GROUP REPORT
&
ABSTRACTS

Group 3

Search and Rescue

GROUP 3 REPORT
SEARCH AND RESCUE

Co-Chairpersons: Tsuneo Katayama and Dennis Wenger

Group III considered the five discussion issues. For purposes of this summary, the first two have been combined

Identify Critical Issues That Have Emerged and Lessons That Have Been Learned in Recent Earthquakes.

Before addressing these issues, it was essential that the group arrive at some consensus regarding what "search and rescue" (SAR) entailed. After discussing "What is SAR?" the group opted for the definition, that it is "the process of mobilizing and managing the resources necessary to safely and expeditiously locate and then remove trapped and often injured victims from partially or totally collapsed structures or environments." In addition, the members agreed to include activities related to victim actions at the time of impact and the linkage between rescue and emergency medical system (EMS) activities.

With regard to this focused definition, the following critical issues or lessons were noted:

- Response Time
- The Mismatch of Resources and Needs for Rescue
- Massive Volunteering
- SAR Management Issues, including resources, strategy and personnel, and volunteer/professional interaction
- International Concerns
- Cross-cultural Differences
- Legal Liability
- Medical Issues
- SAR and EMS Integration into a new SAREMS system
- The relationship of patterns of destruction to occupant safety, rescue strategy and activities, and building "triage"
- Size of the Disaster in relationship to planning

Concerning these issues, the group noted that research findings from recent earthquakes have found that the vast majority of the victims are rescued during the initial "*Golden 24 Hours*" after the impact. Therefore, *response time* is a critically important issue. Furthermore, it has been observed that there is a *mismatch* between the need for critical human and material resources for SAR during the first 48 hours and the availability of these resources. Simply put, adequate resources often arrive after the first two days and after the time when they are critically needed. In addition, *massive volunteering* has been observed. In recent earthquakes trained and untrained volunteers rescued the vast majority of the victims. In general, research has shown that volunteers rescue at least 80 percent of the victims, while

professional, trained responders are generally limited to freeing the relatively few victims who require extensive equipment or skill to extricate.

In light of these logistical and response problems, it is not surprising that a number of *management* problems and concerns have been identified. In particular, observed management problems concern selecting appropriate SAR strategies, the effective integration of volunteer and professional SAR activities and the utilization of volunteer resources. Furthermore, effective rescue site coordination has been found to be problematic. Finally, it has been observed that there is a need for new, more adaptive rescue and extrication equipment.

Both *international* and *cross-cultural* issues were discussed. It was observed that there are serious problems with the effective utilization of foreign rescue teams. These problems concern the delay in their arrival past the initial period in which they are needed, cultural difficulties, such as a lack of knowledge of local customs and language, and problems of political protocol. In addition, some interesting cross-cultural differences were noted. For example, in the United States volunteer participation is more individually motivated and based than has been observed in other countries, such as Mexico. In these countries groups of citizens often volunteer together as members of work groups, families, or neighborhood associations. *A major difference between Japan and the United States was noted in that fires are expected to be a much more serious component of post-earthquake response in Japan.* Furthermore, the vast differences in existing resources between industrialized and post-industrialized societies and many developing nations was noted to have a significant effect on SAR effectiveness.

It was observed that issues concerning *legal liability* for SAR actions on the part of both professionals and volunteers have yet to be resolved. Also, a number of important *medical issues* have surfaced, including those involving the treatment of entrapped victims and those with crush-syndrome. Also, increasing attention is now being paid to psychological stress on the part of first responders. Furthermore, it is not realized that the SAR and emergency medical systems (EMS) are inherently interrelated. The effectiveness of SAR and EMS activities can only be maximized by integrating them into a single system, i.e., an SAREMS model.

A number of engineering-related issues have also been observed. These issues center upon three primary concerns. First, the relationship between patterns of structural and nonstructural destruction and occupant activities and safety must be studied. Second, there is a need to understand how damage patterns influence SAR strategy and activities. Third, the need for building "triage" has become apparent. This activity involves the engineering analyses of damaged structures in order to provide rescue personnel with guidance regarding which sites or buildings hold the greatest potential for eliciting live, though entrapped, victims.

Note Changes in Practices That Have Resulted from Recent Earthquakes and Ensuing Research

Changes in practice were noted in the following seven areas:

- An integrated, Multi-disciplinary Approach to SAR
- The Diffusion of the Incident Command System to Improve Management
- The Development of National SAR Teams to Speed Response
- The Development of Community Volunteer Programs

- The Development of New Equipment
- Epidemiological Applications
- Increased Utilization of Psychological Debriefing

The first three of these applications are related to the problems of an integrated approach, management, and response time. First, SAR is increasingly being organized and studied from an integrated, multi-disciplinary perspective. SAR and EMS components are increasingly integrated within local communities. But in addition to the emergence of SAREMS, we are seeing the inclusion of engineers, construction specialists, and other relevant experts on SAR teams. Second, the Incident Command System (ICS) has been developed as a management model to handle a number of the observed management problems. Although ICS is not a perfect model that is appropriate in all settings, it certainly is a significant improvement over previous command strategies or a lack of prior planning. Third, the development of 25 national SAR teams at the federal level has been a response to the problem of rapid response. The planning calls for these units to be able to respond within the critical 24-hour period to assist with SAR efforts.

The massive volunteer response that has been observed in recent earthquakes has resulted in the development of programs to better utilize volunteer efforts and resources. Community volunteer training programs have been started in local communities. The two most visible are the CERT program in Los Angeles and the CORE program in Oakland, California. These programs go beyond simple public education or awareness efforts, and involve multi-functional training. In addition, increasing attention has been paid to training within the work place

The remaining three applications are in response to other recently noted issues.

Identify Problems that Continue to Challenge Improved Preparedness, Response and Reconstruction Practices

Many of the previously discussed problems and issues are still present. In addition, some other, more specific issues have also been noted. The group decided that the field is still plagued by the following problems:

- Management of SAR response
- Response Time
- Resource Availability at Time of Greatest Need
- The Effective Utilization and Training of Volunteers
- Management of Training across Municipal Departments
- Increased Professional and Volunteer Training
- Lack of Standardized Training Certification for SAR
- Inadequate Knowledge Base for Training
- Lack of Sharing of Information by Responders after Events
- Inadequate Diffusion and Utilization of Research Results

- Lack of Comparative, Cross-cultural Research
- Need for the Development of New Extrication Equipment
- Lack of Financial Support for Disaster Preparedness in Relationship to Other Local Policy Issues

In addition to those problems previously discussed, the group noted that it is sometimes difficult to obtain the cooperation of various municipal departments in the implementation of various volunteer training programs. While increased training is needed both for professional and volunteers, it was noted that there continues to be a lack of standardized certification for SAR training. Furthermore, effective training, particularly of volunteers, is hindered because of the inadequate knowledge base that exists on exactly what training and skills are necessary given the level of expertise held by volunteers. It was observed that not only can the diffusion and use of research findings be improved, but that there is a general lack of candor and sharing of information among practitioners. Finally, the often mentioned problem of a lack of support for preparing for low probability, high consequence events such as earthquakes was repeated.

Identify Existing Research Needs and Areas of Future Collaboration

A number of areas for research were identified. Among the major were the following:

- Comprehensive, Cross-cultural Research on such issues as Management, Volunteers, ICS, International Teams, and equipment
- Epidemiological studies
- Human Factors and Protection Action Research
- Increased Research on Equipment
- More investigations into the viability of building triage
- Evaluation of the effectiveness of critical stress debriefings
- Multi-disciplinary case studies

The group placed its highest priority on comparative, cross-cultural research. In particular, future research should focus upon *management issues*, in particular the effectiveness and applicability of ICS to various types of SAR settings, and the procurement, distribution and coordination of resources. Furthermore, it is important that future research focus upon the key issue of *volunteer training*. It is important that research be undertaken to determine what SAR relevant skills and expertise are already possessed by the public and what additional training is needed. Additional research on volunteers should focus upon the group nature of volunteering and look at the feasibility of training within work groups. Finally, research on volunteers must focus on mechanisms for increasing the motivation and participation of low-income residents in volunteer programs.

Comparative, cross-cultural research is also needed on the efficacy of international rescue teams and the development of improved equipment and technology. This research might involve the exchange of personnel.

Research on various components of *earthquake epidemiology* is also needed. This research should focus upon such topics as on-site treatment and survivability under conditions of entrapment. Simply put, for what length of time is SAR cost-effective? Similarly,

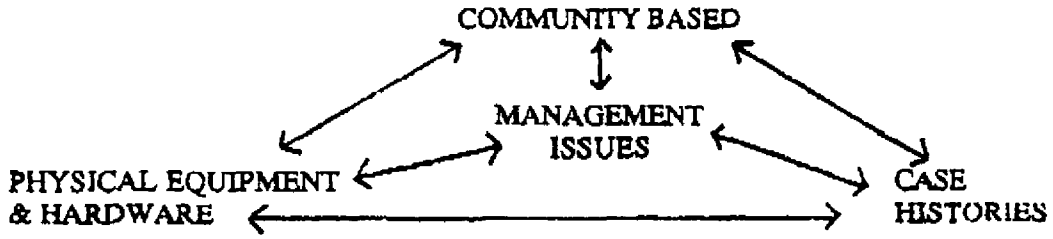
future examinations of *victims' actions* in relationship to patterns of destruction should be undertaken. Basically, research should focus upon what actions occupants can take at the time of impact to lower their risk in relationship to specific damage patterns.

While research on extrication equipment is needed, studies of "building triage" are equally important The focus of this research should be upon two issues. First, pre-event analysis should classify and categorize existing buildings and structures in order to determine the likelihood that occupants may survive structural damage. This information will be vitally important to SAR managers in deciding which sites hold the greatest payoff for success in multi-site situations. Second, the research should examine how the patterns of destruction influence both the survivability of the victim and the effectiveness of SAR efforts.

Research should also focus upon the need, effectiveness and impact of after-action, stress debriefings. These debriefings increasingly are being held, and research upon their effectiveness and consequences is needed.

Finally, multi-disciplinary case studies are needed. This research should combine the expertise of architects, civil engineers, epidemiologists, sociologists, emergency management and emergency medical experts, and policy analysis into an integrated, cross-disciplinary team that can take a holistic approach to the problem.

The following paradigm can be used to structure or model these research efforts:



WORKING GROUP ABSTRACTS

EARTHQUAKE PREDICTION POLICIES IN CALIFORNIA

Richard Andrews

Interaction of Research and Practice in the Evolution of Policies Relating to Earthquake Prediction Response

Developments during the 1970s:

- Traditional Definition of Earthquake Prediction
- Haicheng Prediction
- Establishment of California Earthquake Prediction Evaluation Council (CEPEC)
- Development of a Legal Context

Developments: 1980-1985

- Establishment of National Earthquake Prediction Evaluation Council (NEPEC)
- Brady-Spence Prediction
- Assessment by Southern California Preparedness Project (SCEPP) of Japanese Program developed under authority of the Large-Scale Earthquake Countermeasures Act
- Research Developments relating to Long-Term Earthquake forecasting

Parkfield Earthquake Prediction Experiment

- Review Process
- Development of Plans and Procedures by the California Office of Emergency Services
- Public Information Efforts Related to Parkfield Experiment
- Review of Experiences with "C" level Status and "B" level Alerts
- Modifications in Procedures
- Impact of Loma Prieta Earthquake

State of California Short-Term Earthquake Prediction Response Plan

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Governor's Office of Emergency Services,
2800 Meadowview Road, Sacramento, CA 95832

Development of Earthquake Advisory Process

- North Palm Springs Earthquake
- San Diego and Chalfant Valley--first Earthquake Advisories
- Whittier Earthquake
- Superstition Hills Earthquake Sequence
- Lexington Reservoir Earthquake Advisories and Loma Prieta

Development of State Earthquake Advisory Process Procedures

- Policy Assumptions
- Interaction between Course of Scientific Research and Advisory Procedure
- Upland Earthquake Advisory

Use of Parkfield Model

- Southern San Andreas (Coachella Valley) Response Plan
- Long Valley Response Plan

Challenges for Future

- Enhancement of local government/private industry/public plans for responding to earthquake advisories
- Implications of prediction/advisory for large-magnitude event in an urbanized area

URBAN SEARCH AND RESCUE
DEVELOPING LOCAL GOVERNMENT RESPONSE

Frank W. Borden

Introduction

A catastrophic earthquake in or near an urban center will cause emergency conditions that vary widely in degree of devastation, scope and urgency. Thousands of persons located in these areas will be in life-threatening situations requiring immediate rescue and medical care. As emergencies of these types fall into a "strong probable" category, it is imperative that we plan for them in advance. Most often, the difference between an emergency and a disaster is the amount of preparation that goes on before the emergency. This includes researching the problems and developing scenarios from past events involving structural collapse, like the 1985 Mexico City and 1989 Loma Prieta earthquakes, identifying the expertise and resources needed as well as what is presently available, and addressing the shortfalls both in resources and training.

Urban Search and Rescue (USAR) is "the process of mobilizing and managing the resources necessary to safely and expeditiously locate and then remove trapped and often injured victims from partially or totally collapsed structures or environments." This involves an integrated response system of highly specialized equipment, well-trained personnel from different disciplines, effective communications and an established method of command control and logistical support. Because time is such a critical factor in saving lives, response will also involve emergent volunteers.

Plans and Development

The Los Angeles City Fire Department, like other fire departments throughout the world, has responded to and handled rescue efforts of this type in the past. Our Department has experienced major events of this category, as at the Veterans Hospital in Sylmar, in 1971, a building collapse caused by an earthquake, and the Sylmar Tunnel Incident caused by an explosion and many structural collapses caused by fire, construction problems, etc. What has changed over the years is the increasing frequency of this type of event and the increasing probability of future occurrence, particularly during an earthquake. The increase in population and building in our city clearly adds to the probability factor. At the same time, through incidents worldwide, the experience, knowledge base, techniques and technology to properly mitigate these situations has also increased and changed

Having identified a technical USAR capability as an area of need, the Los Angeles Fire Department began an extensive research and development program in the 1980s to identify a specific course of action for our Department. We expanded our involvement with our city government, local and state governments, and with many nationwide multi-disciplinary organizations concerned with search and rescue including the Federal Emergency Management Agency and the Department of Defense. Networking contacts were established with members of the academic, public service and medical services communities throughout the world.

The City's Emergency Operations Organization (EOO) recognizes the potential for a catastrophe in the Los Angeles area and has embarked upon a multifaceted program of preparedness for dealing with collapsed structure rescue situations. The EOO, with the Fire

Los Angeles City Fire Department, Disaster Preparedness Division,
534 East Edgeware Road, Los Angeles, CA 90026

Department as the lead agency, has been working in the areas of system development, training, equipment evaluation and acquisition, resource inventory, command organization and multi-agency response. Potentially hazardous structures and areas subject to ground failure are continually being evaluated for pre-event planning.

Since it is known that approximately 80% of the rescues made from collapsed structures are performed by local untrained civilians, the Fire Department, through its Disaster Preparedness Division, has been training teams of civilian volunteers from the community, business, and City employees, to act as an adjunct to government response in Emergency Response Teams. Members of these teams are trained in search and light rescue, as well as incident management and disaster medical operations. The emergence of over 7,000 members of the Community Emergency Response Teams will certainly have an impact on reducing life loss and injury.

Future Needs

Experience with catastrophic structural collapse and the resulting loss of life has been a grim teacher. Research is needed in areas of how structures collapse; new and effective tools for locating victims, and cutting, breaching and lifting solid objects; the epidemiology of victims, their types of injuries, and how they survive; emergency medical care for the trapped victims; and improved methods in managing response and training responders. Computer applications in collapsed structure and response modeling would be very useful.

Local government needs to assess their risk and capability in dealing with collapsed structure incidents, whether they are a single and isolated event or a widespread disaster with multiple collapses. Areas for development may include an effective command and coordination system for response, a mutual aid plan for specialized USAR resources with other jurisdictions and organizations, a USAR training program for government and community, and an emergency operations organization at the local level that maximizes the response capability of all entities within a jurisdiction.

The City of Los Angeles has emphasized the interdisciplinary requirements associated with this complex problem involving preventive mitigation, planning and training, response from trained community volunteers, fire, medical, and public works personnel, including structural engineers, and equipment from other governmental agencies and the private sector. The solution to the problem of collapsed structure rescue will only be realized through a well-managed and fully integrated response system that begins at local government and expands through regional, national, and international levels.

RESPONSE--SEARCH AND RESCUE

Henry R. Renteria

The Loma Prieta earthquake which struck the Santa Cruz, San Francisco, and Oakland areas resulted in the loss of 62 lives and damages totaling $5 billion. The majority of the deaths (42) were caused by the collapse of the Cypress Freeway. All search and rescue activities also were concentrated on the freeway. The City was fortunate in that there were no buildings which collapsed and in turn would have required search and rescue activities.

In the initial minutes and hours after the quake struck, the majority of the rescue was conducted by volunteers who converged onto the scene. They risked their own lives on the freeway to help victims who were trapped and injured. Post-earthquake review shows that these volunteers would be even more valuable and pose less of a risk to themselves and others if they were trained and organized.

Modeled after similar programs in Los Angeles and Sunnyvale, the City of Oakland Office of Emergency Services developed and implemented the Citizens of Oakland Respond to Emergencies (C.O.R.E.) Program. The purpose of the program is to develop a cadre of trained neighborhood groups which can respond to disasters and work with professional first responders. Training is comprised of three modules. Upon completion of all modules, the groups are able to conduct urban light search and rescue, fire suppression, disaster medical, damage assessment, and other emergency response functions.

Neighborhood groups, such as tenant and homeowner associations in addition to crime watch groups and church congregations, were recruited due to their communications and organizational structures. City employee groups were also chosen by work locations with specific emphasis on those buildings with high concentration of the general public.

Currently under study is how this program can be implemented at various businesses throughout the city. Also considered are nonprofit agencies and especially those which provide essential human care services.

To address the need for managing those volunteers who still choose to converge at a site in order to help, the City launched a separate program. As one of the functional responsibilities defined in the City Emergency Plan, the Personnel Department has been charged with providing the Convergent Volunteer Management Program. Trained city employees will establish, at a predetermined site, a center where volunteers will be referred, screened, and dispatched to help based on skills or resources they have.

A key component of working with volunteers with special skills is the acceptance of police, fire, and medical responders. First responders must be aware of these volunteers and be willing to use them to accomplish the tasks required. Professionals will be willing to accept this type of support if they know trained individuals will be joining them. Another important factor is identification. All C.O.R.E. volunteers receive green hard hats and vests which clearly identify them to our police and fire personnel.

Recruitment is always easier after a major disaster due to the high public interest and support. Since the program is designed for neighborhoods, those groups which already meet for neighborhood reasons are the ideal recruitment audience. The most difficult are those neighborhoods where no organization exists and few individuals are interested. Consequently some neighborhoods may have as many as 50 team members while others have as few as 5.

City of Oakland, Office of Emergency Services,
One City Hall Plaza, Oakland, CA 94612

By the second anniversary following the earthquake, Oakland had approximately 400 trained C.O.R.E. volunteers and 1,500 currently in training. A newsletter has been developed to keep in constant communication with all members. Also in place are plans to use trained C.O.R.E. members to conduct training of new members.

An annual awards and recognition banquet is being planned to honor all volunteers who have completed the program. Elected officials have become so supportive of the program that they even challenge themselves on who can have the most teams in his or his Council District.

As with any successful program, there are always costs involved. A volunteer recruitment and response program such as this cannot be accomplished without funding. Initial start-up costs were approximately $50,000, with the annual budget between $70,000 and $100,00 per year depending on members trained. The average cost to recruit, train, and equip each volunteer is approximately $65 per person.

Individuals or agencies wishing more information or copies of training materials can write or call City of Oakland, Office of Emergency Services, 475 - 14th Street, 9th Floor, Oakland, CA 94612, 510-238-3938.

RESPONSE--SEARCH AND RESCUE

Dennis E. Wenger

Introduction

The introduction will discuss the nature of the search and rescue (SAR) process and discuss some of the focal concerns and problems inherent in SAR. The importance of viewing SAR as a process will be stressed. The successful accomplishment of SAR must be understood as related to numerous pre-event factors, including both professional and volunteer SAR training, building codes and their enforcement, and medical resources. Furthermore, it must be understood that SAR does not end with the extraction of people, but must be linked to emergency medical provisions.

Previous Studies

Previous studies of SAR will be reviewed. There is a rather long history of research on SAR, going back to the 1950s. While attention will be given to the early and landmark studies, such as those by Form and Nosow, and the classic work of Drabek et al., the emphasis will be upon research findings from the most recent events, including Mexico City, Armenia, Oakland, and Charleston. Among the research to be reviewed will be that of Durkin, Durkin and Murakami, Olson and Olson, Krimgold, the Disaster Research Center, and my own work.

Major Findings from the Research Efforts

The major findings will be reviewed. A nonexhaustive, only purely illustrative, list might include the following: 1) volunteer and emergent group response is massive, 2) the initial SAR activity is accomplished by volunteers and emergent groups, 3) since most survivors are rescued within the first two days, this volunteer activity is critically important to the rescue effort, 4) although professional SAR teams provide a valuable service, they often arrive too late to undertake other than highly specialized rescue activities requiring sophisticated skills or equipment, 5) the integration of volunteer and established, professional activities is seldom efficiently achieved and volunteers are rarely effectively utilized, 6) problems of management of rescue activities are serious and include difficulties in coordinating activities across independent organizations, disagreements over rescue strategy, and ambiguous authority relationships.

Applications of Research Findings into Practice

It will be noted that it is difficult to document that specific research findings have been the precipitant of specific changes in practice. Perhaps the most readily apparent adoption occurs in the hardware sector of SAR, where rescue tools, techniques and devices become fads among professional SAR organizations. Also, adoption of ICS as a "cure-all" for management problems at SAR sites can also be noted. (Some discussion of the efficacy and utility of ICS for SAR could be presented, i.e., a comparison of "command and control" models as opposed to "resource management" models of SAR can be made.)

Hazard Reduction & Recovery Center, Texas A&M University,
College Station, TX 77843

While it may be difficult to document specific applications, certain emergency preparedness programs, such as those in Los Angeles and Oakland, have begun volunteer training programs that are consistent with the findings from the research literature. (These programs will be discussed and reviewed in light of research findings.)

It will be emphasized that greater attention must be paid to planning for volunteer activities and integrating these activities with those of professional, formal SAR organizations. Furthermore, our approach to disaster and emergency planning in general needs to be reoriented toward planning for ad hoc and emergent activities.

Future Research Needs and Areas of Application

Areas in which future research is needed will be discussed. For example, we need more research on the utility of such inherently incompatible SAR techniques as dogs, high technology, and heavy rescue. In addition, we need systematic research on the needs and skills of volunteers, specifically the kinds of training and skills they need to be effective. Research should be conducted into the patterns of destruction to buildings and how they impact SAR efforts. Also, we have few studies of victim actions at the time of impact and how it increases or decreases their level of risk.