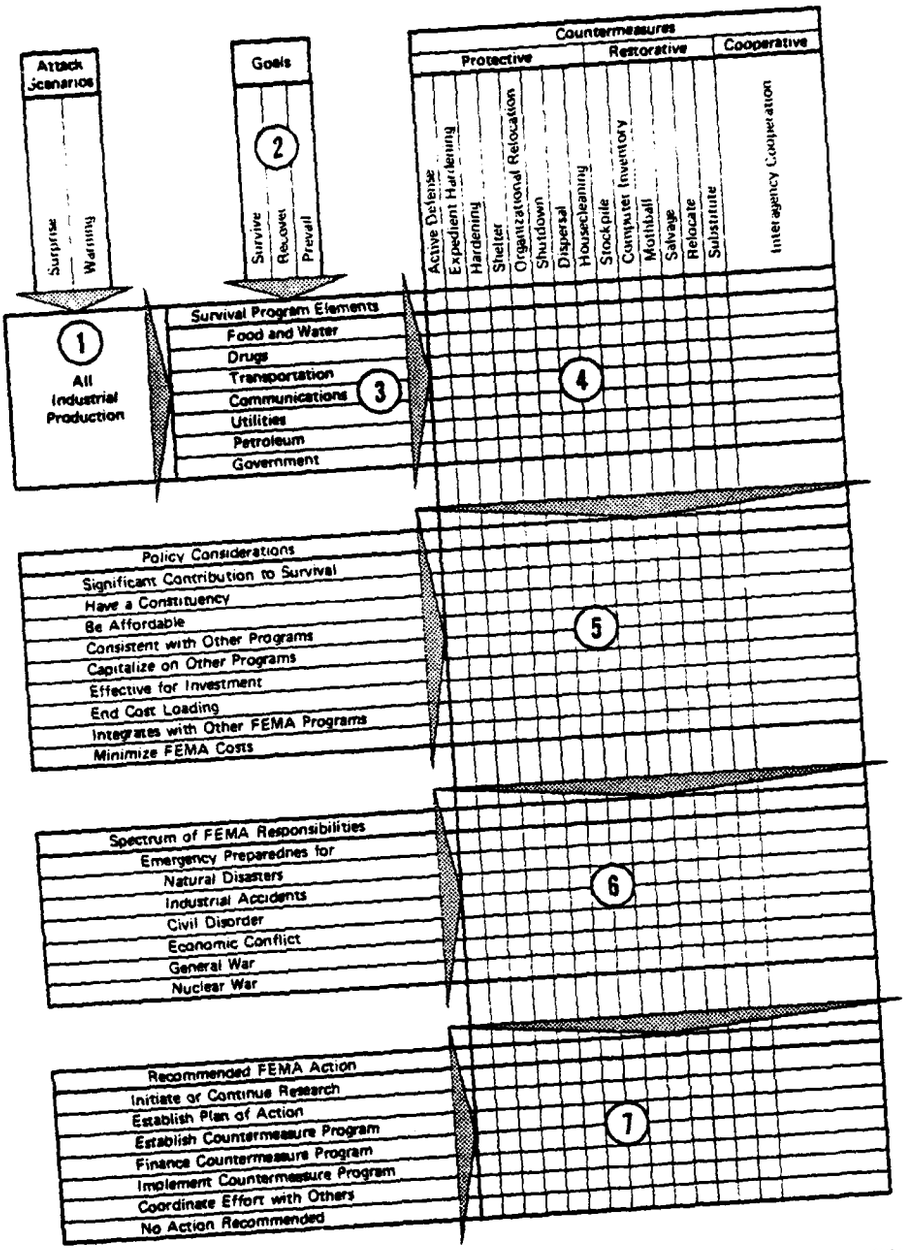
The following charts were prepared for the oral presentation of this report on the derivation of a FEMA Industrial Preparedness Program. The presentation shows the logic and derivation process needed to identify all candidate programs and relate them both to the crisis and types of industry to which they apply. The resulting programs serve as a basis for defining a FEMA Program and specify the next steps required to initiate such a program. Some new countermeasures have been identified; all programs have been evaluated in terms of whether they require continuing research and testing or whether they are ready for implementation.



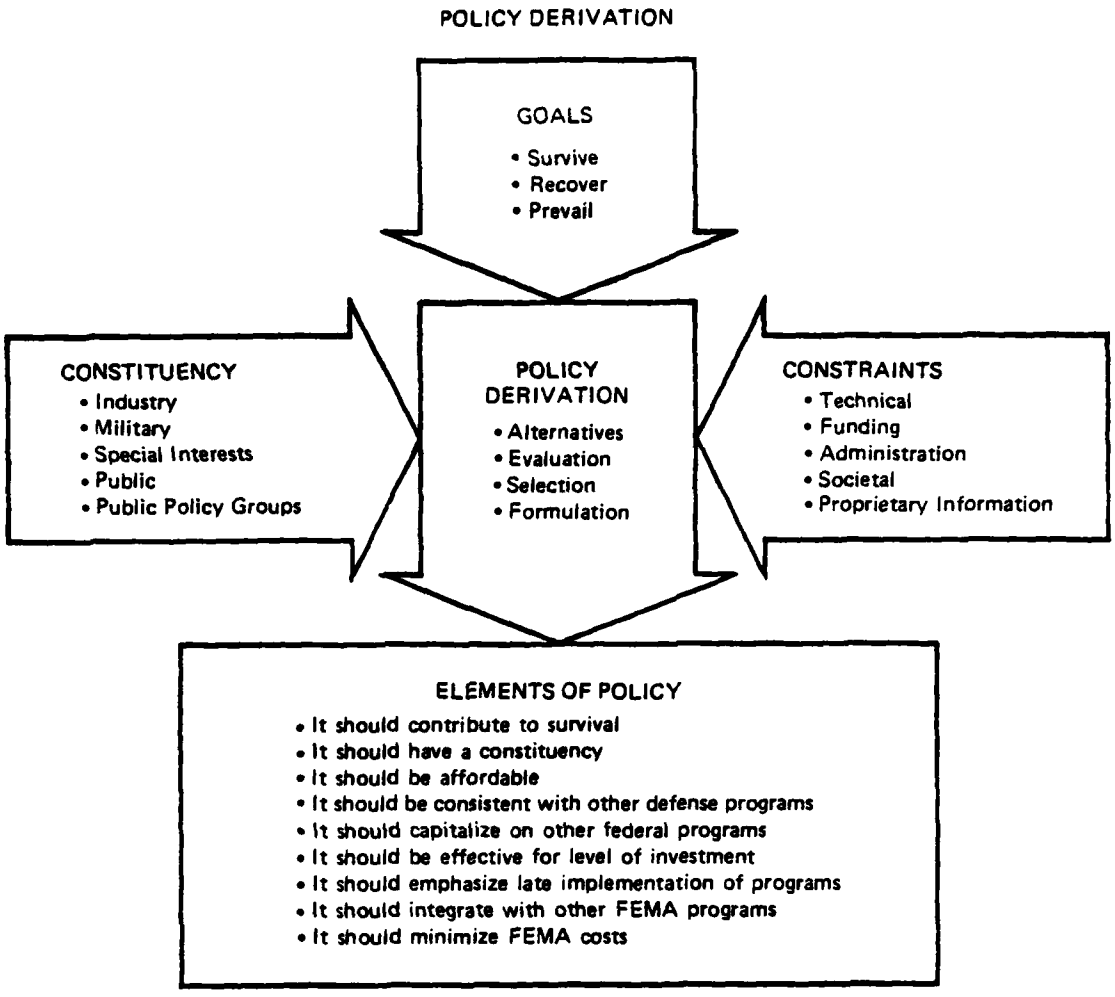
The purpose of this study was to prepare a basis for a coherent FEMA Industrial Preparedness Program. This consisted of (1) defining preparedness goals in terms to measure program effectiveness, (2) suggesting policy factors to use in the selec ion of programs and (3) relating countermeasures to the industries they served and the problems they mitigated and finally (4) to present the practical range of program choices available to protect each critical industry within policy constraints of technology, money and potential effort.

The extensive library of earlier research was used to prepare the compendium of countermeasure alternatives.



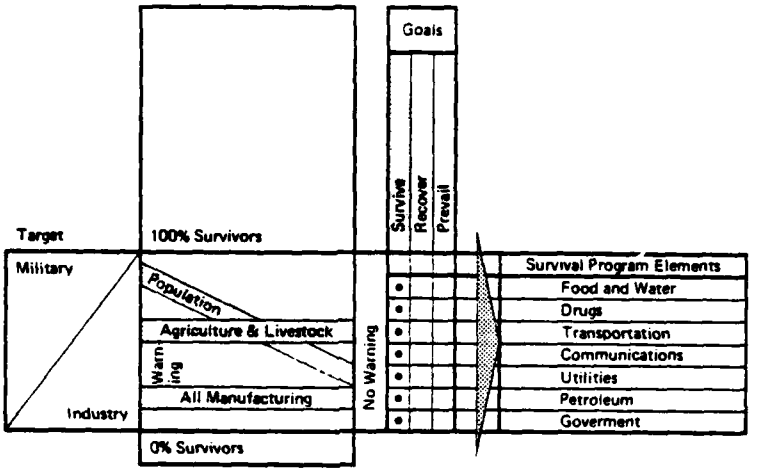
The approach used in the study was first to determine the survivability of resources under a range of attack scenarios (Box 1). Existing attack scenarios (UNCLEX-73) were used to compare surviving population resource requirements with surviving resources available to meet their needs. Resources in short supply to meet a range of post attack goals were then identified (Box 2). Since the objective of this study was to establish a basic program, the resources in short supply were screened to select those essential to survival (Box 3).

The next step was to identify the countermeasures which could be effective in preserving the survival resources (Box 4). To be implemented the countermeasure not only had to be technically feasible but also had to fulfill a number of policy considerations (Box 5). The applicability of the countermeasure to FEMA areas of interest other than nuclear war was evaluated as well (Box 6). Countermeasures that met the policy criteria were then identified as candidates for the FEMA basic Program (Box 7).



A FEMA program for assuring Survival should be comprised of countermeasures consistent with policy considerations. For example, it should be affordable -cost what the Congress is willing to pay - or it will never be implemented. Such policy considerations are derived by bringing together goals, constituency and constraints as shown in the above figure. While this approach may not have identified every issue relevant to every countermeasure, there is nevertheless a high level of assurance that a countermeasure that passes this test has a high probability of successful implementation.

MINIMUM RESOURCES TO SURVIVE



The ratio of surviving resources to surviving people is a function of warning time and targeting. Fixed resources suffer essentially the same damage with or without warning and people survive in greater numbers if they are warned of the impending attack. Thus the greater the warning time the more essential it is to establish countermeasures to protect resources. The size of the attack (number of weapons) effects absolute damage but not necessary the ratio. Thus the planning of countermeasures tends to be similar within a range of feasible attack levels.

Resources to survive begin with food in stockpile until a new crop can be harvested and distributed. The stock and the capability to produce must be large enough to feed all survivors while they work to reestablish the economy. Next, since food and people do not necessarily survive at the same location, transportation must be available to bring the two together. But transportation requires fuel so energy sources for food logistics (and some other critical activities) must be provided for. But people with the food may not wish to send it to people without food so Government is required to order the movement. Next with time many enterprises can reestablish themselves but the electric power, water, transportation, communication, etc., are beyond their control and must be reestablished by government. Finally doctors to maintain health will survive in about the same proportion as people but they will need drugs to carry out their practices.

EXAMPLES OF RELATIONSHIP OF INDUSTRY TO NATIONAL SURVIVAL

Industry	I O Class No.	National Survival	Max. Prod. 1st 6 mos	Indus. Preparedness Factor W CRP	W/ CRP
MANUFACTURING					
All					
CONSUMPTION SUPPORT					
Drugs	2901	26	10	0.33	0.1
Tires	3201	33	14	0.47	0.2
Motor Vehicles	5902	9	3	0.10	0.0
Aircraft	6001	12	5	0.17	0.09
etc....					
PRODUCTION SUPPORT					
Synthetic Rubber	2802	22	6	0.29	0.11
Petroleum Refining	3100	25	10	0.48	0.18
Miscellaneous Iron & Steel	3704	18	8	0.38	0.15
Computers	5101	15	6	0.29	0.11
Electric Transfer and Switch Gear	5302	16	11	0.52	0.20
etc....					
TRANSPORTATION AND STORAGE					
Rail Operations		29	12	0.27	0.15
Truck Terminals		25	9	0.20	0.11
Roadways		75		1.67	0.94
Food Storage		50		1.11	0.62
Strategic Stockpiling		77		2.34	1.25
Petroleum Products		30	13	0.29	0.16
etc....					
COMMUNICATIONS AND UTILITIES					
Radio Stations		86			
Elec. Power Gen.		51			
Substations		51			
etc....					
EXTRACTION AND CONSTRUCTION					
Agricultural Crops		75			
Livestock		61			
Coal Mining		95			
Oil Fields		90			
etc....					

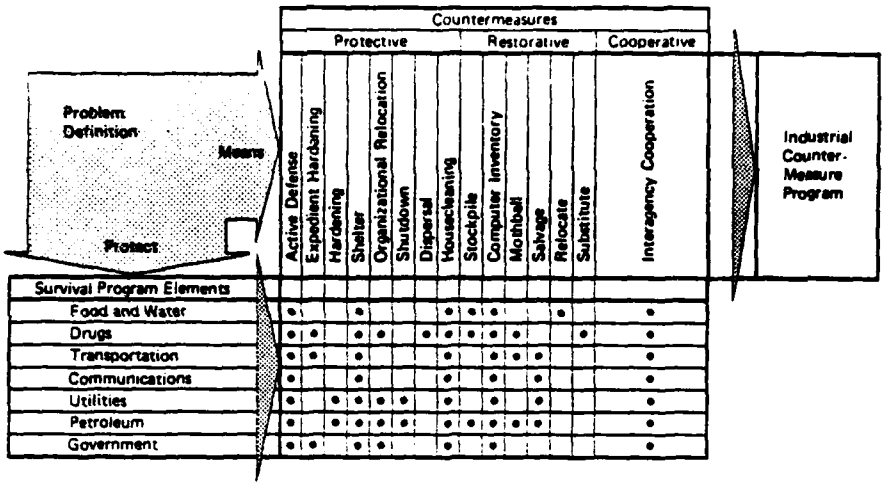
The first step in determining whether an industry should be protected is to measure its survivability under a range of attack designs, population protection and warning times. This procedure serves to provide the ratio between survivors and surviving resources. When this is translated into estimated 6 months production after an attack it is possible to list all short supply resources by pre-attack standards.

An industrial preparedness factor was defined based upon a surprise attack (no crisis relocation planning, with 45 percent of the population surviving) and upon an attack after a period of warning (with CRP, and thus 80 percent of the population surviving). This factor measured the ratio of maximum productive capacity of individual industries during the first 6 months to the percent of surviving population.

Severe difficulties for any manufacturing sector were not considered unless the residual production capability was substantially below two-thirds of the population survival rate (45 percent) for a consumption support industry or below two-thirds of the uninjured survival rate (32 percent) for a production support industry. For the crisis relocation situation, 80 percent of the population survived and was considered uninjured.

Thus, if the IPF was greater than one for any given industry, it was assumed that production would be sufficient for survival. However, if the ratio was substantially less than one for any given industry, it was assumed that industry would need help in the form of an industrial preparedness program.

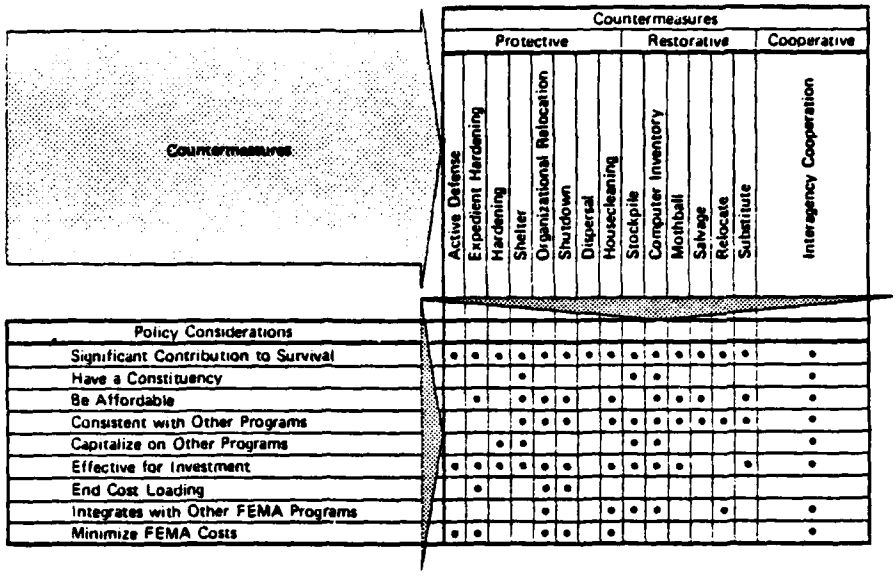
This approach provided the ability to concentrate any selected industrial preparedness programs on those industries requiring help rather than developing a program which did not discriminate.



Not all countermeasures are effective for all resources which must be protected to assure their post-attack availability. In addition, some critical resources can be protected by more than one countermeasure. For example, very little can be done (nor need it be) to protect the production of food. Farm land is widely dispersed, so much of it is free of fallout. Farmers survive better than the population as a whole. Seeds should be adequately available. Only fuel for farm machinery and transport to move the food are in critical supply and these are treated as separate critical resources. In contrast transportation is seriously at risk but there are a number of countermeasures to protect, restore and allocate transportation. The matrix above identifies the countermeasures which can be considered for assuring the availability of each resource.

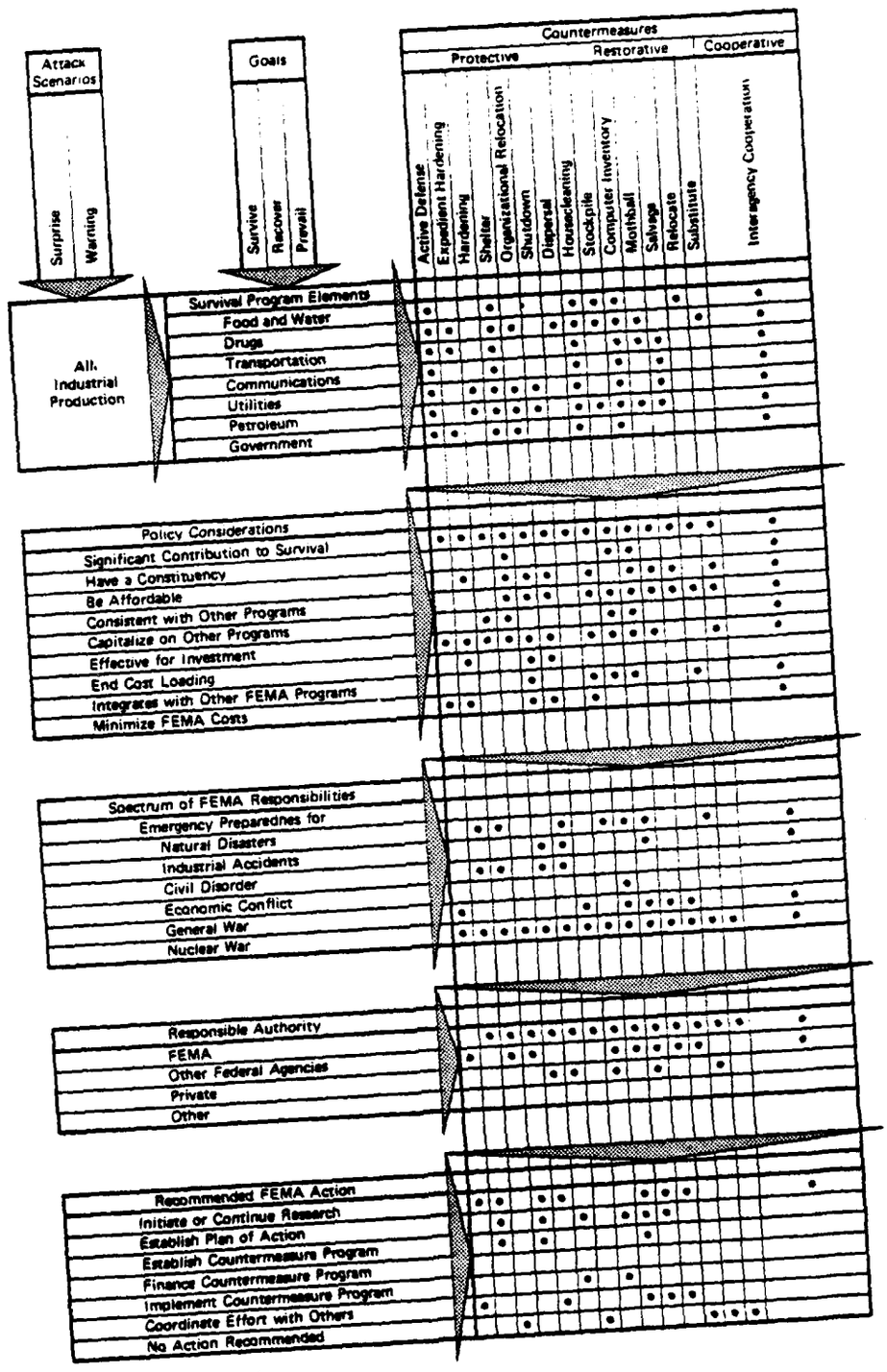
The matrix shows therefore where benefit/cost analysis must be performed to construct an optimum "assurance" program. The matrix also indicates each of the special conditions that a specific countermeasure should be designed to meet. For example, a computer inventory has a contribution to make in assuring post attack availability of nearly all critical resources. The design principle would be the same in each case but the data and use of the data would be different in each case. The next step in planning then is to focus on the countermeasure identified in the matrix to design specific programs.

PROGRAM COMPONENT / POLICY ELEMENT RELATIONSHIP



After countermeasures have been selected on technical grounds to meet identified requirements, they must then be screened for implementability. The elements of policy derived in an earlier step serve as criteria. The first criterion is "it must contribute to survivability." In the specific instance this can be quantified by relating a range of levels of implementation under a range of attack conditions. Alternatives can then be compared in terms of costs and effectiveness. But this may not be enough. The measure must also have a constituency who want the measure implemented and will help to support it. A negative constituency must also be investigated. A strong public opposition may prevent an otherwise good measure from successful inclusion in the program. In addition, even if the cost/effectiveness rate is high it still may be too expensive when compared with the public willingness to pay or the amounts available to other programs. For example, a hardening program could be designed to give a high assurance of survivability but be too expensive to sell to Congress. Also there is no point in spending to save more resources than other defense programs save in people to use the resources.

If other federal programs can be adapted to save resources (such as the Strategic Petroleum Reserve) that also is a big advantage. Now that FEMA has the full spectrum of disaster responsibilities, the compatibility of this proposed countermeasure to their programs is an important consideration. Finally a program (such as hasty hardening) that experiences its costs in the future instead of now will be easier to promote.



BASIC INDUSTRIAL PREPAREDNESS PROGRAM SUMMARY

APPENDIX C

FIRST FEMA WORKSHOP ON INDUSTRIAL PREPAREDNESS

Table C-1 AGENDA: FIRST FEMA WORKSHOP ON INDUSTRIAL PREPAREDNESS

November 19, 1979

9:00	Welcome and Introductory Remarks J.D. Sartor - WCC R. Peterson - FEMA
9:30	Project Objectives R. Cannell - WCC
9:45	Workshop Objectives E. Schuert - WCC

TOPICAL PAPERS

10:00	Recovery from Nuclear Attack J. Greene - ICEP
10:40	The Post-Attack Environment H. Berger - ASC
11:20	Survival During the First Year after a Nuclear Attack R. Sullivan - SPC
12:00	Industrial Preparedness E. Block - SAI
12:40	Lunch
1:45	Industrial Hardening C. Wilton - SS
2:25	Industrial Hardening J. Russel - Boeing
3:05	Organizational Relocation J. Miller - Boeing
3:45	Transportation J. Billheimer - Systan
4:25	The Petroleum Industry, an Overview R. Laurino - CP&R E. Block - SAI
5:05	Summary E. Schuert
5:30-8:30	Victorian Room, St. Francis Hotel, Powell and Geary Sts., San Francisco

November 20, 1979

GROUP DISCUSSION

9:00	The Definition of an Industrial Preparedness Program Discussion Leader - J. Russel - Boeing
10:00	Candidate Industrial Preparedness Programs Discussion Leader - R. Cannell - WCC
11:00	Industrial Preparedness Program Implementation Discussion Leader - E. Schuert - WCC
12:00	Lunch

SUMMARY AND CONSENSUS

1:30	State of the Art of Industrial Preparedness J. Zaccor - SS
2:00	A Candidate Industrial Preparedness Program R. Cannell - WCC
2:30	Industrial Preparedness Implementation Alternatives J. Greene - ICEP
3:00	Concluding Remarks R. Peterson - FEMA

Table C-2 PARTICIPANTS: FIRST FEMA WORKSHOP ON INDUSTRIAL PREPAREDNESS

Lt. Col. D.C. Anselm	JCS
Dr. Howard Berger	Analytical Assessment Corp.
Mr. John Billheimer	Systan Inc.
Dr. Ellery Block	Science Applications Inc.
Mr. Rogers Cannell	Woodward-Clyde Consultants
Ms. Patricia Fleischauer	Woodward-Clyde Consultants
Mr. Jack Greene	International Center for Emergency Preparedness
Mr. Robert Hubinette	Center for Planning and Research, Inc.
Mr. Ken Kaplan	Management Science Associates
Mr. Richard Laurino	Center for Planning and Research, Inc.
Mr. Hong Lee	Advanced Research and Applications Corp.
Ms. Derry MacBride	Woodward-Clyde Consultants
Mr. John Miller	The Boeing Aerospace Company
Richard Peterson, Capt. USN	FEMA
Joseph Russel, Rear Adm. USN Ret.	The Boeing Aerospace Company
Mr. James Sartor	Woodward-Clyde Consultants
Mr. Edward Schuert	Woodward-Clyde Consultants
Dr. Roger Sullivan	System Planning Corporation
Lt. Col. D.H. Thomas	DNA
Mr. Charles Wilton	Scientific Service Inc.
Mr. James Zaccor	Scientific Service Inc.

APPENDIX D

SECOND FEMA WORKSHOP ON INDUSTRIAL PREPAREDNESS

Table D-1 AGENDA: SECOND FEMA WORKSHOP ON INDUSTRIAL PREPAREDNESS

	Monday, April 14, 1980
9:00	Introductory Remarks Rogers Cannell - WCC
9:30	A Review of Soviet Strategy and Civil Defense Leon Goure - AISI
10:15	Active/Passive Defense Ellery Block - SAI
10:45	Industrial Preparedness Program Alternatives Ed Schuert - WCC
12:00	Luncheon Speaker Mr. John W. Macy, Jr., Director - FEMA
2:00	Cost Considerations of Hardening as a Component to an Industrial Preparedness Program Joe Russel - Boeing
2:30	Cost Considerations of Expedient Hardening as a Component to an Industrial Preparedness Program Chuck Wilton - SSI
3:00	Cost Considerations of Organizational Relocation Planning as a Component to an Industrial Preparedness Program Ralph Garrett - FEMA
3:30	Cost Considerations of Key Worker Shelters as a Component to an Industrial Preparedness Program Mike Pachuta - FEMA
4:00	The FEMA Stockpile Program Robert Mroczek - FEMA
4:30-5:00	A National Inventory of Industrial Products Through Resource Management Arnold Marvin - FEMA
	Tuesday, April 15, 1980
9:00	Interagency Cooperative Measures David Bloom - DOE
9:30	Cost/Financing Workshop Discussion Leader - Pat Fleischauer - WCC
11:30	Policy Derivation Workshop Discussion Leader - Rogers Cannell - WCC
12:30	Luncheon Speaker, Workshop Summary Ed Schuert - WCC
2:00	A New Context for Recuperation Herman Kahn - Hudson Institute
4:00-4:15	Concluding Remarks Captain Peterson - FEMA

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Table D-2 PARTICIPANTS: SECOND FEMA WORKSHOP ON INDUSTRIAL PREPAREDNESS

Lt. Col. D.C. Anselm	JCS	Mr. John W. Macy, Jr.	FEMA
Dr. Dave Bensen	FEMA	Mr. Arnold Marvin	FEMA
Mr. David Bloom	DOE	Mr. Joseph Massa	FEMA
Dr. Ellery Block	SAI	Mr. Tom McKay	FEMA
Dr. Paul Bracken	Hudson Institute	Mr. Don Moore	FEMA
Mr. Frank Camm	FEMA	Mr. Ugo Morelli	FEMA
Mr. Russ Clanahan	FEMA	Dr. Mike Pachuta	FEMA
Mr. Rogers Cannell	WCC	Richard Peterson, Capt. USN	FEMA
Mr. William Chipman	FEMA	Robert Mroczek	FEMA
Ms. Nancy Collins	FEMA	Joseph Russel, Rear Adm. USN Ret.	Boeing
Dr. George Divine	FEMA	Mr. Edward Schuert	WCC
Ms. Patricia Fleischauer	WCC	Dr. Walter Schumann	SAI
Mr. James Frankosky	SAI	Dr. Roger Sullivan	SPC
Mr. Ralph Garrett	FEMA	Mr. Dan Sullivan	FEMA
Dr. Leon Goure	AISI	Mr. Leonard Sullivan	SPC
Mr. John Helmer	BMD SYS COM	Mr. Robert Stokley	ICEP
Mr. James Jacobs	FEMA	Mr. Jim Sutch	CDA
Mr. Herman Kahn	Hudson Institute	Mr. Ronald Weitz	SAI
Mr. Cleve Laird	DOE	Mr. Charles Wilton	SSI
Mr. Richard Laurino	CP&R	Elbert Yee	FEMA

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Candidate Industrial Preparedness Program (Unclassified), Woodward-Clyde Consultants, December 1980, 70 pages, DCPA 01-79-C-0304, Work Unit 4221C

The requirements of industry to contribute to the nation's recovery after a nuclear war is evaluated and a basic industrial preparedness program is recommended for implementation. This program evolved from a recommended national policy on industrial preparedness which is developed in the report. The program considers a set of six essential industries and the applicability of fifteen countermeasures to augment industries post attack availability and usefulness. Recommended FEMA action is summarized.

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