ATC 55: EVALUATION AND IMPROVEMENT OF INELASTIC SEISMIC ANALYSIS PROCEDURES

Initial Workplan

12/22/00

A. Introduction

The Applied Technology Council (ATC), a professional non-profit corporation whose mission is to develop user friendly engineering applications for natural hazard mitigation, has proposed to evaluate and improve the application of inelastic analysis procedures used in state-of-the-art performance-based engineering methods for seismic design, evaluation, and rehabilitation of buildings. ATC's proposal has been accepted by the Federal Emergency Management Agency (FEMA) and a contract has been issued to perform the work. This document is a detailed Initial Workplan for the three phases of the project. The workplan will be updated at the end of Phase I and again at the end of Phase II. This workplan provides:

- a step-by-step outline of the individual elements of work on the project;
- assignment of the elements of work to project team members;
- coordination of the elements of work into integrated and coherent products;
- description of the deliverable work products;
- schedule for completion of the work and delivery of the products.

The following section, **Background**, provides the context for the current work and summarizes the need for improved inelastic procedures. This is followed by a brief statement on the **Purpose and Objectives** of the project. A summary of the basic **Approach** to the work, including the planned time phases, is provided. The general **Organization and Management Plan** is included. Finally, the **Project Tasks and Schedule** are summarized.

B. Background

Knowledgeable engineers have long recognized that the response of buildings to strong ground shaking caused by earthquakes results in inelastic and nonlinear behavior. Until recently, most structural analysis techniques devised for practical application relied on linear procedures. In the last ten years there has been an emergence of inelastic analysis procedures intended to provide engineers with more reliable and transparent tools for predicting seismic behavior of structures. These have facilitated the development of performance-based evaluation and design for new and existing buildings.

In 1996 the Applied Technology Council (ATC), with funding from the California Seismic Safety Commission, published the document*, ATC-40: The Seismic Evaluation and Retrofit of Concrete Buildings* (ATC, 1996). *FEMA 273/274: Guidelines and Commentary for the Seismic Rehabilitation of Buildings* were prepared by ATC (for the Building Seismic Safety Council) and issued in 1997. Both documents present similar performance-based engineering methods that rely on nonlinear static analysis procedures (NSPs). The two approaches are essentially the same when it comes to generating a "pushover" curve to represent the lateral capacity of a building (Figure 1). They differ, however, in the technique used to calculate the inelastic displacement

demand for a given ground motion. *FEMA 273/274* documents a procedure known as the Coefficient Method. In the Coefficient Method, displacement demand is calculated by modifying elastic (or linear) predictions of displacement demand for anticipated differences between linear and nonlinear response, based in part, on statistically-based analytical investigations into nonlinear response behavior. (Krawinkler et al., 1992; Miranda and Bertero,1994; and Vidic et al., 1994). *ATC-40* details the Capacity Spectrum Method (Freeman et al., 1975). In this approach the pushover curve is plotted as a "capacity curve," a form in which plotting occurs in the domain of modal response acceleration vs. modal response displacement, as opposed to base shear versus roof displacement. Modal displacement demand is determined from the intersection of the capacity curve with a demand curve that consists of the smoothed response spectrum representing the design ground motion, modified to account for inelastic structural response behavior.

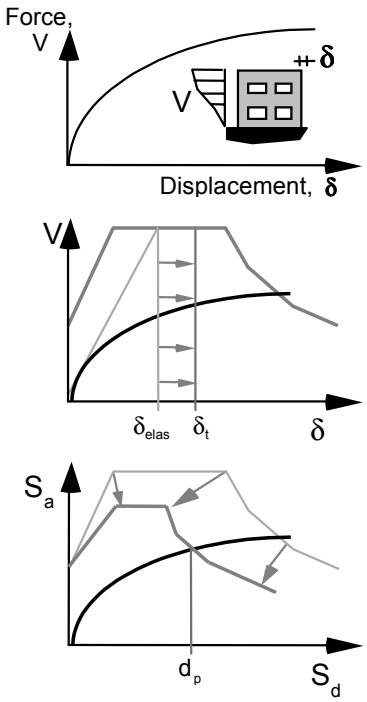

Figure 1. Schematic representations of push over curves.

Structural engineers have applied nonlinear static procedures to the evaluation and rehabilitation of many structures in the past ten years. The use of NSPs has accelerated since the publication of ATC-40 and FEMA 273. There is consequently much information available on the practical application of these procedures. FEMA has recently issued *Case Studies: An Assessment of the NEHRP Guidelines for the Seismic Rehabilitation of Buildings* (BSSC, 1999). This document provides a summary of the application of the procedures of FEMA 273, including its NSP, to over 40 buildings by practicing engineers. Additionally, several major institutions, including Stanford University and the University of California, Berkeley, have implemented guidelines for the rehabilitation of their existing buildings and design of new buildings using performance-based procedures and simplified inelastic analyses. Simplified dynamic analysis procedures have also been adapted to evaluate earthquake damaged structures (ATC, 1998abc). There is much information available on the issues encountered by practitioners when using the simplified dynamic analysis procedures. This information can be used to improve the future use of similar techniques.

In addition to the rather broad recent implementation of pushover methods in application to evluation and upgrade of existing buildings, there has been very recent progress in applying these methods to the design of new buildings. An appendix to the 2000 edition of the *NEHRP Recommended Provisions for Seismic Regulation for Buildings and Other Structures* introduces pushover analysis as an alternative method for evaluation of strength and deformation demands on structures.

Concurrent to the development and initial applications of these performance-based methods, ongoing research portends important modifications, improvements, and alternatives to current NSPs. For example, several researchers have suggested that the Capacity Spectrum Method could be used to represent conventional (R, μ, T) methods of generating inelastic spectra (Fajfar, 1999; Chopra and Goel, 1999). Appendix I of the Structural Engineers Association of California (SEAOC) Blue Book (1999) covers performance-based design and includes a Direct

Displacement-Based Procedure that applies principles of NSPs to the design of new buildings. Priestley (2000) describes a direct displacement procedure and compares it to other NSPs. The SAC Joint Venture, a partnership of SEAOC, ATC, and California Universities for Research in Earthquake Engineering, has extended the methods contained in FEMA 273 to explicitly account for uncertainty in both ground motion and structural response (SAC, 1999). The SAC procedures also incorporate practical application of incremental dynamic analysis to determine global structural stability (Luco and Cornell, 1999). Others are the studying the effects of strength and stiffness degradation, and higher mode effects on inelastic response

The *ATC 40* document states explicitly that NSPs are relatively new and that future improvements and modifications are to be expected. In practice, engineers have found that in some cases different methods give substantially different estimates for displacement demand for the same building and ground motion, as well as the distribution of displacement demand throughout the structure (Aschheim et al., 1998; Maffei, 2000; Foutch, 2000). The disparities in displacement predictions highlight the need for comparison and further study of different approaches. Such study would provide guidance to structural engineers in the use of NSPs.

There has been a large national investment in performance-based engineering because of the tangible prospect to vastly improve seismic design practices. The future of performance-based engineering depends on reliable and credible inelastic analysis procedures. The proposed project defines a practical and effective way to resolve differences, incorporate new knowledge, and build consensus and guidance for improved use of nonlinear static analysis procedures as applied to both existing structure evaluation and upgrade, and, new structure design.

C. Purpose and Objectives

The objectives of this project are (1) the development of practical recommendations for improved prediction of inelastic structural response of buildings to earthquakes (i.e., guidance for improved application of inelastic analysis procedures) and (2) the identification of important issues for future research. Specific anticipated outcomes are:

1. Improved understanding of the inherent assumptions and theoretical underpinnings of existing and proposed new analysis procedures.
2. Recognition of the applicability, limitations, and reliability of various procedures.
3. Guidelines for practicing engineers to apply the procedures to new and existing buildings.
4. Direction for researchers on issues for future improvements of inelastic analysis procedures.

The results of the project will culminate in a project document to be published by FEMA. This document will provide a comprehensive discussion of inelastic seismic analysis of new and existing buildings. It will contain guidelines for applications of selected procedures including their individual strengths, weaknesses and limitations. The document will also contain illustrative examples and expert commentary on key issues. The document will serve to update and supplement existing publications including *FEMA 273/274, ATC 40,* and the *NEHRP Recommended Provisions*.

D. Approach

The technical approach to be followed on this project will encompass a variety of efforts, including: information and data gathering; data analysis and synthesis; identification and development of major issues impacting improved use of inelastic analysis procedures; the planning and conduct of a national workshop to present and resolve major issues and identify research needs; the development of guidance to practicing engineers for improved use of existing and proposed procedures; and the documentation of project findings in suitable reports and engineering applications. In order to accomplish the project objectives expeditiously, the Project Team will conduct these activities in three distinct time phases. These are briefly described as follows:

Phase I – Assembly and Refinement of Key Issues

The focus of the first phase of the project will be the assembly and refinement of important issues relating to the improvement of inelastic seismic analysis procedures. Activities include the solicitation of input from researchers and practicing engineers. Study models of typical buildings will be developed to stimulate discussion, facilitate analytical studies, and provide example applications. As a result of the process key issues requiring analytical study will be identified for investigation in Phase II. This phase will be completed in the Spring of 2001.

Phase II – Resolution of Issues and Development of Practical Guidance

The second phase of the project will consist of analytical studies to explore selected key issues, the generation of written discussions on important topics, and the development of examples of the application of inelastic analysis procedures. The phase will also include assembly of guidelines for the improved practical implementation of the procedures. This work will be completed in the Fall of 2001.

Phase III – Presentation, Review, and Finalization of Project Report Document

The final phase of the work will include a national Workshop to present the results of the work and to gain focussed input on particularly critical issues. The final project document will incorporate the results of the Workshop. The Final report will be issued in early 2002.

E. Organization and Management Plan

An organization chart for the Project Team is shown in Figure 2. All project personnel are listed on the chart. The follow is a brief description of the roles for each position.

The Applied Technology council will be responsible to FEMA for the successful completion of all work on the project. The **Principal Investigator** (PI) will manage the business aspects of the project, including contract funds. The **Project Director** will manage the day-to-day activities of the Project Team and the conduct of the work. The Project Director will also have final editorial authority over project documents. The **Project Administrator** will coordinate the assistance provided by ATC staff and maintain project documents, information, and records.

The overall direction of the project work will be the responsibility of the **Project Management Committee,** chaired by the Project Director. This group will establish the goals of the project and the general strategy to meet them. They will be responsible to see that high standards for

technical and presentation quality are maintained at all times. All major project decisions will be subject to the review and approval of this group.

The advisory **Project Review Panel** will provide independent expert review of the project work on a periodic basis. They will be provided draft documents for review and will participate in meetings to convey their opinions and comments.

The **Project Working Group** will carry out most of the day-to-day activities for the project under the direction of the Project Director.

A key aspect of the project is the active input of interested and qualified researchers and engineering practitioners. These **Project Participants** will be actively solicited at the beginning of the project. It is anticipated that selected qualified Participants will be assigned specific tasks in the future.

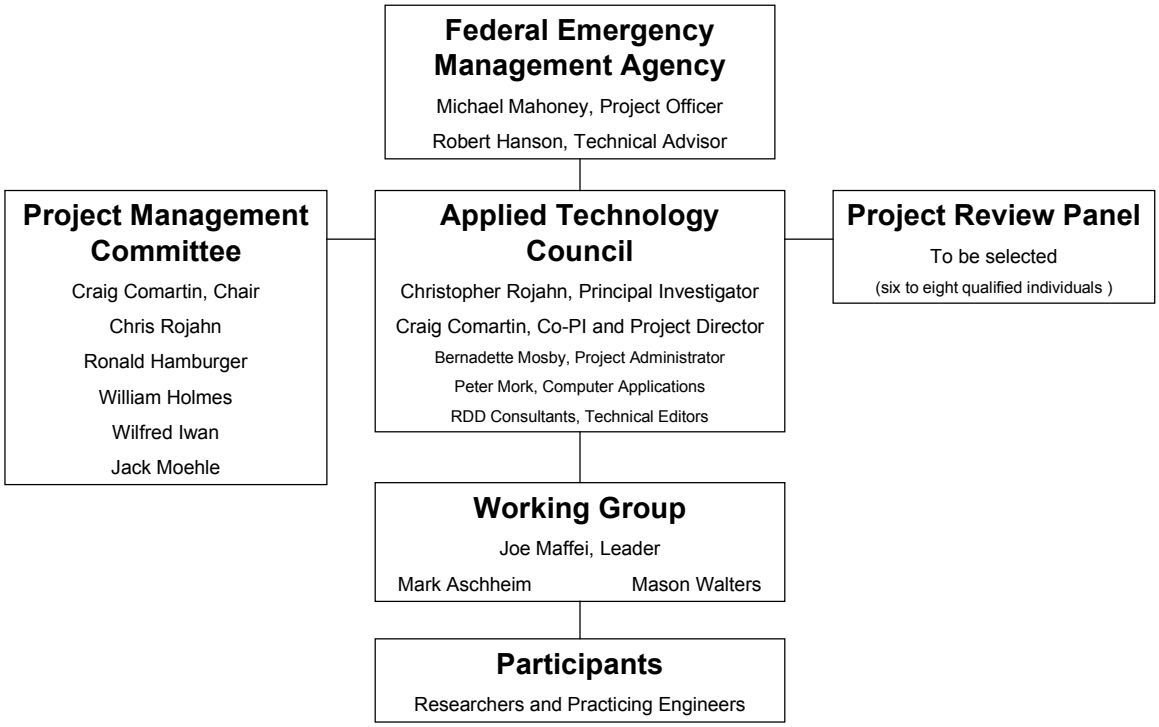

Figure 2: ATC 55 Project Organization Chart

E. Project Tasks and Schedule

The project will be executed by ATC over a 18-month period through the conduct of eight major tasks, as described below. This initial workplan provides more detail for the Phase I portion of the project, since the tasks for the subsequent phases are somewhat dependent on the Phase I results. The tasks and workplans for the subsequent phases will be revised at appropriate times as noted. Note also that some tasks extend over more than one time phase. A project schedule is provided at the end of this workplan.

1. Project Workplan

1.1 Develop initial project workplan – This task is the formulation of the initial workplan for the project. The Project Director is responsible to generate a draft plan and distribute it for review to FEMA, the Project Management Committee and the Working Group. The initial Plan addresses Phase I in detail. Plans for the subsequent Phases II and III are developed in less detail to allow for incorporation of the results of Phase I work.

1.2 Review and revise initial workplan – The initial workplan incorporates input from the entire Project Team and FEMA. The workplan will be available to Project Participants on the project web page

1.3 Issue initial workplan – ATC will distribute the final initial workplan to all Project Team members and FEMA (see Deliverables under Task 2).

1.4 Revise Phase II workplan – At the end of Phase I the workplan for Phase II will be revised and updated to reflect the results of the first phase.

1.5 Issue Phase II workplan - This will be submitted to FEMA as a part of the Phase I submittal.

1.6 Revise Phase III workplan - At the end of Phase II the workplan for Phase III will be revised and updated to reflect the results of the first two phases.

1.7 Issue Phase III workplan - This will be submitted to FEMA as a part of the Phase II submittal.

2. Project Management

Project personnel and contracts

The selection of all project personnel will be based on suggestions developed by the Project Director and Principal Investigator subject to approval by FEMA. The business administration aspects of the project including, consulting contract agreements with project personnel, are the responsibility of the Principal Investigator.

2.1 Select PMC (Project Management Committee) – The group identified in this workplan are confirmed.

2.2 Issue PMC contracts for Phase I – Contracts will be issued based on the scope of work for Phase I with provision for extension and scope revision for the following phases.

2.3 Select PRP (Project Review Panel)

2.4 Issue PRP contracts for Phase I– Contracts will be issued based on the scope of work for Phase I with provision for extension and scope revision for the following phases.

2.5 Select PWG (Project Working Group) - The group identified in this workplan are confirmed.

2.6 Issue PWG contracts for Phase I

2.7 Revise all contracts for Phase II

2.8 Issue new contracts for Phase II – Additional project personnel may be engaged to perform tasks in Phase II.

2.9 Revise all contracts for Phase III

2.10 Issue new contracts for Phase III

Meetings

2.11 PMC Meetings

2.12 PRP Meetings

2.13 PWG Meetings

Project Web Site

2.14 Develop site - A dedicated project website constitutes a primary communication activity between the Project Team and Project Participants. Access will be unrestricted so long as the individual registers as a Project Participant. Documents may be downloaded and returned with comments by email. Documents cannot be changed on line. Initially the site will contain a registration form for Project Participants (see Tasks 3.1 and 4.1), the project workplan (see Task 1.3), a compilation of project issues summaries (see Task 6.1) for review and comment, a research (see Task 3.2) and applications (see Task 4.2) summary forms to allow researchers and practitioners to describe their relevant work. Also, some study examples of analyses using various simplified inelastic procedures may be used to illustrate pertinent issues.

2.15 Maintain site – ATC will update the site on an on-going basis to reflect the results of the work and the progress of the project. Project Participants will be encouraged to comment on all materials via email that will be assigned to the appropriate Working Group member for review and action, if warranted.

Project Deliverables

2.16 Initial Workplan

2.17 Phase I – The Phase I submittal to FEMA will include:

a. Summary of the state of the art in research related to inelastic seismic analyses.

b. Summary of the state of the practice in applications of inelastic analysis procedures to new and existing buildings.

c. A comparison of the states of art and practice

d. A glossary of terms and nomenclature related to inelastic seismic analyses.

e. An itemized summary of key issues for study and resolution

f. A revised Workplan for Phase II including:

- scope and personnel for the analytical studies.
- subject and authors of key issue papers.
- scope and personnel for applications examples
- outline for applications guidelines

- budget and schedule

2.18 Phase II - The Phase II submittal to FEMA will include:

a. results of the analytical studies.

b. updated itemized summary of key issues.

c. draft issues papers.

d. draft application examples

e. draft application guidelines

f. A revised Workplan for Phase III including:

- suggested workshop format and preliminary agenda.
- list of suggested Workshop attendees.
- budget and schedule

2.19 Phase III - The Phase III submittals to FEMA will include:

a. Final review draft report including:

- resolution/recommendations on key issues.
- issues papers.
- application guidelines.
- application examples.

b. Camera ready and electronic copies of final report.

3. Review of relevant research

The primary objective of this task is to document the best available information on the state of the art in inelastic analysis procedures. The strategy is to engage Project Participants from the research community and obtain their input on project issues.

3.1 Solicitation strategy and potential participant list –The invitation to potential Participants will direct interested parties to the project web site. To become a Participant, the individual will simply fill out a registration form. Each Participant will be asked to review and comment on the issue summaries (see Task 6.1). In addition, they will be asked to provide detailed information on their own relevant research activities (see Task 3.2). The project Working Group will generate a list of potential Participants based on a review of current research publications.

3.2 Response format for research summaries – The Project Working Group will design a format for researcher Participants to describe their relevant work. Figure __ illustrates a draft example.

3.3 Initial solicitation – Invitations will be sent to the list of potential participants. The invitation to become a Participant will be published in relevant newsletters (SEAOC and

other state organizations, EERI, etc.). The intention is to open participation to any interested individual who may not have been identified initially.

3.4 Review and summarize response – The Working Group will review material received from researchers and summarize the information as it relates to the issues. This will be coordinate with the updating of the issues described in Task 6.3.

3.5 Follow-up contacts by PWG – Project Working Group members will contact selected Participants to gather additional information.

3.6 Summarize state of art – The results of this process will be a summary of the state of the art in current research as it relates to the application of inelastic seismic analysis procedures to evaluate performance of new and existing buildings. This information will be submitted to FEMA as a part of the Phase I submittal.

3.7 Identify potential future Participant assignments – As a part of this overall task, the Project Working Group will identify individual researchers for possible future assignments on the project in subsequent phases. For example, the analysis work under Task 5 may be parceled out to selected qualified individuals, particularly if their on-going research is relevant and applicable to the resolution of the key issues identified in Task 6.3. The intention is to leverage project resources by utilizing and augmenting existing data and projects to the maximum extent possible. This information will be submitted to FEMA as a part of the Phase I submittal.

3.8 Solicit and incorporate feedback from Participants – Throughout this process, the Working Group will provide information on results to Participants in an effort to stimulate and maintain interest in the project. This will be accomplished by email announcements and posting of material on the web page.

3.9 Review by FEMA and PRP – The results of this task will be incorporated into the Phase I Report (see Task 2.17).

4. Review of project examples

The primary objective of this task is to document the best available information on the state of the practice in the application of inelastic analysis procedures to new and existing buildings. The strategy is to engage Project Participants from the community of practicing engineers and obtain their input on project issues. This task is parallel and similar to Task 3. The minor differences are noted in the following subtasks.

4.1 Solicitation strategy and potential participant list

4.2 Response format for practice summaries – The practitioner Participants will be asked to provide pertinent examples from their experience with actual applications of inelastic procedures. Figure __ illustrates a draft example.

4.3 Initial solicitation

4.4 Review and summarize response

4.5 Follow-up contacts by PWG

4.6 Summarize state of practice

4.7 Identify potential future Participant assignments

4.8 Solicit and incorporate feedback from Participants

4.9 Review by FEMA and PRP

5. Perform analytical studies

The objective of this task is to resolve selected key issues through analytical studies. The results will be used to improve the recommendations for application of inelastic procedures.

5.1 Develop potential study examples – The Working Group will generate potential study examples early in the project to illustrate the issues and stimulate response from participants. These will be refined over the course of the project to be used in the analytical studies and applications examples. The models are expected to fall into two related categories. The first will be example "buildings" exhibiting various types of observed behavior (i.e. soft/weak stories in concrete or steel frames, flexurally controlled shear walls, shear controlled behavior, buckling in concentric braced frames). The second type will be generic "capacity curves" or behavior models. These will be possibly derived from the example buildings categories to reflect typical inelastic behavior and the range of important parameters (i.e. initial strength and stiffness, stiffness degradation, strength degradation, unloading stiffness).

5.2 Refine study examples – The Working Group will update the study examples based on the response from Participants (see Tasks 3 and 4), the development of important issues (see Task 6.3), the needs of the analytical studies (see Tasks 5.4 and 5.5), and applications examples (see Tasks 6.8 and 6.9).

5.3 Characterization of ground motion parameters – The Working Group will compile information on ground motion for use in the analytical studies (see Tasks 5.4 and 5.5) and applications examples(see Tasks 6.8 and 6.9).

5.4 Formulate scope of analytical studies – The refined issues from Task 6.3 are likely to include some that might be partially or fully resolved through analytical studies. The scope of these studies will be formulated by the Working Group. It is anticipated that it may be possible to formulate studies that will use and/or extend existing data identified in Task 3. This information will be submitted to FEMA as a part of the Phase I submittal.

5.5 Carry out analytical studies

5.6 Interpret and summarize results – The Working Group will intrepret he results of the studies and the implications with respect to resolution of key issues. Particulary attention will devoted to the practical implications with respect to the applications guidelines for selected inelastic procedures (see Task 6.10). - This information will be submitted to FEMA as a part of the Phase II submittal.

5.7 Solicit and incorporate feedback from participants

5.8 FEMA and PRP review

6. Develop draft recommendations

The objective of this task is draft guidelines for the practical application of selected inelastic procedures. These will be developed based on the current state of the art and practice

6.1 Assemble initial issue summaries – The Working Group will assemble initial issues relating to the application of inelastic analysis procedures. The format will comprise a succinct (one sentence) issue statement, an explanatory paragraph, pertinent references, and other appropriate information. An example draft Issue Summary is illustrated in Figure ___. Initial issues are likely to include:

Applicability

- Software limitations
- Three dimensional modeling
- Appropriateness of various analysis methods
- Variation in results using different procedures
- Uncertainty in ground motion and component capacity
- Global and component acceptability
- Differences between application to new buildings versus existing buildings
- Clarity and ease of use

Terminology

- Force-based versus displacement-based presentations
- Spectral presentation: Acceleration vs. Displacement vs. Period
- Different terminology used to express the same concepts
- Different meanings for the same terms
- Relating terminology between coefficient, capacity spectrum, and R-μ-T methods

Technical/Theoretical

- Inter-relationship of coefficient, capacity spectrum, and R-μ-T methods
- Relationship of effective damping to ductility
- Determination of initial stiffness and its effect
- Effect of Strength on Response
- Degradation of strength and stiffness
- Single-degree-of-freedom versus multi-degree-of-freedom and higher mode effects
- Ground motion parameters
- Probability and uncertainty
- Incremental dynamic analyses

- Load patterns for pushover analyses
- Variation in hysteretic parameters
- Limitations of various procedures
- Introduction of new methods

6.2 Review response to issue summaries – The Working Group will assemble and incorporate the response of researchers and practitioners to the issue summaries.

6.3 Revise and consolidate issues – The Working Group will continuous update the issues summaries in an effort to consolidate, eliminate, and resolve the issues. This will be accomplished with several different actions:

a. Drop issues – Some may be determined to be insignificant for the current project.

b. Combine issues – For example, higher mode effects and load patterns for pushover analyses are probably the same issue for practical purposes.

c. Define semantics – The subject of inelastic analyses in general suffers greatly from confusion over the meaning of words and phrases and the lack of a conventional nomenclature.

d. Forego issues – Some are beyond the scope of the current study.

e. Investigate – For example, the analytical studies are likely to resolve some issues.

Updated information will be submitted to FEMA as a part of both the Phase I and Phase II submittals.

6.4 Compare the state of art and practice – The Working Group will compare the state of the art and practice from Tasks 3 and 4. This process will accomplish two objectives. First it will identify improvements that could be made to the use of inelastic procedures based on research results. Secondly, it will identify practical problems that may not be adequate addressed in current research. This information will be submitted to FEMA as a part of the Phase I submittal.

6.5 Develop glossary and nomenclature – As noted in Task 6.3, the Working Group will propose a singular consistent definition for key terms and a set of symbols for use with inelastic procedures. This information will be submitted to FEMA as a part of the Phase I submittal.

6.6 Select and assign issues papers – One result of the process of issues review and refinement (Tasks 6.2and 6.3) and the comparison of the state of art and practice will be the identification of particularly important issues. These will be the subject of several (4-6) issues papers intended to provide a relatively thorough presentation and discussion for inclusion in the final report. They are also intended to stimulate discussion for the Workshop. Qualified individuals selected from the Project Team or Participants identified in Tasks 3.7 or 4.7 will prepare the issue papers. This information will be submitted to FEMA as a part of the Phase I submittal.

6.7 Write issue papers

6.8 Select and assign application examples – Similarly to Task 6.6, the Working Group will formulate several (3-4) example applications of inelastic procedures. These will be coordinated with the applications guidelines (see Task 6.10) and the major issues (see Task 6.3). Qualified individuals selected from the Project Team or Participants identified in Tasks 3.7 or 4.7 will prepare the application examples. This information will be submitted to FEMA as a part of the Phase I submittal.

6.9 Perform application examples

6.10 Develop applications guidelines for procedures – The Working Group, with the potential assistance of other Participants, will develop step-by-step guidelines for the improved application of selected inelastic procedures. These will also identify the particular strengths and weaknesses of each procedure. The guidelines will be coordinated with the issue papers and example applications.

6.11 Potential mini-workshops on key issues – In Phase II it may be beneficial to convene small meetings of selected Participants to assist the Project Team in the resolution of some issues.

6.12 Assemble workshop materials/draft – Workshop materials will include draft applications guidelines, issue paper drafts, and example applications. This information will be submitted to FEMA as a part of the Phase II submittal.

6.13 Solicit and incorporate feedback from participants

6.14 FEMA and PRP review

7. Plan and Conduct Workshop

The goal of the pre-Workshop activities is to identify a small number of key issues relating to the application of inelastic procedures. This will provide focus for the Workshop. The purpose of the Workshop will be to present the results of the project and to gain further insight on the important issues.

7.1 Propose agenda and format – The general format will comprise presentation and discussion of issue papers and example applications. This information will be submitted to FEMA as a part of the Phase II submittal. A detailed agenda will be prepared by the Working Group in Phase III.

7.2 Propose list of participants – This information will be submitted to FEMA as a part of the Phase II submittal. *Note: This needs to be resolved with FEMA. The contract refers to a general solicitation and also limits participation to 70 total. It would probably be best to have 70 invited, but allow any Participant to attend.*

7.3 FEMA and PRP review

7.4 Arrange for venue

7.5 Issue invitations

7.6 Issue workshop materials – All Workshop attendees will be expected to review materials in advance of the Workshop.

7.7 Workshop presentation preparation

7.8 Conduct workshop

7.9 Summarize results

8. Prepare Final Report

8.1 Incorporate workshop results

8.2 Prepare final draft - This will be submitted to FEMA as a Phase III submittal.

8.3 FEMA and PRP review

8.4 Technical edit

8.5 Copy edit

8.6 Incorporate final review comments

8.7 QA review

8.8 Issue electronic and camera ready copy - This will be submitted to FEMA as a Phase III submittal.

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Task	2000			2001												2002		
	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
	PHASE I								PHASE II							PHASE III		
1. Project Work Plan																		
1.1 Develop initial project work plan	■	■																
1.2 Review and revise initial workplan			■															
1.3 Issue initial workplan			♦															
1.4 Revise Phase II workplan								■										
1.5 Issue Phase II workplan								♦										
1.6 Revise Phase III workplan																		
1.7 Issue Phase III workplan																		
2. Project Management																		
Project personnel and contracts																		
2.1 Select PMC (Project Management Committee)	■	■																
2.2 Issue PMC contracts for Phase I			♦															
2.3 Select PRP (Project Review Panel)			■	■														
2.4 Issue PRP contracts for Phase I					♦													
2.5 Select PWG (Project Working Group)	■	■																
2.6 Issue PWG contracts for Phase I			♦															
2.7 Revise all contracts for Phase II									♦									
2.8 Issue new contracts for Phase II									♦									
2.9 Revise all contracts for Phase III															♦			
2.10 Issue new contracts for Phase III															♦			
Meetings																		
2.11 PMC Meetings		♦		♦			♦			♦			♦			♦		
2.12 PRP Meetings								♦										
2.13 PWG Meetings			♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦	♦
Project Web Site																		
2.14 Develop site			■	■														
2.15 Maintain site					■	■	■	■	■	■	■	■	■	■	■	■	■	■

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Task	2000			2001												2002		
	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
	PHASE I								PHASE II							PHASE III		
Deliverables																		
2.16 Initial Workplan			♦															
2.17 Phase I Submittal								♦										
2.18 Phase II Submittal														♦				
2.19 Phase III Submittals																♦		♦
3. Review of relevant research																		
3.1 Solicitation strategy and potential participant list																		
3.2 Response format for research summaries																		
3.3 Initial solicitation																		
3.4 Review and summarize response																		
3.5 Follow-up contacts by PWG																		
3.6 Summarize state of art																		
3.7 Identify potential future Participant assignments																		
3.8 Solicit and incorporate feedback																		
3.9 Review by FEMA and PRP																		
4. Review of project examples																		
4.1 Solicitation strategy and potential participant list																		
4.2 Response format for practice summaries																		
4.3 Initial solicitation																		
4.4 Review and summarize response																		
4.5 Follow-up contacts by PWG																		
4.6 Summarize state of practice																		
4.7 Identify potential future Participant assignments																		
4.8 Solicit and incorporate feedback from Participants																		
4.9 Review by FEMA and PRP																		

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Task	2000			2001												2002		
	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
	PHASE I								PHASE II						PHASE III			
5. Perform analytical studies																		
5.1 Develop potential study examples																		
5.2 Refine study examples																		
5.3 Characterization of ground motion parameters																		
5.4 Formulate scope of analytical studies																		
5.5 Carry out analytical studies																		
5.6 Interpret and summarize results																		
5.7 Solicit and incorporate feedback from participants																		
5.8 FEMA and PRP review																		
6. Develop draft recommendations																		
6.1 Assemble initial issue summaries																		
6.2 Review response to issue summaries																		
6.3 Revise and consolidate issues																		
6.4 Compare the state of art and practice																		
6.5 Develop glossary and nomenclature.																		
6.6 Select and assign issues papers																		
6.7 Write issue papers																		
6.8 Select and assign application examples																		
6.9 Perform application examples																		
6.10 Develop applications guidelines for procedures																		
6.11 Potential mini-workshops on key issues																		
6.12 Assemble workshop materials/draft																		
6.13 Solicit and incorporate feedback from participants																		
6.14 FEMA and PRP review																		

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Task	2000			2001												2002		
	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M
	PHASE I								PHASE II						PHASE III			
7. Plan and Conduct Workshop																		
7.1 Propose agenda and format													▬					
7.2 Propose list of participants													▬					
7.3 FEMA and PRP review													▬					
7.4 Arrange for venue													▬					
7.5 Issue invitations													♦					
7.6 Issue workshop materials														♦				
7.7 Workshop presentation preparation														▬	▬			
7.8 Conduct workshop															♦			
7.9 Summarize results															▬			
8. Prepare Final Report																		
8.1 Incorporate workshop results															▬			
8.2 Prepare final draft															▬	▬		
8.3 FEMA and PRP review																▬		
8.4 Technical edit															▬	▬	▬	▬
8.5 Copy edit															▬	▬	▬	▬
8.6 Incorporate final review comments																	▬	
8.7 QA review																		▬
8.8 Issue electronic and camera ready copy																		♦