



Sandia National Laboratories

Operated for the U.S. Department of Energy by
Sandia Corporation

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SEP 8 2005

Nader L. Mamish, Director
Emergency Preparedness Directorate
Division of Preparedness and Response
Office of Nuclear Security and Incident Response
MS O-6H2
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Mr. Mamish:

Re: Project Title JCN R3137 (formerly J3162), Rev. 3, titled: "Review of NUREG-0654, Supplement 3, 'Criteria for Protective Action Recommendations for Severe Accidents.'" NRC Letter Request, dated 07/18/05, amendment to current contract by adding Task 9, and extending period of performance end date from June 30, 2006 to November 15, 2006. Subsequent to submitting Rev 2, negotiations between NRC and Sandia resulted in the agreement that Sandia will split the proposal for the amendment; the second part of the proposal will be an option NRC can decide to exercise well within FY2006. Additionally, regarding option to the base contract, Sandia will be allowed to re-bid the option when the time comes. These changes in the proposal narrative are reflected in the enclosed Rev 3.

Enclosed is the above-referenced Sandia National Laboratories (SNL) Work for Others Proposal. We are submitting this proposal to you in parallel with submission to the Department of Energy/National Nuclear Security Administration (DOE/NNSA). This proposal is contingent upon your acceptance and written in response to the above-mentioned NRC document. Please send future funding documents/proposal requests following the enclosed Procedural Change notice.

Congress has mandated that DOE inform other Federal agencies sponsoring work at DOE laboratories of the amount of their funding that is used for Laboratory Directed Research and Development (LDRD). This is simply a reporting requirement and does not represent a new charge. Consistent with the Department of Energy's (DOE) full cost recovery policy, DOE collects, as part of its standard indirect rate, an LDRD cost levied on all monies received at SNL. The estimated amount of LDRD costs is identified in the last line of the NRC Form 189, Part I. DOE believes that LDRD efforts provide opportunities in research that are instrumental in maintaining cutting edge science capabilities that benefit all of the customers at SNL. The Department will conclude that by approving and providing funds to DOE to perform work under this proposal, you acknowledge that such activities are beneficial to your organization and consistent with appropriation acts that provide funds to you.

The Department of Energy will be accepting the funding document. For any questions in reference to the funding document, please contact Delores Lineback, DOE/NNSA/SSO, at (505) 845-6055. To assist you in working with the DOE, we have enclosed their administrative instructions for submission of interagency agreements (funding document) to DOE/NNSA for reimbursable work. Your funding document and supporting documentation should include information required by the DOE as delineated in these instructions. Technical questions regarding this proposal should be addressed to Lori Dotson, SNL, (505) 284-9205.

Sincerely,

Enclosures:
189 package (2 copies)
DOE/AL Administrative Instructions (1 copy)

Copy to (w/enc):
USNRC Reginald Augustus, MS T9-E30 (189 forms only)
USNRC R. L. Sullivan, MS O-6H2

Ref: Project Title: J3162, Rev. 3, titled: "REVIEW OF NUREG-0654"

Electronic copy to:

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NRC FORM 189 (Part 1) (5-1998) NRCMD 11.7			U.S. NUCLEAR REGULATORY COMMISSION			DATE PROPOSAL SENT SEP 8 2005	
DOE LABORATORY PROJECT AND COST PROPOSAL FOR NRC WORK			New		FY 2005		
			X Revision		Number 3		
Project Title Review of NUREG-0654, Supplement 3, "Criteria for Protective Action Recommendations for Severe Accidents			Job Code R3137 (formerly J3162)				
NRC Office Nuclear Security and Incident Response			NRC B&R Number 42015131397 see note				
DOE Contractor Sandia National Laboratories			NRC BOC Code 253D				
Site Albuquerque, New Mexico			Contractor Account No. DE-AC04-94AL85000				
Cognizant Personnel		Organization	Phone No.				
NRC Project Manager Kathryn M. Brock		EPD-A	(301) 415-2015				
Other NRC Technical Staff Randy L. Sullivan		EPD-B	(301) 415-1123				
DOE Project Manager Dolores Lineback		DOE/NNSA/SSO	(505) 845-6055				
Laboratory - Project Manager M.C. Walck/L.J. Dotson		6860/6874	(505) 844-0121 (505) 284-9205				
Principal Investigator(s) Joseph A. Jones		6874	(505) 844-2822				
Key Personnel Joseph A. Jones Lori J. Dotson		6874 6874	(505) 844-2822 (505)284-9205				
STAFF YEARS OF EFFORT (Round to nearest tenth)			FY2004	FY2005	FY2006	FY2007	FY2008
Direct Scientific/Technical			0.44	1.68	0.64	0.05	0.00
Other Direct (Graded)			0.0	0.0	0.0	0.0	0.0
Total Direct Staff Years			0.44	1.68	0.64	0.05	0.00
COST PROPOSAL (round to nearest thousand \$)							
Direct Labor - Labor categories, labor rates and proposed hours of effort for each category			61.6	252.8	102.0	8.4	0.0
Overhead			12.6	50.6	20.4	1.7	0.0
Materials/Services			0.2	1.2	2.6	0.0	0.0
Travel Expenses							
Foreign			0.0	0.0	0.0	0.0	0.0
Domestic			1.1	6.0	31.0	1.4	0.0
Subcontract(s)			0.0	24.0	200.0	10.0	0.0
Other Direct			0.0	0.0	0.0	0.0	0.0
G&A			52.6	214.1	123.6	8.6	0.0
TOTAL ESTIMATED LABORATORY PROJECT COST			128.1	548.6	479.6	30.1	0.0
DOE Federal Administrative Charge (FAC) 3% FY03+			3.8	16.5	14.4	0.9	0.0
Total DOE Project Cost			131.9	565.1	494.0	31.0	0.0
Carryover Funding from Prior FY (Includes DOE Adder)			0.0	-48.1	-120.0	-31.0	0.0
Carryover Funding to Next FY (includes DOE Adder)			48.1	120.0	31.0	0.0	0.0
Total Funding Required			180.0	637.0	405.0	0.0	0.0
LDRD (For Information Purposes Only)			8.1	34.6	30.2	1.9	0.0

Note: NSIR is the owner of the project. NRR is providing startup funds, but the majority of funding will be from NSIR. Therefore, per agreement between SNL and DOE, the DOE NSIR B&R is assigned to this project to keep all work under one project.

**DOE LABORATORY PROJECT AND
COST PROPOSAL FOR NRC WORK**

**R3137
(formerly J3162)**

DATE

SEP 8 2005

FOR PROJECTS, EXCLUDING TASK ORDERS AND TASK ORDER AGREEMENTS

PROJECT TITLE

**Review of NUREG-0654, Supplement 3, "Criteria for Protective Action
Recommendations for Severe Accidents"**

DOE PROPOSING ORGANIZATION

Sandia National Laboratories

ESTIMATED COST

TASK 1	TASK 2	TASK 3	TASK 4
TOTAL ESTIMATED COST FY04: \$36.6K	TOTAL ESTIMATED COST FY04: \$23.8K FY05: \$55K	TOTAL ESTIMATED COST FY04: \$23.8K FY05: \$56K	TOTAL ESTIMATED COST FY04: \$23.9K FY05: \$189.6K
TASK 5	TASK 6	TASK 7	TASK 8
TOTAL ESTIMATED COST FY04: \$0K FY05: \$78K	TOTAL ESTIMATED COST FY04: \$23.8K FY05: \$58K	TOTAL ESTIMATED COST FY04: \$0K FY05: \$88.5K FY06: \$140K	TOTAL ESTIMATED COST FY06: Optional
TASK 9	TASK 10	TASK 11	TASK 12
TOTAL ESTIMATED COST FY05: \$40K FY06: \$164.1K	TOTAL ESTIMATED COST FY06: \$189.9k FY07: \$31K	TOTAL ESTIMATED COST	TOTAL ESTIMATED COST
TASK 13	TASK 14	TASK 15	TASK 16
TOTAL ESTIMATED COST	TOTAL ESTIMATED COST	TOTAL ESTIMATED COST	TOTAL ESTIMATED COST

PROJECT DESCRIPTION

Provide narrative description of the following topics in the order listed. Attach on plain paper to this NRC Form 189. If an item is not applicable, so state.

- | | |
|--|---|
| 1. OBJECTIVES OF PROPOSED WORK | 8. REPORTING REQUIREMENTS AND SCHEDULE |
| 2. SUMMARY OF PRIOR EFFORTS | 9. SUBCONTRACTOR/CONSULTANT INFORMATION |
| 3. WORK TO BE PERFORMED AND EXPECTED RESULTS | 10. SPECIAL FACILITIES, IF REQUIRED |
| 4. PROPOSED PERSONNEL - INCLUDE RESUMES | 11. CONFLICT-OF-INTEREST INFORMATION |
| 5. MEETINGS/TRAVEL | 12. CLASSIFICATION OR SENSITIVITY, IF APPLICABLE
(e.g. safeguards, proprietary, other) |
| 6. NRC FURNISHED MATERIALS | 13. ADDENDUM COST AND SCHEDULE INFORMATION |
| 7. RELATIONSHIP TO OTHER PROJECTS | 14. SPENDING PLAN |

SEE NRC MANAGEMENT DIRECTIVE 11.7 FOR ADDITIONAL INFORMATION

SIGNATURE - APPROVAL AUTHORITY

Louie G. Dotson

6874

DATE

9/8/05

SIGNATURE - APPROVAL AUTHORITY

Marion C. Walsh

6860

DATE

9/8/05

**REVIEW OF NUREG-0654, SUPPLEMENT 3,
"CRITERIA FOR PROTECTIVE ACTION RECOMMENDATIONS
FOR SEVERE ACCIDENTS"
PROJECT DESCRIPTION**

1. OBJECTIVES OF PROPOSED WORK:

a. Background

Studies of severe reactor accidents and their consequences conducted in the early 1990's led the staff to conclude that the preferred initial Protective Action Recommendation (PAR) for a severe (core damage) accident is to evacuate promptly rather than to shelter the population near the plant, barring any constraints to evacuation. Supplement 3 to NUREG-0654/FEMA-REP-1, "Criteria for Protective Action Recommendations for Severe Accidents," dated July 1996 ("Supp. 3") provides guidance for implementing this conclusion through a simplified decision making process for protective actions in response to severe reactor accidents. Severe reactor accident analyses, documented in NUREG-1150, "Severe Accident Risks: An Assessment for Five U. S. Nuclear Power Plants", provide the related technical basis.

Supp. 3 would have licensees preferentially recommending evacuation within a 2-mile radius and five miles downwind, in lieu of sheltering, in the case of severe reactor accidents. The staff has reinforced the guidance contained in Supp. 3 through outreach, training and inspection. Nuclear power plant licensees have largely accepted the guidance. As an unintended consequence, it has been discovered that some licensees now severely restrict the consideration and use of sheltering as evidenced in the design of their initial and follow-up notification forms and, in at least one case, entirely preclude the use of sheltering in their Emergency Plan. In addition, from an offsite perspective, some states plan only to make a Protective Action Determination (PAD) of evacuation, and thereby effectively eliminate any consideration of sheltering, regardless of the licensee recommendation (PAR).

10 CFR 50.47(b)(10) requires that nuclear plant licensees develop a range of PARs for the 10-mile plume exposure Emergency Planning Zone (EPZ), including evacuation, sheltering and issuance of radioprotective drugs, e.g., potassium iodide (KI). The capability to appropriately recommend protective actions is inspected during Nuclear Regulatory Commission (NRC)-evaluated EP biennial exercises, and is tracked as a Performance Indicator (PI) within the Reactor Oversight Process (ROP). This requirement extends beyond the 10-mile EPZ, on an ad hoc basis, should that unlikely contingency ever prove to be necessary. The regulatory basis for reasonable assurance that the public health and safety can be protected is based, in part, on NRC oversight of the licensee's capability to make appropriate and timely PARs.

In the wake of the terrorist attacks of September 11, 2001, the staff completed an evaluation of the nuclear power reactor Emergency Preparedness (EP) planning basis with respect to the existing threat environment. The staff committed to this review in a non-publicly available SECY paper. The review was conducted in 2003, and documented in SECY-03-0165. The staff concluded that the EP planning basis for nuclear power reactors remains valid. Vulnerability studies revealed that the timing and magnitude of releases related to terrorist-based events are no more severe than the shortest timing or largest magnitude sequences (from a spectrum of accidents) already considered in the EP planning

basis. However, terrorist-based events could present unique challenges to EP programs. The staff developed a plan to address issues identified in the evaluation. One of the identified issues concerns the appropriateness of current NRC guidance on the development of PARs and the need to re-evaluate such guidance.

The staff briefed the Commission regarding EP issues on September 24, 2003. One of the topics covered in that briefing related to the appropriateness of current NRC guidance for nuclear power plant licensees on the development of PARs. Subsequent to the September 24, 2004 meeting, the staff received a Staff Requirements Memorandum (SRM) from the Commission on "the Briefing on Emergency Preparedness Program Status", with the following direction: "Continue to evaluate the NRC protective action recommendation guidance to assure that it continues to reflect our current state of knowledge with regard to evacuation and sheltering. Update the guidance, as necessary."

The staff has reviewed the recommendations of Supp. 3, and has identified areas for improvement and areas which warrant further review and investigation. Note that many of these considerations may be dependent on the relative density of the population and the design of the supporting transportation infrastructure. Or, phrased more succinctly, their relative importance to the reduction of dose and other considerations may be dependent on the Evacuation Time Estimate (ETE). Sites with shorter ETEs may not benefit as much from a reconsideration of sheltering and its use as a PAR, due to an existing low population and ample roadway capacity for evacuees.

- Early evacuation is certainly the best option when there is time to move people before a release begins. However, this may not be the best option in some scenarios, as there are considerations that may make sheltering, or other strategies, more appropriate. In some highly unlikely severe accident scenarios, the release begins in about 30 to 40 minutes (about the time it takes for public notification) and much of the source term is released within the following 90 minutes. The release does not terminate after this period, but the radioactive nuclide content decreases significantly. While the source term may be large and local shelter not robust, in some cases, evacuation through the plume may not be the preferred protective action given the short time frame of the release.
- The PAR regimen should be reviewed for its use and appropriateness during a "fast breaking" emergency. In this case, immediate shelter-in-place may be more appropriate than a recommendation and determination to evacuate.
- The establishment of local sheltering locations that would afford more protection than normal homes has not been given in-depth consideration. Multi-story schools and commercial buildings offer significant protection and may be only minutes away from the affected population, whereas evacuation travel time to a location outside of the 10-mile EPZ could be significantly longer.
- There are also other techniques for avoiding high dose rates associated with severe accidents. The most severe consequences are estimated to result from narrow plumes, as this concentrates radioactive nuclides. However, doses from such narrow plumes may be avoided by moving short distances at right angles from the plume. In some cases, a few hundred yards may reduce dose by three orders of magnitude. While there may be issues associated with the recommendation and

implementation of such a strategy, the technique has not been evaluated for its applicability and use in emergency situations, i.e., in locations with high population density.

- Supp. 3 focuses on “severe” core damage accidents, without regard to the relative frequency or the possibility for licensee recognition of accident severity. This equates to using the worst case scenario for planning purposes and may be counterproductive when applied to many other types of accidents.
- Recent research has revealed that the meaning of “shelter,” when used in a PAR, is not immediately clear to the public and some stakeholders¹.
- A shadow evacuation effect, if it exists, could put the at-risk population at greater risk as a result of the potential for increased travel time within the plume.

The possibility of evacuating the public located within the 10-mile EPZ of nuclear plants has received wide and critical attention, and is seen as controversial at some sites. Within some segments of the public and for some critics of nuclear power, the prospect of evacuating even small population centers is generally feared and the implications misunderstood. Further, the perception that evacuation is the only adequate PAR may degrade public confidence, particularly where high population density and existing transportation infrastructure makes evacuation appear to be difficult. These concerns have brought the staff to the conclusion that NRC guidance for PAR development may not fully consider the appropriateness of sheltering and other strategies in response to certain scenarios.

As previously noted, the Commission has directed that a review be conducted of the effectiveness of the NRC’s PAR development guidance, as it appears appropriate to expand the use of sheltering in some situations and existing regulatory guidance preferentially advises evacuation. This review would consider population density, shadow evacuation effects, evacuation times versus release duration and the efficacy of local sheltering facilities, as well as the expected positive effect sheltering-in-place could have on traffic control issues. The review may result in recommended changes to NRC guidance for the development of PARs.

Requirements, Related Guidance & Reports

10 CFR Part 50, Section 50.47, *Emergency Plans*.

Appendix E to 10 CFR Part 50, *Emergency Planning and Preparedness for Production and Utilization Facilities*.

Regulatory Guide 1.101, Rev. 2, *Emergency Planning and Preparedness for Nuclear Power Plants*.

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*.

Supplement 3 to NUREG-0654/FEMA-REP-1, Rev. 1, *Criteria for Protective Action Recommendations for Severe Accidents*.

- NUREG/CR-1856, *An Analysis of Evacuation Time Estimates Around 52 Nuclear Power Plant Sites*, Vol. 1 & 2.¹
- NUREG/CR-4831, NNL-776, *State of the Art in Evacuation Time Studies for Nuclear Power Plants*, 1992.
- NUREG-1150, *Severe Accident Risks: An Assessment for Five U. S. Nuclear Power Plants*, 1990, Vol. 1, Final Summary Report.
- NUREG/BR-0230, *Response Coordination Manual 1996 (RCM-96)*.
- NUREG/CR-XXXX, *Planning and Implementation of Public Evacuation Processes*, Sandia National Laboratories.
- NUREG-CR-XXXX, *Technical Review and Recommended Modifications to NUREG-4831, "State of the Art in Evacuation Time Estimate Studies for Nuclear Power Plants"*, Sandia National Laboratories.
- Environmental Protection Agency (EPA) EPA-520/6-74-002, *Evacuation Risks - An Evaluation*, 1974.
- EPA 520/1-78-001A, *Protective Action Evaluation Part I: The Effectiveness of Sheltering as a Protective Action Against Nuclear Accidents Involving Gaseous Releases*, 1978.
- EPA 400-R-92-001, *Manual of Protective Action Guides and Protective Actions for Nuclear Incidents*, May 1992.
- Federal Emergency Management Agency (FEMA) / Disaster Research Center at Ohio State University, *Evacuation Behavior and Problems: Findings and Implications from the Research Literature*, 1980.
- FEMA / Oak Ridge National Laboratory (ORNL), RR-9, *Evacuation: An Assessment of Planning and Research*, 1987.
- FEMA / Systan Co., *Emergency Evacuation Management Requirements and Concepts*, 1981.
- Atomic Industrial Form (AIF) / Battelle Human Affairs Research Centers, et al., *Planning Concepts and Decision Criteria for Sheltering and Evacuation in a Nuclear Power Plant Emergency*, 1985.
- National Science Foundation/Battelle Human Affairs Research Center, *Evacuation Decision Making and Emergency Planning*, 1980.
- ORNL/TM-9882, *Evacuations Due to Chemical Accidents: Experience From 1980 to 1984*, 1986.
- ORNL/TM-10277, *Evacuation in Emergencies: An Annotated Guide to Research*, 1987.
- Becker, S. M., *Psychological and Communication Issues in Radiological Terrorism Situations*, University of Alabama at Birmingham, presented at the Fortieth Annual Meeting of the National Council on Radiation Protection and Measurements.
- Perry, Ronald W., *Citizen Evacuation in Response to Nuclear and Non-Nuclear Threats*, 1981.
- Perry, Ronald W., *Comprehensive Emergency Management: Evacuating Threatened Populations*, 1985.
- Perry, Ronald W., et al., *Evacuation Planning in Emergency Management*, 1981.

¹ Becker, S. M., *Psychological and Communication Issues in Radiological Terrorism Situations*, University of Alabama at Birmingham, presented at the Fortieth Annual Meeting of the National Council on Radiation Protection and Measurements.

Witzig, W. F. and J. K. Shillenn, *Evaluation of Protective Action Risks*. Prepared under contract to the NRC by Penn State University, 1987.

Nuclear Energy Institute (NEI) 99-01, Revision 4, *Methodology for Development of Emergency Action Levels*, January 2003.

Selected licensee and offsite response organization emergency plan implementing procedures, re: development and notification of PARs.

b. Objectives.

The purpose of nuclear plant emergency preparedness programs and the public evacuation plans that support them, is to reduce dose to the public during a radiological emergency. In order to ensure NRC Protective Action Recommendation (PAR) guidance continues to support this purpose, the Contractor shall provide an evaluation of the current NRC PAR guidance contained in Supplement 3 to NUREG-0654/FEMA-REP-1. The evaluation will consider:

- Technological advances,
- A spectrum of nuclear plant accidents,
- Improvements in accident progression understanding,
- The “post-9/11 threat environment”,
- Improvements in Evacuation Time Estimate (ETE) technologies,
- Additional sheltering strategies,
- Additional evacuation strategies,
- “Fast breaking” accident scenarios, and
- Improvements in dose projection techniques.

Specifically, the Contractor shall focus on the appropriateness of Supp. 3 guidance for preferential evacuation, as compared with modified or enhanced sheltering options. The spectrum of nuclear plant accidents that can result in the need for protective actions to protect the public health and safety must be considered and a spectrum of frequencies developed to place in perspective the relative need for each protective action. Additional protective action methods should be considered. Any recommended change in PAR strategy must show that a reduction in public dose during a radiological emergency is likely and discuss the limitations of that strategy, e.g., low population density versus high population density, availability of robust building stock versus rural areas, “fast breaking” event versus one with a slower evolution, relative frequencies.

NRC will review the evaluation, coordinate the review with the Federal Emergency Management Agency (FEMA) (co-author of Supp. 3), and determine if a revision to Supp. 3 is warranted. If a revision to Supp. 3 is warranted, NRC will exercise the option identified in Task 8 (Section III) and ask the Contractor to provide a revision to Supp. 3, that reflects the results of the above evaluation.

2. SUMMARY OF PRIOR EFFORTS:

Not applicable.

3. WORK TO BE PERFORMED AND EXPECTED RESULTS:

Task 1: The Contractor shall review the documents listed in Section I of this proposal from the perspective of information provided and referenced in Supp. 3, licensee and offsite response organization plans and procedures, NUREG/BR-0230 and NUREG-1150.

Sub-task a: Meet with NRC representatives to discuss the body of literature, with specific regard to PAR development issues.

Sub-task b: Meet with stakeholders to discuss Supp. 3 and their experience with its implementation.

Note: Sub-tasks a & b will be scheduled during the same week.

Estimated Completion Date: Two months after project initiation.

Estimated Level of Effort: 1.5 staff months.

Task 2: The purpose of this task is to depict the spectrum of events requiring PARs and provide the relative frequencies of the spectrum identified, and to sort those accidents requiring a simplified PAR scheme from those with time to develop a more complex PAR scheme. To this end, the Contractor shall review the spectrum of accidents that can result in the need for PARs. It is preferred that the spectrum of accidents be catalogued at a "fleet" level rather than at a site-specific level, though it may be determined that sorting by reactor type is most appropriate. Using information gained from this review, the Contractor shall develop a suite of reactor accidents that are General Emergencies, using information contained in NEI 99-01 as the standard classification scheme. The Contractor shall catalogue the relative frequencies of this suite of accidents to the extent the general (not site-specific) frequencies are available, e.g., through NUREG-1150. The Contractor shall examine the relative frequency of accidents considered "fast breaking" or "severe" (in the terminology of NUREG-1150) versus those considered to be "not severe" or where there is time (e.g., four or more hours) to consider and prepare for PAR implementation. The Contractor shall determine those sequences for which rapid "simplistic PARs" may be necessary to reduce public dose.

Please note this task is intended to be accomplished using existing accident progression analyses, such as NUREG-1150. Where a frequency is not known, it may be included in a qualitative manner. There is no intention to quantify the frequency of terrorism-based events, but this contingency will be considered in any enhanced PAR strategy recommended.

This results from the completion of this task shall be submitted to NRC as a technical letter report for review and comment. NRC comments will be incorporated after review.

Estimated Completion Date: Draft, three months after project initiation; final, one month after NRC comments received by the Contractor.

Estimated Level of Effort: Three staff months.

Task 3: The Contractor shall examine technological advances currently available, and in use in the nuclear industry, that may change the understanding of PAR development and implementation as expressed in Supp. 3, such as:

- Improvements in accident progression understanding,
- Improvements in evacuation time estimate technologies,
- Improvements in dose projection techniques,
- Improvements in public notification methods,
- Improvements in evacuation dynamics understanding, and
- Improvements in other areas important to public evacuations.

Information gained from completion of this task shall be submitted to the NRC as a technical letter report for review and comment. NRC comments will be incorporated after review.

Estimated Completion Date: Draft, six months after project initiation; final, one month after NRC comments received by the Contractor.

Estimated Level of Effort: Two staff months.

Task 4: The Contractor shall re-examine the efficacy of alternative sheltering and evacuation strategies in terms of reducing dose to the public from nuclear power plant accident plumes, and will:

- Perform a parametric study with MACCS2 to determine the relative advantages of shelter and evacuation (in terms of reduced dose to individuals). Specific parameters to be studied include:
- Timing of offsite release compared to the Evacuation Time Estimate (ETE) (artifact of population density and roadway network),
- Dose savings for sheltering or evacuation versus plume type,
- Timing of release versus public notification time,
- Time to evacuate,
- Duration of sheltering period for various types of shelter,
- Alternative evacuation strategies, e.g., cross-wind evacuation and staged evacuation,
- Sheltering in typical local housing by region,
- Alternative sheltering strategies, e.g., use of local commercial or governmental buildings,
- Plume radio-nuclide content (i.e., dose rate to public, an artifact of accident type related to accident frequency) versus dose saving of sheltering or evacuation,
- Sheltering in non-severe (yet General Emergency level) accidents,
- Efficacy of sheltering versus evacuation for various ETE values,
- Efficacy of sheltering as an initial action followed by staged evacuation, including the logistics of public contamination assessment, public dose assessment, KI distribution, etc., and
- Other valuable parameter comparisons revealed in the course of the study.
- Examine the impact of sheltering one Emergency Planning Zone (EPZ) area on the evacuation of other areas (assumed to be positive),

- Examine the anticipated public reaction to sheltering strategies from a review of literature, documentation from public meetings and other available research,
- Examine other sheltering strategies for viability if others are identified, and
- Catalog implementation requirements for strategies that appear to reduce dose to assess the feasibility of implementing the strategy.

It is anticipated that as the Contractor performs the proposed MACCS2 runs, it may be determined that some are of little value while other parameter comparisons not currently recognized may be seen as providing important information. The Contractor should work closely with the Technical Monitor identified in this Statement of Work (SOW) to discuss revision to the proposed computer runs.

This task shall be submitted to NRC as a technical letter report for review and comment. NRC comments will be incorporated after review.

Estimated Completion Date: Draft, 10 months after project initiation; final, one month after NRC comments received by the Contractor.
Estimated Level of Effort: Six staff months.

Task 5: Where alternative evacuation strategies appear to have merit, the Contractor shall examine their efficacy in terms of implementation, realism and cost issues. While this task is dependent on the results of Task 4, it is possible that the following strategies may be worthy of additional evaluation:

- Cross-wind evacuation by walking or driving perpendicular to a severe accident plume,
- Staged evacuation,
- Delayed evacuation,
- Improvements in traffic control techniques to facilitate evacuation,
- Efficacy of sheltering special needs groups to facilitate public evacuation, and
- Other techniques for improving or strategies for implementing evacuations.

This task shall be submitted to NRC as a technical letter report for review and comment. NRC comments will be incorporated after review.

Estimated Completion Date: Draft, 12 months after project initiation; final, one month after NRC comments received by the Contractor.
Estimated Level of Effort: Two staff months.

Task 6: The Contractor shall survey available literature for understanding of the behavioral psychology and sociology applicable to evacuees, and:

- Determine likely public acceptance of alternate sheltering strategies,
- Determine likely public acceptance of alternate evacuation strategies,
- Determine methods to communicate advanced PAR strategies to the public, and
- Determine if other sociological factors should be considered in the development of PAR strategies.

This task shall be submitted to NRC as a technical letter report for review and comment. NRC comments will be incorporated after review.

Estimated Completion Date: Draft, 12 months after project initiation; final, one month after NRC comments received by the Contractor.

Estimated Level of Effort: Two staff months.

Task 7: The Contractor shall identify changes in PAR strategies that would result in dose savings to the public, improve public confidence, or facilitate implementation of protective actions. The Contractor shall also determine if there are better strategies for the recommendation and implementation of protective actions during nuclear power plant radiological emergencies. The psychology and sociology of evacuees must be considered, as well as methods to improve public understanding. Limitations of the various strategies must be assessed in terms of:

- Population density,
- Spectrum of accidents where dose savings could be expected,
- Applicability to fast breaking events,
- Public willingness to implement the new strategies,
- Public understanding of PARs,
- Ability of strategy to be implemented by licensees, perhaps with limited information,
- Reactor design distinctions (if any),
- Ability of offsite response organizations to implement the PAR regimen, and
- Other relevant factors.

The Contractor shall provide this determination in the form of a report suitable for NRC management review. This report will be reviewed to determine if the strategies are viable and changes are warranted to Supp. 3. Reference for all sources of information will be documented with appropriate footnotes.

The Contractor should plan for at least three formal review cycles of the summary report. Each version should be returned to NRC within three weeks of comments being transmitted to the Contractor. The estimated completion date provided below is for the first draft to be placed into the review cycle.

Estimated Completion Date: 15 months after project initiation.

Estimated Level of Effort: Six staff months.

Task 8: (optional) *Should NRC management together with our FEMA counterparts (co-authors of Supp. 3) determine that a revision to Supp. 3 is warranted, the Contractor will be instructed to prepare a revision to Supp. 3 to incorporate the knowledge gained from the preceding tasks. Upon review, the Contractor shall incorporate the comments of the NRC Technical Monitor and staff into the draft revision, and submit the updated document to the NRC Project Manager in anticipation of at least three formal review cycles. Each version should be returned to NRC within three weeks of comments being transmitted to the Contractor. The Contractor shall anticipate providing support at one public meeting. Upon completion of the review cycles, the Contractor shall prepare a final revision, and submit it to the NRC for publication. The estimated completion date provided below represents the first draft being placed in the review cycle.*

NOTE: This task is not quoted in Rev. 1. If NRC decides to fund Task 8, then the contract will be rewritten in a subsequent revision to include this task.

Estimated Completion Date: Six months, after option is selected.

Estimated Level of Effort: Six staff months.

Task 9: Study of Public Views on Nuclear Power Plant Emergency Preparedness Protective Actions

BACKGROUND

In July, 2004, Sandia National Laboratories (Sandia), working with the Nuclear Regulatory Commission's (NRC) Emergency Preparedness Directorate (EPD), began a project entitled, "Review of NUREG-0654, Supplement 3, 'Criteria for Protective Action Recommendations for Severe Accidents'" (Job Code: R3137). The objective of this project is to provide an evaluation of the current NRC Protective Action Recommendation (PAR) guidance contained in Supplement 3 to NUREG-0654/FEMA-REP-1 (Supp. 3). (Reference: NRC Form 189, DOE B&R No. 401001140, dated June 28, 2004, and as revised on July 20, 2004.) The "PAR Study", as it has come to be called, resulted from Commission direction that the effectiveness of the NRC's PAR development guidance be reviewed, and that the relative merits of certain protective actions (e.g., evacuation, sheltering-in-place) be studied for a variety of situations.

Studies of severe reactor accidents and their consequences conducted in the early 1990's led NRC staff to conclude that the preferred initial PAR for a severe (core damage) accident is to evacuate promptly, rather than to shelter the population in place (sheltering-in-place). And, as recently as January, 2005, NUREG/CR-6884, "Identification and Analysis of Factors Affecting Emergency Evacuations," Sandia (under contract to the NRC) studied the recent history of large-scale public evacuations in the United States and found that evacuations are effective in protecting public health and safety.

Supp. 3 provides guidance for implementing protective actions through a simplified decision-making process. Following the guidance provided, Supp. 3 would have nuclear power plant (NPP) licensees preferentially recommending evacuation within a 2-mile radius and five miles downwind, in lieu of sheltering, in the case of severe reactor accidents. Licensees have largely accepted this guidance. As an unintended consequence, some licensees now severely restrict the consideration and use of sheltering-in-place as

evidenced in the design of initial and follow-up notification forms, and may (as evidenced in one case) entirely preclude the use of sheltering-in-place in their Emergency Plan.

At the same time, 10 CFR 50.47(b)(10) requires that nuclear plant licensees develop a range of PARs (evacuation and sheltering-in-place) for the 10-mile plume exposure Emergency Planning Zone (EPZ). The capability to appropriately provide PAR's to State and local governmental authorities is inspected during NRC-evaluated radiological emergency preparedness biennial exercises, and tracked as a Performance Indicator (PI) within the NRC's Reactor Oversight Process (ROP).

In reviewing the appropriateness of PARs for a variety of situations, the current project is considering:

- Technological advances,
- A spectrum of nuclear plant accidents,
- Improvements in accident progression understanding,
- The "post-9/11 threat environment",
- Improvements in Evacuation Time Estimate (ETE) technologies,
- Additional sheltering and evacuation strategies,
- "Fast breaking" accident scenarios, and
- Improvements in dose projection techniques.

Sandia has focused on the appropriateness of Supp. 3 guidance for preferential evacuation, as compared with modified or enhanced sheltering options. The spectrum of nuclear plant accidents that can result in the need for protective actions to protect the public health and safety is being considered, and a spectrum of frequencies developed, to place in perspective the relative need for each protective action.

Since the inception of this project, an additional consideration has presented itself. NRC staff realizes that public perception plays an important part in our ability to plan and execute protective actions, both that of evacuation and sheltering-in-place. It is believed that public reaction to a Protective Action Determination (PAD) is based on a variety of factors, such as the clarity of the direction, perception of and confidence in Federal, State and local governmental authority, understanding of the hazard, and effectiveness of public information programs.

Evacuation of the public located within the 10-mile EPZ of NPPs, in particular, has received wide and critical attention. Within some segments of the population, the prospect of evacuating even small population centers may be feared and the implications misunderstood, and sheltering-in-place may be contrary to the natural instincts of individuals to move away from the hazard. Further, the perception that evacuation is the only adequate PAR and PAD may degrade public confidence, particularly where high population density and existing transportation infrastructure make public evacuation more challenging.

It is also recognized that public perception and reaction to a PAD within a 10-mile EPZ of an NPP might be different to that of the public-at-large. For instance, those living within a 10-mile EPZ may be better informed than the public-at-large. NRC regulations require that licensees periodically provide written information to this population on emergency preparedness and response. Licensees may also be quite active in providing various forms of "outreach" to the local public and community organizations.

Thus, NRC guidance for PAR development may not fully consider the appropriateness of sheltering and other strategies in response to certain scenarios, and questions have been raised as to the public's actual response to any protective action direction from governmental authorities. Likely public reaction is an important factor in the consideration of appropriate protective actions. Actual public reaction is an important factor in the overall effectiveness of the emergency response. It is important that a study of public perception and likely response be incorporated into the scope of the current review of Supp. 3.

OBJECTIVE

The objective of this study is to determine the likely reaction of the public within NPP EPZs to the direction to take protective action during an NPP emergency. Secondary objectives include survey of the likely reactions of emergency workers, and determination of the effectiveness of protective action messages and public education efforts.

TASK STATEMENT

To accomplish the objective in Section II, an extensive multi-site, multi-method study will be undertaken. Methods to be employed include focus groups, telephone surveys and one-on-one interviews. While the study will take into account previous work in this field, it is expected to break new ground in the understanding of public perception, behavior, preferences, concerns and information needs during an emergency at a NPP.

The study, identified in this amendment, is comprised of eight (8) interrelated tasks.

Subtask 9.1: Review of Existing Literature

The Contractor shall begin the study with a review of the published scientific literature on emergencies, which have required the public to take protective actions. National and international sources of information will be examined.

Estimated Completion Date: One month after project initiation.
Estimated Level of Effort: 0.5 Staff Months

Subtask 9.2: Development of a Research Plan

Based on the objective of this study and information found in the literature review (Subtask 9.1), the Contractor shall develop a detailed research plan designed to support the multi-site, multi-method approach. The plan will fully identify the secondary objectives of the study (referred to in Section II).

As the plan is being developed, it is anticipated that the Contractor will participate in two (2) in-person meetings with NRC decision-makers and subject matter experts. One of the meetings may be publicly observed, and both may involve the participation of the Federal Emergency Management Agency (FEMA) and other governmental agencies.

The goal of the development process will be to identify key constructs, issues and questions the NRC wishes to have explored in the research. The plan will be submitted to the NRC Technical Reviewer and the Project Manager for review and comment. It is anticipated that

the plan will also be forwarded to others within the NRC for review and comment. The NRC Technical Reviewer will collect comments, and forward those accepted to the Contractor for incorporation into the plan.

Estimated Completion Date: Two months after project initiation; final, one month after NRC comments received by the Contractor.

Estimated Level of Effort: 0.5 Staff Months

Subtask 9.3: Development of a (Focus Group) Facilitator Guide

Based on information gained in Subtasks 9.1 and 9.2, the Contractor shall design a facilitator's guide for use in a series of focus groups to be held throughout the United States in NPP EPZ's. The guide will be tested internally to identify and correct problems with its use and design. The draft guide will be submitted to the NRC Technical Reviewer and the Project Manager for review and comment. It is anticipated that the guide will also be forwarded to others within the NRC for review and comment. The NRC Technical Reviewer will collect comments, and forward those accepted to the Contractor for incorporation into the guide.

Estimated Completion Date: Three months after project initiation; final, one month after NRC comments received by the Contractor.

Estimated Level of Effort: 0.5 Staff Months

Subtask 9.4: Conduct of Focus Groups

Based on information gained in Subtasks 9.1 and 9.2, and the instrument developed in Subtask 9.3, the Contractor shall conduct approximately 15 focus groups from approximately 3 EPZs. The groups will be comprised of individuals who live within the 10-mile EPZs of NPPs, and will be purposefully diverse (e.g., by age, race, ethnicity, educational background, socioeconomic status). Sites for conduct of focus groups will be chosen to ensure geographic, population density and other variability. Other activities that are included as part of this task are the following: provision of relevant information to support agency OMB research approval (assumed to take 30 days); development of informed consent and other necessary forms consistent with current research ethics standards; preparation and submission of institutional review board (IRB) packet and other necessary approvals (assumed to take 2 weeks); development of participant recruitment strategy; travel to focus group sites; transcription; preparation of topline reports; development and piloting of coding scheme; coding of data; assessment of interrater reliability; and analysis.

The sites, approximate group characteristics and approximate focus group schedule will be reviewed with the NRC Technical Monitor prior to conduct. The focus group effort will be documented, along with the results, in a technical letter report addressed to the NRC Technical Reviewer, with a copy to the Project Manager.

Estimated Completion Date: Nine months after project initiation.

Estimated Level of Effort: 6.4 Staff Months

Task 10**Subtask 10.1:****Cognitive Response Testing Interviews**

To augment data gathered from focus groups, cognitive response testing interviews will be conducted. In addition to public perception of alternative PARs, these interviews will also allow for the identification of terms that are unclear and passages that are difficult to understand in current public education and informational materials and messages. This information will be used to guide the potential development of communication materials of alternative PARs. The cognitive response testing interviews were originally included in Task 9 and travel and logistics were covered with the Focus Group efforts. Sandia will have the opportunity to submit an updated proposal prior to initiating this task that addresses any changes identified in subsequent tasks that would affect the level of effort.

Information on public education and information materials, gained as a result of the focus groups and interviews, will be gathered, analyzed and summarized. This effort will be documented, along with the results, in a technical letter report addressed to the NRC Technical Reviewer, with a copy to the Project Manager.

Estimated Completion Date: Nine months after project initiation.

Estimated Level of Effort: 0.9 Staff Months

Subtask 10.2: Planning and Conduct of Telephone Survey

Based on information gained in Subtasks 9.1, 9.2 and 9.4, the Contractor shall develop a telephone survey instrument (questionnaire) and an appropriate sampling methodology and approach to be used in a large-scale survey (approximately 800 completed surveys) of individuals living within NPP EPZ's. Where appropriate, the instrument should allow the Contractor to follow up on issues identified in the focus groups described in Subtask 9.4. In addition, the sampling approach should ensure that participants are drawn from a variety of EPZ's with varying locations and characteristics. Once the instrument and sampling approach have been determined and documented, pre-testing will be carried out, interviewers will be briefed/trained, the telephone survey will be conducted, data will be recorded and compiled, necessary programming will be carried out, and an analysis of the data will be performed.

Prior to the conduct of the telephone survey, a survey plan will be developed and submitted to the NRC Technical Monitor and the Project Manager in a technical letter report for review and comment. It is anticipated that the plan will also be forwarded to others within the NRC for review and comment. The NRC Technical Reviewer will collect comments, and forward those accepted to the Contractor for incorporation into the plan. Sandia will have the opportunity to submit an updated proposal prior to initiating this task that addresses any changes identified in subsequent tasks that would affect the level of effort.

The results of the survey will be documented in a technical letter report addressed to the NRC Technical Reviewer, with a copy to the Project Manager.

Estimated Completion Date: Ten months after project initiation.

Estimated Level of Effort: 6.0 Staff Months

Subtask 10.3: Reporting and Dissemination of Findings

Upon completion of Subtasks 9.1 through 9.4 and Subtasks 10.1 through 10.4, the Contractor shall give a series of briefings to NRC staff and management summarizing the findings and discussing their implications. Also included will be recommendations as to how the public information and education materials and messages can be improved. In addition, the Contractor shall discuss the methodology of the study and report key findings to the broader emergency preparedness and response community by giving papers and presenting at professional conferences, and participating in a select group of interagency meetings. Examples include the FEMA/NRC Steering Committee meeting, the Federal Radiological Preparedness Coordinating Committee (FRPCC), the National Radiological Emergency Preparedness conference (NREP), and the annual meeting of the National Council on Radiation Protection and Measurements. The Contractor shall also provide support at one or two related public meetings hosted by the NRC.

Estimated Completion Date: 12 months after project initiation.

Estimated Level of Effort: 0.25 Staff Months

Subtask 10.4: Preparation of a Draft NUREG/CR

The Contractor shall prepare a draft NUREG/CR, and submit it to the NRC Technical Monitor, with a copy to the Project Manager, for review and comment. The Contractor shall incorporate the comments of the NRC Technical Monitor into the draft NUREG/CR, and upon approval of the draft NUREG/CR by the NRC Technical Monitor, the Contractor shall submit the document as a final draft version of the report for further management and staff review. This will be in anticipation of four additional review cycles. It is expected that the NRC will have on average three weeks for each review cycle to comment on the draft document. The Contractor will address each set of comments and re-submit for further review within two weeks of receipt. Upon completion of incorporation of the final set of comments, the Contractor shall prepare a camera-ready NUREG/CR, and submit it to the NRC for publication.

Estimated Completion Date: 15 months after project initiation.

Estimated Level of Effort: 1.4 Staff Months

4. PROPOSED PERSONNEL:

NRC:

Technical Monitor

R. L. Sullivan

Sr. Emergency Preparedness Specialist

Emergency Preparedness Directorate

Phone: 301-415-1123

Email: RXS3@nrc.gov

Project Manager

Kathryn M. Brock

Project Manager
Emergency Preparedness Directorate
Phone: 301-415-2015
Email: KMB@nrc.gov

SNL:

Mr. Joseph Jones is a Principal Member of the Technical Staff in SNL's Program Development and Environmental Decisions Department (6874). He has a BS in Civil Engineering and has been primarily involved in radioactive materials management and cleanup activities both nationally and internationally. He is currently the program manager for the SNL Nuclear Risk and Technologies Center Consequence Management Program.

Mr. Jones has over 20 years experience and has been at SNL for over 15 years working on national and international projects including design and construction of radioactive waste processing and storage facilities in the US and Russia. Mr. Jones has also led decontamination and demolition projects at SNL and managed the development of a comprehensive sealed source tracking database for the Department of Energy. Mr. Jones is the project manager on the Identification and Analysis of Factors Affecting Emergency Evacuations NUREG currently in draft for the NRC and is the principal investigator on the update to NUREG/CR-4831, "State of the Art in Evacuation Time Estimate Studies for Nuclear Power Plants" currently in progress for the NRC. Mr. Jones will serve as the Principal Investigator for this project and will support the research activities and development of recommendations.

Ms. Lori Dotson is a Principal Member of the Technical Staff in SNL's Program Development and Environmental Decisions Department (6874). She has an M.S. in Hydrology and a B.A. in Geology. She recently completed research on large-scale emergency evacuations in the U.S. and managed a project to update NRC's evacuation time estimate guidance. She also recently developed an emergency response plan for transportation accidents involving radioactive materials and conducted a lab-directed research study on radiological dispersal devices (RDD), which covered all aspects of an RDD including crisis response and consequence management.

Ms. Dotson will serve as the Project Manager for this project. Ms. Dotson has a combined 20 years of work experience, including 9 years at Sandia, 8 years in consulting, and 3 years in industry. Ms. Dotson has managed and conducted research on a wide variety of topics, including managing NRC's update to its guidance for evacuation time estimate studies, conducting research on large-scale emergency evacuations in the U.S., managing a radioactive materials incident reporting database, managing transportation risk assessment studies, developing parameters for probabilistic risk assessments for nuclear waste repositories, managing environmental contamination assessment/remedial action investigations for RCRA and CERCLA sites, and conducting regulatory assessments.

J. D. Smith is a Senior Nuclear Engineer/Research Scientist with over a quarter century of technical and managerial experience in nuclear, kinetic, and very high-power directed energy concepts and devices, as well associated systems applications. He has a Masters in Nuclear Engineering from the University of New Mexico (1982), and a B.S. in Mathematics from New Mexico Institute of Mining and Technology (1977). Currently Principal Member of Technical Staff for Sandia National Laboratories serving in both Technical Integration and Systems Analysis Manager roles for the DOE Office of Nuclear Energy, Science and

Technology (NE) Advanced Fuel Cycle Initiative (AFCI) Program. Responsibilities include technical and managerial direction of \$70M national program seeking to ensure nuclear future by solving the spent fuel problem, Technical Integration Liaison to Separations program area and associated National Technical Director, and close coordination with DOE-HQ Office of Nuclear Energy Science and Technology, Office of Civilian Radioactive Waste Management DOE Site Contractor Management, AFCI National Technical Directors (ANL, INL, LANL), as well as Sandia and other DOE National Laboratory Management and Staff.

Dr. Nathan Bixler is a Principal Member of the Technical Staff in SNL's Modeling and Analysis Department. He has a Ph. D. in Chemical Engineering from the University of Minnesota and has been primarily involved in computer modeling of fluid dynamics and nuclear accidents and consequences. Dr. Bixler has been at SNL for over 20 years; the past 14 years have involved work for the USNRC. From 1990 to 2000, Dr. Bixler was the PI and PM for the VICTORIA code development effort for RES. VICTORIA performs detailed chemistry and aerosol modeling of fission product releases during a severe accident. Dr. Bixler was also the PI and PM for the completion of the RADTRAD code for NRR during 1998 and 1999. Current activities are primarily focused on development and application of the MACCS2 code. MACCS2 is NRC's consequence analysis tool that is used to support level-3 PRAs and other risk-informed regulation activities.

Dr. Carmen M. Méndez is a Senior Member of the Technical Staff at Sandia National Laboratories. She has a Ph.D. in Industrial Engineering: Human Factors, Safety and Sociotechnical Systems from the University of Wisconsin at Madison with a minor in Statistics and Research Methods from the Psychology Department. In addition to her dissertation research (*Comparing the relationship between employee and employer perceived safety hazards, implemented safety practices, and reported accidents*), Dr. Méndez has managed a wide range of projects dealing with human factors and organizational behavior theories, including projects for the Occupational Safety and Health Administration (OSHA), RAND Corporation, Accenture, Honeywell, and Viasystems. Dr. Méndez has been involved in data collection, analysis, and evaluation of risks and hazards.

SUBCONTRACTOR:

Steven M. Becker, Ph.D. is Associate Professor of Environmental Health Sciences at the University of Alabama at Birmingham (UAB) School of Public Health. In addition, he is Director of the Disaster and Emergency Communication Research Unit at UAB, and a Lister Hill Scholar in Health Policy. Dr. Becker's research focuses on the public health, psychosocial, behavioral and risk communication aspects of incidents involving invisible agents. Over the past 15 years, he has conducted on-site work after a range of disasters and emergencies in North America, Europe and Asia, including the 1999 nuclear criticality accident in Tokaimura, Japan. He has also done follow-up research on the Chernobyl nuclear accident in Ukraine and Belarus. He serves as Principal Investigator for the Radiological/Nuclear portion of the Pre-Event Message Development Project. Funded by the Centers for Disease Control and Prevention (CDC), this multi-year, multi-site project seeks to identify key concerns, information needs and preferred information sources for the general public, first responders, hospital personnel, and the public health workforce. Data are then utilized to develop and craft more responsive, effective self-protection messages. In 1997, Dr. Becker developed the "Environmental Disasters" course, which is one of the nation's only fully multidisciplinary, university-level classes on chemical and nuclear/radiological incident management. In addition, he was a co-author of the

comprehensive curriculum on disaster that was published by the Association of Schools of Public Health and the Centers for Disease Control and Prevention (CDC) in 2001. Dr. Becker's research has appeared in such medical and health journals as *Environmental Health Perspectives*, *Safety Science*, *Military Medicine*, *Emergency Medicine Practice*, and *Bioterrorism and Biosecurity*. He is also a regular contributor to Harvard's University's annual course on "Nuclear Emergency Planning." In 2005, Dr. Becker was elected a full Council Member of the National Council on Radiation Protection and Measurements. Previously, he was a co-author of NCRP 138 ("Management of Terrorist Events Involving Radioactive Material"). He currently co-chairs the Council's subcommittee on "Radiation Protection for First Responders - Training, Preparedness and Response."

Sandia National Laboratories (SNL) can remove or substitute any personnel from an NRC work order, including "Key Personnel," however, removals or substitutions for "Key Personnel" shall be made in accordance with NRC MD 11.7, Part XI-4.

5. MEETINGS/TRAVEL:

Frequently and periodically, over the course of this contract, the Contractor and the NRC Technical Monitor will interact (e.g., email, telephone, conference call) to discuss the contract's progress, NRC comments, and the general conduct and content of sub-tasks associated with this contract. It is anticipated that most of the communication between the NRC and the Contractor will be handled in this manner. The following specific meetings and travel are anticipated under this project:

Task 1: One trip (for two) for five days to NRC Headquarters is anticipated to kick-off the project, meet with the NRC Project Manager & Technical Monitor (whose names are provided in Section VIII), support the completion of Sub-tasks a and b, and discuss project requirements and the schedule as a whole.

Task 2: Upon completion of Task 2, a meeting will be held to discuss the catalogue and NRC comments. If the comments are complex, an in-person meeting may be held at NRC with agency subject matter experts, otherwise the meeting may be held at the laboratory or via conference call at the option of NRC.

Tasks 3, 4, 5 and 6: At the option of NRC, one or two face-to-face meetings may be held to discuss the technical letter reports required by these tasks. These meetings may take place at NRC or at the laboratory, or the NRC may determine that adequate oversight can be accomplished via a conference call. The conduct and location of these meetings is dependent on the complexity of the technical issues involved.

Task 7: One trip (for two) for five days to NRC Headquarters is anticipated to present project results, meet with NRC Management and discuss these results. Also, three trips (for two) should be anticipated to present the results and status of this project at public or professional conferences or meetings as selected by NRC.

Task 8 (Optional): Two trips (for two) should be anticipated to present the results and status of this project at public or professional conferences or meetings as selected by NRC. Not included in the Rev. 1 quote.

Subtask 9.1: One trip (for two) for two days to NRC Headquarters is anticipated to kick-off this project amendment; meet with the NRC Project Manager & Technical Monitor (whose names are provided in Section VII); support the completion of Subtask 9.1; and, discuss project requirements and the schedule as a whole.

Subtask 9.2 & 9.3: None.

Subtask 9.4: Travel will be needed to support participation of the Contractor in at least 10 focus groups at a minimum of 3 EPZs, which will be determined over the course of the conduct of this contract amendment.

Subtask 10.1: Travel may be needed to support participation of the Contractor in the collection and analysis of public education and information materials.

Subtask 10.2: Travel may be needed to support participation of the Contractor in the development and conduct of the telephone survey.

Subtask 10.3: Two trips (for one or two) to support meetings with NRC staff and briefings of NRC management. A minimum of four trips to support interagency meetings and presentations at professional conferences.

Subtask 10.4: One trip (for two) for two days to NRC Headquarters is anticipated to close this contract amendment; meet with the NRC Project Manager & Technical Monitor (whose names are provided in Section VII).

The Contractor may propose additional travel deemed necessary for the successful completion of this effort. Over the course of the contract, NRC staff may travel to the Contractor site for meetings. Once the contract has been awarded, the NRC Technical Monitor and Project Manager must approve all additional travel in advance.

Deviations from the travel submitted as part of NRC form 189 and accepted by issuance of an NRC form 173 will be coordinated with the NRC project manager as soon as the need for such a deviation is identified to ensure it will not interfere with the timely completion of proposed work.

An NRC Form 445 will be processed 40 days prior to OCONUS travel. In addition, a DOE F1512.1 (Request for Approval of Foreign Travel) will be submitted at least 45 days in advance.

6. NRC-FURNISHED MATERIALS:

NRC documents related to this effort.

7. RELATIONSHIP TO OTHER PROJECTS:

The Protective Action Recommendations (PAR) in Supplement 3 to NUREG-0654/FEMA-REP-1, provide guidance for implementing protective actions in response to severe reactor accidents. Protective actions are generally considered evacuation or shelter in place.

Sandia recently completed the draft Identification and Analysis of Factors Affecting Emergency Evacuations (J3056), which is an extensive evaluation of evacuation case studies. Additionally, Sandia has completed the draft White Paper (J3103) for the update to NUREG/CR-4831, "State of the Art in Evacuation Time Estimate Studies for Nuclear Power Plants" and is currently developing an updated NUREG/CR. Two factors affecting evacuations and the time estimates to implement evacuations are directly related to PARs and are two key factors in making protective action decisions.

8. REPORTING REQUIREMENTS AND SCHEDULE:

a. Deliverables/Milestones

A. Technical Reporting

Task 1 - Document meetings and literature review.

Estimated Completion Date: Two months after project initiation.

Task 2 - Draft technical letter report for review and comment, and final report with comments incorporated.

Estimated Completion Date: Four months after project initiation.

Task 3 - Draft technical letter report for review and comment, and final report with comments incorporated.

Estimated Completion Date: Seven months after project initiation.

Task 4 - Draft technical letter report for review and comment, and final report with comments incorporated.

Estimated Completion Date: 11 months after project initiation.

Task 5 - Draft technical letter report for review and comment, and final report with comments incorporated.

Estimated Completion Date: 13 months after project initiation.

Task 6 - Draft technical letter report for review and comment, and final report with comments incorporated.

Estimated Completion Date: 13 months after project initiation.

Task 7 - Report suitable for NRC management review, NRC staff comments incorporated, and NRC management review cycle begun.

Estimated Completion Date: 15 months after project initiation.

Task 8 (optional) - Revision of Supp. 3 suitable for NRC management and FEMA review, NRC staff comments incorporated, and the review cycle begun.

Estimated Completion Date: Six months after option is selected.

Task 9

Subtask 9.1 - Document literature review.

Estimated Completion Date: One month after project initiation.

Subtask 9.2 - Draft research plan for review and comment; final research plan with comments incorporated.

Estimated Completion Date: Draft, two months after project initiation; final, three months after project initiation.

Subtask 9.3 - Draft facilitator guide for review and comment; final facilitator guide with comments incorporated.

Estimated Completion Date: Draft, three months after project initiation; final, four months after project initiation.

Subtask 9.4 - Technical letter report.

Estimated Completion Date: Nine months after project initiation.

Task 10

Subtask 10.1 - Technical letter report.

Estimated Completion Date: Nine months after project initiation.

Subtask 10.2 - Draft survey plan for review and comment; final survey plan with comments incorporated. Technical letter report.

Estimated Completion Date: Draft, seven months after project initiation; final, eight months after project initiation. Technical letter report, 10 months after project initiation.

Subtask 10.3 - Presentations, TBD.

Estimated Completion Date: 12 months after project initiation.

Subtask 10.4 - Draft NUREG/CR, incorporation of comments from multiple review cycles, final NUREG/CR.

Estimated Completion Date: 15 months after project initiation.

No more than 30 copies of any interim report will be furnished to the NRC project manager.

Dennis E. Berry, Director, Nuclear and Risk Technologies Center, and/or Marianne C. Walck, Risk and Vulnerability Programs Manager, Organization 6800, Sandia National Laboratories, Albuquerque, NM, are designated as the authorizing officials for publications of NRC Form 426A.

b. Monthly Letter Status Report (MLSR)

A Monthly Letter Status Report (MLSR), following the Management Directive 11.7 instructions, will be submitted to NRC by the 20th of each month. The MLSR shall be delivered to the Project Manager, Kathryn Brock, MS O6-H2, the Technical Monitor, Randy Sullivan, MS O6-H2, and the Division of Contracts, (DC), Office of Administration, Attn: Joyce Fields and Beverly Anker, MS T7-I2. The Financial Status section of the MLSR will follow NRC Management Directive 11.7's MLSR Financial Status Report format to the extent permitted by the current SNL Financial System.

9. SUBCONTRACTOR/CONSULTANT INFORMATION:

Dr. Steve M. Becker, University of Alabama at Birmingham, has been added for subcontractor efforts on Task 9 and 10 (Rev 2) for this project. Anticipated effort is estimated at 21 percent. The other potentially anticipated subcontractor work will be for word processing and WordPerfect support. \$35K is reserved in the contract for this effort (fully loaded).

Resumes for proposed subcontractors, if applicable, have been provided under Section 4 of this proposal. Acceptance of this proposal indicates approval of personnel proposed herein.

Subsequent subcontractor efforts not described in this proposal will be managed per NRC Management Directive 11.7, Part XI. Conflict of interest issues are covered in section 11 of this proposal, which addresses all proposed personnel, including subcontractors.

10. SPECIAL FACILITIES, IF REQUIRED:

Not applicable.

11. CONFLICT-OF-INTEREST INFORMATION:

No contractual or organizational relationships of Sandia National Laboratories, its employees, or anticipated subcontractors and/or consultants have been identified with industries regulated by NRC and suppliers thereof that might give rise to a potential or actual conflict of interest.

US Nuclear Regulatory Commission (NRC) recognizes that Sandia National Laboratories will perform the work assigned to DOE under this project pursuant to the "Non-Department of Energy Funded Work" provision of the DOE/Sandia Corporation contract for the management and operation of Sandia National Laboratories.

The DOE-approved Sandia Corporation OCI Management Plan governing access to and flow of information between Sandia Corporation and its Lockheed Martin affiliated corporate entities will apply to all work performed under the terms of this project. This Sandia Corporation OCI Management Plan and the procedures resulting from the plan are subject to DOE audit at all times. A copy of the Sandia Corporation OCI Management Plan is available upon request to David L. Goldheim, Corporate Business Development and Partnership Center, MS- 0185, Sandia National Laboratories, Albuquerque, NM 87185-0185, (505-845-7730).

In accordance with the Organizational Conflicts of Interest terms of the DOE/Sandia Corporation contract, Sandia Corporation, including any of its officials who may acquire information as part of their management responsibilities, is prohibited from further disseminating any third-party proprietary data or government sensitive data or information (as indicated by restrictive markings identifying the data and information so protected) to its Lockheed Martin affiliated corporate entities.

In view of the above, the NRC hereby agrees that Lockheed Martin affiliates of Sandia Corporation shall not, due to their organizational relationship with Sandia Corporation, be

precluded from bidding on and competing for follow-on contracts or subcontracts to be awarded by NRC that relate to the work under this project.

12. CLASSIFICATION OR SENSITIVITY, IF APPLICABLE:

Not applicable.

13. ADDENDUM COST AND SCHEDULE INFORMATION:

Not applicable.

14. SPENDING PLAN:

A Spending Plan, NRC Form 189 (Part 3), is included.

15. DOE FEDERAL ADMINISTRATIVE CHARGE (FAC):

DOE departmental overhead charges of 3 percent for FY04 and subsequent years will be added on all billings.

16. DOE-ACQUIRED MATERIAL:

No materials purchases of individual items over \$500 are currently planned for this project.

Purchases of items \$500 or greater not identified in this proposal will be requested separately in writing. When property is purchased, it will be reported in the MLSR. Property will only be tracked at the \$5,000 or greater level by DOE, or if property is sensitive. Additionally, NRC-funded software with a useful life of 2 years or more and a development cost of \$500 or more will be reported in the MLSR in the month the development of the software is completed.

17. FUNDING REQUIRED

The Department of Energy (DOE) requires that Sandia National Laboratories request, from other federal agencies, funding for the first fiscal year plus the first three months of the following year if the work transcends fiscal years. However, the NRC has published new guidelines that only allow continuity funding through the first two months of the subsequent fiscal year (end of November), with new fiscal year funding issued by mid-November by NRC for on-going projects.

NRC FORM 189 (PART 3)
 (6-1994)
 NRCMD 11.7

U.S. NUCLEAR REGULATORY COMMISSION

SPENDING PLAN

Complete as part of the Laboratory's Cost Proposal for each new project or task order.

NAME OF LABORATORY
 Sandia National Laboratories

TITLE OF PROJECT
 Review of NUREG-0654, Supplement 3, "Criteria for Protective Action Recommendations for Severe Accidents"

		JOB CODE R3137 (formerly J3162)					
		MODIFICATION NUMBER (if applicable) Number 3					
		PERFORMANCE PERIOD					
		FROM	TO				
		7/15/04	11/15/06				
		Total estimated costs of the proposed project or modification at the time of proposal submission. \$1222K					
Provide cost details by month for the total project or modification.							
MONTH	7/15/04 thru	7/29/05	Aug-05	Sep-05	Oct-05	Nov-05	Dec-05
TOTAL ESTIMATED COSTS (\$K)	\$576.1K	\$40.0K	\$40.0K	\$40.0K	\$46.0K	\$46.0K	\$41.0K
PROJECT COMPLETION (%) (cumulative)	47.1%	50.4%	53.7%	57.5%	57.5%	61.2%	64.6%
MONTH	Jan-06	Feb-06	Mar-06	Apr-06	May-06	Jun-06	
TOTAL ESTIMATED COSTS (\$K)	\$47.9K	\$42.0K	\$47.0K	\$47.0K	\$47.0K	\$45.0K	
PROJECT COMPLETION (%)	68.5%	71.9%	75.8%	79.6%	83.5%	87.2%	
MONTH	Jul-06	Aug-06	Sep-06	FY07			
TOTAL ESTIMATED COSTS (\$K)	\$42.0K	\$42.0K	\$42.0K	\$31.0K			
PROJECT COMPLETION (%) (cumulative)	90.6%	94.0%	97.5%	100.0%	100.0%	100.0%	100.0%
MONTH							
TOTAL ESTIMATED COSTS (\$K)							
PROJECT COMPLETION (%)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
MONTH							
TOTAL ESTIMATED COSTS (\$K)							
PROJECT COMPLETION (%) (cumulative)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
MONTH							
TOTAL ESTIMATED COSTS (\$K)							
PROJECT COMPLETION (%)	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

NOTE: The Spending Plan will be submitted with the NRC Form 189 initially. Thereafter, it will be updated and submitted with the "Monthly Letter Status Report" (MLSR), as required in Handbook 11.7, Part III, B.2

**DOE LABORATORY PROJECT COST PROPOSAL FOR NRC WORK
FORECAST MILESTONE CHART**

Complete as part of the Laboratory's Cost Proposal for new project or task order.

Modification Number
(If applicable)
Number 3

DATE

SEP 8 2005

TITLE OF PROJECT Review of NUREG-0654, Supplement 3, "Criteria for Protective Action Recommendations for Severe Accidents"

DOE PROPOSING ORGANIZATION SANDIA NATIONAL LABORATORIES

FORECAST MILESTONE CHART - SCHEDULE TO START = Δ _____ Δ = COMPLETE
PROVIDE ESTIMATED DOLLAR COST FOR EACH TASK FOR EACH FISCAL YEAR.

TASK		FY 2004				FY 2005				FY 2006				FY 2007				FY 2008				TASK TOTAL
		1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	3rd	4th	
1	SCHEDULE			Δ	Δ																	
	COST			\$36.6K				\$0.0K				\$0.0K				\$0.0K				\$0.0K		\$36.6K
2	SCHEDULE				Δ	Δ																
	COST			\$23.8K		\$55.0K		\$0.0K				\$0.0K				\$0.0K				\$0.0K		\$78.8K
3	SCHEDULE					Δ	Δ															
	COST			\$23.8K		\$56.0K		\$0.0K				\$0.0K				\$0.0K				\$0.0K		\$79.8K
4	SCHEDULE					Δ		Δ														
	COST			\$23.9K		\$189.8K		\$0.0K				\$0.0K				\$0.0K				\$0.0K		\$213.5K
5	SCHEDULE					Δ			Δ													
	COST			\$0.0K		\$78.0K		\$0.0K				\$0.0K				\$0.0K				\$0.0K		\$78.0K
6	SCHEDULE				Δ				Δ													
	COST			\$23.8K		\$58.0K		\$0.0K				\$0.0K				\$0.0K				\$0.0K		\$81.8K
7	SCHEDULE						Δ		Δ													
	COST			\$0.0K		\$88.5K		\$140.0K				\$0.0K				\$0.0K				\$0.0K		\$228.5K
8 Optional	SCHEDULE																					
	COST			\$0.0K		\$0.0K		\$0.0K				\$0.0K				\$0.0K				\$0.0K		\$0.0K
9	SCHEDULE							Δ				Δ										
	COST			\$0.0K		\$40.0K		\$164.1K				\$0.0K				\$0.0K				\$0.0K		\$204.1K
10	SCHEDULE								Δ			Δ										
	COST			\$0.0K		\$0.0K		\$189.9K				\$31.0K				\$0.0K				\$0.0K		\$220.9K
	SCHEDULE																					
	COST			\$0.0K		\$0.0K		\$0.0K				\$0.0K				\$0.0K				\$0.0K		\$0.0K
	SCHEDULE																					
	COST			\$0.0K		\$0.0K		\$0.0K				\$0.0K				\$0.0K				\$0.0K		\$0.0K
	SCHEDULE																					
	COST			\$0.0K		\$0.0K		\$0.0K				\$0.0K				\$0.0K				\$0.0K		\$0.0K
	SCHEDULE																					
	COST			\$0.0K		\$0.0K		\$0.0K				\$0.0K				\$0.0K				\$0.0K		\$0.0K
	SCHEDULE																					
	COST			\$0.0K		\$0.0K		\$0.0K				\$0.0K				\$0.0K				\$0.0K		\$0.0K
TOTAL ESTIMATED PROJECT COST				\$131.9K		\$565.1K		\$494.0K				\$31.0K				\$0.0K				\$0.0K		\$1222.0K