
Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants

Criteria for Protective Action Recommendations for Severe Accidents

Draft Report for Comment

Manuscript Completed:
Date Published:

Prepared By:

Sandia National Laboratories
Albuquerque, NM 87185
Operated by
Sandia Corporation
for the U.S. Department of Energy

R. Sullivan, NRC Technical Lead

Prepared for
Division of Preparedness and Response
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
NRC Job Code



DRAFT

Sandia is a multi-program laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

ABSTRACT

DRAFT

DRAFT

TABLE OF CONTENTS

	<u>Page</u>
1.0 INTRODUCTION	1
1.1 Previous Guidance.....	2
2.0 IMPLEMENTATION OF GUIDANCE	3
2.1 Implementation of the PAR Logic Diagram at a General Emergency	3
2.2 Termination of Protective Actions.....	4
2.3 Definition of Terms.....	4
2.4 Precautionary Protective Actions at Site Area Emergency	5
2.5 Wind Persistence Issues.....	6
3.0 DETERMINATION OF PAR FOR LARGE EARLY RELEASE SCENARIOS	6
Attachment 1 Protective Action Logic Diagram	7
Appendix A Emergency Response Communications with the Public in Support of Emergency Preparedness and Response	

DRAFT

This Page Intentionally Left Blank

1.0 Introduction

In late 2004, the Nuclear Regulatory Commission (NRC) staff initiated a project with Sandia National Laboratories to analyze the relative efficacy of alternative protective action recommendation (PAR) strategies in reducing consequences to the public from a spectrum of nuclear plant core melt accidents. The study results are documented in NUREG/CR-6953, Vols. 1 & 2 "Review of NUREG-0654, Supplement 3, Criteria for Protective Action Recommendations for Severe Accidents," (informally, the PAR Study). The PAR Study provides a technical basis for improving NRC PAR guidance.

A draft of NUREG/CR-6953 was provided to the Advisory Committee on Reactor Safeguards (ACRS) for review. ACRS documented their review in a July 27, 2007, letter to the Nuclear Regulatory Commission (ADAMS Accession No. ML071980087) concluding that NUREG-0654 Supplement 3 should be revised. ACRS also recommended that PAR strategies should not become overly complicated such that they slow down decision making during emergencies. The staff agreed with the ACRS recommendations.

The PAR Study analyzed the relative efficacy of alternative PAR strategies for the protection of public health and safety during a spectrum of core melt accidents. The staff selected a series of source terms and evaluated the potential consequences to the public under the various strategies. Three General Emergency accident conditions were analyzed:

- Rapidly progressing severe accident;
- Progressive severe accident; and
- Severe accident without loss of containment.

It should be noted that rapidly progressing severe accidents are very unlikely to occur but are currently required to be addressed as an important element of the emergency preparedness planning basis.

The PAR Study staff examined various PAR strategies for each of the three General Emergency accident conditions including:

1. Immediate radial evacuation (current strategy);
2. Lateral evacuation (perpendicular to the plume);
3. Staged evacuation (close-in population leaves first, others shelter-in-place and then leave);
4. Shelter-in-place followed by radial evacuation;
5. Shelter-in-place followed by lateral evacuation;
6. Preferential sheltering (in large public structures) followed by radial evacuation; and
7. Preferential sheltering followed by lateral evacuation.

The PAR Study staff modeled a hypothetical site with generic weather and a population of about 80,000 based on 100 residents per km² in the 10-mile emergency planning zone (EPZ). The relative benefit of alternative PAR strategies was compared to the current strategy and reported qualitatively.

PAR Study results suggest that the NRC should consider improvement of its PAR guidance. A synopsis of results follows:

- Radial evacuation (away from the plant) should remain the major element of protective action strategies.
- Sheltering-in-place should receive more emphasis in protective action strategies because it is more protective under rapidly progressing severe accidents at sites with longer evacuation times. Preliminary calculations indicated that site-specific evacuation time criteria can be identified for use in protective action procedures.
- Staged evacuation, wherein the public close to the plant is evacuated first while those further out shelter-in-place, should be considered because it is more protective than immediate radial evacuation. Although in some scenarios the improved efficacy of staged evacuation is not large, the strategy decreases demand on offsite response organization resources as well as disruption to the public.
- Precautionary protective actions such as evacuating schools and parks during a Site Area Emergency are prudent and should be considered.
- Strategies that reduce evacuation time reduce consequences. The NRC has drafted rulemaking and guidance to enhance licensee assessment of evacuation issues.
- Evacuation time estimates are important in preplanning PAR strategies. The NRC has drafted rulemaking to enhance regulatory oversight in this area.
- Advance planning for the evacuation of special needs populations that do not reside in special facilities may not be consistently addressed within all nuclear plant emergency planning zones.

These results guide revision of NUREG-0654 Supplement 3, which was first published in July 1996, as a draft report for interim use and comment. Additional insights from the PAR Study, as well as input from State and local government emergency response professionals, stakeholders, and industry, have been considered in the development of revised guidance.

In addition to the technical analyses documented in NUREG/CR-6953 Vol. 1, the staff has conducted a public telephone survey of plume exposure pathway emergency planning zone (EPZ) populations. The public survey provided information on the tendencies of this population with respect to emergency response. These insights have assisted the staff in improving the PAR guidance. The staff published the survey results as NUREG/CR-6953 Vol. 2.

1.1 Previous Guidance

The guidance of this Supplement to NUREG-0654 supersedes previous guidance on the development of PAR logic for nuclear plant accidents. This includes the guidance contained in Appendix 1 of NUREG-0654, FEMA-REP-1 Rev.1 "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants," published in November 1980 and NUREG-0654, FEMA-REP-1 Rev. 1, Supp. 3, "Criteria for Protective Action Recommendations for Severe Accidents," published in July 1996 as a "Draft Report for Interim Use and Comment". 10 CFR 50.47(b)(10) states: "Guidelines for the choice of protective actions during an emergency, consistent with Federal guidance, are developed and in place..." This supplement is considered as the "Federal guidance" referred to in the regulation and it will be used to determine compliance with 50.47(b)(10). It should be noted that there is no intent to affect the protective action guidelines developed and promulgated by the Environmental Protection Agency (EPA). The EPA protective action guides remain the appropriate federal guidance on radiological criteria for consideration of protective actions.

2.0 Implementation of Guidance

The PAR Logic Diagram contained in Attachment 1 of this supplement should be used to develop a site-specific PAR Logic Diagram for use by the licensee emergency response organization. **Attachment 1 is not intended to be used without site-specific modification.** The site-specific PAR logic diagram is expected to be contained in emergency plan implementing procedures used by the nuclear plant emergency response organization (ERO). The Logic Diagram given here is intended for shift personnel. It is designed to be implemented rapidly and without the initial need to confer with offsite response organization (ORO) personnel. The PAR Logic Diagram used by the licensee augmenting ERO may differ in this and perhaps other aspects, reflecting the expectation that the augmenting ERO has more resources than the shift organization. The requirement to provide OROs with a PAR within 15 minutes of declaration of a General Emergency remains in effect regardless of differences in licensee PAR Logic Diagrams used by shift and augmenting ERO personnel. The initial PAR must be made rapidly and in accordance with approved procedures and those procedures should be developed in partnership with responsible OROs.

The notes supporting the PAR Logic Diagram contain direction for the development of site-specific elements and criteria that replace the general guidance of the diagram. The diagram will be simplified when the site-specific elements are developed and the diagram is deployed in an emergency plan implementing procedure.

This guidance suggests that nuclear plant operators and the OROs responsible for implementing protective actions discuss and agree to various elements and criteria of the PAR Logic Diagram. However, in no case is it intended that nuclear plant operators delay the recommendation of protective actions pending discussions with OROs at the time of a General Emergency. OROs have the responsibility to decide which protective actions to implement. Operators have the responsibility to make timely PARs in accordance with federal guidance and plant conditions. Operators must provide timely PARs to OROs to allow them to make timely and well informed decisions.

It is expected that nuclear plant operators will develop PAR procedures that embody ORO input at the various decision points where it is called for in the guidance. The agreement should be made in terms of criteria that can be put into the logic diagram. This criteria and the approved PAR logic diagram in plant emergency plan implementing procedures is the plant commitment to OROs of what PARs will be provided immediately upon the declaration of a General Emergency. In the rare case where a responsible ORO chooses not to participate in the development of a site specific PAR Logic Diagram in accordance with this guidance, the licensee may use ORO emergency plans and/or implementing procedures as a basis to develop the necessary decision points.

2.1 Implementation of the PAR Logic Diagram at a General Emergency

Licensees are expected to provide immediate notification to OROs upon the declaration of an emergency. In the case of a General Emergency declaration the notification must be accompanied by a PAR. The PAR must be developed in accordance with approved site emergency plan implementing procedures. The previous guidance of NUREG-0654, Supplement 3, noted that it was to be used for severe accidents. In practice this was translated into the expectation that it would be used for General Emergencies. However, it should be noted that the emergency action level schemes approved by NRC are conservative. A General

Emergency is a serious event and warrants a protective action offsite, but it is not necessarily synonymous with a severe accident as the term is used in nuclear plant accident consequence analyses. This guidance recognizes that disparity and requires evacuation (or shelter-in-place as appropriate) of the closest population but provides a decision point for increase of protective actions after that initial protective action. General Emergencies are very unlikely events. That one would be followed by severe core melting is even more unlikely and that containment would rapidly fail is still more unlikely. The PAR Logic Diagram in this guidance reflects this probabilistic perspective in a qualitative manner, while requiring escalated protective actions when appropriate.

2.2 Termination of Protective Actions

It is expected that the licensee will implement mitigative actions to ameliorate any General Emergency condition. It is likely, although not certain, that these actions will be successful. It is not the responsibility of the licensee to make any recommendation for terminating protective action direction already given to the public. Protective action should not be terminated until fully discussed among responsible state and local officials with the licensee supplying input regarding plant status. Similarly, a licensee is not expected to terminate a General Emergency without wide consultation. Termination of the General Emergency may take some time thereafter to assure that the plant condition is safe and to confer with authorities. The PAR Logic Diagram recognizes this path and provides decision points for expansion of protective actions given current plant status.

2.3 Definition of Terms

- **“Shelter-in-place”** (SIP) is intended to mean that instructions are given to remain indoors, turn off ventilation (as appropriate for the region and season), close windows, monitor communications channels and prepare to evacuate. Those not at home (e.g., shopping, dining, working, etc.) are asked to stay in their current location. The instructions should also specify that shelter-in-place is safer than evacuation at this time or, alternately, that others more immediately threatened are evacuating and the roads should remain open for them. The intent is that the public remain where they are or seek shelter close by but not return home to shelter. Communications with the SIP population must be clear and often to be effective.
- **“Heightened Preparedness”** is intended to mean that the population within the plume exposure emergency planning zone is informed of the serious emergency at the nuclear plant, told that they should monitor the situation and to prepare for the possibility of evacuation, SIP and/or other protective actions. Further, if an evacuation is taking place, the public not involved should be asked to stay off the roads to allow those immediately threatened to evacuate. Communications with this population must be clear and often to be effective.
- **Emergency Response Planning Area (ERPA)** is defined as local areas within the EPZ for which emergency response information is provided. These areas are typically defined by geographic or political boundaries to support emergency response planning and may not conform to a precise 10 mile radius from the NPP.

- **Evacuation Tail** – A small portion of the population that takes a longer than expected time to evacuate and is the last to leave the evacuation area. The tail generally conforms to about the last 10 percent of the population.
- **Evacuation Time Estimate** – Licensees are required to estimate the time needed to evacuate the public from the plume exposure pathway Emergency Planning Zone (EPZ) extending about a 16-km (about 10-miles) radius around each nuclear power plant. ETE results provide emergency planners information to support protective action decisions, including whether evacuation or shelter-in-place is the better response to the emergency.

2.4 Precautionary Protective Actions at Site Area Emergency

The NRC does not require that precautionary protective actions be recommended by licensees to OROs at a Site Area Emergency declaration. However, it was apparent for some scenarios analyzed in the PAR Study that precautionary protective actions taken earlier than a General Emergency can reduce consequences. However, a review of four actual Site Area Emergencies that have taken place since 1980 shows that none of them required offsite protective actions. Some of these emergencies were declared due to an overly conservative emergency action level scheme that has largely been replaced at nuclear plants. Site Area Emergencies are rare and likely to be even rarer in the future due to this enhancement.

ORO at many sites already plan precautionary protective actions upon declaration of a Site Area Emergency. These actions include sounding sirens, informing the population that an event has taken place at the site, evacuating schools, closing parks and preparing special needs facilities for potential evacuation. Based on the PAR Study and the historical record, it can be noted that precautionary protective actions are prudent only for a Site Area Emergency that is a precursor to a more serious event and that such an event has not occurred in the past 3000 years of power reactor operations since the Three Mile Island accident (~30 years and 100 reactors). However, such an accident is part of the emergency preparedness planning basis and licensees are required to be prepared for such an event. It is expected that operators will likely be able to discern whether a Site Area Emergency is potentially a precursor to a more serious accident or as in the historical cases that core damage is not likely.

It is recommended that OROs consider the implementation of precautionary protective actions appropriate for their locale at a Site Area Emergency declaration after conferring with licensee personnel regarding the nature of the event and likelihood of core degradation. Should operators be unable to provide this assessment it is prudent to implement precautionary protective actions. Heightened Awareness is one appropriate precautionary protective action. It is not recommended that these precautions be automatic at Site Area Emergency.

It may be the case that a licensee or ORO has committed to site-specific precautionary protective actions, such as early and/or preferential evacuation of beach or other recreational areas at the Site Area Emergency. This guidance should in no way be interpreted as countermanning these commitments which may exist in licensing basis documents or approved State emergency plans. Although this guidance may be cited as a basis for changing such commitments, no changes in practice or procedure should be implemented until the appropriate approval process is completed.

2.5 Wind Persistence Issues

Licenseses have noted that meteorology at some sites includes shifting wind directions. This could result local authorities expanding protective actions while an evacuation is proceeding if the wind direction changes more quickly than evacuation can be accomplished. Multiple changes in protective action direction can undermine credibility and could increase shadow evacuations potentially increasing evacuation times for the population actually at risk. Licenseses at some sites have postulated that it may not be possible to succinctly identify the “downwind direction” in a manner that supports evacuation without the need for expansion before it is completed. This guidance identifies the need for sites to perform a wind persistence analysis to determine if the site specific PAR Logic Diagram should include additional downwind sectors for the initial protective action. Another solution to this issue is to identify larger emergency response planning areas (ERPAs). Licenseses have found that larger ERPAs can reduce the need to expand areas affected by protection actions due to wind shifts. It may be appropriate to consider prevailing winds and typical wind persistence when identifying ERPAs.

3.0 Determination of PAR for Large Early Release Scenarios

The large early release (LER) is a very unlikely scenario, but the EP planning basis includes planning for this event. Historically, EP regulations and guidance have been based on a spectrum of accidents. This concept is embodied by NUREG-0396, “Planning Basis for the Development of State and Local Government Radiological Emergency Response” in the specification of the EPZ. NUREG-0654, page 6, notes that planning should not address a single accident sequence as each accident could have different consequences. The LER, if it exists, occupies the very unlikely region of the accident spectrum. The NRC staff no longer considers credible the LER accident sequences and source terms previously identified in agency studies such as NUREG-1150, “Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants.” In fact, the staff does not have current analyses that quantify a spectrum of credible LER source terms. This may be a topic for further research, but the low probability of such events may hinder dedication of resources. The lack of a spectrum of LER source terms impacted the development of PARs for the LER.

The staff chose to perform a series of calculations using a spectrum of source terms from current studies but with hypothetical timing to reflect the LER. The object of this effort was to identify the relative efficacy of protective action options at sites with high population densities. (Adams No. MLXXXXXXX.) Options examined were:

- Initial SIP for the 2 mile radius and immediate evacuation for 2-5 mile downwind
- Immediate evacuation for 2 mile radius and initial SIP for 2-5 mile downwind
- Immediate keyhole evacuation

The factor that determines which protective action is best is the travel speed of the evacuating population. Travel speed is related to population density and is influenced by the road network and evacuation planning. Travel speeds used in the analysis was derived from current evacuation time estimates for evacuation of 90% of the general public under normal weekday conditions, but the analysis is independent of site. The calculation determined relative efficacy rather than absolute consequences.

Multiple weather trials were tested and the mean of consequences was assessed. The staff recognized that extreme weather conditions such as inversion, significant precipitation or no

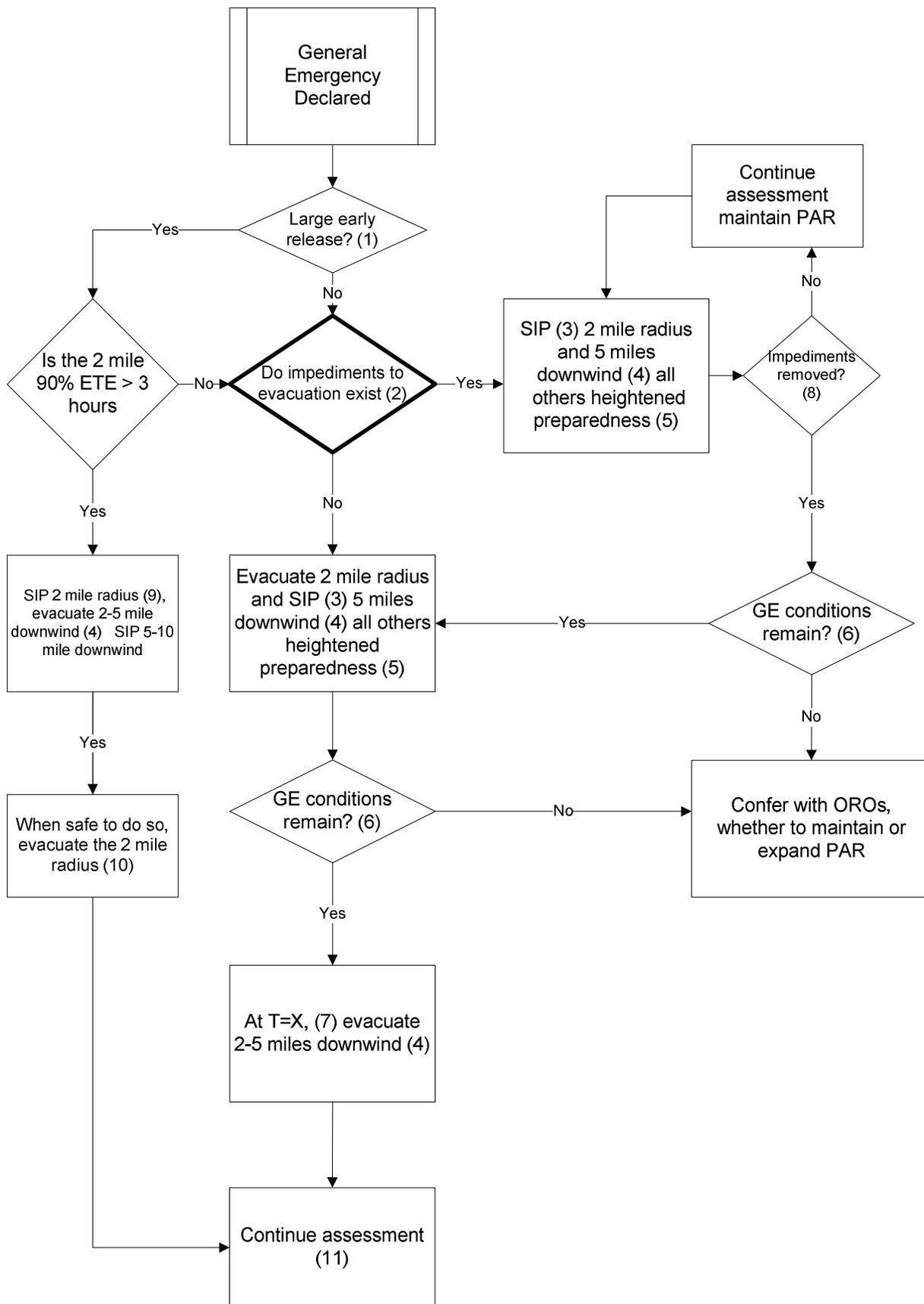
wind conditions could change the efficacy of SIP and make evacuation preferred. The PAR Logic Diagram guidance reflects this.

The data showed a significant benefit for initial SIP (the first option above) where the 2 mile ETE was in excess of 3 hours (or a speed less than 1.0 mph), assuming the population begins moving one hour after the accident begins. It is expected that few sites will meet this criteria. However, sites that require time to establish evacuation support for the 2 mile evacuation (a smaller minority) must add that time to the ETE to make the determination. The preferred outcome for sites with a 2 mile ETE greater than 3 hours would be for the evacuation plans to be enhanced to increase evacuee travel speed.

Licensees may perform a site specific analysis to determine if other criteria are more appropriate. This must be submitted to NRC for review and approval in accordance with 10 CFR 50.4 before it is implemented in protective action procedures.

Attachment 1

Protective Action Logic Diagram



Protective Action Recommendation Logic Diagram Notes

Note 1

- **Large early release:** This is a General Emergency (GE) with rapid loss of containment integrity and loss of ability to cool the core. This element is only used for those unlikely scenarios where containment integrity can be determined as bypassed or immediately lost during a GE. If this scenario can not be identified, assume it is not taking place and answer “no” to this decision block. This decision block is only necessary for those high population sites that estimate the 2 mile ETE to be in excess of 3 hours for 90% completion. For the majority of sites, immediate evacuation of the 2 mile radius will be the initial action regardless of GE scenario (pending there are no impediments to evacuation).

Note 2

Impediments include:

- **Evacuation support not yet in place:** e.g., the GE is the initial notification to offsite response organizations or if there is a previous emergency classification notification, the GE notification occurs prior to preparations to support evacuation. However, many sites have a low population density within 2 miles and evacuation support readiness will not ever be considered an impediment. This element must be discussed and agreed to with OROs. The expected time for evacuation support to be put in place should be agreed to with OROs in advance and embodied in the site-specific PAR logic diagram for those sites where delay of a 2 mile radius evacuation is necessary pending support set up. The licensee would base the recommendation on the agreement and would not confer with OROs on this matter before making the initial PAR.
- **Hostile action event:** Many OROs consider that initial SIP is preferred in this type of event. This element would be discussed and agreed to with OROs. The licensee would base the recommendation on the agreement and would not confer with OROs before making the initial PAR.
- **Licensees are not responsible to solicit information or make a determination if weather or other impediments (e.g., earthquake, wildfire) to safe public evacuation exist at the time of the emergency.** However, the licensee will consider an impediment to exist if OROs notified the licensee that an impediment exists, e.g., roads are closed due to deep snow.

Note 3

- **“Shelter-in-Place” (SIP)** is intended to mean that instructions are given to remain indoors, turn off ventilation (as appropriate for the region and season), close windows, monitor communications channels and prepare to evacuate. The instructions should also specify that SIP is safer than evacuation at this time or, alternately, that others more immediately threatened are evacuating and the roads should remain open for them. Communications with the SIP population must be clear and often to be effective.

Note 4

- Downwind sector(s) and adjacent sectors
- Site specific wind persistence analysis may indicate the need to include additional sectors with initial recommendation. This element must be discussed and agreed to by OROs.

Note 5

- **“Heightened Preparedness”** is intended to mean that the population within the plume exposure emergency planning zone is informed of the serious emergency at the nuclear plant, told that they should monitor the situation and to prepare for the possibility of evacuation, SIP and/or other protective actions. Further, if an evacuation is taking place, the public not involved should be asked to stay off the roads to allow those immediately threatened to evacuate. Communications with this population must be clear and often to be effective.

Note 6

- Once a General Emergency is declared termination will not likely occur for some time. However, if the conditions that caused the declaration are ameliorated, (i.e., core cooling is restored) it may not be necessary to expand the PAR to evacuate additional areas. The criteria to be embodied in the site-specific PAR logic diagram are:
 - Core cooling not established or
 - Release is probable or occurring and dose projections show protective action guidelines likely to be exceeded in areas not evacuated or
 - Dose projections from a previous release show that protective action guidelines will be exceeded.

Note 7

- At T=X hours, (X = the site-specific 2 mile ETE for 90% evacuation) evaluate need to expand the PAR based on plant conditions. The licensee identifies the value of T using the site specific ETE. The shift staff is expected to make this PAR without conferring with OROs and it is not based on verification of evacuation progress. If the augmenting ERO has activated, there should be sufficient resources available for the licensee to confer with OROs more fully.

Note 8

- In the case where the impediment was time to set up evacuation support (e.g., at a high population site): When the agreed to time has elapsed (e.g., 1 hour) for evacuation support to be in place the PAR should be changed. It is not intended that licensee shift staff confer with OROs prior to changing the PAR.
- In the case where the impediment was a hostile action event: Within 1 hour of the initial PAR, the licensee must discuss with OROs whether the sheltering PAR should be changed. This will be dependant on plant status as well as local law enforcement support obtained by OROs. It would be preferable if this activity were accomplished by the licensee augmenting ERO.
- In the case where the impediment was due to weather or other road disruption causes, OROs will determine when it is appropriate to change the protective action. Licensees may inquire as resources allow, but have no responsibility for PAR modification unless a

PAR change is necessary due to meteorological or plant conditions. OROs will determine when it is safe for the public to evacuate.

Note 9

- Initial SIP is only appropriate for sites with 2 mile radius evacuation times exceeding 3 hours, otherwise immediate evacuation of 2 mile radius is appropriate. However, sites with longer evacuation times, should also consider current meteorological conditions. Significant precipitation, inversions, or calm 'no wind' conditions may provide a basis for immediate evacuation because these conditions would reduce risk to the evacuating population. Local weather conditions are a factor in the decision to SIP.

Note 10

- Evacuation after the initial SIP period is critical to reducing public exposure. However, the large early release scenario can not be precisely characterized in advance. While perhaps the worst case scenario is known, it is extremely unlikely and should not be used as the sole model. In general, accident analyses show that the source term is expected to be initially large and that it will be reduced within a few hours due to exhaustion of the available radionuclide. Mitigative actions may also be implemented to reduce the source term. While the timing of this reduction can not be specified, the licensee must identify when it would be safer for the 2 mile radius to evacuate. This is expected to be within 4 hours but a time can not be specified and the determination would be based on information available to the licensee.

It is also expected that evacuation of the sheltered population would be discussed with OROs and plans made for rapid evacuation of the public through potentially contaminated areas. It should be noted that lateral evacuation could reduce exposure if plume meander has been minimal.

Note 11

- Continue radiological and meteorological assessment and evacuate any areas where dose projections or field measurements indicate that protective action guidelines are likely to be exceeded. SIP additional areas as appropriate. Maintain heightened preparedness. OROs should communicate often with the public while protective actions are in effect.
- Continue plant assessment to determine if accident conditions warrant changes to PAR.

APPENDIX A

Effective Communication with the Public in Support of Emergency Preparedness and Response

This Page Intentionally Left Blank

Appendix to Supplement 3 'Effective Communication with the Public to Support Emergency Preparedness and Response'

1.0 Purpose

This Appendix provides guidance to licensee and offsite response organizations (OROs) intended to enhance communications with the public before and during nuclear power plant emergencies. Guidance is provided for integration of new protective action elements such as expanded use of shelter-in-place (SIP), heightened preparedness and staged evacuation as well as methods to reduce shadow evacuations.

Recommendations from NUREG/CR 6953, "Review of NUREG-0654, Supplement 3, 'Criteria for Protective Action recommendations for Severe Accidents'" Volumes 1 and 2 (informally, the PAR Study, NRC, 2007; NRC, 2008b) are addressed in this guidance. The guidance supplements the guidance contained in NUREG-0654 / FEMA-REP-1, Rev. 1, Sections E and G by providing methods and techniques to enhance the effectiveness of communications with the public during planning and during emergencies. Implementation of these methods presented can improve public understanding of and compliance with protective action direction from government authorities.

2.0 Introduction

Research on alternative protective actions showed that SIP and staged evacuation can enhance public health and safety during a nuclear plant accident (NRC, 2007). Research on large scale evacuations (NRC, 2005a; NRC, 2008a) highlights the importance of clear communication with the public during emergencies. However, to achieve the desired public response, information must be appropriately communicated (NRC, 2008b). This guidance also serves to address several recommendations identified in NUREG/CR 6953 Volume II synopsis as follows:

- Communicate the benefits and appropriateness of staged evacuation and SIP;
- Develop guidance on the importance of communicating with the public during a SIP and to direct an effective evacuation upon the termination of SIP;
- Develop communications that will support effective staged evacuation;
- Develop communications to minimize shadow evacuation;
- Develop communications that address the evacuation of schoolchildren;
- Enhance processes for identifying residents that may require assistance during an evacuation; and
- Update emergency planning information brochures with instructions on the management of pets at congregate care centers.

2.1 Public Response

There is much agreement among researchers that an individual's decision to implement protective actions is influenced by, among other things, the belief and understanding of the warning (NRC, 2007). More specifically, the following items are necessary for assembling effective public warning messages (Mileti, 2000):

1. Hazard – describe the event that is about to occur in enough detail for members of the general public to understand the hazard and why it may be a threat to safety.
2. Location - define the areas that may be affected such that the general public will understand who is at risk as well as who is NOT at risk.
3. Guidance – provide clear instructions on what people need to do, how to do it, where to go, and how to get there.
4. Time - inform the public how long they have to implement protective actions and why the time is important. The frequency of the messaging is important because the number of times a message is heard affects hearing, understanding, and belief while increasing confidence that the message is understood and decreasing the opportunity of misinterpretation.
5. Source - the source of the protective action recommendation affects the perception of risk. Information from a credible and reliable source encourages believability.

Communications with the public during emergencies should expeditiously address information needs to minimize the time individuals take to verify information and implement a protective action.

2.2 Staged Evacuation and Heightened Preparedness Protective Actions

Two protective actions are introduced in this guidance that may be new in some EPZs: staged evacuation and heightened preparedness. A staged evacuation is one in which one area is directed to evacuate first, while others are asked to SIP and await the order to evacuate if necessary. For nuclear plants staged evacuation would be directed for the 2 mile area around the plant while downwind areas out to 5 miles SIP. Heightened preparedness is intended to mean that the population within the plume exposure emergency planning zone is informed of the serious emergency at the nuclear plant, told that they should monitor the situation and to prepare for the possibility of evacuation, SIP and/or other protective actions. Further, if an evacuation is taking place, the public not involved should be asked to stay off the roads to allow those immediately threatened to evacuate. Communications with this population must be clear and often to be effective.

These protective actions require additional communication in both the public information program and during an emergency to ensure the public understands the expected response.

2.3 Department of Homeland Security Guidance

This communication appendix is intended to be consistent with Department of Homeland Security (DHS) guidance which is established to prepare the public for events that might require protective actions. DHS guidance, developed in response to Homeland Security

Presidential Directive 8 (HSPD-8), establishes policies to strengthen the preparedness of the United States. HSPD-8 includes encouraging active citizen participation and involvement in preparedness efforts. HSPD-8 also provides for a comprehensive plan to provide accurate and timely preparedness information to public citizens, first responders and other interested parties (DHS, 2003). The DHS provides detailed information on the expectations for citizen preparedness during an emergency at their website www.dhs.gov. The guidance encourages individuals to take responsibility for themselves and their families in the unlikely event of an emergency through planning and preparedness. The DHS principal components for public preparedness include: 1) Make a plan; 2) Be informed; and 3) Get Involved. The methods and means for members of the public to implement these components are detailed on the DHS website.

3.0 Planning and Preparedness

Communication with residents of the EPZ begins with the annual dissemination of emergency planning information to the public within the EPZ, as required in Appendix E of 10 CFR 50.47. This information is provided in the form of brochures, phone books, calendars, utility bills, etc., to inform residents on radiation, instructions for evacuating and sheltering, arrangements for special needs individuals, contacts for additional information, and other emergency preparedness related topics. In a comprehensive telephone survey conducted in 2008 of residents within EPZs, most respondents stated they are familiar with these emergency information materials and many keep this information readily accessible. Results of the survey are published in NUREG/CR-6953 Volume II (NRC, 2008b). The insights gained from research of large scale evacuations (NRC, 2005; NRC, 2008a) and from the focus groups and telephone survey conducted with NUREG/CR 6953 Volume II, found that communications can enhance preparedness.

3.1 Public Information Brochures

The public information program is intended to provide the permanent and transient population within the EPZ the opportunity to become aware of preparedness information annually (NRC, 1980). Guidance on the content of public information brochures is found in NUREG-0654 / FEMA-REP-1, Rev. 1 Section II, G which suggests information to the public include, but not be limited to, educational information on radiation, contacts for additional information, protective measures such as evacuation routes, sheltering, respiratory protection, radioprotective drugs, and information for special needs individuals. While these brochures are largely retained by residents of EPZs (NRC, 2007), the information and instructions tend to be directed to individuals who are at home when an emergency might occur. Clarifying expectations for those who are not at home when a protective action is issued will provide members of the public a greater understanding of what is expected in the unlikely event of an emergency.

The following information should be included in public information brochures.

1. Emphasis on the individual's responsibility for emergency preparedness – Consistent with DHS guidance, discussion should be provided to encourage residents to be prepared and have an emergency response kit.
2. Discussion of personal belongings evacuees should bring in an evacuation including those who may use public transportation.

3. Instructions of what to do if sirens sound – Sirens are intended to support an initial notification and the public should listen for an EAS message prior to taking any other action.
4. Definition of heightened preparedness and staged evacuation as protective actions and the expected actions.
5. A list of television and radio stations that provide emergency information.
6. A map of the EPZ that shows evacuation routes and emergency response planning areas (also referred to as protective action zones).
7. Location of where people should go if ordered to evacuate, including if applicable, an explanation of how to register at a reception center and the availability of congregate care centers or shelters if they need a place to stay.
8. Location of bus routes and pick-up points along routes for transit-dependent population.
9. A registration card and phone numbers for residents who may need assistance evacuating to register their need.
10. Definitions of terminology that may be used in EAS messages or media broadcasts.
11. Basic information regarding radiation and nuclear energy.
12. Explanation of types of protective actions that may be recommended.
13. Instructions on what to do if ordered to evacuate.
14. Instructions for those who will need a ride to evacuate - It is important to emphasize that residents should request a ride from a neighbor, relative, or friend while also assuring residents that transportation will be available if they are unable to obtain a ride.
15. Specific direction to parents not to pick up children from school.
 - a. Clearly describe the school evacuation process and locations where parents may meet up with their children.
16. Information regarding potassium iodide (KI), where applicable, including what to do if KI is not available to the individual.
17. Information on whether KI will be available at congregate care centers. This should include why it is safe to wait until evacuees get to the centers to take KI.
18. Instructions on how to shelter-in-place. Residents should be instructed on the basics of closing doors and windows and shutting off air conditioning as applicable for the region. Residents should also be instructed to prepare for a possible evacuation while they are SIP.

19. Information on what to do with pets - Brochures typically state that pets should be left at home or that pets are not allowed at congregate care centers. Research shows that residents are more likely to comply with an evacuation order if they can bring their pet (NRC, 2005; NRC, 2008a), thus public information brochures should not suggest that pets be left at home. Also, open ended statements such as “pets are not allowed at congregate care centers” do not instruct residents what to do. A statement such as “Pets may be brought to congregate care centers provided they remain in a pet carrier, in the vehicle, or outside at all times” informs the recipient that pets may evacuate with the family but restrictions may be applied.
20. Information to limit Shadow Evacuation – The emergency public information brochure should define a shadow evacuation and not that it has the potential to impede the traffic flow slowing down evacuees from the affected area. The brochure should clearly state that those who are not within the declared evacuation area should not evacuate until directed.

In review of existing public information brochures it was found that the basic information may not provide complete instructions. Providing additional detail in the brochures can better inform the public of expectations during an emergency. Data shows that the public follows instruction more readily when better informed (NRC, 2008b). Additional information and guidance is provided in the following subsections for selected topics.

3.1.1 Heightened Preparedness

Heightened preparedness and staged evacuation, introduced in this update to Supplement 3, should be included in the public information brochures. Implementation of a ‘heightened preparedness’ among those within the EPZ would begin with the initial alert and notification. Heightened preparedness is established when the population within the EPZ is informed of the serious emergency at the nuclear plant and understand that they should monitor the situation and prepare for the possibility of evacuation, sheltering and/or other protective actions. Public information brochures should include the definition of this term and relate this to the initial alert and notification.

3.1.2 Evacuation General Guidance

Evacuation remains a key element of emergency preparedness and public information brochures should provide some detail on the expectations of the public. Public information brochures should identify that the evacuation will be directed by local authorities who will staff traffic control points throughout the evacuation area. To avoid confusion, details should be included on the expected actions of the public if they are not at home when an evacuation order is issued such as:

- Actions to take for those in vehicles when the order is issued – some existing public information brochures instruct drivers to roll up windows and turn off vents, but do not provide instructions on whether drivers should exit the EPZ immediately or if they can drive home first.
- Actions to take for those whose family is not together at home – information should be provided for families to create an emergency plan to address separation and reunion issues. Families should be encouraged to allow schools to evacuate

children in accordance with established plans. When children are not at school but not at home, the guidance must recognize the need for families to gather children.

- Actions to take for those who are at other locations (i.e., working, shopping, dining, etc.) without access to the EAS message.

Brochures should identify that under some situations individuals may have time go home, pack and evacuate or that they may be requested leave the area immediately and that specific directions will be provided through EAS messaging.

3.1.3 Staged Evacuation

Staged evacuation is the preferred initial protective action in response to a General Emergency because it is more protective of public health and safety than other actions (NRC, 2007). In a staged evacuation those closest to the plant (i.e., within 2 miles) are evacuated first while others shelter. The evacuation is later expanded as necessary. Public information brochures should explain that the purpose of staged evacuation is to rapidly protect those at most risk. A key point in the brochure and the EAS messages is to request that others stay off the roads to allow the initial evacuation to proceed. At many sites, this evacuation can be accomplished relatively quickly. It may be appropriate to note the time frame in brochures to assure the public that they will not have to wait long for their turn to evacuate, should that be necessary. Those asked to SIP or to implement heightened awareness should prepare for the possibility of evacuation should it be necessary.

3.1.4 School Evacuation

Research shows that people prefer to evacuate as a family unit and that parents will attempt to pick up children from school (NRC, 2008b). Emergency preparedness professionals should recognize that parents will become aware of an impending school evacuation before buses are mobilized due to the immediacy of cell phone communication among children. This early awareness may result in large numbers of parents picking up their children. This sensitive issue should be addressed with a two fold approach.

- Brochures and other communications with parents of children in public schools should discuss the benefits allowing schools to implement evacuation plans without interference. Consideration may be given to including a discussion of how parental interference could hamper the evacuation process and thereby increase risk to all students during an emergency.
- Although potentially difficult to manage in an emergency, school evacuation planning should accommodate parents picking up children. This may include developing an expedient means to release children to parents, friends or relatives and may also include provisions to manage additional traffic.

3.1.5 Transit Dependent Public Evacuation

Transit dependent residents will need transportation assistance in order to evacuate (NRC, 1980). It is important that planning documentation emphasize that transit dependent residents should request a ride from a neighbor, relative or friend while also assuring residents that transportation will be available if they are unable to obtain a ride. Research suggests that most evacuees with vehicles would provide a ride to someone in

need during an evacuation (NRC, 2008b). In some EPZs people requiring transportation assistance are asked to register with the ORO. In most EPZs brochure include bus routes for pick up and instructions to go to the nearest major street where buses are traveling. The following additional information should be included:

- Encourage those who may be transit dependant (e.g., those with no vehicles, unsupervised children at home, or one vehicle that may be away) to read and keep this information handy,
- Describe how transit dependent residents are expected get to the bus route and what to do if they can not get to the bus route on their own (e.g., register for assistance),
- Whether they can bring their pets, and if restrictions such as a pet carrier are required,
- When the bus runs will start, taking into account that it may take a couple of hours to mobilize drivers and buses,
- How long residents may expect to wait for pick up,
- Why they are safe outdoors while waiting for pick up and
- Whether multiple bus runs will be made within the EPZ.

3.1.6 Shelter in Place

Instructions are typically provided on how to SIP and include details such as closing doors and windows, turning off air conditioning or heating (as appropriate for the region and season) and monitoring communications channels for further instructions. In addition, details should be included on expected actions for the following situations:

- Actions to take for those in vehicles when the order is issued, e.g., leave the EPZ or enter a nearby substantial building,
- Actions to take for those whose family is not together at home, e.g., implement family emergency plan,
- Actions to take for those who are working, shopping, dining, etc., e.g., remain in the building where they are currently located and monitor for additional information.

Emergency messaging should synchronize with the information in the brochure and be repeated often to reassure the public that the direction remains appropriate.

3.1.7 Special Needs Individuals

NRC research identified that eight percent ($\pm 3.5\%$ at the 95% confidence level) of the EPZ population nation-wide requires assistance from outside the home during an evacuation (NRC, 2008b). The research indicated that only 29% than of these people have registered with local authorities (this figure is less accurate due to a smaller sample size). It should be noted that the NRC research was at the national level and specific programs may be more or less effective. Emergency response personnel who have supported evacuations have noted that significant resources must be dedicated to this population group. A typical means for registering special needs individuals not in special facilities is to provide a post card in public information brochures. This method has not reached a majority of those in need.

The response rate from registration services currently available indicate that this is an area where enhanced communication in the planning phase may yield substantial improvement. Although most EPZ residents have reviewed the public information brochures (NRC, 2008b), of those who stated they may need evacuation assistance, 42 percent indicated they did not know they could register. About 30 percent have not 'taken the time' to register. Less than 10 percent of those respondents who would need assistance to evacuate indicated that they were concerned about providing personal information to others. This population group is rather diverse and may include those with physical or mental handicaps, the aged and those recently but temporarily incapacitated.

These results indicate residents with special needs are willing to inform authorities of their need; however, the current registration process could be improved. Public information brochures should address the need to registration for assistance, but efforts should not be limited to registration cards.

Some techniques that may result in increased registration using the public information brochure include:

- Providing a distinct section in the beginning of the brochure to attract the attention of those who might need assistance. A bold phone number and if available a web address should be provided to allow registration over the phone or internet.
- Changing the title from Special Needs to "Evacuation Assistance" or other more general term to remove any connotation that may be sensitive;
- It may help to move the registration card to the first or second page of the brochure and to modify the card to attract readers. The card itself could be a different color and might include questions designed to elicit a response, for instance, does the resident have a pet. This information is not necessarily of use to responders, but may stimulate some residents to complete the card.
- Brochures should inform residents that information will be kept confidential.
- Outreach efforts within the community should routinely include the need to register for evacuation assistance.
- Elder centers or advocacy groups may exist in the EPZ and could be contacted for assistance in registration.

However, the responsibility for planning does not rest solely with local authorities. Individuals must take responsibility for their own family's emergency planning. This should include requesting help before it is necessary.

4.0 Communications During an Emergency

Local authorities will use the approved alert and notification system to warn the public of an emergency and the need to take protective actions. This system normally consists of sirens (and perhaps tone alert radios) to alert the public and the Emergency Alert System (EAS) to notify. Detailed information can be communicated to the public via EAS messages and media broadcasts.

4.1 Initial Alert and Notification

The requirement for a prompt initial alert and notification message to the public is provided in 10 CFR 50.47 with additional guidance included in NUREG-0654 / FEMA-REP-1, Rev. 1. The initial alert and notification message is principally an alerting mechanism and is not a detailed informational tool. The alerting of the public includes the sounding of sirens, tone alert radios, and in some instances direct communication to selected facilities. For many sites, sirens may be sounded in response to a SAE, with some sites limiting the use of sirens to a General Emergency. Instructions are provided in the public information brochures directing residents to monitor the radio or television for an EAS message if they hear the sirens. Most residents of EPZs believe they are relatively well informed of what to do if sirens sound in an emergency (NRC, 2008b). The intent of the initial notification is to bring awareness to the public that there is an incident at the NPP using a scripted EAS message.

It is important that emergency response instructions be consistent within the EAS message and also consistent with public information brochure (ANL, 2001). EAS messages should be reviewed for internal consistency and with public information brochures. For instance, when a phone number is included in an EAS message for residents use to obtain additional information, the EAS message should not also state that residents refrain from using the phone. Likewise, the public information brochure should not state that residents refrain from using the phone if a number is provided in the EAS message. Such contradictory information should be clarified or omitted.

The initial message shall clearly state whether a release is taking place as provided in NUREG-0654 / FEMA-REP-1, Rev. 1, E(3). As indicated in Section 2.1, Public Response, it is important for the public to understand the hazard and why it may be a threat to their safety. To accommodate this in a pre-established message, some agencies have prepared alternate EAS messages to allow selection and use of the most appropriate for a given emergency.

NUREG-0654 / FEMA-REP-1, Rev. 1, E(3) also provides that initial notification include information about the class of the emergency such as an Unusual Event, Alert, Site Area Emergency, or General Emergency. It should be recognized that the general public does not have an understanding of the importance of these terms (NRC, 2008b). Reference to emergency classification should not be used to convey the severity of the event as this will not be recognized by the general public.

4.2 Ongoing Communication during an Emergency

After the initial alert and notification, the public will maintain an awareness of the event via media broadcasts and subsequent EAS messaging. The length of time during which the public will be expected to monitor the situation should be mentioned as early in the

communication as practical. If the initial notification to the general public is at SAE, it may be hours before there is new information available that is substantively different than the original messaging. It is important to maintain a current status of the emergency with the public through frequent and scheduled updates even when there is no measurable or definable change in the emergency status.

The national survey of residents of EPZs (NRC, 2008b) found that less than 30 percent of residents believe they would monitor an emergency event for more than four hours. Thus, for an emergency in which it may be necessary to ask the public to monitor the situation for many hours, it is important to convey the reason for such a lengthy monitoring period and to assure the public that as events unfold, there will be time to implement any recommended protective actions. The objective of this lengthened period of communicating routinely to the public should be to instill a 'heightened preparedness' among those in the EPZ.

As defined earlier, heightened preparedness means the population within the plume exposure EPZ is informed of a serious emergency at the nuclear plant, understand that they should monitor the situation and prepare for the possibility of evacuation, sheltering and/or other protective actions. Communications during this time period must be clear and frequent to effectively instill a heightened preparedness among the public. The details of the message should instill confidence in the public that the emergency is being monitored and that the public will have time to comply with any protective action, if one is deemed necessary during the course of the event.

If the emergency progresses to the point of requiring protective actions, after receiving a recommendation from the licensee and considering independent assessment information and consulting with appropriate agencies, the ORO will make a protective action decision and will convey this to the public. Instructions will be provided via an EAS message and supporting media broadcasts. Messaging used to communicate action must be very specific, easy to understand, complete, and trustworthy (Mileti, 2000). Information provided should be specific and detailed on the protective action that is recommended such as shelter-in-place, evacuation, and the taking of KI, and it should be expected that most residents will follow instructions (NRC, 2008b). The message should also define who is at risk as well as who is not at risk, and the public should be able to easily identify which group they are in (Mileti, 2000). Enough information should be provided to communicate why the hazard is a threat recognizing that withholding good or bad information from the public can affect the response (Mileti, 2000).

4.2.1 Sheltering-in-Place Messaging

SIP is a basic protective action and is discussed in public information brochures. For SIP, residents should be instructed to go inside or remain indoors, turn off ventilation, seal windows, monitor communications channels *and* prepare to evacuate. The instructions should specify that sheltering is safer than evacuation at this time. An impediment to SIP may include loss of power or communication systems. When these systems are not available to inform the public to SIP and subsequently to inform the public when to exit the shelter and evacuate, then the effectiveness of SIP as a protective action may not be achieved. If a power outage is associated with a nuclear power plant emergency, and if power is not expected to be returned to normal in a short amount of time, SIP may not be the most appropriate protective action.

Messaging should address the locations at which people might be sheltering such as at home, work or other location. Frequent updates should be provided on the need to shelter and expected length of the shelter period. When SIP instructions are provided, recognize that for large commercial, industrial, and government buildings, it is often not a simple task to turn off heating and air conditioning units. Large facilities may require a building engineer to support such an activity. Communications should address the importance of shutting off outside air sources and inform those sheltering in such facilities as to why it may or may not be appropriate to stay in place if ventilation can not be shut off.

In review of EAS messages, some identify that during a SIP protective action, residents should take KI that has been provided. It is important that instructions be provided to those who are not residents, such as tourists, and to residents who may not have or may not know the location of their KI. Individuals who do not have KI available need to know if it is still appropriate to SIP. This detail is specific to each State because some States do not implement KI programs while others distribute KI to residents or stockpile KI for distribution at reception centers.

It should be clear that SIP is a two step process (Argonne, 2001) which must always include provisions for ending the protective action. Expectations at the end of the SIP period should be clearly communicated. The benefits from SIP diminish quickly if the notification to leave and subsequent evacuation are not conducted optimally (NRC, 2007). Analysis show that SIP in residences and buildings can be highly effective at reducing dose, although reliance on large dose reduction factors for SIP should be accompanied by cautious examination of the local housing conditions (EPA, 1991).

4.2.2 Evacuation Messaging

Evacuation is discussed as a protective action in public information brochures. It should be recognized that even if an evacuation is ordered immediately, the mobilization of residents and the travel time to exit the EPZ takes time. During this time, instructions and communication to the public should be continuous and informative on the status of the incident as well as the status of the protective action. Communications should address the known population groups including permanent residents, transit dependent residents, transients (i.e., tourists, employees or other non-EPZ residents), special needs individuals not residing in special facilities, schools, and special facilities. Messaging should address the locations at which people might be when an evacuation is ordered such as at home, work, or other location because their response decisions may be based on their location.

Instructions on evacuation should be specific and identify protective action zones that are under an evacuation order, messaging should also clearly state that people in areas not under an evacuation order should refrain from travel to allow evacuees to exit the area. It is important to inform people of any time constraints that may exist. For instance, if people need to leave their residence, work place, etc, within an hour, this should be communicated. This type of detail provides the public the information to decide if they have time to return home from work, gather necessities, and then evacuate.

Information directed to transients should clearly identify the immediacy of the need to comply. If time permits, transients may want to return to hotels to gather belongings, finish their task at work, etc., and then evacuate. However, if the order is for immediate evacuation, then instructions should clearly indicate such. It should be recognized that the transient population may not be aware of the Emergency Response Planning Area or Protective Action Zone they are in.

The following evacuation information should be provided in media broadcasts and on websites when available:

- To whom the message applies (e.g., residents, tourists, employees, special needs residents, etc.);
- Where to find information to determine if you're in the evacuation zone such as the public information brochure, phone book, etc. This should be specific enough that tourists and visitors to the EPZ will be able to determine if they are in an affected area. Maps are recommended with very clear boundaries of the affected areas;
- Where to go, such as a reception facility, and explain the reason why they should go to the facility. Be very clear, for instance if the EAS and media messaging is stating that there has not been a release from the plant, the instructions to go to a reception center should not state that the purpose is to screen residents for contamination;
- When to leave, such as immediately, within an hour, etc., informing the residents of the level of urgency.
- Any special activities which should be performed prior to leaving home such as turn off ventilation, lock and secure home for a brief absence;
- What to do if you do not own a vehicle and can not get a ride with a neighbor;
- If children are evacuated from school, indicate where parents can meet them;
- Who to call if you need assistance;
- Who not to contact for additional information, such as 911;
- When additional information and updates will be provided via the media;

4.2.2.1 Staged Evacuation

The preferred protective action is a staged evacuation directing that the 0-2 mile area around the nuclear plant be evacuated first, while others SIP. The purpose of staging an evacuation is to allow an area with the highest risk to be evacuated first with little effect from background traffic on the roadways. Although most residents believe they would support a staged evacuation order (NRC, 2008b), the potential for a shadow evacuation of the surrounding areas exists as it does with any evacuation. For a staged evacuation, clearly defining the limits of the evacuation area is important for success. Clear and direct communication identifying areas that should not evacuate and identifying the reason for staying off of the roadways is to allow those more at risk to leave. The public that is asked to SIP should be informed that they will be evacuated should it be necessary as soon as those at risk are moved. This communication combined with traffic control are necessary for the staged evacuation to be successful.

4.2.2.2 School Evacuation

Emergency planning for the evacuation of schoolchildren is often established to move children early such as at SAE or in some instances at the Alert. Public information brochures normally identify that schoolchildren will be evacuated from school and parents should meet them at designated locations. Although many jurisdictions will close schools and evacuate children at Site Area Emergency or earlier, it should be expected that parents will receive word of the evacuation through informal channels. Cell phones are widely available and used by children of all ages and parents will likely be informed of preparations for evacuation. Plans for the early evacuation of schoolchildren were developed long before cell phones were available.

A result of this “societal notification” parents, friends and family can be expected to pick up children even if informed children will be evacuated (NRC, 2008b). Additional communication that emphasizes the benefits and safety of organized evacuation of the schools can alleviate some parents concerns and reduce potential added traffic congestion in these areas. However, school administrators should understand the strong desire to evacuate as a family and should plan to accommodate the pick up of children. This includes developing an expedient means to release children to parents, friends, or relatives. Local traffic control plans around schools should be prepared to manage vehicles and buses in the area.

4.2.2.3 Shadow Evacuation

A shadow evacuation is the evacuation of people from an area that is outside an officially designated evacuation area usually consisting of areas adjacent to the affected area. A shadow evacuation should be anticipated (NRC, 2008b) and can be controlled or mitigated through better communication, education of the public, and implementation of traffic control (NRC, 2005a, 1992a). Emergency response agencies are typically focused on getting an immediate message to the affected population, but for large scale events, a clear message should also be provided to those that are in areas not affected by the incident. In particular, the success of staged evacuation depends on minimizing shadow evacuation that can delay the evacuation of those most at risk. NRC research indicates that about 70% of EPZ populations will comply with SIP while a staged evacuation takes place. However, the same population indicated that a majority may evacuate if simply told others are evacuating but they need not (NRC 2008b). The proper message is necessary to ensure effective response.

4.2.2.4 Transit Dependent Evacuation

Communications to the transit dependent population group should emphasize the need to request a ride from a neighbor, relative, or friend. For those who can not obtain a ride, information should be provided, consistent with the public information brochure, such that transit dependent residents know where bus routes are and how they are expected to get to the bus route. This information should also include how long they should expect to wait along a bus route and why they are safe waiting outside. Instructions to this population group should include:

- A map of bus routes or a list of major roads on which buses are running;
- How often buses will be running;
- How these residents are expected to get to the bus route;

- What to do if they can not get to a bus route;
- Whether they are safe outdoors while waiting for pick up;
- Bringing provisions for a few days, which may include clothing, medical supplies, and other accessories;
- Any limits on allowable belongings such as whether they can bring their pets and if must they be in a pet carrier; and
- How long they may expect to wait for a bus.

Recognize that this population group accounts for thousands of individuals in many EPZs. Once the individuals are at the bus stop, communication with them will be limited; thus, initial instructions must be thorough and accurate.

4.2.2.5 Special Needs Residents not Residing in Special Facilities

Although registration programs are established within EPZs in an attempt to identify this population the registration response rate is generally low. These individuals should first be instructed to obtain a ride from a friend or neighbor if at all possible. Instructions should clearly state what to do for residents who have registered with authorities as needing assistance. A key element of this messaging is how long residents should expect to wait for pre-arranged assistance to arrive, and what to do if assistance does not arrive during the specified timeframe. It can take many hours in some EPZs to mobilize and complete the evacuation. This information will need to be carefully coordinated with response agencies to include the specific areas where these agencies are focusing on assisted evacuation efforts. Residents should be instructed what to do while waiting for assistance to arrive. Instructions also need to be provided to residents who have not preregistered for assistance. For those who still require transport, phone numbers should be provided to contact response agencies for assistance.

4.2.2.6 Special Facilities Evacuation

Special facilities have specific evacuation plans and may receive early warning through direct notification during an emergency. This preplanned activity helps assure that the special facilities are notified promptly to allow reaction and response activities to begin. Although the warning may be direct and the facility response may be prompt, the nature of these facilities requires additional time to implement a protective action strategy. EPZ evacuation times for special facilities such as hospitals, nursing homes, etc., may be longer than the evacuation time for the general public. The evacuation time depends on the special facility population, unique needs of the residents, available resources to evacuate the facilities, and the number of bus and ambulance trips required.

In the evacuation of special facilities for Hurricanes Katrina and Rita, most of the special facilities had independent evacuation plans (NRC, 2008a), but frequently the facilities identified the same ambulance or bus service to support an evacuation. When all of the facilities required evacuation at the same time, there were not enough resources available. It is important that emergency management agencies communicate directly with facilities to both determine if they need assistance evacuating the facility, and to follow up at a later time to verify expected resources arrived for the evacuation of the facility.

5.0 Additional Guidance for More Effective Messaging

In addition to the existing guidance provided in NUREG-0654/FEMA-REP-1, Rev. 1 and that provided above, the following should be considered in the development of communication messaging:

- As new communications systems become more widely available, emergency response organizations are utilizing them in addition to the normal alert and notification system. Secondary systems utilizing Reverse 911[®] type telephone messaging are available in many areas and route alerting is commonly identified as a backup or alternative method of notification. In some EPZs, residents can register to receive emergency messaging via cell phone text messaging and automated telephone calls.
- Emergency response agencies are typically focused on getting an immediate message to the affected population. A clear message should also be provided to residents in areas not affected by the incident. Residents of areas not affected by the incident should be instructed to stay off the roadways to allow those evacuating from the EPZ to proceed.
- Messages must be consistent. When a phone number is included in the EAS message for residents to obtain additional information, the EAS message should not also state that residents refrain from using the phone. Such contradictions are confusing to members of the public who may already be anxious about the current state of events. Use of phone numbers such as 211, 311, or others should only be encouraged in areas where it is confirmed that the phone service can handle the large number of calls anticipated.
- As provided in NUREG-0654 / FEMA-REP-1, Rev. 1, G(4)(c), each organization is to establish coordinated arrangements for dealing with rumors. It should be recognized that rumor control may play a greater role in communications than anticipated in the past. With the mass use of cell phones and Internet access, communication among the public has become immediate in emergency events. Text messages are 'blasted' to large groups of recipients and Internet social networking utilities are widely used. Emergency response agencies should monitor social networks and address errant information through rumor control expeditiously. The use of blog sites by emergency management agencies is helpful in addressing rumor control.
- Establishing an emergency management Internet blog has proven effective in providing current updates of incidents as well as clarifying erroneous information. Response personnel can use cell phones to send text, photos, or video directly to their websites to provide first hand credible information on the incident. The agencies Internet blog can be managed out of the emergency operations center.
- Under the National Response Framework, the DHS assumes overall coordination of an incident if it progresses to a General Emergency. As Federal agencies, such as DHS, become integrally involved in the incident the public should be informed that these are planned actions in order to avoid unnecessary confusion.

- EAS messages that include instructions for taking KI should also include information for those who do not have their KI available. Desire for additional information on this topic was identified in focus group sessions with residents of EPZs (NRC, 2008b). Information should be specific for the protective action ordered. For a sheltering or evacuation protective action in which the public is also asked to take their KI, instructions should clearly state what to do if individuals do not have KI, such as KI will be available at the reception center. Residents should be informed why it is acceptable or safe to wait and receive KI at a reception center.
- Public will generally want to confirm the need to take action, and it may be expected they will actively seek out additional information (Mileti, 2000). With telephones, cell phones, and Internet access at the fingertips of most Americans, it should be expected that attempts to confirm information will be immediate, and the propagation of information will occur quickly. Requests that the public refrain from using these services are not likely to be heeded. A better approach is to assure adequacy of the available systems and for emergency response agencies to also utilize these services to provide additional information to the public.
- Cable overrides and cable scrolls used to provide emergency information should be carefully constructed such that messages are not so lengthy that residents can not determine whether they are affected by the incident.

6.0 REFERENCES

Department of Homeland Security (U.S.) (DHS). "Homeland Security Presidential Directive – 8: National Preparedness." (HSPD-8). December 17, 2003.

Oak Ridge National Laboratory. "Questions and Answers Regarding Actions to Take when Ending Shelter in Place." Department of Homeland Security Chemical Stockpile Emergency Preparedness Program Protective Action Working Integrated Process Team. Shumpert, Barry. ORNL/TM-2003/230. September, 2003.

Mileti, D. S. and L. Peek. "The Social Psychology of Public Response to Warnings of a Nuclear Power Plant Accident." *Journal of Hazardous Materials*. Vol. 25: pp. 181-194. 2000.

Nuclear Regulatory Commission (U.S.) (NRC). NUREG/CR-6981, SAND2008-1776P. "Assessment of Emergency Response Planning and Implementation for Large Scale Evacuations." Washington D.C.: NRC. October 2008a.

Nuclear Regulatory Commission (U.S.) (NRC). NUREG/CR-6953, Vol. II. SAND2008-4195P. "Review of NUREG-0654, Supplement 3, "Criteria for Protective Action Recommendations for Severe Accidents. Focus Groups and Telephone Survey" Washington D.C.: NRC. October 2008b.

Nuclear Regulatory Commission (U.S.) (NRC). NUREG/CR-6953, Vol. 1. SAND2007-5448P. "Review of NUREG-0654, Supplement 3, "Criteria for Protective Action Recommendations for Severe Accidents." Washington D.C.: NRC. December 2007.

Nuclear Regulatory Commission (U.S.) (NRC). NUREG/CR - 6864, SAND2004-5901. "Identification and Analysis of Factors Affecting Emergency Evacuations." Washington D.C.: NRC. January 2005a.

Nuclear Regulatory Commission (U.S.) (NRC). NUREG/CR-6863, SAND2004-5900. "Development of Evacuation Time Estimate Studies for Nuclear Power Plants." Washington D.C.: NRC. January 2005b.

Nuclear Regulatory Commission (U.S.) (NRC). Supplement 3 to NUREG-0654/FEMA-REP-1, Rev. 1, "Criteria for Protective Action Recommendations for Severe Accidents." Washington D.C.: NRC. 1996.

Nuclear Regulatory Commission (U.S.) (NRC). NUREG-0654/FEMA-REP-1, Rev. 1, "Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants." Washington D.C. NRC. 1980.