NNWSI

WMPO AUDIT 88-06

SANDIA NATIONAL LABORATORIES

VOLUME II

JOE HOLONICH

SNL NNWSI PROJECT

QUALITY ASSURANCE PROCEDURE

NNWSI Procedure for Quality-Related Work Stoppage

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Approved: NA Division Supervisor Date: NA

Approved: Quality Assurance Date: Jan 9, 1987

Approved: Thomas O. Hunter SNL NNWSI Project Manager Date: 1/9/87

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1.0 Purpose:

This document defines the authority and procedure for stopping work based on quality-related deficiencies.

2.0 Scope:

This document is intended to cover situations wherein the quality of items or activities is in question. However, the provisions of this procedure may also be used as a guide in communicating work stoppages for other reasons (e.g., policy, priority, or design changes).

3.0 Authority:

Division Supervisors, Task Leaders, Contract Monitors*, and the Project Manager, due to their positions and responsibilities, inherently have the authority to stop work in the functional areas and organizations for which they are responsible. Additionally, Quality Assurance personnel, in accordance with the project Quality Assurance Program Plan, are delegated the authority to stop work in all situations for quality-related reasons. The Quality Assurance personnel referred to herein are those personnel in the SNL NNWSI department whose primary job responsibilities are quality assurance and verification.

4.0 Procedure

4.1 Situation

Quality-related work stoppage may be imposed when the quality of the activity or of the result of the activity (e.g., test data, manufactured items, design work) is indeterminate, in question, or known to be inadequate. Such a work stoppage prevents wasted effort and the generation of substandard product.

4.2 Initiation of Work Stoppage

Any of the individuals identified in paragraph 3.0 above can initiate a work stoppage in either of two ways - by a Nonconformance Report or by written correspondence. A verbal request by the initiator may precede or accompany the document initiating the work stoppage.

*Contract Monitors are reminded that they must adhere to SLI 6632, "Changing and Terminating Contracts," which states that only the Sandia Contracting Representative (SCR) is authorized to direct a contractor to stop work. In such cases, the Contract Monitor works through the SCR to initiate a work stoppage.

4.2.1 Initiation by Nonconformance Report (NCR)

In addition to actions specified in the appropriate procedure for nonconformance reporting, the words "Work Stoppage" will be placed prominently in the section of the NCR for deficiency description.

Upon receipt of such an NCR, the recipient will take immediate action to terminate the subject activity.

4.2.2 Initiation by Correspondence

In cases where work stoppage via NCR is inappropriate, or where more detailed documentation for the work stoppage is desired, the initiator may use a letter or memorandum to impose a work stoppage. Such correspondence should contain, at least:

a. Instructions to stop the subject activity.

b. An explanation of the problem or situation that requires work to be stopped.

c. A request that corrective actions be developed for Management and QA Coordinator approval. (Such a request may not be necessary for management or task leader-imposed work stoppages, as they may develop the corrective actions.)

d. A request for immediate acknowledgment of receipt of the notification.

4.3 Response to Work Stoppage

The responsible party will take immediate action to terminate the subject activity.

The responsible party will develop corrective actions to rectify the quality deficiency that caused the work stoppage. Such corrective actions shall address:

a. Efforts necessary to correct the immediate problem/deficiency.

b. Analysis of the root causes of the problem and actions necessary to eliminate the root causes in order to prevent recurrence of the problem.

c. Actions necessary to repair, correct, or upgrade any "product" (e.g., test data, design work, hardware, reports, etc.) affected by the deficiency prior to the work stoppage.

These corrective actions will be documented in the disposition section of the NCR or by letter or memorandum to the initiator.

4.4 Rescission of Work Stoppage

4.4.1 Work stoppages can be rescinded at any time by the initiator.

4.4.2 For work stoppages initiated via NCR, the work stoppage is rescinded upon verification by QA personnel that corrective actions have been implemented. The words "work stoppage rescinded" may be entered in the verification portion of the NCR.

4.4.3 For work stoppages imposed by means of letter or memo, the initiator and the QA Coordinator will verify to their satisfaction that appropriate corrective actions have been implemented. At that time the initiator will prepare a letter or memo to the responsible party which refers to the initiating correspondence and the activity which was subject to the stoppage and which states that the work stoppage is rescinded. This letter will be co-signed by the QA Coordinator.

5.0 Records

All correspondence regarding work stoppages is to be entered into the SNL NNWSI Department Records Center in file designation 90/1293/NCF/Q-level designator.

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SNL NNWSI PROJECT
QUALITY ASSURANCE PROCEDURE

QUALITY ASSURANCE LEVEL ASSIGNMENT
AND WORK PLANS

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Approved: [signature] — May 2, 1988
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for Department Manager — Date

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QUALITY ASSURANCE LEVEL ASSIGNMENTS AND WORK PLANS

1.0 PURPOSE

The purpose of this Quality Assurance Procedure (QAP) is to define the responsibility and process for preparing and approving Work Plans, including those prepared for assigning and obtaining approval of Quality Assurance Levels for items, activities and/or tasks involved in the SNL NNWSI Project. The process for revising these Work Plans and Quality Assurance Levels is also specified herein.

2.0 SCOPE

This procedure applies to all performance assessment, design, and site characterization work performed at Sandia National Laboratories (SNL) within the NNWSI Project Department or by other SNL organizations or contractors for the SNL NNWSI Project Department.

3.0 DEFINITIONS

3.1 Information Needs - The next level in the hierarchy under design and performance assessment issues. Information needs comprise requirements for additional data or analyses.

3.2 Investigations - The next level in the hierarchy under site characterization programs. Investigations comprise requirements for additional data or analyses.

3.3 Issues - The next level in the hierarchy under key issues. Issues are questions relating to the design and performance assessment of the mined geologic disposal system that must be answered to satisfy key issues and demonstrate compliance with the applicable Federal Regulations (including 10 CFR Part 60, 10 CFR Part 960, 40 CFR Part 191, and 10 CFR Part 20).

3.4 Item - An all-inclusive term that is used in place of any of the following: appurtenance, assembly component, equipment, material, module, part, structure, subassembly, subsystem, system, unit, data, sample (geologic, environment, or radiological), and prototype hardware.

3.5 Key Issues - Relate to broad-level technical or institutional requirements grouped into four topical areas relating to the overall performance of the site, as identified by the DOE Siting Guidelines, 10 CFR Part 960.

3.6 Non-standard Method - A method or technique which is not established or prescribed as an acceptable means performing an experiment, test, or design effort.

3.7 Planning Cost Account (PCA) - A subdivision of a Work Breakdown Structure (WBS) element which describes an effort for achieving an objective of the WBS element.

3.8 Principal Investigator (PI) - The SNL staff member responsible for completion of a particular investigation or design. This individual may or may not also be the Task Leader.

3.9 Programs - The next level in the hierarchy under key issues. Programs are questions relating to the site characterization of the mined geologic disposal system that must be answered to satisfy key issues and demonstrate compliance with the applicable Federal Regulations (including 10 CFR Part 60, 10 CFR Part 960, 40 CFR Part 191, and 10 CFR Part 20).

3.10 Quality Assurance Coordinator - The person responsible for establishing and implementing the Quality Assurance Program in SNL Organization 6310 or his designee(s).

3.11 Quality Assurance Criteria - The 18 points of a QA Program outlined in 10 CFR 50, Appendix B.

3.12 Quality Assurance Level Assignment Sheet (QALAS) - The form used to document the assignment of Quality Assurance levels to tasks described in a Work Plan.

3.13 Quality Assurance Level I - Those radiological health and safety related items and tasks that are important to either safety or waste isolation and that are associated with the ability of a geologic nuclear waste repository to function in a manner that prevents or mitigates the consequences of a process or event that could cause undue risk to the radiological health and safety of the public.

3.14 Quality Assurance Level II - Those items and tasks related to the systems, structures, and components which require a level of quality assurance sufficient to provide for reliability, maintainability, public and repository worker nonradiological health and safety, repository worker radiological health and safety, and other operational factors that would have an impact on DOE/HQ - OGR and WMPO concerns, and the environment.

3.15 Quality Assurance Level III - Those items and tasks not classified as Quality Assurance Levels I, II or "None."

3.16 Quality Level Assignment Criteria Sheet (QLACS) - The form used to document the selection of Quality Assurance criteria to tasks described in a Work Plan.

3.17 Task - A subdivision of a Work Breakdown Structure (WBS) Planning Cost Account (PCA) which describes a particular research and development effort, laboratory or field experiment or test, or design effort. A WBS PCA may or may not be divided into tasks.

3.18 Task Leader (TL) - The SNL staff member responsible for developing the technical guidance, budget, and schedules for a Work Breakdown Structure (WBS) task. This individual may or may not also be the Principal Investigator.

3.19 Technical Procedure - A set of written instructions that address technical requirements, constraints, and acceptance limits and which defines procedural steps to accomplish the respective task.

3.20 Work Breakdown Structure (WBS) - A system used by the NNWSI Project to categorize the tasks to be performed for a particular project.

3.21 Work Plan - A planning document which describes the activities and tasks performed within a Work Breakdown Structure element. For technical activities, it fulfills the function of "scientific investigation plans" as defined in the NNWSI QA Plan.

4.0 PROCEDURE

4.1 Preparation of Work Plans

4.1.1 The responsible Task Leader shall ensure that a Work Plan is developed for each performance assessment, design, or site characterization Work Breakdown Structure (WBS) element prior to the start of work.

4.1.2 The purpose of a Work Plan is to provide evidence of sufficient planning to ensure controlled performance of work and to provide information for the justification of Quality Assurance level assignments. Work Plans shall be prepared concurrent with the preparation of Quality Assurance Level Assignment Sheets and Quality Level Assignment Criteria Sheets (Section 4.3).

4.1.3 The Work Plan shall have a cover sheet and a Table of Contents [See Appendix D and E]. The cover sheet shall specify the WBS element title, Fiscal Year, identification number (WBS number), and revision designator, and shall provide for approval signatures and dates. The Table of Contents shall list all sections of the Work Plan as they appear in the body of the Work Plan (Section 4.1.4).

4.1.3.1 The title of the Work Plan shall be the same as the WBS title specified in the NNWSI Project Work Breakdown Structure Dictionary.

4.1.3.2 The identification number shall consist of the SNL WBS number.

4.1.3.3 The revision designator shall be an alpha character. The initial issue will be denoted as "Revision A." Additional revisions will be denoted with ascending letters of the alphabet.

4.1.3.4 Signatures and date lines shall be provided for the Task Leader, SNL technical reviewer(s), Division Supervisor, SNL Quality Assurance Coordinator, SNL Technical Project Officer (TPO), WMPO PQM, and responsible WMPO Branch Chief.

4.1.4 The Work Plan shall have 13 sections (with appropriate sub-sections) as follows:

1. <u>Objective and Issues Addressed</u>
   - A. Objective
   - B. Issues/Information Needs and, as applicable, Programs/Investigations Addressed
   - C. Regulations & Requirements
   - D. Related Project Plans

2. <u>Task Leader/Principal Investigator(s)</u>
   - A. Task Leader
   - B. Principal Investigator(s)

3. <u>Statement of Work</u>
   A. Rationale
   B. Impacts if Not Done
   C. Constraints
   D. Quality Level of Previous Work
   E. Planning Cost Account number, title, description
      Task number, title, description
      1) Methods, Techniques, or Equipment
      2) Technical Procedures
         a) Available Procedures
         b) Needed Procedures
      3) Computer Codes
         a) Available Computer Codes
         b) Needed Computer Codes
      4) Documentation of Results

4. <u>Data and Materials Needed</u>
   A. Planning Cost Account number and title
      Task number and title
      1) Data Needed
         a) Source of Data
         b) Quality of Data
      2) Materials Needed
         a) Source of Materials
         b) Quality of Materials

5. <u>Non-Standard Methods or Techniques</u>

6. <u>Location of Work Performance</u>

7. <u>Quality Assurance Requirements</u>
   A. QA Level Assignments
   B. Applicable SNL QA Procedures, DOPs, QAPs

8. <u>Application of Results</u>

9. <u>Schedule</u>

10. <u>Past and Expected Achievements</u>
    A. Past Achievements
    B. Expected Achievements

11. <u>Milestones and Deliverables</u>

12. <u>Costs</u>

13. <u>Performance Measurement</u>

4.1.4.1 Section (1) of the Work Plan shall:

a. State the objectives of the WBS element as a summary of the combined objectives of the Planning Cost Accounts included in the Statement of Work.

b. Identify the Design and Performance Assessment Issues/Information Needs and, as applicable, the Site Characterization Programs/Investigations addressed. Use the SCP/CDR Consultation Draft dated January 1988. For Issues not addressed in the SCP/CDR Consultation Draft, use the Office of Geologic Repositories "Issues Hierarchy for a Mined Geologic Disposal System," dated September 1986 (OGR/B-10).

Hierarchy of Terms

Design	Performance Assessment	Site Characterization
Design Issue	PA Issue	Site Program
Information Need	Information Need	Investigation
Design Activity	PA Activity	Study
Design Sub Activity	PA Sub Activity	Activity

c. Reference the applicable regulations, requirements, performance criteria, and higher level planning documents (e.g., Site Characterization Plan, Exploratory Shaft Test Plan).

d. Discuss related Project plans including the interfaces between work being performed in the WBS element and other work in the NNWSI Project.

4.1.4.2 Section (2) of the Work Plan shall list the Task Leader and the Principal Investigator(s) responsible for each PCA or task in the WBS element.

4.1.4.3 Section (3) of the Work Plan shall contain the following:

a. A one or two paragraph rationale of the approach or strategy to be followed in performing the work, including a brief discussion of the controlling principles underlying the work.

b. A one or two paragraph statement of the impacts if the work is not done.

c. A very brief statement of any constraints or restrictions which may exist on the work. For example, there may be no constraints, or work may be constrained by having access to the site, access to results of other work, etc. In addition, the work may constrain or impact other work, equipment, facilities, etc.

d. A brief description of any previous work done in this WBS element (or its equivalent predecessor) which is intended to be used in support of the WBS element work. This description shall include the identification of the QA level(s) or QA controls under which the previous work was done.

e. The detailed statement of work which describes the Planning Cost Accounts (PCAs) in the WBS element. PCAs may be subdivided into tasks. Subdivision of a PCA into tasks is required if the tasks have different Quality Assurance Level Assignments (Section 4.5.1).

4.1.4.3.1 A description of each PCA and each task to be accomplished shall be provided.

4.1.4.3.2 For each WBS task (or PCA if the PCA is not subdivided in tasks), the following information shall be provided:

a. The methods, techniques, and equipment which will be used to perform the activity or task.

b. Approved technical procedures which are available to perform the activity or task and those technical procedures which need to be prepared prior to performing the activity or task.

c. Computer codes which are available or must be developed to perform the activity or task, including a statement of the application of the computer code.

d. A statement of how the results will be documented (e.g., SAND report, Letter Report), including references to document numbers.

4.1.4.4 Section (4) of the Work Plan shall identify, for each PCA or task, the data needed, the expected source of the data, the quality of the data, materials needed, expected source of the materials and the quality of the materials. Materials in this sense means major equipment items necessary to do the work or samples needed.

4.1.4.5 Section (5) of the Work Plan shall identify non-standard methods used to perform the tasks and shall indicate if the non-standard method has been developed or is yet to be developed. Reference shall be made to documentation of these non-standard methods.

4.1.4.6 Section (6) of the Work Plan shall identify the location (or locations) where work supporting the WBS element will be performed, including all contractors' locations.

4.1.4.7 Section (7) of the Work Plan shall include the following:

a. A "blanket" statement as follows: The Quality Level Assignments for each PCA or each Task, as applicable, shall be as specified in the SNL and WMPO-approved QALAS.

b. A summary table by PCA and Task listing all applicable SNL QA Procedures and DOPs.

4.1.4.8 Section (8) of the Work Plan shall identify the manner in which information arising from each activity will be applied or utilized in the Project.

4.1.4.9 Section (9) of the Work Plan shall provide a summary table at the PCA level of major events, including start and stop dates.

4.1.4.10 Section (10) of the Work Plan shall list past achievements in terms of milestones, documents or other "deliverables" as appropriate, and expected achievements by describing work to be accomplished. Past achievements shall include the immediate past fiscal year (FY). Expected Achievements shall include the current FY and a minimum of three additional FYs.

4.1.4.11 Section (11) of the Work Plan shall list expected achievements in terms of milestones.

4.1.4.12 Section (12) of the Work Plan shall list expected costs for the WBS element by fiscal year.

4.1.4.13 Section (13) of the Work Plan shall list the Performance Measurement criteria to be applied to the WBS element.

4.1.4.14 Additional information may be included in the Work Plans as specified by the SNL TPO.

4.2 <u>Initial Review and Approval of Work Plans</u>

4.2.1 Work Plans for administrative or non-technical WBS elements or for certain WBS elements specified by the WMPO Project Quality Manager (PQM) are required to be reviewed as specified only in Sections 4.2.2, 4.2.7 and 4.2.9, and distributed according to Section 4.2.11. The complete review and distribution process specified in Sections 4.2.2 through 4.2.12 applies to Work Plans for technical WBSs only (except for design-related WBSs, which need not be reviewed and approved by the WMPO). The SNL Quality Assurance Coordinator shall be responsible for obtaining written concurrence from the WMPO PQM on those WBS elements which are determined to be administrative or non-technical which are assigned a Quality Level assignment of "None."

4.2.2 The Task Leader shall review the Work Plan for technical completeness and accuracy and for compliance with this QAP. The Division Supervisor responsible for the WBS element may delegate this responsibility to another individual if the Task Leader is not available. The Task leader shall sign and date the Work Plan and forward it to the technical reviewer.

4.2.3 A technical review of the Work Plan shall be conducted by a qualified individual(s) other than those who developed the original plan. The technical reviewer(s) shall be selected by the Division Supervisor responsible for the WBS element. The responsible Division Supervisor may conduct the review if he is the only available technically qualified individual and if the need is documented and approved in advance with concurrence of the SNL Quality Assurance Coordinator.

4.2.4 Comments regarding the technical merit of the methods, techniques, equipment, computer codes, data, or information described in the Work Plan shall be documented by the technical reviewer. These comments shall be filed in the SNL NNWSI Project Records Management Center (Section 7.1). Editorial comments or comments that do not address technical issues need not be documented.

4.2.5 The Task Leader shall be responsible for documenting the resolution of comments from the technical reviewer. Documentation regarding the resolution of technical comments shall be filed in the SNL NNWSI Project Records Management Center (Section 7.1).

4.2.6 After the technical comments have been resolved, the technical reviewer shall sign and date the Work Plan and forward it to the responsible Division Supervisor.

4.2.7 The Division Supervisor shall review the Work Plan and resolve comments with the Task Leader. The Division Supervisor shall sign and date the Work Plan.

4.2.8 An individual from the SNL Quality Assurance organization shall review the Work Plan for compliance with this QAP and to ensure that the proper Quality Assurance levels have been assigned to the tasks described in the statement of work. The SNL Quality Assurance reviewer shall sign and date the Work Plan and forward it to the SNL TPO.

4.2.9 The SNL TPO shall review, sign and date the Work Plan.

4.2.10 The SNL TPO shall forward the Work Plan to the WMPO PQM for WMPO review and approval. (Alternatively, the SNL QA Coordinator may forward the Work Plan to the WMPO PQM).

4.2.11 The SNL Task Leader shall ensure that the resolution of WMPO review comments is documented and that these documents are forwarded to the SNL NNWSI Project Records Management Center (Section 7.1).

4.2.12 The SNL Quality Assurance Coordinator or Task Leader shall ensure that approved Work Plans are forwarded to the SNL NNWSI Project Records Management Center (Section 7.1).

4.3 <u>Preparation of Quality Assurance Level Assignment Sheets (QALAS) and Quality Level Assignment Criteria Sheets (QLACS)</u>

4.3.1 Concurrent with the preparation of the Work Plan and prior to the start of work, the responsible Task leader shall ensure that a QALAS (Appendix A) and associated QLACS (Appendix B) are prepared for each activity described in the Work Plan <u>prior to the start of work</u>.

4.3.2 The SNL Quality Assurance Coordinator shall ensure that a QALAS is prepared for each administrative or non-technical WBS element which specifies a QA Level Assignment of "None" (Section 4.2.1). A QLACS is not required for administrative or non-technical WBS elements.

4.3.3 The QALAS shall have a unique identification number and revision number and shall provide for approval signatures and dates. For technical activities, the QALAS shall reference the Work Plan number and revision and activity title for which the QALAS is being prepared. For administrative or non-technical WBS elements, the QALAS shall reference the WBS element title for which the QALAS is being prepared.

4.3.3.1 The SNL Quality Assurance Coordinator shall be responsible for assigning and maintaining a list of QALAS numbers. The list of the QALAS numbers shall be filed in the SNL NNWSI Project Records Management Center (Section 7.2).

4.3.3.2 The revision number shall be an alpha character beginning with "A." Additional revisions will be denoted with ascending letters of the alphabet.

4.3.3.3 Signature and date lines shall be provided for the Task leader, Division Supervisor, SNL Quality Assurance Coordinator, SNL TPO, WMPO PQM, and WMPO Branch Chief.

4.3.3.4 The PCA title on the QALAS shall represent the corresponding PCA discussed in the Work Plan.

4.3.3.5 Each QALAS shall contain a description of the tasks being performed in that PCA. These tasks shall represent those discussed in the corresponding Work Plan.

4.3.3.6 The QALAS shall state the QA level, justification for the QA level, and applicable QA criteria for each task, except that criteria need not be listed for QA Level III tasks. The Quality Assurance level shall be determined in accordance with Section 4.5 of this QAP. The QA level justification shall include documentation of the step from the Quality Assurance Level Assignment Checklist which was used to establish the appropriate QA level (Appendix C).

4.3.4 A QLACS shall be prepared for each QA Level I or II technical task described in the QALAS. Administrative and non-technical tasks do not require a QLACS, nor do QA Level III tasks.

4.3.4.1 The QLACS shall reference the Work Plan and revision number, QALAS and revision number, activity title, task description, and Principal Investigator.

4.3.4.2 On the QLACS, those QA criteria which apply to the task shall be designated as "Applies." Those Quality Assurance criteria which do not apply to the task shall be designated as "Does Not Apply." Annex 1 to Appendix B, "Guidance on Applicability of QA Program Elements," may be used for determining applicability of individual criteria. For QA level I or II tasks, a justification shall be provided for those QA criteria which do not apply to the task. The applicable elements should directly correspond to the QA procedures cited in Section 7 of the Work Plan.

4.4 <u>Review and Approval of Quality Assurance Level Assignment Sheets and Quality Level Assignment Criteria Sheets</u>.

4.4.1 The Task Leader shall review the QALAS and QLACS regarding technical activities and tasks for completeness and accuracy and for compliance with this QAP. The Division Supervisor responsible for the WBS element associated with the QALAS may delegate this responsibility to another individual if the Task Leader is not available. The Task Leader shall sign and date the QALAS and forward it and the associated QLACS to the Division Supervisor. The Task Leader shall not be required to review and approve the QALAS for administrative or non-technical WBS elements.

4.4.2 The Division Supervisor shall review the QALAS and QLACS regarding technical activities and tasks, sign and date the QALAS and forward the QALAS and QLACS to the SNL Quality Assurance Coordinator. The Division Supervisor shall not be required to review and approve the QALAS for administrative or non-technical WBS elements.

4.4.3 A member of the SNL Quality Assurance organization shall review the QALAS and QLACS for compliance with this QAP and to determine that the proper QA level and QA criteria has been assigned to each task and to verify that adequate justification is provided for selection of the QA levels and for QA criteria which were not selected. The SNL Quality Assurance reviewer shall sign and date the QALAS (including the QALAS for administrative and non-technical WBS elements) and forward it along with the QLACS to the SNL TPO.

4.4.4 The SNL TPO shall review and sign and date the QALAS (including the QALAS for administrative and non-technical WBS elements). The QALAS and QLACS for technical activities and tasks shall be forwarded to the WMPO Project PQM for WMPO review and approval. The QALAS for non-technical and administrative WBS elements shall be returned to the SNL Task Leader.

4.4.5 The SNL Task Leader shall ensure that the resolution of WMPO review comments is documented and that these documents are forwarded to the SNL NNWSI Project Records Management Center (Section 7.1).

4.4.6 The SNL Task leader shall ensure that approved QALAS and QLACS are forwarded to the SNL NNWSI Project Records Management Center (Section 7.1).

4.5 <u>Determination of Quality Assurance Levels</u>.

4.5.1 Each technical task or PCA shall be given a QA level assignment of either QA Level I, QA Level II, or QA Level III, each administrative or non-technical task or PCA shall be given a QA level assignment of "None." If an item or task is assigned a QA level without further subdivision, all of its subparts will have the same QA level unless an exemption is specifically documented and justified as exempt. Except for design activities, all activities required to obtain an item will have the same level of QA as the item, unless an exemption is specifically documented and justified as exempt.

4.5.2 The QA level of each technical task shall be determined by using the Quality Assurance Level Decision Tree and Annex 1, "Guide for QA Level Decision Tree," provided in Appendix C. Each question on the Decision Tree shall be considered by the Task Leader in order. Use Annex 1 for the detailed decisions abbreviated in the numbered "Decision Boxes" on the Decision

Tree. The QA level is established by whichever question is first answered, "yes." The full content of paragraphs 4.5.3.1 through 4.5.5 shall be considered when using the checklist. The step of Appendix C which is used to select the appropriate QA level shall be documented on the QALAS.

4.5.3 Quality Assurance Level I items and tasks are those that may affect the ability of the repository to meet the preclosure and postclosure performance objectives specified by the NRC and the U. S. Environmental Protection Agency (EPA) for protecting public health and safety from radiological hazards.

4.5.4 Quality Assurance level II items and tasks are those that pertain to the operation of the exploratory shaft facility or the repository, including the items and tasks that support the preclosure performance objectives that are designed to minimize the nonradiological hazard to the public and repository workers, and the radiological hazard to the repository worker. Also included are those items and tasks that may have a major impact of project costs and schedules.

4.5.5 Quality level III items and tasks are those which are not assigned QA level I, II, or "None." It is a level of quality assurance sufficient to perform the task to meet the end results, and includes: (1) design tasks which are purely preliminary and are conducted to define the range of alternatives, methods, or equipment which are determined to be worthy of more detailed study (Prior to ACD), and (2) experimental tasks which are preliminary, conducted to determine how best to structure more detailed data collection.

5.0 <u>DOCUMENT REVISIONS</u>

5.1 <u>Revisions to the Work Plans</u>

5.1.1 The Task Leader shall be responsible for revising the Work Plan whenever a new PCA or task is added to the statement of work or when an approved QA level is determined to be inappropriate. Revisions to the Work Plan for other reasons may be made at the discretion of the Task Leader. Additionally, the Task Leader will review the Work Plan at least once annually, at a time appropriate to support the Work Package Authorization System, and will initiate a revision for updating the Work Plan.

5.1.2 Two alternative procedures shall be followed for revisions and approval of revisions.

5.1.2.1 If the revision is being made to a Work Plan which was used as a basis for assigning and obtaining approval of Quality Assurance levels on items, PCAs and/or tasks involved in the SNL NNWSI Project, <u>and</u> if the revision is the result of (a) adding a new PCA or task to the statement of work of the Work Plan, (b) modifying the description of PCAs or Tasks (Section 4.1.4.3.1), (c) changing the data and materials needed (Section 4.1.4.4), (d) changing the non-standard methods and techniques (Section 4.1.4.5.), (e) changing the Quality Assurance Requirements (Section 4.1.4.7), or (f) changing the expected application of the results (Section 4.1.4.8), then the Work Plan shall be reviewed and approved in the same manner as the original Work Plan (Section 4.2).

5.1.2.2 If the Work Plan is being revised for reasons other than those specified in Section 5.1.2.1, the Work Plan shall be subject <u>only</u> to the review and approval as specified in Sections 4.2.2, 4.2.7 and Section 4.2.9. Following this review and approval, a copy of the Work Plan shall be forwarded to the SNL QA Coordinator. The SNL Quality Assurance Coordinator shall review such revisions to ensure that the previously approved QA level assignments are still valid. The SNL Quality Assurance Coordinator shall be responsible for forwarding a copy of these revised Work Plans to the WMPO PQM for information.

5.1.3 The latest revision in the Work Plan may be denoted by placing a vertical line in the right margin next to the revision. All vertical lines indicating prior revisions shall be deleted.

5.1.4 The SNL Task Leader shall be responsible for forwarding revised Work Plans to the SNL NNWSI Project Records Management Center (Section 7.1).

5.2 <u>Revisions to the Quality Level Assignment Sheets and Quality Level Assignment Criteria Sheets</u>.

5.2.1 The Task Leader shall ensure that the associated QALAS and QLACS are revised or prepared whenever a revision is made to a Work Plan for the purposes of adding a new PCA or task or changing a QA level assignment. The QALAS and QLACS shall also be revised whenever QA criteria for a task needs to be added or deleted. Revisions to the QALAS and QLACS for other reasons may be made at the discretion of the Task Leader.

5.2.2 The identification number and revision number of the associated revised Work Plan shall be referenced on the new or revised QALAS and QLACS. If a previously approved QALAS is being changed, then the QALAS revision number shall be increased and referenced on the associated QLACS.

5.2.3 If the revision to the QALAS and QLACS is the result of adding a new task, changing a previously approved QA level or deleting QA criteria, then the QALAS and QLACS shall be reviewed and approved in the same manner as the original QALAS and QLACS (Section 4.4).

5.2.3.1 When a change to a QA level assignment involves upgrading from QA Level II to QA Level I, it shall be substantiated that the QA requirements equivalent to those which would have been applied to a QA level I item or task were implemented. Technical justification for upgrading the QA level shall be documented and include the following:

- An evaluation and analysis by the SNL Quality Assurance Coordinator of the QA controls originally applied to an item or task against the intent of the QA controls required for QA Level I.

- A technical review of the data and information by two independent qualified peers. These peers shall be selected by the responsible Division Supervisor.

- A statement of verification by the original Principal Investigator (when possible) regarding the validity of the data and information.

- WMPO Director review and approval.

5.2.3.2 If the revision to a QALAS or QLACS is being made for reasons other than changing a QA level assignment or deleting QA criteria, then the QALAS and associated QLACS shall be subject to internal SNL review only (Section 4.4). The SNL Quality Assurance Coordinator or representative shall review such revisions to ensure that the previously approved QA level assignments and QA criteria are valid. The SNL Quality Assurance Coordinator shall be responsible for forwarding a copy of these revisions to the WMPO PQM for information.

5.2.4 The SNL Task Leader shall be responsible for forwarding the revised QALAS, QLACS, and associated documentation to the SNL NNWSI Project Records Management Center (Section 7.1).

6.0 RESPONSIBILITIES

6.1 The Task leader shall be responsible for the following functions:

- o Ensuring that Work Plans are prepared (Section 4.1.2).
- o Reviewing and approving Work Plans (Sections 4.2.1, 5.1.4, and 5.1.5).
- o Documenting the resolution of technical review comments regarding Work Plans (Section 4.2.4).
- o Ensuring that the QALAS and QLACS are prepared for technical activities and tasks (Section 4.3.1).
- o Reviewing and approving the QALAS and QLACS (Sections 4.4.1, 5.2.3, and 5.2.5).
- o Revising Work Plans (Section 5.1.1).
- o Revising the QALAS and QLACS (Section 5.2.1).
- o Documenting the resolution of review comments from WMPO regarding Work Plans (Section 4.2.9).
- o Forwarding approved Work Plans to the SNL NNWSI Project Records Management Center (Sections 4.2.10 and 5.1.6).
- o Documenting the resolution of review comments from WMPO regarding the QALAS and QLACS (Section 4.4.5).
- o Forwarding approved QALAS and QLACS to the SNL NNWSI Project Records Management Center (Sections 4.5.6 and 4.4.6.2).

6.2 The Principal Investigator shall be responsible for providing a statement of verification regarding the validity of data and information for the purpose of upgrading a QA level assignment from QA Level II to QA Level I (Section 5.2.4).

6.3 The Technical Reviewer shall be responsible for the following functions:

- o Conducting a technical review of the Work Plans (Section 4.2.2).

- o Documenting comments regarding the technical review of Work Plans (Section 4.2.3).
- o Approving Work Plans (Section 4.2.5).
- o Conducting and documenting technical reviews of data and information for the purpose of upgrading a QA level assignment from QA Level II to QA Level I (Section 5.2.4).

6.4 The Division Supervisor shall be responsible for the following functions:

- o Selecting technical reviewers for the Work Plans (Section 4.2.2).
- o When necessary, documenting that he is the only available technically qualified reviewer of Work Plans (Section 4.2.2).
- o Reviewing and approving Work Plans (Section 4.2.6, 5.1.4, and 5.1.5).
- o Reviewing and approving the QALAS and QLACS (Section 4.4.2, 5.2.3, and 5.2.5).
- o Selecting technical reviewers of data or information for the purpose of upgrading a QA level assignment from QA Level II to QA Level I (Section 5.2.4).

6.5 The SNL Quality Assurance Coordinator shall be responsible for the following functions:

- o Obtaining written concurrence from the WMPO PQM on those WBS elements determined to be administrative or non-technical (Section 4.1.3).
- o Reviewing and approving concurrence with the need for a Division Supervisor to be a technical reviewer for Work Plans (Section 4.2.2).
- o Reviewing and approving Work Plans (Sections 4.2.7, 5.1.4, 5.1.5).
- o Ensuring that the QALAS is prepared for administrative or non-technical WBS elements (Section 4.3.2).

- o Assigning and maintaining a list of QALAS numbers (Section 4.3.3.1).

- o Reviewing and approving the QALAS and QLACS (Sections 4.4.3, 5.2.3, and 5.2.5).

- o Conducting and documenting evaluations of the QA controls originally applied to an item or task against the intent of the QA controls required for QA Level I for the purpose of upgrading a QA level assignment from QA Level II to QA Level I (Section 5.2.4).

6.6 The SNL Technical Project Officer shall be responsible for the following functions:

- o Reviewing and approving Work Plans (Sections 4.2.8, 5.1.4, and 5.1.5).

- o Reviewing and approving the QALAS and QLACS (Sections 4.4.4, 5.2.3, and 5.2.5).

7.0 RECORDS

7.1 Copies of all correspondence and documentation regarding Work Plans, Quality Assurance Level Assignment Sheets and Quality Level Assignment Criteria Sheets shall be maintained in the SNL/NNWSI Department 6310 Records File - 90 Series - 90/1293/QAL, Quality Assurance Level Assignment Packages. This documentation shall include the following:

- o Concurrence from the WMPO PQM on those WBS elements determined to be administrative or non-technical.

- o Concurrence from the SNL Quality Assurance Coordinator of the need for a Division Supervisor to be a technical reviewer for Work Plans.

- o Technical review comments and the resolution of technical review comments regarding Work Plans.

- o Review comments and the resolution of review comments from WMPO regarding Work Plans, Quality Assurance Level Assignment Sheets, and Quality Level Assignment Criteria Sheets.

- o Approved Work Plans, Quality Assurance Level Assignment Sheets, and Quality Level Assignment Criteria Sheets.

- Technical reviews of data and information for the purpose of upgrading a QA level assignment from QA Level II to QA Level I.

- Evaluations, for the purpose of upgrading a QA level assignment from QA Level II to QA Level I, of the QA controls originally applied to an item or task against the intent of the QA controls required for QA Level I.

- Statements for verification regarding the validity of data and information for the purpose of upgrading a QA level assignment from QA Level II to QA Level I.

7.2 A listing of all Quality Assurance Level Assignment Sheets shall be maintained in the SNL/NNWSI Department 6310 Records File - 35 Series - 35/1292/5.6, Master Document List.

8.0 <u>REFERENCES</u>

10 CFR 20, Standards for Protection Against Radiation.

10 CFR 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Nuclear Reprocessing Plants.

NVO 196-17, NNWSI QA Plan.

9.0 <u>APPENDICES</u>

Appendix A - Quality Assurance Level Assignment Sheet

Appendix B - Quality Level Assignment Criteria Sheet
Annex 1 - Guidance on Applicability of QA Program Elements

Appendix C - Quality Assurance Level Decision Tree
Annex 1 - Guide for QA Level Decision Tree

Appendix D - Cover Sheet

Appendix E - Table of Contents

Appendix A

Quality Assurance Level Assignment Sheet

NNWSI Quality Assurance Level Assignment

WP No.__________________
Rev. __________________

QALAS No.__________________
Rev. __________________
Page __________of__________

Approvals (Signature and Date)

TL__________________________ QA Coord__________________________

Supervisor____________________ TPO______________________________

WMPO (PQM)____________________ WMPO (Tech)________________________

PCA:______________________________________

Task Description	QA Level	QA Criteria	Level Justification

Appendix B

Quality Level Assignment Criteria Sheet

Quality Level Assignment Criteria Sheet

WP No. ____________________ QALAS No. ____________________
Rev. ____________________ Rev. ____________________

PCA: ____________________ TL or PI ____________________

Task: ____________________

QA Criterion	Applies	Does Not Apply	Comments*
1. QA Organization			
2. QA Program			
3. Design & Scientific Investigation Control			
4. Procurement Document Control			
5. Instructions Procedures & Drawings			
6. Document Control			
7. Control of Purchased Material, Equipment, and Services			
8. ID and Control of Materials, Parts, Components and Samples			
9. Control of Processes			
10. Inspection			
11. Test and Experiment/ Research Control			
12. Control of Measuring and Test Equipment			
13. Handling, Shipping, and Storage			
14. Inspection, Test, and Operating Status			
15. Control of Nonconformances			
16. Corrective Action			
17. QA Records			
18. QA Audits			

*Use additional sheets if necessary

Annex 1 to Appendix B

Guidance on Applicability of QA Program Elements

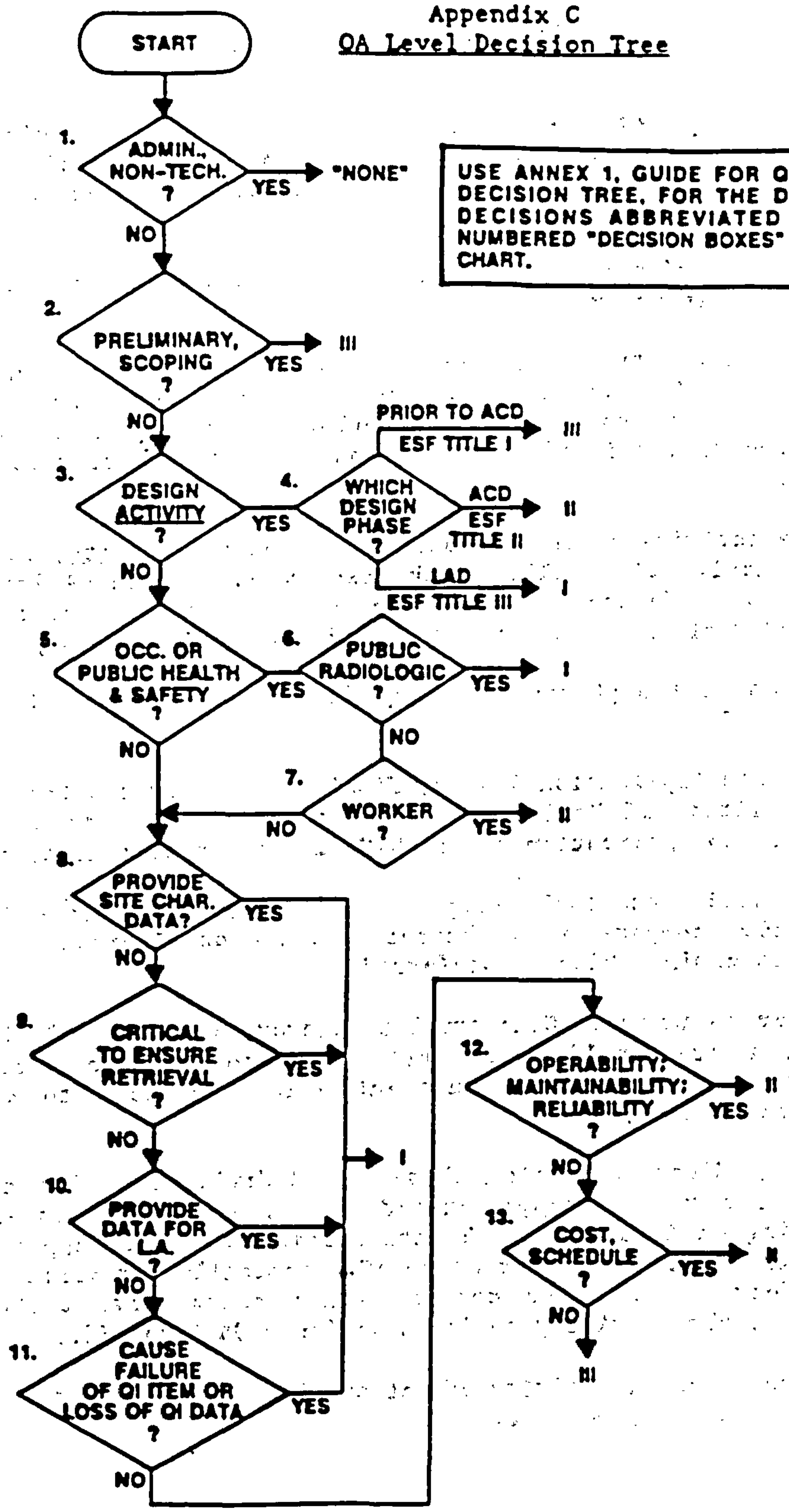
Element No.	Title	
1	QA Organization QA Program	These two elements specify the overall structure of the QA Program, some organization constraints, and certain training requirements. You have to specify these for your Planning Cost Accounts (PCAs) and Tasks, as they apply "across-the-board."
3	Design and Scientific Investigation Control	This is a split-personality element. Design-related PCAs and Tasks must adhere to the design control and verification requirements. Testing, analysis, experimentation, code use and development, and data base PCAs and Tasks are affected by the "scientific investigation control" requirements.
4	Procurement Document Control	This specifies that purchasing documents are to be reviewed and controlled and specifies some content requirements for POs. If you will purchase anything, this applies.
5	Instructions, Procedures, and Drawings	This says PCAs and Tasks affecting quality must be performed according to written procedures or drawings. Being not applicable would have to be strongly justified.
6	Document Control	If your PCA or Task involves procedures, drawings, formalized plans, or other documents which should be change-and/or distribution-controlled, this applies.
7	Control of Purchased Material, Equipment, and Services	Requirements on procurement planning, source selection, control of vendors, receipt inspection, etc. If you will buy anything, this applies.

Element No.	Title	
8	Identif. and Control of Materials, Parts, Components and Samples	Pertains to manufactured items requiring serial number or part number I.D. Also applies to control of field and lab samples.
9	Control of Processes	Requirements concerning special processes include qualification of personnel and procedures. Includes some manufacturing processes only (welding, NDE).
10	Inspection	Concerns determination of acceptability of repository hardware and "one-of-a-kind items of hardware developed and built to support research PCAs and Tasks."
11	Test and Experiment/ Research Control	Applicable for equipment testing PCAs and Tasks only.
12	Control of Measuring and Test Equipment	If your work involves use of gages, instruments or other measuring or test equipment, this applies to them.
13	Handling, Shipping, and Storage	This has to do with the preservation and protection of materials from damage. Core samples are a good example; so might be sensitive, expensive measuring instruments.
14	Inspection, Test, and Operating Status	This calls for indication (by tags, records or other means) of the status of items which must undergo a series of inspections or tests.
15	Control of Nonconformance	This element applies if any other elements are applicable.
16	Corrective Action	Closely associated with elements 15 and 18; applies whenever they do.
17	QA Records	Applicable to all other PCAs and Tasks implemented via Records Management System.
18	QA Audits	Another "across-the-board" element; all PCAs and Tasks are subject to audit.

Summary

- The following elements will normally apply to all PCAs and Tasks: 1, 2, 15, 16, 17, and 18.
- Design, analysis, code-related PCAs and Tasks are affected by certain aspects of element 3.
- Testing experimentation, research PCAs and Tasks are affected by: certain aspects of 3, 8, 5, 6, 11 and 12.
- Hardware or manufacturing-related PCAs and Tasks are affected by: 8, possibly 9, 10, possibly 13, and possibly 14.
- Any purchased materials or services are affected by 4 and 7.
- Applicability of elements 8, 9, 10, 13, and 14 take careful consideration of each case.
- Any PCAs and Tasks governed by or which generate procedures or drawings are affected by 5 & 6.

Appendix C
QA Level Decision Tree



USE ANNEX 1, GUIDE FOR QA LEVEL DECISION TREE, FOR THE DETAILED DECISIONS ABBREVIATED IN THE NUMBERED "DECISION BOXES" ON THIS CHART.

Appendix C
Annex 1

Guide for QA Level Decision Tree

This annex provides the detailed text of questions (decisions) that must be addressed in determining the QA Level of an item or activity. The numbers of the questions below correspond to the numbered decision boxes in the QA Level Decision Tree.

1. Is the WBS element, PCA, or task under consideration administrative or non-technical in nature?

2. Is the activity under consideration clearly preliminary or scoping in nature? (For example, if the activity concerns data collection or generation, is the activity intended only to determine how to go about the experiment, rather than for the purpose of producing site characterization data.)

3. Is the activity under consideration a design activity, as opposed to an item to be designed? (NOTE: Task Leaders may assign QA Levels for individual items to be designed (systems, structures, or components) by utilizing the remainder of the decision tree [decision boxes 5 through 13].)

4. In which of the phases of design listed below is the design activity to be performed?

   - License Application Design, Final Procurement and Construction Design, or ESF Title III Design - the design phase which is conducted immediately prior to application for an NRC license, procurement, or construction.

   - Advanced Conceptual Design or ESF Title II Design - design phases which involve comparative technical analyses of alternatives/methods/equipment to determine which is preferred.

   - Prior to Advanced Conceptual Design or ESF Title I Design - design phases which are preliminary and are conducted to define the range of alternatives/methods/equipment which are felt to be worthy of more detailed study.

(NOTE: Regardless of design phase, if individual design activities will be conducted for the purposes stated above, the Task Leader may assign the corresponding QA Level to those activities, subject to approval. For example, if during the design phase prior to ACD, nominally categorized as QA Level III, design efforts were to be conducted for comparative technical analysis of alternatives, that activity could be assigned QA Level II.)

5. Could the item or activity affect preclosure health and safety of the public or the repository workers?

6. Could the item or activity cause, or result in, an accident that could result in a radiation dose, either to the whole body or to any organ, of 0.5 rem, either at or beyond the nearest boundary of the unrestricted area at any time until the permanent closure of the repository?

7. Is the item or activity essential to the design, construction, and operation of the repository or Exploratory Shaft Facility, and could it have a major impact on the nonradiological health and safety of the public or repository worker, or if the item fails or the activity is performed inadequately would the repository workers be exposed to radiation or radioactive contamination in excess of the limits expressed in 10 CFR 20? ("Major impact" means a catastrophic accident with the possibility of one or more deaths.)

8. Will the item or activity provide site characterization data? Site-characterization data are the field and laboratory data and subsequent analyses that provide the basis for determining and demonstrating that the natural and the engineered systems of the repository are capable of providing long-term waste containment and isolation. This includes all tests, experiments, and research which have a significant impact to site-characterization or are an essential part of the data base that directly support the final design of the repository and the waste package as well as the assessment of repository performance. It also includes those activities (e.g., tests, experiments, and research) that are one of several independent activities contributing to a single base of information that is considered in formulating the repository design or performance assessment of the engineered or natural barriers.

9. Is the item or activity critical to ensuring the capability to retrieve emplaced waste up to the time of repository closure?

10. Is the intended purpose of the activity to provide the data which will be utilized for a license application?

11. If the item fails or if the activity is performed inadequately, could a failure of QA Level I item, or the irretrievable loss of data from a QA Level I activity, be caused?

12. Is the item or activity critical to ensuring the nonradiological operational reliability and maintainability of engineered structures, systems, or components of the repository facility?

13. If the item fails or the activity is performed inadequately, could a major cost overrun[1] or major schedule slippage[2] result? (1. More than 50 percent of the budgeted cost of the activity or item, and in excess of $500,000; 2. Schedule slippage exceeding 50 percent of the start-to-completion time, excluding slippage under two months.)

Appendix D

WP________
Rev.________
Page 1 of____

Work Plan

for

Sandia National Laboratories

NNWSI WBS Element________

____
(FY __)

Approved:	____________________ SNL Task Leader	____________ Date
Approved:	____________________ SNL Technical Reviewer	____________ Date
Approved:	____________________ SNL Supervisor	____________ Date
Approved:	____________________ SNL QA	____________ Date
Approved:	____________________ SNL TPO	____________ Date
Approved:	____________________ WMPO (Tech)	____________ Date
Approved:	____________________ WMPO (PQA)	____________ Date

Appendix E

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8. <u>Application of Results</u>

9. <u>Schedule</u>

10. <u>Past and Expected Achievements</u>
    A. Past Achievements
    B. Expected Achievements

11. <u>Milestones and Deliverables</u>

12. <u>Costs</u>

13. <u>Performance Measurement</u>

UNCONTROLLED

NNWSI Project
Training and Familiarization Procedures

Page	1	2	3	4	5	6	7	8	9	10	11	12
Revision	0	0	0	0	0	0	0	0	0	0	0	0

Approved: Mary A. Tang — Author — 7/31/86 Date

Approved: R. Richards — QA Coordinator — 7/31/86 Date

Approved: Morris ... — SNL TPO — 8/1/86 Date

Approved: As stated below — WMPO PQM — 10/10/86 Date

Approved by WMPO letter, Vieth to Hunter, subject: "Waste Management Project Office (WMPO) partial Approval of Sandia National Laboratories (SNL) Nevada Nuclear Waste Storage Investigations (NNWSI) Project Quality Assurance Program Plan (QAPP) and Implementing Quality Assurance Procedures (QAP)," dated October 10, 1986.

SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT
Issued to: M. D. Catt..., SAIC
Copy Number: #015
RETURN TO 6310 RECORDS CENTER
WHEN NO LONGER NEEDED.

NNWSI Project Training and Familiarization Procedures

1.0 Purpose

The purpose of this Quality Assurance Procedure (QAP) is to state those actions necessary to implement a training program to familiarize SNL NNWSI personnel with this organization's mission, structure and policies, including the Quality Assurance Program, and to describe continuing training, including action necessary to implement it.

2.0 Scope

This QAP delineates the basic training and familiarization necessary for all personnel working on the NNWSI Project within organization 6310 and the continuing instruction for maintenance of technical and QA currency. This QAP does not address procedures for the training or certification of personnel who perform audits or inspections, including nondestructive examination (NDE). See QAP 2-6 and QAP 2-7.

3.0 Applicability

This QAP applies to all SNL NNWSI Project Department personnel including contract personnel working within the department, and to other SNL organization personnel who are involved in an NNWSI activity and have been designated by the responsible 6310 technical supervisor to require training.

4.0 Definitions

(a) Familiarization. Instruction provided to personnel to inform them regarding general project structure and criteria, including the applicable standards and procedures, applicable QAPP requirements, specific QAPs and instruction regarding their position responsibilities and authority.

(b) Training. Instruction provided to personnel to enable them to achieve and maintain proficiency required by position responsibilities, as well as instruction to adapt to changes in technology, methods, or job responsibilities.

5.0 Procedures

5.1 Familiarization Program

5.1.1 The SNL NNWSI organization supervisors of all newly assigned personnel will develop and monitor a Familiarization Program, tailored to each employee's position responsibilities when they are assigned to the organization. The Familiarization Program will be a written document which outlines topics and familiarization activities, and which provides a general schedule for completion of the activities. A detailed example of a Familiarization Program is included as Appendix A.

5.1.1.1 Items which could be included in a Familiarization Program are:

(1) The mission and overall structure of the Office of Geologic Repositories (OGR) and associated programmatic requirements (e.g., those of the Nuclear Waste Policy Act).

(2) The NNWSI organizational structure (Waste Management Project Office (WMPO), Participating Organizations, NTS contractors, plus functions of key positions and individuals.

(3) The Work Breakdown Structure (WBS), including the functions of other Participating Organizations.

(4) The SNL organizational structure for NNWSI, SNL NNWSI major project activities, interaction with external and internal agencies.

(5) A detailed introduction to the SNL NNWSI QA Program, including an overview of the SNL NNWSI QAPP and SNL NNWSI QAPs and DOPs and a study of the procedures pertaining to the responsibilities of the person for whom the familiarization program is being written. This introduction should include a statement by the supervisor regarding SNL policy on adherence to these plans and procedures.

(6) Introduction to the specific technical (or other) work subjects to which the individual will be assigned, including familiarization with the Work Plans for the WBSs involved.

(7) The process for generating and issuing technical documents (SAND Reports and Sandia Letter Reports (SLTRs)) and submitting them into the SNL NNWSI Records Management System.

(8) The organization and operating of the SNL NNWSI Records Management System.

Note: The Familiarization Program should be tailored to the background of the individual and the content of his work. For example, an individual who has transferred from another nuclear waste program organization would require considerably less familiarization with the overall OGR Program than would an employee new to waste management work.

5.1.1.2 The structure of the Familiarization Program document shall, as a minimum, appear as follows:

(1) There shall be an introductory statement which explains the program and provides guidance on completing it. A goal (deadline) for completing the program shall be provided.

(2) The program shall consist of a series of learning activities proceeding from the general (e.g., overall OGR program) to the specific (e.g., current status of work in the individual's area of assignment). Each learning activity should be stated as an activity to complete with the objective of the activity made clear. A

sign-off space shall be provided, with the signatory designated, to document completion of the activity; this signature shall be dated.

(3) Space for a final dated sign-off by the supervisor shall be provided which documents satisfactory completion of the Familiarization Program.

5.1.2 The newly assigned individual will complete the Familiarization Training Program within the time allowed.

5.1.3 The supervisor will sign the completed Familiarization Program document and transmit it to the SNL NNWSI Records Center with the record's file number, 6310 90/1293/FAM/Q(level designator).

5.1.4 For personnel who are assigned to this organization when this procedure becomes effective, documented Familiarization Programs will also be developed by each individual's supervisor. These programs will be based upon each individual's experience in the organization as judged by the supervisor. It is permissible for the supervisor to document that, based on experience, an individual is fully familiarized with the activities for which he is responsible, with no further specific familiarization training required, except that all personnel must have formal familiarization training in the QA Program and QA-related procedures.

5.2 Continuing Training

5.2.1 Continuing training will be based on identified needs for training by SNL NNWSI task leaders, principal investigators and other program members. It will include formal training and informal training. Needs for training will be based on changes to policies and procedures, scientific or technical advances, weaknesses identified through audits and surveillances, new requirements, or other reasons determined by management or QA personnel.

5.2.2 Preparation for and conduct of formal training will include the following steps:

(1) Designation of an instructor by the Department Manager, also known as the Technical Project Officer (TPO), or by a division supervisor.

(2) Development of a training plan by the instructor with contents as outlined below:
- -- Determination of the overall objective(s) of the training (What should the "trainees" know or be able to do as a result of the training?).
- -- Determination of the existing average level of knowledge of the training audience (What do they know now?).
- -- Specific learning objective(s) to be achieved (Difference between the two levels of knowledge or performance above.).
- -- Development of a way to measure the degree to which the "trainees" have achieved the objective(s) upon completion of the training (e.g., question-and-answer session, informal oral "quiz," written examinations, performance evaluation, etc.).

-- Determination of the most effective training activity to achieve the specific objectives (lecture, forum, demonstration, practical exercise, small group conference, etc.).
-- Development of a Lesson Plan to conduct the training.
-- Development of a list of training aids and facilities necessary to conduct the training.

Both the statement of the objective and the statement of measurement should be written in terms of expected outcomes evidenced through student performance.

(3) Execution of the training as outlined in the training plan.

(4) Submittal of a completed and signed QA training session summary (Form QAP 2-5(1)-See Appendix A) by the instructor to the SNL NNWSI Records System, using the records file number, 6310 90/1293/TNG/Q(level designator). Information to be submitted includes the following:
-- Date
-- Subject matter with reference to the approved training session
-- Duration of training or familiarization
-- Name(s) of instructor(s)
-- Names of attendees
-- Outcome of the activity performed to measure degree of completion of objective.

A catalog of completed training plans, training materials, or video tapes of courses will be maintained in the SNL NNWSI Records Center. The records file numbers specified in this QAP will ensure placement within appropriate Records Center files.

5.2.3 Preparation for and conduct of informal training will include the following actions:

(1) The SNL NNWSI task leaders or other project members will identify a need for training and will present it to the department manager or to the QA coordinator along with recommendations for training implementation if possible. The department manager and QA coordinator will determine the presenter and the type of information (e.g., the department manager, supervisor, or a project leader may present QA information at a department or a division meeting).

(2) Scheduling and execution of the training session by the presenter.

(3) Form QAP 2-5 (1) may be used by the presenter to document informal training sessions. However, if this form is not used, the following minimum documentation of training sessions is required and must be submitted to the records files with the designation of 6310 90/1293/TNG/Q(level designator). Information on the training should include the date(s) of the training, the subject matter covered, names of instructors, names of attendees, duration, and brief description of types of instruction (e.g., practical exercise).

5.2.4 Additional training is provided via the distribution of Quality Assurance Advisories or Quality Assurance Bulletins. A QA Advisory is used for dissemination throughout the organization of QA-related information that is of no particular urgency. A QA Bulletin would be used for the same purpose for information which is urgent. Any individual in the organization may identify the need for either of these documents to the QA organization. The QA Coordinator will arrange for preparation and issuance of these documents as they are determined to be necessary. The distribution of the documents can be tailored based on the subject matter of the Advisory or Bulletin. A copy will be entered in the SNL NNWSI Records System file 6310 90/1293/QAB/Q(level designator).

5.2.5 Training in terms of instruction to maintain proficiency and to adapt to changes in technology, methods, or job responsibilities is available through the SNL In-Hours Technical Education Courses (INTEC) Program. The goal of the INTEC Program is to provide educational opportunities for SNL staff to increase technical and analytical capabilities. Supervisors will determine the extent to which such available training can be utilized by individual staff members and will coordinate such training with the Department Manager.

5.2.6 In conjunction with annual performance appraisal, supervisors will evaluate the need for additional training or familiarization of personnel performing QA Level I or II activities. Supervisors will document this evaluation in the record of performance appraisal for each such individual and will initiate action to cause such training to occur.

6.0 Records Management

The following QA records, which have been described above, are listed according to their records file designations:

(1) Familiarization Program -- 6310 90/1293/FAM/Q(level designator)

(2) Form QAP 2-5 (1): Training Session Summary plus other documentation of formal training as outlined in Section 5.2.3(3) -- 6310 90/1293/TNG/Q(level designator)

(3) Quality Assurance Advisories and Quality Assurance Bulletins -- 6310 90/1293/QAB/Q(level designator)

7.0 Appendices

Appendices for this QAP (2-5) are:

Appendix A -- Example of SNL NNWSI Familiarization Program

Appendix B -- Form QAP 2-5 (1), Training Session Summary

APPENDIX A
EXAMPLE
Sandia National Laboratories
Nevada Nuclear Waste Storage Investigations Project
Familiarization Program

Instructions to (staff member): The tasks stated below are a basic body of knowledge for staff working in your particular area on the NNWSI Project at Sandia National Laboratories. They are to be completed by you to the satisfaction of the individual designated to sign for each task. It is recommended, but not necessary, that they be completed in sequential order. These familiarization activities are categorized as program (P), Quality Assurance (Q), and technical (T) activities. Once all tasks are completed and signed off, your immediate supervisor will sign for completion of your Familiarization Program.

The goal for completion of this program is ____________________.
(Date)

Instructions to Designated Signatories: The tasks described below are to be performed or conducted by the new staff member to the satisfaction of the individual designated to sign off the task.

Task No.	Activity
P-1	1. Review the structure of the organizations pertinent to the Geologic Repository program and the NNWSI Project from DOE to SNL Department 6310. 2. Determine the general structure of the Geologic Repository Program Work Breakdown Structure (WBS). Determine the general WBS responsibilities assigned for NNWSI to all Participant Organizations.

Suggested references: Mission Plan, Project Plan, 6310 Department briefing viewgraphs, WBS Dictionary, discussion with staff members.

____
Supervisor/Date

P-2	Generally scan the National Waste Policy Act (NWPA) of 1982 to become familiar with contents and to identify major requirements of the law.

____
Self/Date

Task No.	Activity
P-3	1. Determine the process for approval and publication of Sandia reports (SAND documents) and Sandia letter reports (SLTRs) within Department 6310. 2. Discuss with the Technical Publications Coordinator the above process. Reference: DOP 6-2 and procedures for SLTRs. ____________________ Technical Publications Coordinator/Date
P-4	Discuss with your supervisor the functions and responsibilities of the division. Further discuss how a supervisor's role differs from that of a task leader. ____________________ Supervisor/Date
P-5	View NRC "Licensing Briefing" videotapes: ____________________ Self/Date
T-1	For each of the WBS activities listed below, 1. Read the most current version of the work plan for the activity. 2. Discuss with the task leader: - the content of the work - the major products of the work - how the tasks are or will be carried out - the status of any purchase orders/contracts

Task No.	Activity

T-1 (Cont.)

(EXAMPLE OF SIGN-OFFS)

WBS Activity		Task Leader
124212	Field Test	R. M. Zimmerman/Date
124213	Laboratory Properties	F. B. Nimick/Date
124214	Water Migration Analysis	E. A. Klavetter/Date
12522	Site Characterization Plan	A. Stevens/Date
1261	Exploratory Shaft	R. M. Zimmerman/Date

T-2 Discuss with your supervisor or Task Leader the objective(s), plans, current status, milestones, and accomplishments or problems of the specific tasks upon which you will be working.

Supervisor or Task Leader/Date

Q-1 Discuss with the QA Coordinator:

- A brief comparison of ANSI/ASME NQA-1 and 10 CFR 50 Appendix B
- The 18 "basic requirements"

QA Coordinator/Date

Q-2
1. Read "Sandia National Labs NNWSI QA Program Plan (QAPP)," which is SLTR 86-0001.
2. Obtain a list of current QAPs and DOPs from the QA Coordinator, scan them to determine general content, purpose, and applicability.
   Recommendation: Review the related sections of SNL NNWSI QAPP in conjunction with the procedures.

Self/Date

Task No.	Activity
Q-3	Discuss with the QA Coordinator, or designee, those QAPs and DOPs which will be of distinct significance in relation to your work. ____________________ QA Coordinator or Designee/Date
Q-4	1. Discuss with the Department 6310 Records Management Coordinator the Records Management System (RMS) for SNL NNWSI. Identify how "QA records" are handled within the RMS. Learn how to properly index records. Understand the interaction between SNL and the Project Records Center in Mercury, Nevada. ____________________ Records Management Coordinator/Date 2. Study the Data Records Management System (DRMS) procedure (DOP 11-3) to generally understand the purpose and scope of the DRMS as a subsystem of the RMS. Then discuss the operation of the DRMS with the DRMS Coordinator focusing on internal quality checks in the DRMS and the file code indexing of DRMS records. ____________________ DRMS Coordinator/Date
P-6	Discuss with the Department Manager (TPO) the following topics: - Sandia's role, among the participant organizations in the NNWSI Project. - The relationship of Department 6310 with WMPO. The relationship of 6310 with other Sandia organizations. - The role of the QA function regarding Sandia's work and the NNWSI effort as a whole. ____________________ Department Manager/Date

Having performed all of the above tasks, ______________________________
has completed the steps required in this Familiarization Program for the Sandia National Laboratories Nevada Nuclear Waste Storage Investigations Project.

____
Supervisor/Date

UPON COMPLETION, THIS DOCUMENT SHOULD BE FILED IN:
6310 90/1293/FAM/Q(level designator)

Appendix B

FORM QAP 2-5 (1)
Training Session Summary

Objective and Subject Matter Covered in Training Session:

Duration and Dates of Training Session:

Attendees (List can be attached):

Activity Performed to Measure the Degree of Completion of the Objective and Outcome of the Activity:

Signed:___________________________
Instructor/Date

Copy to:
6310 90/1293/TMG/Q (level designator)

Note: If this is the first presentation of the training material, attach a copy of the Training Plan and Lesson Plan. If not, make reference to the records location of the material presented.

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Rev. 0
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SNL NNWSI PROJECT
QUALITY ASSURANCE PROCEDURE

QUALIFICATION OF QUALITY ASSURANCE PROGRAM AUDIT PERSONNEL

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Rev.	0	0	0	0	0	0	0

Richard M. Baehr — 8/31/87
Author: R. M. Baehr, 6310 — Date

Approved by:

N/A
Division Supervisor — Date

[signature] — Aug 31, 1987
Quality Assurance: R. R. Richards, 6310 — Date

Thomas Hunter — 8/31/87
Department Manager: T. O. Hunter, 6310 — Date

SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT

Issued to: M. D. Cotter, SAIC

Copy Number: #009

RETURN TO 6310 RECORDS CENTER
WHEN NO LONGER NEEDED.

1.0 Purpose

The purpose of this Quality Assurance Procedure (QAP) is to state the minimum qualification requirements for personnel who perform or participate in quality assurance audits as Auditor or Lead Auditor.

2.0 Definitions

Auditor - An individual who performs any portion of an audit, including Lead Auditor.

Lead Auditor - An individual specifically qualified to organize and direct an audit, to report audit findings, and to evaluate corrective action.

Nuclear Audit - An audit of a QA program for which the requirements are derived from 10 CFR 50, Appendix B; ANSI/ASME NQA-1 or other similar nuclear QA standards.

3.0 Training Methods to Develop Competence for Auditing

The Quality Assurance Program Coordinator will establish or recommend the use of established training methods to develop Auditor or Lead Auditor competence to perform various types of audits required. One or more of the following methods may be used to achieve this goal.

3.1 Orientation

Training to provide a working knowledge of the SNL NNWSI QA Program and QA Procedure 18-1 for implementing audits and reporting results.

3.2 Training Programs

Course(s) of instruction to provide general and specialized training in audit performance. General training shall include fundamentals, objectives, characteristics, organization, performance, and results of quality auditing. Specialized training shall include methods of examining, questioning, evaluating, and documenting specific audit items and methods of closing audit findings.

3.3 On-the-Job Training

Instruction, guidance, and counseling provided during the conduct of an audit under the direct supervision of a Lead Auditor. Such training will include planning, performing, reporting, and follow-up action involved in conducting audits.

4.0 Qualification Requirements

4.1 Qualification of Auditor

An individual must meet all of the following requirements to qualify as an auditor.

4.1.1 Education and Experience commensurate with the scope, complexity, and special nature of the activities to be audited.

4.1.2 Completion of one or more of the training activities listed in paragraph 3.0. (Note: individuals who are qualified as Lead Auditor are automatically qualified as Auditors.)

4.2 Qualification of Lead Auditor

An individual shall meet the requirements listed below before being designated a Lead Auditor.

4.2.1 Education and Experience - A minimum of 10 credits to be documented as in the Lead Auditor Qualification Record (Appendix A). Also see Appendix B for explanation of credits.

4.2.2 Possess the capability to communicate effectively, both in writing and orally, as attested to by the QA Coordinator or member of management on the Auditor Qualification Record (Appendix A).

4.2.3 Have completed training, as necessary, to ensure competence in auditing skills. Training in the following areas shall be provided based on management evaluation of the particular needs of each prospective Lead Auditor.

4.2.3.1 Knowledge and understanding of the SNL NNWSI QAPP, 10 CFR 60, ANSI/ASME NQA-1, and other nuclear and/or DOE related codes, standards, regulations, and regulatory guides, as applicable to the NNWSI Project.

4.2.3.2 Knowledge of principles and techniques of auditing, including audit planning, examining, questioning, evaluating, reporting, follow-up on corrective action items, and closing out audit findings.

4.2.3.3 Knowledge of SNL documents needed to plan audits of functions related to quality for the following activities: design, purchasing, fabrication, handling, shipping, storage, cleaning. installation, inspection, testing statistics, nondestructive examination, maintenance, repair, and safety aspects of the NNWSI facility.

4.2.4 Pass an examination which evaluates comprehension and ability to apply the body of knowledge identified above. The test may be oral, written, practical, or any combination of the three types. The Quality Assurance Coordinator is responsible for the development of the examination and its administration. The results of the examination will be recorded as "passed/failed" on the Lead Auditor Qualification Record (Appendix A). Copies of the objective evidence regarding the type and content of the examination shall be filed in the SNL NNWSI Record Management System. (Note: evidence of fulfillment of any of the above requirements (4.2.1-4.2.4) in the form of Lead Auditor Qualification documents from other employers may be accepted for the purposes of this procedure, except that this organization will evaluate the communication ability expressed in 4.2.2 and will administer an NNWSI-specific exam to fully satisfy 4.2.4.

5.0 <u>Maintenance of Qualification</u>

Auditors and Lead Auditors remain qualified by participating as a member of an audit team in at least one acceptably organized and controlled audit per year, such as management, project, or supplier audit; review and study of codes, standards, procedures, instructions, and other documents related to the Quality Assurance Program and program auditing; or participation in training programs. Based on annual assessment, the NNWSI Project Department Manager may extend the qualification, require retraining, or require requalification. These evaluations will be documented on the Auditor or Lead Auditor Qualification Record (Appendices A and C).

5.1 <u>Requalification of Auditors and Lead Auditors</u>

For a lapse of one year, one or more of the following actions is required.

5.1.1 Retraining in accordance with the requirements of 4.1.2 or 4.2.3.

5.1.2 Re-examination in accordance with 4.2.4 (for Lead Auditors).

5.1.3 Participation as an Auditor in at least one Nuclear Quality Assurance Audit.

5.1.4 For a lapse of two or more years 5.1.1 through 5.1.3 are required for requalification.

6.0 The Records of Personnel Qualification/Certification for Auditor/Lead Auditor (Appendix A or C), including examinations, will be kept in the SNL NNWSI Division Records Center in the QA records 90/1293/CRT file. The records for each Auditor/Lead Auditor will be maintained and updated annually.

7.0 <u>Appendices</u>

Appendix A: Form QAP2-7(1) Lead Auditor Qualification Form.

Appendix B: Instructions for Qualification Points.

Appendix C: Form QAP2-7(2) Auditor Qualification Form

APPENDIX A

SANDIA NATIONAL LABORATORIES NNWSI
LEAD AUDITOR QUALIFICATION FORM

NAME:	Date
EMPLOYER:	
QUALIFICATION POINT REQUIREMENTS	CREDITS
Education – University/Degree Date — 4 Credits Max.	______
1. Undergraduate Level 2. Graduate Level	
Experience – Company/Dates — 9 Credits Max.	______
Technical (0-5 credits) and Nuclear Industry (0-1 credit), or Quality Assurance (0-2 credits), or Auditing (0-4 credits)	
Professional Accomplishment – Certificate/Date — 2 Credits Max.	______
1. P.E. 2. Society	
Management – Justification/Evaluator/Date — 2 Credits Max.	______
Explain: Evaluated by: (Name and Title) ______ Date	
Total Credits:	______

AUDIT COMMUNICATION SKILLS – WRITTEN AND ORAL
Evaluated by: (Name and Title) ______ Date
AUDIT TRAINING COURSES
Course Title or Topic: 1. 2. — Date
AUDIT PARTICIPATION

	Location	Audit	Date
	1.		
	2.		
	3.		
	4.		
	5.		

EXAMINATION:	PASSED:	DATE:
AUDITOR QUALIFICATION CERTIFIED BY: (Signature and Title)	Manager, NNWSI Project Dept.	Date Certified

ANNUAL EVALUATION (Signature and Date)					

FORM QAP 2-7(1)
FILE 90/1293/AUD/Q1

APPENDIX B
INSTRUCTIONS FOR QUALIFICATION POINTS

• **EDUCATION** (Highest degree only) from an accredited institution	MAXIMUM 4 CREDITS
Associate Degree	- 1
Associate Degree in Engineering, Physical Sciences, Mathematics, or Quality Assurance	- 2
Bachelor Degree	- 2
Bachelor Degree in Engineering, Physical Sciences, Mathematics, or Quality Assurance	- 3
Master Degree in Engineering, Physical Sciences, Business Management, or Quality Assurance - additional credit	- 1
• **EXPERIENCE**	MAXIMUM 9 CREDITS
Technical - One Credit for Each Year	- 5
Nuclear Industry* - including either Nuclear Power Industry, Navy Nuclear experience or Nuclear Weapons complex experience	- 1
Quality Assurance*	- 2
Auditing*	- 1
• **PROFESSIONAL CERTIFICATION** in Engineering, Science, or Quality Assurance	MAXIMUM 2 CREDITS
Professional Engineer (Registered by State Agency)	- 2
National Professional or Technical Society	- 2
• **RIGHTS OF MANAGEMENT****	MAXIMUM 2 CREDITS

* Additional credit if two(2) or more years of technical experience have been in this area.

** Based on performance factors such as leadership, sound judgement, maturity, analytical ability, tenacity, past performance, and QA training courses beyond those specifically required by this procedure.

APPENDIX C
SANDIA NATIONAL LABORATORIES NNWSI
AUDITOR QUALIFICATION FORM

______________________________, is qualified as a Quality Assurance Auditor within the SNL NNWSI Project Department by virtue of completing the Auditor training identified below:

☐ Orientation - Training which provided a working knowledge of the SNL NNWSI QAPP and QAP 18-1, "QA Auditing Procedures."

☐ Training Program - Provide name of course and sponsor; attach course description.

☐ On-the-Job Training - Training, guidance, and counseling during the conduct of audit(s) under the direct supervision of Lead Auditor ______________________________.

______________________________ ______________
QA Coordinator (Signature) Date

____
(Printed Name)

Annual Evaluation and Recertification:

Signature					
Date					

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SNL NNWSI PROJECT
QUALITY ASSURANCE PROCEDURE

SURVEILLANCE REQUIREMENTS

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Rev.	0	0	0	0	0	0

R R Richards — 7/24/87
Author: R. R. Richards, 6310 — Date

Approved by:

T E Blejwas — 7/27/87
Division Supervisor: T. E. Blejwas, 6313 — Date

Richard M. Baehr — 7/27/87
Quality Assurance: R. M. Baehr, 6310 — Date

T E Blejwas — 7/28/87
for Department Manager: T. O. Hunter, 6310 — Date

SNL NNWSI DEPARTMENT 6310
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Surveillance Requirements

1.0 PURPOSE:

The purpose of this procedure is to specify the actions to be taken in conducting surveillances of SNL NNWSI Project activities.

2.0 SCOPE:

This procedure covers those observation or monitoring activities that are done as a part of the SNL NNWSI QA Program to verify that specific project activities or items conform to requirements specified for those items or activities. This procedure may also be used to conduct overviews whose purpose is to provide assurance that future activities will occur properly.

In addition to the general scope stated above, a specific application of this procedure is for planning, performing, and documenting "source verifications" in order to determine acceptability of purchased items at the vendor facility.

This procedure specifically does not cover inspections (of items for acceptance), audits, or the checks or overviews performed by supervisory or management personnel in carrying out their function.

3.0 PROCEDURE

3.1 Scheduling of Surveillances:

Surveillances may be performed on either a scheduled or unscheduled basis.

3.1.1 The QA Coordinator will establish a schedule of surveillances of project activities based on the schedule of performance of those activities and their relative importance to the project.

3.1.2 Other surveillances may be performed at the request or initiation of QA personnel, Principal Investigators, Task Leaders, Contract Monitors, or supervisory/management personnel. Even though these surveillances are unscheduled, the following requirements of this procedure apply.

3.2 Surveillance Preparation and Planning:

3.2.1 Identify the Surveillance Team. By coordination between concerned parties, a surveillance team of one or more persons will be identified to plan, perform, and report on the surveillance. An individual will be designated as "team leader." Personnel designated to participate in surveillance activities must be qualified (as specified in DOP 2-6) in the technical area to be surveilled or in QA. However, personnel who report directly to the immediate supervisor responsible for the work being surveilled should not be selected to perform surveillance of that work. For the purpose of this procedure, those "responsible immediate supervisors" are considered to be:

- for contract work, the supervisor of the work who is employed by the contractor,

- for work performed by an SNL organization other than the NNWSI Project Department ("the department"), the Division Supervisor of that organization, and

- for work within the department, the WBS Task Leader.

3.2.2 Plan the Surveillance. The surveillance team leader shall plan the surveillance and document that planning. This documentation shall include as a minimum (see Appendix A for an example form for surveillance planning):

- The activity or item to be surveilled, including the specific characteristics of concern (i.e., the purpose and scope of the surveillance).

- The members of the surveillance team. (Their responsibilities may be addressed also.)

- The organization to be contacted during the surveillance.

- Criteria for determining acceptability of the item or activity surveilled.

The surveillance plan shall be reviewed and approved by the cognizant SNL Division Supervisor within the department. The surveillance planning and approval shall be done at any time prior to performance of the surveillance.

3.2.3 Notification. The surveillance team leader shall notify the organization or individual responsible for the item or activity of concern, either orally or in writing, prior to performance of the surveillance.

3.2.4 Prepare Checklist(s). The surveillance team members will, whenever practical, prepare checklists for the performance of the surveillance. These checklists should identify characteristics to be checked as well as acceptance criteria, and they should provide for recording objective evidence of the results of the surveillance.

3.3 Performance of the Surveillance:

3.3.1 The surveillance team will perform the surveillance, using any checklists developed to guide their activities and for recording the results.

3.3.2 Any activity or item that is found to be in non-compliance with procedural requirements, or project specifications applicable to it, will be documented on an SNL NNWSI Nonconformance Report by the team member who discovers the situation.

3.4 Surveillance Reporting:

3.4.1 Using information provided by other team members (from checklists or other means of recording surveillance results), the surveillance team leader will prepare a surveillance report. The report will contain as a minimum:

- The item or activity surveilled.
- Date of the surveillance.
- Names of surveillance team members.
- Name(s) of personnel contacted and their organization.
- Identification of any equipment used in performing the surveillance.
- Surveillance criteria.
- Results of the surveillance, including a statement of the acceptability or non-acceptability of the item or activity.
- Description of any deficiencies, nonconformances, or potential quality problems identified.

3.4.2 The surveillance report shall be signed by the team leader and sent to the organization surveilled, the individual within the SNL NNWSI Project Department responsible for the activity or item surveilled, with copies to the team members, SNL NNWSI QA Coordinator, and the Records Management System (see Section 4.0, below), as a minimum.

3.5 Surveillance Follow-Up:

3.5.1 For surveillance results documented on Nonconformance Reports, that system will provide for follow-up of corrective actions. For other surveillance results, follow-up will be conducted at the discretion of concerned parties. No documentation is required.

4.0 RECORDS MANAGEMENT

4.1 The following documents are required to be submitted to the SNL NNWSI Records Management System, by the individual indicated:

- Surveillance schedule and revisions - QA Coordinator
- Surveillance Plan - Surveillance team leader
- Nonconformance Reports - QA Coordinator
- Surveillance Report - Surveillance team leader

These records go to file 90/1293/SUR/Q? except NCRs, which go to 90/1293/NCR/Q? For surveillance of data gathering activities, NCRs and Surveillance Reports <u>must</u> also be filed in the Data Records Management System. For other activities, these records <u>may</u> be provided or cross-referenced to other appropriate series (e.g., 20, 60, 70, etc.).

5.0 REFERENCES

DOP 2-6, "Qualification and Certification of Project Personnel"

6.0 APPENDICES

6.1 Appendix A - Example Surveillance Plan Form

Appendix A

SNL NNWSI QA
Surveillance Plan

1. Activity or Item (include characteristics of concern and provide reference to applicable contracts, EPs, DIMs, PDMs, etc.):

2. Surveillance Team:

3. Organization to be Contacted (include personnel, if known):

4. Method for Determining Adequacy of Conformance to Requirements:

Surveillance Team Leader	Date
Approved: SNL Division Supervisor	Date

SNL NNWSI PROJECT
QUALITY ASSURANCE PROCEDURE

Nonconformance Control and Reporting for Items and Activities

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APP A 1
0

APP B 1
0

E. W. Shepherd 10/13/87
Author: E. W. Shepherd, 6316 Date

R. B. Pope 10/13/87
Author: R. B. Pope, 6316 Date

Approved by:

R. R. Richards Oct 13, 1987
QA Coordinator: R. R. Richards, 6310 Date

R. B. Pope 10/13/87
Division Supervisor: R. B. Pope, 6316 Date

Thomas O. Hunter 10/14/87
SNL TPO: T. O. Hunter, 6310 Date

1.0 PURPOSE AND SCOPE

This Quality Assurance Procedure (QAP) prescribes the actions for reporting, controlling, and dispositioning nonconforming items and activities. This procedure encompasses the responsibilities and methods necessary to meet the requirements for reporting, controlling, and documentating nonconforming items and activities. Procedures for unusual occurrences (per DOE/NV Order 5000.3) are not covered in this QAP (see SLI 2041).

2.0 APPLICABILITY

This procedure applies to nonconformances associated with items and activities related to the NNWSI project for which SNL has technical or administrative responsibility. It applies to NNWSI project activities at SNL. It also applies to subcontractors when specified in the applicable contract document. (For subcontractors whose QA programs call for developing their own nonconformance control procedure, this may serve as a model.)

The controls outlined in paragraphs 5.1 through 5.6 of this procedure are to be followed when there is an identified nonconforming characteristic involved with Quality Assurance Level I and II activities or items.

All or any individual aspects of this procedure may also be utilized for control of nonconformances associated with Quality Assurance Level III items and activities (see paragraph 5.7). The WMPO disposition approval of the Nonconformance Report (NCR) will not be required for Quality Assurance Level III items and activities.

3.0 DEFINITIONS

3.1 <u>Corrective Actions</u> - Measures taken to investigate and rectify conditions that are adverse to quality and, where necessary, to preclude repetition.

3.2 <u>Disposition</u> - The action taken to resolve a nonconforming condition and to restore acceptable conditions.

3.3 <u>Nonconformance</u> - A deficiency in the characteristics, documentation, or procedure that renders the quality of an item or activity unacceptable or indeterminate.

3.4 <u>QA Coordinator</u> - The person responsible for establishing and implementing the Quality Assurance Program in SNL Organization 6310 or his designee(s).

3.5 Repair - The process of restoring a nonconforming characteristic of an item to a condition such that the capability of an item to function reliably and safely is unimpaired, even though that item still does not conform to the original requirement.

3.6 Rework - The process by which a nonconforming item or activity is made to conform to the original requirements by completion or correction utilizing existing approved procedures and specifications.

3.7 Scrap/Reject - A disposition in which a nonconforming item or activity will not be permitted to be used on the NNWSI Project.

3.8 Segregate/Segregation - The act of setting apart or separating an item or items from others; the action taken (if possible) when an item (or items) is (are) found to be in nonconformance.

3.9 Suspend/Suspension - The temporary cessation of a prescribed activity or activities; the action taken (if possible) when an activity (or activities) is (are) found to be in nonconformance.

3.10 Use-As-Is - A disposition that is permitted for a nonconforming item or activity when it can be established that the item is satisfactory for its intended use.

3.11 Additional Definitions - The definitions contained in Appendix A of NVO 196-17 and SNL QAPP, SLTR 86-0001 shall be used in conjunction with this procedure, as necessary.

4.0 RESPONSIBILITIES

It is the responsibility of all SNL NNWSI Project personnel to follow the requirements of this procedure for the identification and control of nonconforming items and activities under SNL's responsibility.

Detailed responsibilities for SNL NNWSI Project personnel are outlined in Section 5.0 of this procedure.

5.0 PROCEDURE

5.1 Initiation of a Nonconformance Report

5.1.1 The individual who detects a nonconforming condition, shall initiate a Nonconformance Report (NCR). The NCR shall be the form, or shall be fully equivalent to the form, shown in Appendix A. The originator of the NCR shall complete Part I of the NCR, including pertinent information regarding the condition, enabling a disposition to be determined. The originator of the NCR shall obtain an NCR number from the QA Coordinator.

5.1.2 The NCR numbers assigned by the QA Coordinator shall be in sequential order and shall consist of "SNL-" followed by the sequential number assigned.

5.1.3 For nonconforming items, the originator of the NCR shall, as soon as practicable, affix a nonconformance tag to each item which is in nonconformance. The nonconformance tag shall be fully equivalent to the tag depicted in Appendix B. (See paragraph 5.2.)

5.1.4 For nonconforming activities, the originator of the NCR shall, in conjunction with the QA Coordinator determine if work stoppage is required. If work stoppage is required, the procedures of QAP 1-3 shall be followed.

5.1.5 The QA Coordinator shall be responsible for tracking the status of all NCRs pertaining to nonconforming items or activities which are the responsibility of SNL.

5.1.6 A log shall be maintained by the QA Coordinator of the NCR numbers issued. A copy of the original NCR shall be kept with the log until the NCR is closed.

5.1.6.1 NCR logs shall contain the following as a minimum:

o The NCR number.

o A brief description of the nonconformance.

o The person or organization responsible for determining and carrying out the disposition to correct the nonconformance.

o An indication of the status of each NCR - if it is not marked as "closed," it is considered still active.

o Spaces for the Project QA initials indicating monthly reviews.

5.1.6.2 The QA Coordinator shall review the NCR log on a monthly basis to ensure that activity toward disposition of NCRs is maintained and to evaluate for trends in nonconformances or for repetitive/recurring nonconformances.

5.1.7 The originator of an NCR shall send the original NCR to the QA Coordinator.

5.1.7.1 The QA Coordinator will evaluate whether the identified nonconformance also constitutes an "unusual occurrence" as covered by DOE Order 5000.3 and so document on the NCR. If an unusual occurrence is involved, processing per SLI 2041 will be initiated.

5.1.7.2 If the organization responsible for the item or activity which is in nonconformance is not Sandia National Laboratories, the QA Coordinator shall forward the original of the NCR to the project QA personnel of the organization responsible for the nonconforming items or activities for further processing.

5.1.7.3 The QA Coordinator shall send a copy of the NCR to the QASC, the responsible WMPO Branch Chief and SNL's TPO.

5.1.8 NNWSI Project QA personnel at affected organizations are responsible for coordinating the processing of the NCR. Upon receipt of an NCR, its number shall be recorded on any controlled documents associated with the nonconforming item or activity such as, but not limited to, experiment procedures, technical procedures, and laboratory notebooks.

5.1.9 Work on the nonconforming item or activity shall be suspended until completion of the action specified in the NCR disposition. If only a specific portion of the item or activity is in nonconformance, then that specific portion shall be identified and work may proceed on the remaining portions.

5.2 Identification and Segregation of Nonconforming Items

5.2.1 Nonconforming items shall be tagged (or otherwise identified as coordinated with the QA Coordinator on a case by case basis) by the individual initiating the NCR. Nonconformance tags shall be obtained from the QA Coordinator. As a minimum, the tag or identification shall contain the NCR number and date. The tag or identification shall remain with the nonconforming item until the NCR has been dispositioned, and the disposition has been completed and verified. The tag or identification shall be appropriately affixed to the item. If tagging or identification of each item is not practical, then the tag or identification shall be applied to the container or package. The tagging or identification shall be sufficient to avoid inadvertent use of the item. The individual applying the tag or identification shall take care to assure that the tagging or identification will not affect the end use of the item and that it is recognizable and legible. Only the QA Coordinator is authorized to remove the tag or identification.

5.2.2 The following are acceptable methods of identification:

- o Tagging - tags must be attached securely to the item or its packaging to avoid loss during handling, and
- o Identification through marking of the item itself on its packaging where the marking applied directly to the item must be such as to avoid contamination of the item.

5.2.3 The NCR originator, if practical, shall deliver the nonconforming item(s) to the QA Coordinator, who will segregate them in a designated hold area.

5.3 Identification and Suspension of Nonconforming Activities

5.3.1 Nonconforming activities shall be identified as coordinated with the QA Coordinator, on a case by case basis, by the individual initiating the NCR.

5.3.2 The Task Leader responsible for the nonconforming activity shall, as soon as the notification of nonconformance (see Section 5.1.4) is received, suspend the nonconforming activity. The suspension shall be coordinated with and approved by the QA Coordinator. Once the activity has been suspended, the activity cannot be reinitiated until such action has been approved by the QA Coordinator; this shall include the reinitiation of an activity resulting from the verification of the NCR by the QA Coordinator (Sections 5.6 and 5.7).

5.4 Disposition of NCRs

5.4.1 The individual responsible for the nonconforming item or activity (the "dispositioner") will evaluate the nonconformance and develop a course of action to resolve the nonconformance. The identity of the dispositioner shall be documented on Part II of the original NCR by the originator of the NCR or by the QA Coordinator.

5.4.2 The QA Coordinator shall forward the original NCR to the dispositioner.

5.4.3 If the QA Coordinator and dispositioner determine that the condition documented on the NCR is not a nonconformance based on such factors as the definition of a nonconformance, re-inspection, etc., then they shall void the original NCR and document the justification on the NCR. The voided original then shall be sent to the SNL NNWSI Local Record Center and copies shall be sent to the originator and to the WMPO Branch Chief responsible for the activity.

5.4.4 When the NCR is initiated on an item or activity that requires immediate attention, a verbal method of obtaining the disposition may be utilized. The dispositioner is responsible for coordinating the verbal method. The verbal method shall follow the outline in Section 5.4.5 or 5.4.6 of this procedure, except that the dispositioner shall coordinate and document the verbal inputs received from the QA Coordinator and send the documentation to the WMPO Branch Chief responsible for the activity for overall approval. All input from the contacts shall be documented on Part III of the original NCR.

5.4.5 For nonconforming item, the dispositioner of the NCR shall ensure the following:

- o Disposition has identified the course of action to be followed such as repair, rework, use-as-is, reject/scrap.
- o Appropriate justification for the disposition has been documented in part III of the NCR. In the case of use-as-is or repair dispositions, technical justification is required.
- o The disposition has referenced any approved design documents, procedures, plans, work orders, etc., that are to be used for the correction of the nonconforming condition.
- o The technical details for correction of the nonconforming condition are adequate for the recommended disposition.
- o If continued use of the item has been requested, justification for the use to continue has been documented.
- o The disposition complies with existing design documents, test plans/procedures, reports, and regulatory requirements.
- o If a change to reflect the as-built condition is appropriate, then the disposition addresses action to change the existing design documents, test plans/procedures, reports, etc.; any documents changed shall also be cross-referenced on the NCR.
- o Disposition has identified the people or organization responsible to implement the disposition.
- o A description of the cause of the nonconforming condition has been documented.
- o Action needed to preclude recurrence if appropriate has been implemented.

5.4.6 For nonconforming activities, the dispositioner of the NCR shall ensure the following:

- o Disposition has identified the course of action to be followed such as rework, use-as-is or reject.
- o The course of action to be followed to correct the effect of the nonconformance is specified in part III of the NCR.
- o The course of action to be followed includes actions necessary to preclude recurrence of the nonconformance, if appropriate.

- Appropriate justification for the recommended course of action is documented in part III of the NCR unless the disposition is the obviously appropriate course of action.

- The people or organizations to carry out the course of action are identified.

- A description of the cause of the nonconforming condition has been documented.

- Action needed to preclude recurrence if appropriate has been implemented.

5.4.7 The dispositioner shall sign and date part III of the NCR.

5.4.8 If the Task Leader for the item or activity was not the dispositioner, then the Task Leader shall evaluate the disposition/course of action and either modify or concur in the resolution indicating his approval by signing as the second "dispositioner." (Note: the dispositioner may request other individuals, such as Division Supervisors, to evaluate, concur with and sign the recommended resolution.)

5.4.9 The dispositioned NCR shall be forwarded to the QA Coordinator for review and approval. The QA review shall ensure that appropriate QA requirements have been included.

5.4.10 When the disposition for nonconforming items involves repair or use-as-is, upon approval by the QA Coordinator and before the disposition has been implemented, the original of the NCR shall be forwarded to WMPO for review and approval.

5.4.11 Upon approval by WMPO, the original shall be returned to the QA Coordinator, who shall forward the NCR to the organization responsible for implementing the disposition. Receipt will indicate approval and the requirement to implement the disposition.

5.5 Disposition Action

5.5.1 Upon completion of the NCR disposition action, the personnel responsible for implementing the action shall sign and date the NCR in part III, indicating that the disposition action has been completed, and shall then notify the QA Coordinator of completion.

5.6 Verification of NCRs for QA Level I and II Activities and Items

5.6.1 The QA Coordinator shall verify accomplishment of the resolution action. Repaired or reworked items shall be reexamined in accordance with applicable procedures and with the original acceptance criteria unless the nonconforming item disposition has established alternate acceptance criteria.

5.6.2 If the accomplishment of resolution action is acceptable, then the NCR shall be marked "ACCEPTED" and shall be signed and dated in Section IV by the QA Coordinator and copies shall be distributed as follows:

- o Item NCRs (QA Level I and II): responsible WMPO Branch Chief, QASC, originator, responsible TPO, responsible Task Leader, QA, other concerned parties and the Records Management System.
- o Activity NCRs (QA Level I and II): originator, responsible TPO, responsible Task Leader, QA, other concerned parties and the Records Management System

The completed original shall be sent to the SNL NNWSI Record Management System by the coordinating organization.

5.6.3 For items the QA Coordinator shall remove the nonconformance tag or identification from the item to indicate that the nonconformance has been cleared, shall remove the item(s) from the hold area, and shall indicate closeout of the NCR on the process sheets and NCR log.

5.6.4 For activities, the QA Coordinator shall notify by written memorandum to the Task Leader responsible for the activity that the activity may continue.

5.6.5 If the accomplishment of resolution action is unacceptable, then the NCR shall be marked "REJECTED," the NCR shall be signed by the QA Coordinator, and another NCR shall be generated to identify the existing condition. The new NCR shall utilize the same number as the original followed by a dash A (-A). Distribution of the closed NCR shall be as stated in paragraph 5.6.2.

5.7 Processing and Verification of NCRs for QA Level III Activities and Items

5.7.1 For QA Level III activities and items, at the discretion of the NCR originator or the Task Leader, the process described in Sections 5.1 through 5.5 may be used to document, control, and correct nonconformances, with the exceptions that distributions to WMPO and the QASC, and WMPO approval of repair or use-as-is dispositions are not necessary. However, if the NCR form is not used as the vehicle for resolution of nonconformances, the following must occur as a minimum:

- For a nonconforming item or items, the Task Leader must positively control them to prevent their use, processing, delivery, or installation until corrective action is taken.
- For a nonconforming activity (ies), the Task Leader or other responsible individual must identify and describe the nonconformance in the logbook pertinent to the activity.
- The Task Leader or other responsible individual must describe corrective actions taken to correct the nonconforming item or activity and any other affected item or activities in the logbook.

6.0 RECORDS MANAGEMENT

6.1 The NCR and its supporting documents are quality assurance records. They are collected, stored, and maintained in the SNL NNWSI Records Management System under file designator 90/1293/NCR/quality level designator. The QA Coordinator forwards the completed, original NCR to the Local Records Center.

7.0 REFERENCES

NVO 196-17, "NNWSI QA Plan."

SLTR 86-0001, "SNL NNWSI QA Program Plan."

DOE/NV 5000.3, "Unusual Occurrence Reporting."

SLI 2041, "Reporting of Unusual Occurrences."

8.0 APPENDICES

A. SNL NNWSI Nonconformance Report.

B. SNL NNWSI Nonconformance Tag.

SNL NNWSI NONCONFORMANCE REPORT

NCR No.: ______

Part I - Initiation

Originator/Organization: ______________________ NCR Date: ______

Nonconforming Item or Activity and Responsible Organization: ______________________

____

Specification/Drawing/Procedure Requirements: ______ Deficiency: ______

______ ______

______ ______

______ ______

Unusual Occurrence?: [] yes [] no QA Level: ______

Distribution: TPO; WMPO Br. Ch., QASC (I & II); Original to QA Coordinator

---

Part II - Person/Organization Assigned Disposition Responsibility

Person: ______________________

Organization: ______________________

Part III - Disposition

Item-Repair [] Rework [] Use-as-is [] Reject/Scrap []

Activity-Rework [] Use-as-is [] Reject []

Describe Resolution, Technical Justification, and Assignment of Responsibility: ______

____

____

____

____

(attach additional sheets as needed)

APPROVALS OF DISPOSITION:

______ Dispositioner ______ Date ______ Dispositioner ______ Date

______ Project QA ______ Date ______ WMPO/PQM ______ Date ______ WMPO/Branch Chief ______ Date

DISPOSITION ACTION COMPLETED:

______ ______ Date

Part IV - Verification

Approved Disposition Verified and Examined: Accepted [] Reject []

New NCR Number: ______ QA Coordinator: ______ Date: ______

Comments: ______________________

____

Distribution: WMPO/Br. Ch. (items only); QASC; Originator; TPO; Task Leader; QA Coordinator
File: 6310 90/1293/NCR/Q_

SNL NNWSI Nonconformance Tag

NOTE: The Nonconformance Tag shall be as depicted below, shall be no smaller than 2-1/2" x 4", and shall be of durable material with indelible printing.

2-1/2"

minimum

0

SNL NNWSI Nonconformance

This item is in nonconformance with SNL's NNWSI QA Program.

Do not remove this tag without the authority of the SNL NNWSI QA Coordinator.

Do not use item while tag is attached.

NCR No.: SNL-__________
Date: __________
Item: __________

Deficiency: __________

Signature: __________
Initiator

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QAP 16-1
Rev. 0
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SNL-NNWSI PROJECT
QUALITY ASSURANCE PROCEDURE

CORRECTIVE ACTION REPORTING

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Rev.	0	0	0	0	0	0	0

E. W. Shepherd 8/20/87

Author: E. W. Shepherd, 6316 Date

Approved by:

R. R. Richards Aug 21, 1987

QA Coordinator: R. R. Richards, 6310 Date

Ronald B. Pope 8/21/87

Division Supervisor: R. B. Pope, 6316 Date

Thomas Hunter 8-24-87

SNL TPO: T. O. Hunter, 6310 Date

1.0 PURPOSE AND SCOPE

This procedure describes the method to provide for the control and processing of SNL generated Corrective Action Reports (CAR). The CAR provides a systematic method to identify and correct significant programmatic conditions adverse to quality and to prevent recurrence.

2.0 APPLICABILITY

This procedure is to be used by SNL personnel when there is an identified need to initiate a CAR due to the existence of a significant condition adverse to quality in QA Level I or II activities. This procedure is to ensure that the conditions adverse to quality such as programmatic deficiencies or recurring nonconforming conditions are identified, documented, corrected, correction verified, and that appropriate action is taken to prevent recurrence.

3.0 DEFINITIONS

3.1 Corrective Action - Measures taken to rectify conditions that are adverse to quality and, if necessary, to preclude repetition.

3.2 Condition Adverse to Quality - An all inclusive term used in reference to any of the following: failures, deviations, deficiencies, defective items and nonconformances.

3.3 QA Coordinator - The person responsible for establishing and implementating the Quality Assurance Program in SNL Organization 6310 or his designee(s).

4.0 PROCEDURE

4.1 Initiation of a Corrective Action Report (CAR)

4.1.1 Individuals who are responsible for SNL NNWSI activities (Principal Investigators, Task Leaders, and management personnel) or QA personnel shall be responsible for initiating a CAR upon the detection of a significant condition adverse to quality which, if uncorrected, could have a serious effect on safety or operability of the NNWSI Project. These conditions include, but are not limited to, project system deficiencies, repetitive Nonconformance Reports (NCRs), repetitive surveillance findings, or repetitive audit findings.

4.1.2 On Part I of the Corrective Action Report Form (similar to or identical to Appendix A), the initiator shall describe the condition, and sign and date where indicated. The initiator shall then forward the CAR to the SNL NNWSI QA Coordinator for review and concurrence.

4.1.2.1 The SNL QA Coordinator shall, upon receipt of the CAR, ensure that the CAR is entered on the CAR Log Form. A unique number shall be assigned to each CAR and recorded on each page of the CAR.

4.1.3 The QA Coordinator shall review the CAR to ensure that the conditions reported warrant a CAR and that sufficient information has been documented to facilitate a disposition. The QA coordinator shall also review the CAR to assure that it complies with applicable NNWSI Project QA requirements and to determine whether further processing is required as an unusual occurrence according to the requirements of DOE/NVO Order 5000.3 (see SLI 2041). Upon completion of this review, the QA Coordinator shall sign and date Part I of the CAR.

4.1.3.1 If the CAR is justified, then it shall be forwarded to the SNL Technical Project Officer (SNL/TPO) for approval. Upon approval, the SNL/TPO shall sign and date Part I of the CAR and assign an individual to be responsible for the disposition of the CAR in Part II of the CAR. The CAR shall then be forwarded to the dispositioner, and a copy shall also be forwarded to the WMPO QA Support Contractor (QASC).

4.1.3.2 If the CAR is not justified, the QA Coordinator shall indicate in Part II of the document the justification for voiding the CAR. Copies of the CAR shall be sent to the originator and to the SNL/TPO. The log shall be so marked, and the CAR shall be filed in the Records Management System.

4.2 <u>Disposition</u>

4.2.1 The responsible individual, who was identified on the CAR, shall reply to the Corrective Action Report. The responsible individual shall determine the root cause of the adverse condition and complete Part II of the CAR to indicate the corrective action to be taken. The corrective action specified shall address whether items or data processed previously were affected and, if so, the action or actions necessary to resolve that effect. The corrective action will also specify actions to be taken to preclude repetition of the adverse situation. Organizations or personnel responsible for implementation of these actions will be identified, and a schedule for completion of the corrective action will be developed. The proposed corrective action shall be submitted to the SNL/TPO within 15 working days of receipt of the CAR. The dispositioner shall forward a copy of the CAR to the QA Coordinator.

4.2.2 The QA Coordinator shall monitor the CAR Log. If a response from an organization that is responsible for correcting the problem has not been received within the 15 day time limit, then the QA Coordinator shall take action to obtain a response.

4.2.3 Upon receipt of the dispositioned CAR, the SNL/TPO shall review the CAR disposition to ensure that it is sufficient to preclude repetition of the condition. Upon acceptance, the TPO signs and dates Part III, then forwards the CAR to QA Coordinator for verification of the corrective action and forwards a copy of the CAR to the dispositioner for implementation of the corrective action. If the CAR is unacceptable, it shall be returned for further action.

4.3 Verification

4.3.1 The SNL QA Coordinator shall review the corrective action to ensure that the actions have been implemented and are effective.

4.3.2 When the verification is complete, SNL QA Coordinator shall so indicate by signature and date in Part III of the CAR. The completed CAR is then forwarded to the Records Management System. Information copies of the completed CAR shall be sent to the QASC and to the originator of CAR.

4.3.3 The SNL QA Coordinator shall ensure that the CAR log is updated to indicate that the CAR has been closed.

5.0 RECORDS MANAGEMENT

Closed CAR's and any supporting documentation shall be entered by the QA Coordinator, or other person completing the CAR, into the SNL Records Management System in file designator 90/1293/CAR/Q-level designator.

6.0 REFERENCES

- SLI 2041, "Reporting of Unusual Occurrences."
- DOE/NVO Order 5000.3, "Unusual Occurrence Reporting."

7.0 APPENDICES

A. "SNL NNWSI Corrective Action Report"

APPENDIX A

SNL NNWSI
CORRECTION ACTION REPORT

CAR NO.: ____________

Part I

Initiated By: ____ Date ____________

Condition: (Describe the adverse condition in detail; reference any procedure, drawing, specification; name of organization(s) involved; and other information which will assist in arriving at a satisfactory disposition.)

Reviewed By: ____________________________________
QA Coordinator (Print Name)

Unusual Occurrence? ___ Yes ___ No

____________________________________ ______
QA Coordinator's Signature Date

Approved By: ____________________________________ ______
TPO Date

Response Assigned to: ____________________________ Response Required by ______
Date

APPENDIX A (Continued)

SNL NNWSI
CORRECTION ACTION REPORT

CAR NO.: ____________

Part II

Corrective Action: (Describe the cause of the condition, the impact on previously processed items and data, and the corrective action either taken or planned to preclude repetition. Include projected dates of completion and responsible organizations or individual(s).)

(Attach additional sheets if necessary.)

Prepared by: ______________________________ Date ________

Part III

Approval:

SNL/TPO ______________________________ Date ________

Verification:

Verified by: ______________________________ Date ________
SNL QA Coordinator

Remarks:

File:
6310 90/1293/CAR/Q?
6310 NNWSI CF

UNCONTROLLED

SNL NNWSI PROJECT

Quality Assurance Auditing Procedures

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Rev.	0	0	0	0	0	0	0	0

Authors : M J Eatough R R Richards 10/16/86
M. J. Eatough
R. R. Richards
Date

Approved: [signature] 10/17/86
Division Supervisor
Date

Approved: R R Richards 10/17/86
R. R. Richards, QA Coordinator
Date

Approved: Thomas O. Hunter 10/17/86
T. O. Hunter, SNL TPO
Date

SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT
Issued to: M. D. Foster, SAIC
Copy Number: #012
RETURN TO 6310 RECORDS CENTER
WHEN NO LONGER NEEDED.

SNL NNWSI Project
Quality Assurance Auditing Procedures

1.0 PURPOSE

The purpose of this Quality Assurance Procedure (QAP) is to specify the actions necessary to carry out the Quality Assurance (QA) audit program in accordance with the SNL NNWSI Quality Assurance Program Plan (QAPP). The audits shall be carried out to verify compliance with all aspects of the QA program and to determine the effectiveness of the program.

2.0 SCOPE

This procedure applies to the following aspects of the QA audit program for all SNL NNWSI QA Level I and II activities: planning, preparation, performing, reporting, response, and follow-up. It may be used, at the discretion of management or the QA organization, for auditing QA Level III activities. This QAP does not address training, qualification, and certification of audit personnel, which is covered by DOP 2-7.

3.0 DEFINITIONS

3.1 Findings

Statements of fact regarding noncompliance with established policies, procedures, instructions, drawings, or other requirements. Findings require an audit response specifying corrective action.

3.2 Observations

Statements of opinion regarding conditions not covered by specific requirements but which indicates an area for improvement or an adverse trend. Observations do not require corrective actions.

4.0 PROCEDURE

4.1 Planning and Scheduling

4.1.1 Annual Audit Schedule

4.1.1.1 The QA Coordinator will generate an Audit Schedule of external and internal audits at the beginning of each fiscal year. The audits included and their sequence and timing will be based on the status and importance of the audited activities to the NNWSI Project, and they will be scheduled in a manner that provides coverage of and coordination with ongoing program activities. All elements of the SNL NNWSI QA Program Plan will be scheduled to be audited at least annually. The QA Programs of external organizations, such as contractors, performing QA Level I and II work will be audited annually or once during the activity, whichever is shorter. (Pre-award or post-award audits will fulfill this requirement.)

4.1.1.2 The annual Audit Schedule will include the following information: dates of audits, activities or organizations to be audited, and the requirements against which the activities are to be audited.

4.1.1.3 The QA Coordinator will periodically evaluate the Audit Schedule and, as necessary, will revise the Schedule to ensure that audit coverage is current. This evaluation should address the timing of audits with regard to project and contractor activities; the evaluation should also include assessment of the effectiveness of the audit program based on:

a. Previous audit results and corrective actions.

b. Nonconformance reports.

c. Other sources of information, e.g., other participants or the WMPO.

4.1.1.4 The QA Coordinator will provide the annual Audit Schedule, and revisions, to WMPO.

4.1.1.5 The QA Coordinator will, as deemed necessary to provide adequate coverage, supplement the regular schedule of audits with additional audits of specific subjects. Such additional audits can be conducted in the following cases:

a. when significant changes are made in the functional areas of the QA Program,

b. when it is suspected that the quality of an item or service is in jeopardy because of significant deficiencies in the QA Program,

c. when assessment of QA Program effectiveness is considered desirable,

d. with the concurrence of the SNL Purchasing Department Contracting Representative and the contractor, to determine the capability of a contractor QA Program before awarding a contract or purchase order, or

e. after award of a contract, to determine the effectiveness of implementation of a contractor QA Program, and

f. when necessary to verify implementation of required corrective action(s).

4.1.2 Individual Audit Plans

4.1.2.1 For each audit, the designated Lead Auditor will prepare an Audit Plan, utilizing Form QAP 18-1 (1), "Audit Plan." The plan will identify:

a. the organization to be audited

b. the requirements and documents to be audited against

c. the scope of the audit

d. activities to be audited

e. the audit team

f. personnel or organization to be notified

g. the general schedule of the audit (planning through reporting)

h. the date(s) of the audit

i. the procedure or checklists to be used

4.1.2.2 The QA Coordinator will approve each individual Audit Plan prior to its implementation.

4.2 Preparation for Audits

4.2.1 The QA Coordinator will select, in coordination with Division Supervisors, certified Lead Auditors to direct audits who are independent of the activity to be audited. (For internal audits, the TPO or other designated party who does not have direct responsibility for performing the activities to be audited will select the Lead Auditor.)

4.2.2 The Lead Auditor will select, in coordination with Division Supervisors, an audit team consisting of certified auditors who do not have direct responsibility for performance of the specific activities that they are to audit. The audit team should include members who are technically knowledgeable in the activities to be audited.

4.2.3 The Lead Auditor will develop an audit checklist in the format of Form QAP 18-1 (2), "Audit Checklist," which addresses the intended scope of the audit and verifies compliance with the applicable requirements documents, as specified in the Audit Plan. The checklist will include a review of corrective actions specified as a result of previous audits of the organization.

4.2.4 The QA coordinator will establish an "Audit Designator" for the audit. This will be an alphanumeric designation which uniquely identifies the audit.

4.2.5 No later than two weeks prior to the scheduled dates of the audit, the Lead Auditor will notify the audited organization of the audit. The notification will include a copy of the Audit Plan. The notification should also indicate the general schedule desired for the audit visit, any particular personnel requested to participate, and any particular facilities or equipment needed.

4.3 Performance of the Audit

4.3.1 The audit team will hold an opening meeting with the audited organization's personnel and management at the beginning of the audit to introduce the audit team and review the audit plan, schedule, and personnel contacts. At this time, arrangements should also be made for the close-out meeting.

4.3.2 The elements that have been selected for the audit shall be evaluated by the audit team against the requirements specified in the audit checklist, including review of corrective actions taken on previously identified deficiencies. Objective evidence shall be examined by one or more members of the audit team to the depth necessary to determine if these elements are adequate for effective control and to determine whether or not they are being implemented effectively. The lead auditor may deviate from the audit plan to broaden the investigation when findings raise further questions or to delete unimportant activities. These deviations are to be annotated in the checklist.

4.3.3 Audit personnel will document the results of their audit activities on the audit checklist(s). Conditions that require prompt corrective action will be reported immediately to the management of the audited organization.

4.3.4 The close-out meeting should occur immediately after the audit to provide to the audited organization management an oral report of findings and observations. At this time, the lead auditor and the auditee management should agree that the findings are factual.

4.4 Reporting

The audit report is to be written by the audit team and signed by the Lead Auditor. It should be issued within 15 working days of the audit and distributed to all members of the audit team, the QA coordinator, audited organization management, and, if appropriate, the requisitioner and contracting representative for a contractor. The audit report is to include the audit scope, identification of the audit team, identification of the personnel contacted during the audit, and a summary of the audit results, including a statement of the effectiveness of the QA Program elements audited. Both positive and negative conditions and deficiencies should be reported. The audit report shall also contain a description of each reported finding in sufficient detail to enable corrective action to be taken by the audited organization. The audit report shall be addressed to the management of the audited organization. It shall request that they investigate the findings, devise and schedule corrective actions, and provide a written response specifying corrective actions within thirty days of receipt of the audit report.

4.5 Follow-up

4.5.1 The Lead Auditor or QA Coordinator will evaluate the adequacy of the auditee's corrective action with the assistance of the other auditors. If the corrective action is inadequate, the lead auditor will request further action.

4.5.2 Follow-up action will be taken, by observing objective evidence, to verify that corrective action has been accomplished as scheduled. The Lead Auditor will maintain a tracking system which indicates the extent of completion of the audit and close-out of findings.

4.5.3 After the corrective action has been verified, the lead auditor will issue a close-out letter stating that the corrective action is adequate.

5.0 RECORDS MANAGEMENT

Audit records include: audit schedules, individual audit plans, completed audit checklists, audit reports, written responses, and records of completion and verification of corrective actions. These records will be filed in Records Management designator 90/1293/AUD/(QA level designator).

6.0 APPENDICES

Appendix A: Form QAP 18-1 (1), Audit Plan.

Appendix B: Form QAP 18-1 (2), Audit Checklist.

SNL NNWSI QUALITY ASSURANCE
AUDIT PLAN

____
Audit Designator

Organization to be Audited:

Applicable Requirements Documents:

Audit Scope:

Activities to be Audited:

General Schedule of Audit:

Planning and Preparation-

Notification to Auditee-

Date(s) of Audit Performance-

Issue Report-

Audit Team:

Personnel or Organization to be Notified:

Procedure or Checklist to be Used:

______________________ ______________
Lead Auditor Date

Approved: ______________________ ______________
QA Coordinator Date

Form QAP 18-1(1)
File 90/1293/AUD/Q_

SNL NNWSI QUALITY ASSURANCE
AUDIT CHECKLIST

Audit Designator: ____________________ Page __ of __

Requirement	Sat.	Unsat.	Remarks

Form QAP 18-1(2)
File: 90/1293/AUD/Q_ (when completed)

NNA.880122.0033

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SNL NNWSI PROJECT TECHNICAL PROCEDURE

Preparing Cylindrical Samples, Including Inspection of Dimensional and Shape Tolerances

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SNL NNWSI DEPARTMENT 6310
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1.0 Scope

This Technical Procedure (TP) applies to the physical preparation and inspection of rock cores and other cylindrical samples which will be used in support of Nevada Nuclear Waste Storage Investigations (NNWSI) Project Experiment Procedures (EPs). This TP meets or exceeds the dimensional tolerance criteria of the International Society of Rock Mechanics (ISRM) (5.1) or the American Society for Testing and Materials (ASTM) (5.2), or both. The inspection methods are similar to those described in the ASTM procedure.

2.0 Activity Objective

The objective of the activity described in this TP is to prepare and inspect cylindrical samples to prescribed dimensions and tolerances. Although primarily intended to support mechanical experiments, this procedure may be used to support other efforts if determined applicable after a review of recognized standard methods.

3.0 Activity Description

Section 4.1 defines requirements that are common to both the grinding and the inspection of samples, such as sample identification and custody, and documentation requirements. Section 4.2 contains instructions for the machining of samples to nominal diameter and length. Section 4.3 contains procedures for inspection of the samples.

4.0 Operations

4.1 Sample Identification, Custody, and Documentation Requirements for Machining and Inspection Activities

4.1.1 Sample Identification (ID)

Sample IDs will be specified in the EPs requiring this work. These sample IDs will appear on the samples, jars, and corresponding sample custody forms, and will be used throughout work using this TP. If a sample ID marking becomes illegible, it should be rewritten on a portion of the sample where it would not be removed during subsequent processes. In any case, only one unmarked sample should be outside of its jar at any one time.

4.1.2 Documentation Requirements

Responsibility for ensuring that work is performed and documented in accordance with this TP lies with the SNL NNWSI Project Principal Investigator (PI) of the EP requiring the work.

4.2 <u>Machining of Samples</u>

4.2.1 Tolerances

A. The sample diameter will be machined to within ± 0.005 in. (0.13 mm) of the nominal diameter defined in the EP. The EP may also define criteria pertaining to the length-to-diameter ratio (L/D).

B. The sample length will be machined to within ± 0.005 in. (0.13 mm) of the nominal length defined in the EP. The EP may also define criteria pertaining to the length-to-diameter ratio (L/D).

C. The sides of the sample will be generally smooth and free of abrupt irregularities, with all elements straight to within 0.010 in. (0.25 mm) over the full length of the sample.

D. The ends of the sample will be surface ground, lapped, or machined to within 0.001 in. (0.025 mm) flatness.

E. The ends of the sample will be parallel to each other within 0.001 in. (0.025 mm).

F. The ends of the sample will not depart from perpendicularity to the longitudinal axis of the sample by more than 0.001 in. for each inch of sample length (0.025 mm in 25 mm).

G. If applicable, an appropriate ratio between grain and/or pore size and sample dimensions will be defined in the EP.

4.2.1.1 Exemption From Tolerances

Surface features attributable to naturally occurring cavities in rock samples are exempt from the tolerance requirements.

4.2.2 Environmental Criteria

The use of capping materials or end surface treatments other than machining are not permitted. Lubricants or fluids other than distilled water and the sample ID markings are not permitted to contact the samples. Heating of the samples should be minimized. Excess force in fixturing the samples should be avoided. No attempt will be made to control the moisture content of the samples during the work in this TP.

4.2.3 Description of Processes

The following aspects of procedures used on the samples will be documented and provided with the finished samples:

A. Type and make of tools and machines that have been used.

B. Methods used to ensure that rock samples did not come into contact with machining oils or other solvents, other than distilled water.

C. Methods used to clamp the sample to a machine, tool, or fixture.

D. Description of the processes used on the samples (written in the order in which they were performed).

4.2.4 Reporting Measurements of Ground Samples

The measurements report provided with the machined samples will be written in black indelible ink, with units reported in either inches or millimeters, but not a combination of the two. The measurements report will contain:

A. Name, location, and division (if applicable) of the company performing the processing.

B. Title (or number) and revision of the EP which requires the processing.

C. Page # of total page count (e.g. page 1 of 4)

D. Date(s) of measurements.

E. Name and affiliation of person(s) who requested the work.

F. Quantity and identification of samples.

G. Description of measurements, i.e., nominal dimension and tolerance, and measured dimension, including units, for:

1. diameter and length,
2. straightness of sides,
3. flatness of sample ends,
4. parallelism of sample ends,
5. perpendicularity of sample ends to longitudinal axis.

H. Notation of nonconformances and out-of-tolerance measurements.

I. Name of person(s) who performed the machining and subsequent measurements (printed, signed, and dated).

4.2.5 Safety

There should be no safety hazards other than the normal hazards of the equipment. Operations will be in accordance with safety requirements of the facility where the work is being performed and those of the employer of person(s) performing the work.

4.3 Inspection and Acceptance of Samples

Inspections are not to be performed by the same person who performed the machining of the samples or who completed the measurements report described in section 4.2.4 of this TP.

4.3.1 Inspection Equipment

Inspection equipment will be clean during the inspections defined in this TP.

A. Inspections described in Sections 4.3.2.1 - 4.3.2.6 may be made with electrical or mechanical (dial) gage indicators having a readability ten times greater than the tolerance being measured, e.g. to measure a tolerance to $\pm$ 0.005 in., the gage indicator must have a readability of at least 0.0005 in.

B. Surface plates, V-Blocks and leveling plates used during inspections must be of machinist quality so that cumulative errors are less than 0.0001 in. (0.0025 mm).

4.3.1.1 Calibration of Gages

A. For inspections performed by the Mechanical Measurements Division at SNL, gages and instruments will be on a calibration recall system with calibrations traceable to the SNL Primary Standards Laboratory.

B. For inspections performed under contract, requirements for calibration of gages will be specified in the EP.

4.3.1.2 Calibration Checks

Gage blocks (with measurements of length and flatness made by or traceable to the NBS) may be provided with the samples for inspection. If provided, their length and flatness will be measured and reported with the results of the other samples.

4.3.2 Inspection Criteria and Methodology

Surface features attributable to naturally occurring cavities in the rock are exempt from the tolerance requirements.

4.3.2.1 Determination of Deviation from the Nominal Sample Diameter

A. Tolerance
The sample diameter will be within ± 0.005 in. (0.13 mm) of the nominal diameter.

B. Method of Inspection
Determine the diameter of the sample to the nearest 0.001 in. (0.025 mm) by averaging two diameters measured at right angles to each other at about midheight of the sample.

4.3.2.2 Determination of Deviation from the Nominal Sample Length

A. Tolerance
The sample length will be within ± 0.005 in. (0.13 mm) of the nominal length.

B. Method of Inspection
Determine the length of the sample to the nearest 0.001 in. (0.025 mm) at the centers of the end faces.

4.3.2.3 Determination of Deviation from Straightness of the Sample Sides

A. Tolerance
The sides of the sample will be generally smooth and free of abrupt irregularities, with all elements straight to within 0.010 in. (0.25 mm) over the full length of the sample.

B. Inspection Method Choices
B.1 Method #1.

1. Place the cylindrical surface of the sample on a V-block that is laid flat on a support surface. The V-block will have a 90° included angle. The length of the V-block will be sufficient that the sample will not project over its ends during sample measurement.

2. Place the indicating gage in contact with the top of the sample, as shown in Figure 1 (page 12), and observe the dial reading as the sample is moved from one end of the V-block to the other along a straight line, (parallel to the sample axis without sample rotation). The measurement contact tip of the indicating gage will be round in shape.

3. Record the maximum and minimum readings on the indicating gage and calculate and record the difference. If the indicating gage traverses a natural cavity in the rock, the readings in this region should not be used. Repeat the operation two additional times by rotating the sample about its own cylindrical axis approximately 120°, obtaining the max-min at approximately 120° and 240°.

B.2 Method #2

1. Place the cylindrical surface of the sample on a V-block that is laid flat on a leveling plate which is on the support surface. The V-block will have a 90° included angle. The length of the V-block will be sufficient that the sample will not project over its ends during movement of the sample.

2. Adjust both ends of the leveling plate to zero and then traverse the indicating gage back and forth (perpendicular to the core axis) on the sample approximately every 0.12 in. (3.0 mm) for the entire length of the sample.

3. Record the maximum and minimum readings on the indicating gage and calculate the difference. If the indicating gage traverses a natural cavity in a rock sample, readings in this region should not be used. Repeat the operation by rotating the sample approximately every 120°, obtaining the max-min at approximately 120° and 240°.

4.3.2.4 Determination of Deviation from Flatness of the Sample Ends

A. Tolerance

The end surfaces of the sample will be flat to within 0.001 in. (0.025 mm).

B. Inspection Method

1. Insert a leveling plate under a sample with the longitudinal axis of the sample perpendicular to the support surface.

2. Adjust all points of the leveling plate until the top of the sample (end A) is parallel to the support surface.

3. Sweep the entire end surface, recording the min-max. The measurements report should clearly note when a measurement is affected because the gage tip drops into a natural cavity in a rock sample.

4. Repeat steps 1, 2, and 3 for the other end (end B) of the sample.

4.3.2.5. Determination of Deviation from Parallelism of the Sample Ends

A. Tolerance
The ends of the sample will be parallel to each other within 0.001 in. (0.025 mm)

B. Inspection Method
1. Stand the sample with either end on the support surface (with its longitudinal axis perpendicular to the support surface).

2. Place the indicating gage on the upper end of the sample and sweep the entire surface of either end of the sample.

3. Record, in tabular form, the min-max of the indicating gage readings. The measurements report should clearly note when a measurement is affected because the gage tip drops into a natural cavity in a rock sample.

4.3.2.6 <u>Determination of Deviation of the Sample End Perpendicularity to the Longitudinal Axis of the Sample</u>

A. Tolerance

The ends of the sample will not depart from perpendicularity to its longitudinal axis by more than 0.001 in. for each inch of sample length (0.025 mm for each 25 mm of sample length).

B. Method of Inspections

NOTE: This inspection should be performed only if a sample has met the criteria for flatness and parallelism of the ends as specified in Sections 4.3.2.4 and 4.3.2.5 of this TP.

1. Stand the sample (either end up) on a leveling plate on the working surface of a Moore Inc. Model #3 (or equivalent) measuring machine.

2. Run a indicating gage up and down along the side of the sample, adjusting the leveling plate as necessary to bring the side perpendicular to the surface support.

3. Turn the indicating gage approximately 90°, keeping the same sample end on the leveling plate. Run the indicating gage up and down along the side of the sample, adjusting the leveling plate as necessary to bring the side perpendicular to the surface support.

4. Repeat steps 2 and 3 until the longitudinal axis of the sample is as close as possible to being perpendicular to the surface support.

5. Run the indicating gage across the center line of upper end of the sample, recording the maximum deflection.

6. Rotate the indicating gage approximately 90° and repeat the measurement in step number 5.

4.3.3 Reporting Inspection Measurements

The measurements report provided with the machined rock cores will be written in black indelible ink, with all units being exclusively either in inches or millimeters. The measurements report will contain:

A. name, location, and division (if applicable) performing the inspection,
B. title (or number) and revision of the EP which requires the processing.
C. page # of total page count, (e.g. page 3 of 6),
D. date(s) of inspection(s),
E. name and affiliation of person who requested the inspection,
F. manufacturer/make, model, and serial number (or other unique identifier) of gages and instruments used during the inspection,
G. quantity and identification of samples,
H. description of inspection (i.e., method number if more than one type described in this TP, number of measurements, nominal dimension, tolerance, measured dimension, and unit of measurements to record all measurements specified in Section 4.3.2.),
I. notation of nonconformances and out-of-tolerance measurements,
J. name of person(s) who performed the inspection (printed, signed, and dated), or person certifying the inspection.

5.0 References

5.1 International Society for Rock Mechanics (ISRM) Commission on Standardization of Laboratory and Field Tests, "Suggested Methods of Determining the Strength of Rock Materials in Triaxial Compression: Revised Version," 1983.

5.2 American Society for Testing and Materials (ASTM) D4543 - 85, "Standard Practice for Preparing Core Specimens and Determining Dimensional and Shape Tolerances," Published January 1986.

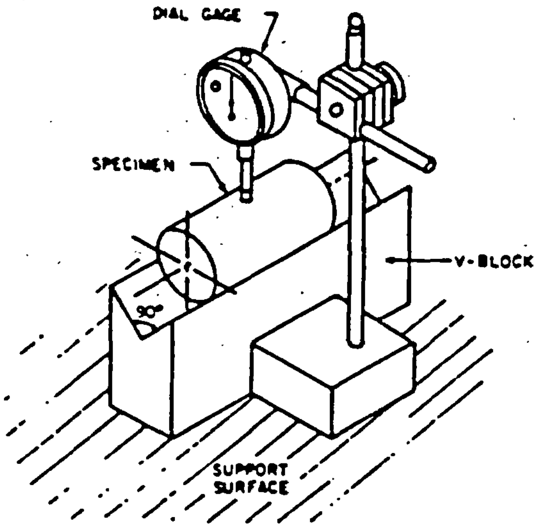

Figure 1. Assembly for Determining the Straightness of Elements on the Cylindrical Surface (Reference 5.2)

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SNL NNWSI Technical Procedure:

Procedures for Laboratory Sample Petrology Determination

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1. PURPOSE

The purpose of this document is to describe the processes and methods used in the Institute of Meteoritics (IM), University of New Mexico, to obtain petrologic data for samples provided for study by Sandia National Laboratories (SNL) as part of the Nevada Nuclear Waste Storage Investigations (NNWSI) Project. A flow chart is provided which details various stages of sample analysis from receipt of rock samples to preparation of a report on results and includes points at which decisions are made regarding application of various analytical techniques (Appendix A). Procedures for these associated techniques are detailed in separate documents including TP-63 for electron microprobe (EMX) analysis; TP-62 for X-ray diffraction (XRD) analysis; TP-80 for scanning electron microscopy (SEM); and TP-61 for whole-rock chemical analysis.

2. SCOPE

This procedure applies to any rock or mineral samples or standard reference material (SRM) provided by SNL for study in conjunction with the NNWSI project.

Specific types of data required may vary, depending on the particular SNL task which the data collected at UNM is to support. Specific requirements are to be detailed in Experiment Procedures (EP) from the SNL Principal Investigator (PI) to UNM, and decisions regarding the most appropriate analytical techniques for obtaining the required data are made in consultation with the PI. Special procedures for maintaining records of sample movement for various sample preparation procedures, other than those detailed in Section 4.3 of this procedure, are to be specified in a EP.

3. PROCEDURES

3.1 Hand Sample (Mesoscopic) Description

All sample data are recorded on the NNWSI-Sandia-IM Tuff Sample Description Form (Appendix B). Mesoscopic descriptive data include color, texture, and clast types, plus an estimate of sizes and sorting characteristics of clasts. An estimate of modal (volumetric) proportions is made for samples containing fragments larger than about 5mm. The estimate is made either visually (utilizing size/proportion charts from Lof, 1982 [Appendix C]), or, on intact cores, by point counts at 1 mm intervals along lines marked on the surface of the core. Lines are generally marked at regular angular intervals about the core axis, typically with 6 to 8 lines per core for a 2 inch diameter core. A 10X hand lens and/or a Bausch and Lomb (Brand) binocular microscope (UNM ID# 36545) with variable magnification) are used to aid in sample examination. A clear plastic scale, graduated in millimeters, is used to aid in size estimation for components; this allows size estimation accurate to about ±0.2 to 0.4 mm. If thin sections are to be made, locations of representative parts of the sample are selected after hand sample description, and lines are marked on the sample to locate the position of chips which will be cut from the sample and used to make the thin sections.

For almost all samples of intact rock, at least one polished thin section will be prepared. Samples for sections are chosen by the Project Research Scientist as those which, in his/her judgement, are representative of the rock as a whole. If there are notable variations in texture or composition, several sections may be prepared to show this variation. Unless otherwise noted on the Sample Description Form, sections are cut perpendicular to bedding or foliation. Procedures for preparation of polished thin sections are detailed in a separate document (TP-60).

3.2 Sample Crushing

If XRD or whole-rock chemical analyses are required, part of the sample must be crushed to a fine powder (100 mesh = 150 um). A representative sample of the rock (typically 10 to 20 g) is selected, broken into small pieces using a Plattner (Brand) hardened steel mortar and pestle; the Plattner mortar is "precontaminated" by fragmenting small amount of sample (1-2 g) which is discarded prior to fragmenting the bulk of the sample. The fragmented sample is crushed in a Spex Industries tungsten-carbide Ball Mixer Mill (Model 8000) for 10 to 15 minutes. The powder is passed through a 100 mesh nylon screen (supplied by Sargent-Welch Scientific Co. or similar supplier). Prior to use, the 100 mesh nylon screen is examined under the binocular microscope for uniformity and the presence of any tears or other damage; damaged screens are not used for sieving. The residual (unpassed) powder is then crushed again in the Spex Mill for 3 to 5 minutes, and passed through the 100 mesh screen. Any residual from this second screening is crushed utilizing a Dia-mon-ite (Brand) synthetic alumina (Al_2O_3) mortar and pestle (manufactured by U.S. Ceramic Tile Co.), and passed through the 100 mesh nylon screen. Screened powder is agitated by shaking of the sample container (by hand) for about 30 seconds after which a small quantity (about 1-2 grams) of mixed powder is returned to the mortar. This powder is re-ground for about 30 seconds (to remove any minerals adhering to the mortar), then scraped from the mortar with a new piece of weighing paper and passed through the sieve again. The sieved powder is agitated in a suitable container (usually the container to be used for storage of the powder) in the mixer mill for 3 to 5 minutes to assure homogeneity. Representative splits of the powder are obtained utilizing a Carpco (Brand) microsplitter. Between samples, the Spex mill, ceramic mortar and pestle, and screens are cleaned by washing in warm soapy water, rinsing in hot tap water followed by deionized water, blotted with a lint-free disposable wiper and allowed to air dry. The Plattner mortar and pestle are brushed and wiped clean. A sample preparation data sheet (Appendix D) is prepared for each group of samples detailing results of screen inspection, sample weights and start/finish completion dates.

Procedures for whole-rock chemical analysis and XRD analysis are detailed in separate documents as listed in Section 1.

3.3 Whole-section Photographs

Whole-section photographs of polished thin sections are prepared in the photo laboratory in the IM utilizing a Nikon F-3 camera and 55mm or 90mm macro lens (or equivalent equipment) and Kodak T-Max (or similar) film. Negatives are printed on non-glossy Kodak Polycontrast rapid II RC paper using standard darkroom techniques, with prints at least 8" X 10". A millimeter scale is photographed with each sample. Prints are made with both normal and reversed images to match the images viewed in the electron microprobe and light optical microscope, respectively. For any photographic work specifically requested in an EP, two copies of requested photographs will be provided to SNL. Negatives are kept on file in the IM and transmitted to the SNL PI as specified in section 4.3. Photographic procedures are outlined in a darkroom manual kept in the photo lab in the IM.

3.4 Microscopic Thin Section Description

Optical petrographic study of polished thin sections is done in the IM using one of two Carl Zeiss Research Microscopes (UNM ID#s 104825 or 144592). These microscopes allow examination of sections in both transmitted and reflected light. Magnification range is between 31X and 500X, and a micrometer eyepiece is used to measure grain sizes. The micrometer scale is a fixed, integral part of the microscope ocular, and calibration of that scale has been done using a glass Carl Zeiss micrometer scale with scale divisions to 0.1 mm. Size estimates are not rigorously quantitative and do not require extreme precision in measurement. Microscopic features of interest may be photographed with a 35mm camera built into one of the microscopes (#104825). Location of the areas photographed are marked on the whole-section photographs, and the resultant 35mm slides are marked with sample numbers and location information as soon as they are returned from processing. Scales for photographs are prepared using standard scale ratio techniques as follows: Note and measure distances, in the same measurement units, between two recognizable points in the photograph with a millimeter scale and in the thin section using the microscope's ocular scale. The ratio of the distance in the photo to the distance on the section gives a number equivalent to the absolute magnification of the photograph. This number, "#", is written on the back of all photographs as "Mag = #", and is used, if necessary, to construct a graphical bar scale for the photograph for reporting. All photographs included as part of reports to the PI will include a bar scale.

Descriptive data are recorded on the same Tuff Sample Description Form containing the hand sample descriptive data. Data include fragment types (e.g., varieties of phenocrysts, shards, pumice, etc.), fragment sizes and size ranges, fragment shape, and other optical properties useful for identification (e.g., color, birefringence, twinning). The degree of welding is estimated based on deformation of matrix material, extent of devitrification is described and other textures of interest, including the size and extent of visible pores, are noted. Modal (volumetric) proportions of various components may be estimated visually if more precise data from point counting are not required.

3.5 Modal Analysis by Point Count

Point counts of modal (volumetric) proportions of identified constituents in polished thin sections are made using a Swift Model CD Automatic Point Counter with motorized mechanical stage (manufactured by Swift, LTD., Basingstoke, England). The stage may be adjusted to provide a minimum grid spacing of 1/3mm ("east-west") by 1/5mm ("north-south"). North-south grid spacing is controlled by the operator by a one-way ratchetting mechanism on the stage allowing spacing at multiples of 1/5 mm; a scale in millimeters engraved on the stage is used as a visual check. East-west spacing is controlled mechanically by the stage gearing, with steps adjustable at 1/3 mm intervals allowing a counting interval of 1/3, 2/3, 1, or 1 1/3 mm; a scale in millimeters engraved on the stage is used as a visual check. Although the operator will constantly check that the equipment is operating properly, occasional errors in grid spacing (i.e. 1 1/3 mm vs. 1 mm for a count line) will not affect results significantly. For most NNWSI work a 1mm by 1mm grid is used unless otherwise specified by the SNL PI in an EP. The total number of points counted (typically about 400 per section) is recorded on the sample description form and the amount of each component is calculated by:

$$M_I = \frac{N_I}{N_T}$$

where M_I is the modal fraction of component I in the section, N_I is the number of points counted for I, and N_T is the total number of points counted. Accuracy of the procedure is dependent on the total number of points counted on a grid, the spacing of which is not significantly smaller than the largest component to be counted. Accuracy may be estimated using the graphical method of Van der Plas and Tobi (1965).

3.6 Safety

No procedures described in this document present any cause for concern regarding personnel safety.

3.7 Data Synthesis and Reporting

Both the type of data synthesis required and reporting formats (letter, memorandum, contractor report, etc.) are specified by the Sandia PI in an EP to the Director of the IM at UNM. All aspects of data collection (including quality assurance) are coordinated by the project Research Scientist in the IM, who is also responsible for preparation of reports in collaboration with the Director.

Originals of all data are kept on file by project in the IM, to be turned over to SNL at the completion of NNWSI related work by UNM at some unspecified future date.

4. QUALITY ASSURANCE

4.1 Personnel

Only qualified personnel approved by the Director of the IM shall be allowed to perform this work. Evidence of qualification, in the form specified in the governing EP(s), will be kept on file in the IM and will be provided to the SNL PI upon request.

4.2 Calibration

Checks of the conditions of the screens used for sieving are discussed in Section 3.2, the scale calibration for the micrometer eyepiece of the petrographic microscopes are discussed in Section 3.4, and the scale on the point counting equipment is discussed in Section 3.5. No other equipment specifically addressed in this procedure requires calibration. Calibration requirements for procedures associated with petrologic analysis are addressed in separate documents on x-ray diffraction (TP-62), electron microprobe analysis (TP-63), and whole-rock analysis (TP-61).

4.3 Sample Traceability

Sample identification numbers will be supplied by SNL with samples provided along with original copies of NNWSI-SNL Sample Collection Reports and Chain-of-Custody forms as described in SNL-NNWSI DOP 8-1. The sample handling requirements outlined in DOP 8-1, and detailed in the EP governing the work, including maintenance of chain-of-custody forms for each sample, will be followed.

Whenever samples must be split for different types of analysis, the new sample numbers generated will be of the general form:

ID-XXab

where	ID	is the SNL ID assigned in the EP governing the work.
	XX	is a one or two letter mnemonic code for the type of analysis the split is for (i.e., TS for thin section, WR for whole-rock analysis, XR for XRD, etc.).
	a	is an arabic numeral in sequence beginning with 1 for each sample of type XX.
	b	is a lower case letter in sequence beginning with "a" used only if further division is required.

For example, if the SNL ID for a sample is USW G-1 1259-IM, and is for chemical analysis and XRD, the new sample numbers will be USW G-1 1259-IM-WR1 and USW G-1 1259-IM-XR1. The remainder will be assigned the number ID-LOa ("a" as above) for "leftover", and "a" will be incremented each time a split of the leftover is taken for another purpose. Minor variations from this ID assignment strategy associated with various analytical techniques (i.e. x-ray diffraction, microprobe analysis, SEM analysis, and whole-rock analysis) are discussed in the appropriate TPs.

Copies of sample shipment letters or memoranda are kept on file with project data in the IM. A letter of transmittal accompanies all samples submitted for thin section preparation and whole-rock analysis, listing the sample numbers and detailing how the particular procedures are to be completed, and requesting the return of all materials upon completion.

Whenever possible, the complete sample ID supplied by SNL or generated by splitting the samples for various analytical techniques will be maintained during all analytical work. If the length of sample numbers is excessive (i.e., too large to be used as a thin section label), a sheet detailing sample number variation will be prepared and kept with the EP and a copy transmitted to the SNL PI before data are collected on the samples. "Working" sample numbers will always be a shortened form of the SNL ID.

Upon request from the SNL PI, or upon completion of NNWSI-related contract work, samples are returned to SNL accompanied by a transmittal letter and original chain-of-custody forms. A copy of this letter is kept on file in the IM.

5. RECORDS

5.1 Records Generated

A Tuff Sample Description form is completed and updated for each sample as successive stages in the analysis are completed. Additional data from other procedures are collected and filed, by sample, with the description. These data may include XRD data and results, whole-rock chemical analysis, microprobe chemical data, etc. In addition to the data filed by Sample, a single project file is maintained with copies of the project EP, any Sample Preparation Data Sheets produced during work on groups of samples (thin section, sample crushing, etc.), all IM-SNL written communications, and notes on any oral communications. All forms will be completed in black, indelible ink. Units to be used to record data will be specified by the EP governing the work.

5.2 Maintaining and Reviewing Records

Project Records are maintained and reviewed by the Project Research Scientist in the IM.

5.3 Transmittal of Records

Copies of records are transmitted with a letter of transmittal to the SNL PI following requirements specified in the EP. All original data, letters, etc. are kept on file in the IM, until such data are requested by the SNL PI or until such time as all NNWSI project-related work is completed.

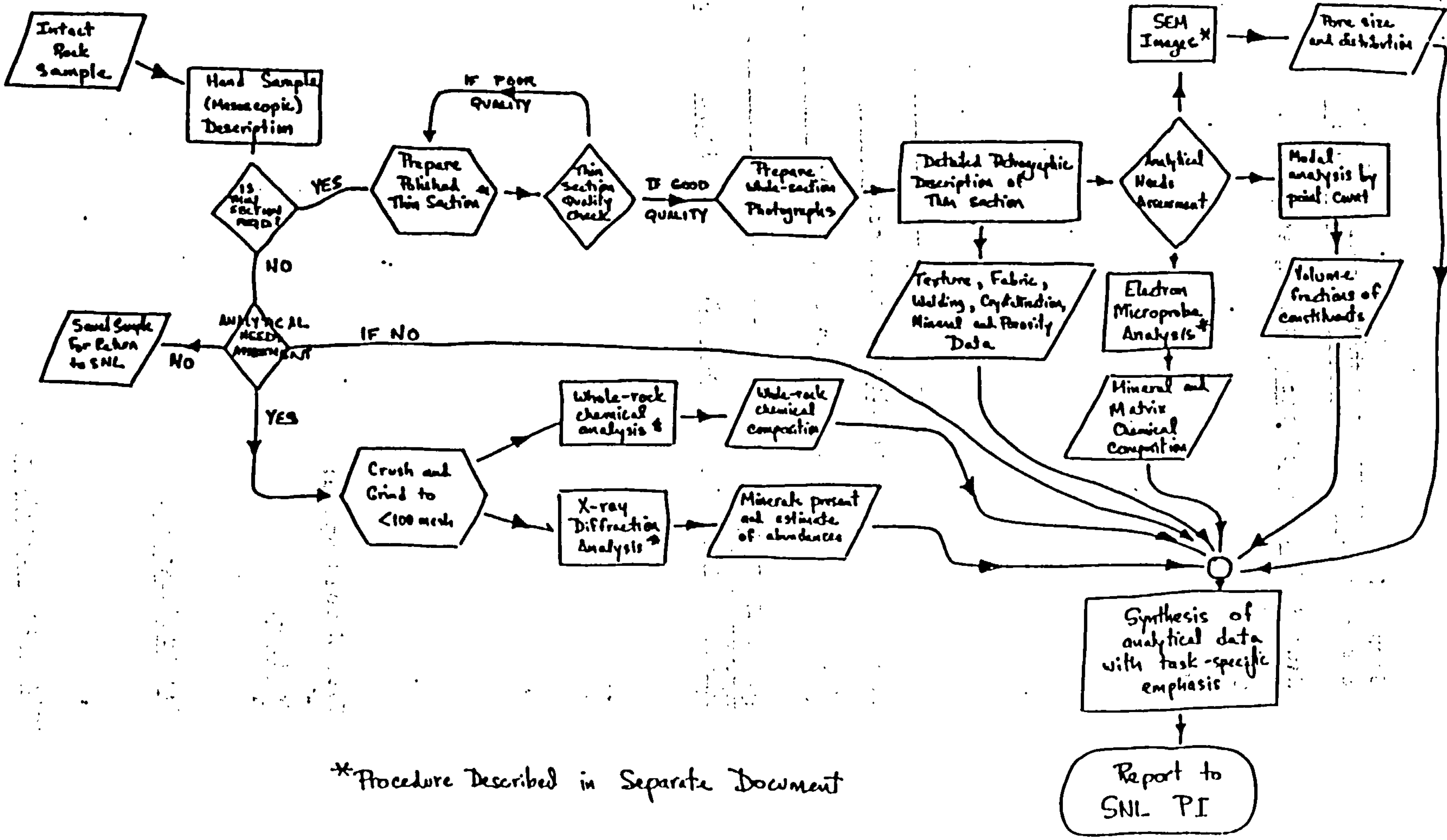
6. REFERENCES

6.1. DOP 8.1 SNL-NNWSI Project Department Operating Procedure for Sample Identification and Handling Procedures.
6.2. TP-60 Procedures for Preparation of Polished Thin Sections.
6.3. TP-61 Procedures for Laboratory Sample Bulk Chemical Determination.
6.4. TP-62 Procedures for Laboratory X-Ray Diffraction Measurements.
6.5. TP-63 Procedures for Electron Microprobe Operation.
6.6. Lof, P., Elsevier's Mineral and Rock Table, Amsterdam, The Netherlands, Elsevier Science Publishers, 1982.
6.6. Van der Plas, L., and Tobi, A.C., A chart for judging the reliability of point counting results: Am. Jour. Sci., v.263, p. 87-90, 1965.

7. APPENDICES

A. Petrologic Analysis Procedures Flow Chart
B. NNWSI-Sandia-UNM Tuff Sample Description Form
C. Copy of Volume % Estimation Diagram from Lof (1982).
D. Sample Preparation Data Sheet for Crushing of Rock Samples.

APPENDIX A: Petrologic Analysis Procedures Flow Chart



*Procedure Described in Separate Document

NNWSI-Sandia-IM Tuff Sample Description Form

TP-59
Rev 0
Appendix B

Sample ID:______________ Date Recvd.________ Source:______________
EP# & Rev.:______________ To:____________ From:______________

Hand Sample Description Geologist:______________ Date:________

Color:

Texture:

Clast Types & Sizes:

Other:

Thin Section Description Geologist:______________ Date:________

Notes (Orientation, Section #'s, etc.):______________

Constituents:

Modal %	Fragment	Size-Range	Shape	Miscellaneous

Est. % void space:

Welding:

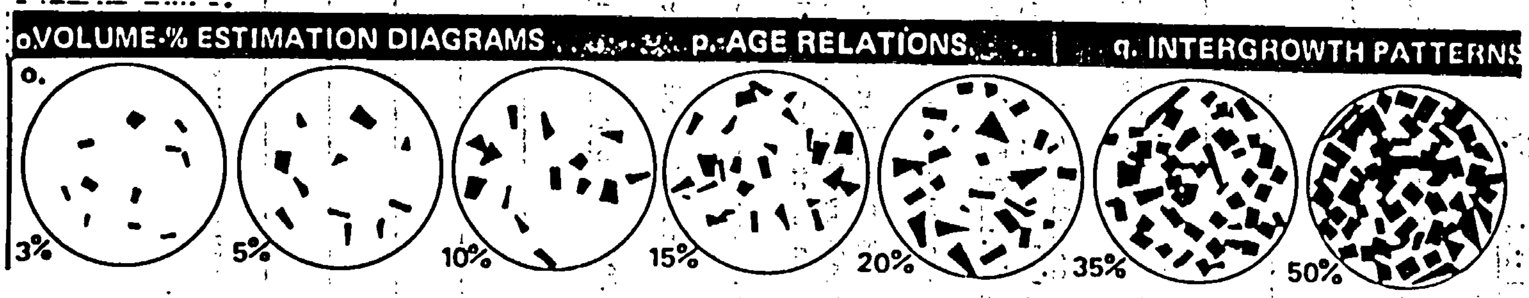
Devitrification:

Misc. Textures-Fabric:

______________ ________
Proj. Research Sci. Date

___ Check here if additional data on back, or ___ on additional sheets.

APPENDIX C. Copy of Volume % Estimation Diagram from Lof (1982).



SAMPLE PREPARATION DATA SHEET FOR CRUSHING OF ROCK SAMPLES

Contract or P.R.#: ____________ Date of Contract: ____________

Operator Name: ____________ Operator Signature: ____________

Operator Location: ____________

EP Number & Rev.: ____________

SNL PI: ____________ Division: ____________ Phone: ____________

==

Form# ___ of ___ (A maximum of 5 samples per form is allowed; if more than one form is required, that is detailed here. A CHAIN-OF-CUSTODY FORM MUST BE MAINTAINED FOR EACH SAMPLE IN ADDITION TO THIS FORM.)

==

1. Materials Used, Machinery Used and Description of Process Steps are detailed in "Procedures for Laboratory Petrology Determination" (TP-59). Any deviation from these procedures are detailed in Sections 4 and 5 below.

==

2. SNL Designated Sample ID, Short Form ID, and Start/Finish Dates:

SNL ID	"Short Form" ID	Start Date	Finish Date	Approx. Weight (g)

==

EP Number & Rev.:____________________ Date of Contract:____________________

Form # ___ of ____

==

3. Record of Visual Inspection of Screens. (Screens MUST BE inspected with a binocular microscope prior to and following the preparation of EACH sample, and results of inspection noted below.)

Date	Pre-Crushing Check	Post-Crushing Check	Comments

==

4. Any Deviations from Technical Procedure:____________________

==

5. Additional Comments: ____________________

==

SNL NNWSI Technical Procedure:

Procedures for Preparation of Polished Thin Sections

Page	1	2	3	4	5	Appendix A
Revision	A	A	A	A	A	A

Author: ______________________ 10/22/87
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Approval: Thomas E. Blejwas 10/29/87
Date
Thomas E. Blejwas, 6313
Division Supervisor

1. PURPOSE

The purpose of this document is to describe the processes and methods used in the Institute of Meteoritics (IM), University of New Mexico (UNM), to prepare polished thin sections of rock samples provided by Sandia National Laboratories (SNL) as part of the Nevada Nuclear Waste Storage Investigations (NNWSI) Project. Polished thin sections of rocks are used in optical petrographic studies, electron-probe microanalysis and scanning electron microscopy.

2. SCOPE

This procedure applies to any rock, mineral, or standard reference material (SRM) samples provided by SNL for study in conjunction with the NNWSI Project; specific requirements are detailed in Experiment Procedures (EP) from the SNL Principal Investigator (PI). General petrologic analysis procedures, including the methodology by which samples are selected for polished thin section preparation, are detailed in the document "Procedures for Laboratory Sample Petrology Determination" (TP-59).

3. PROCEDURES

The following sections detail materials and equipment used and process steps followed in preparation of polished thin sections.

3.1 Materials Used

a. Shell (Brand) Epon 815 Resin and Kodak (Brand) Diethylene triamine or RF-13 hardener, or equivalent material (used for impregnation).
b. Buehler (Brand) Epoxide Resin and hardener or Locktite (Brand) adhesives #s 365, 349 and/or 354, or equivalent material (used for mounting).
c. 1 inch diameter glass petrographic slides.
d. Silica Carbide Grinding Compound, 1000 grit (Metallurgical Supply Co.)
e. Diamond Polishing Paste, various sizes: 9, 6, 1, ¼ micron (Metallurgical Supply Co.).
f. Purified Kerosene and Acetone (Fisher Scientific Co. or similar supplier)
g. New Mexico (25% Cotton) Bond and Eaton Connoisseur Bond, or equivalent (used as substrate for polishing).
h. Kimwipes Disposable Laboratory Wipers (Kimberly Clark Co.) or equivalent.
i. Polystyrene Microbeakers (5ml) and wood or polystyrene applicator sticks for mixing and applying epoxy for impregnation and mounting (Fisher Scientific Co. or similar supplier).
j. Diamond Stylus (for scratching sample numbers on petrographic slides).
k. Glass Plate, 11" x 14" x ¼" (from PPG Industries, Inc. or similar supplier).
l. 3M Brand (or equivalent) Grinding Disc, diamond impregnated, 220 micron.

3.2 Equipment Used

a. Thermolyne (Brand) Nuova 7 Hot Plate (for curing epoxy).
b. Star Diamond Industries (Brand) diamond rock saw.
c. Buehler (Brand) Petrographic Grinder.
d. Buehler (Brand) Petrographic Polishing Laps.

e. Ingram (Brand) Model 137U Trim Saw.
f. Ingram (Brand) Model 400U Thin Section Grinder.
g. Bransonic (Brand) 12 Ultrasonic Cleaner with beaker.
h. Duo Seal (Brand) Vacuum Pump Model 1400 Mfg. by Welch Scientific Co.
i. Heated Vacuum Dessicator Mfg. by Precision Scientific Co.
j. Carl Zeiss Petrographic Research Microscope(s) (UNM ID#s 104825 or 144595.) (for checking section thickness and polish).
k. Kent 3 (Brand) Automatic Lapping and Polishing Unit manufactured by Engis, Ltd., England (for fine final polishing if required).

3.3 Description of Process Steps

(Note: After all steps in which grinding grit or diamond paste is used, the sample is washed twice in isopropyl alcohol or acetone in an ultrasonic bath to remove the grit and any fluids used in the cutting, grinding or polishing process. After each polishing/grinding step [except the final polish], samples are impregnated by covering the sample surface with impregnation material [Sect. 3.1.a] and curing in the manner described below. In order to avoid breathing of possibly toxic organic volatiles generated by mixing and application of epoxies and other impregnation materials, all heat curing and mixing of these materials is caried out under a fume hood.)

Cut and trim sample to form rock chip(s) about 2.5 cm diameter, 8 mm thick on rock saw. In general, chips are initially square with the corners cut off to maximize the area which may be mounted on the 2.5 cm diameter glass slides, however chip shapes may vary as required by the amount of sample available and friability of the samples. Impregnate chip(s) under vacuum with Diethylene triamine and Epon 815 Resin (or equivalent material) as follows: 1. Place each chip in disposable plastic beaker and fill with resin/hardener mix; 2. Place beaker(s) in vacuum dessicator (heat off), close and evacuate using vacuum pump for 5 minutes; 3. Break vacuum and wait several minutes; 4. Evacuate again with vacuum pump for 5 minutes; 5. Break vacuum and remove samples from dessicator. Cure impregnated samples on a pre-heated hot plate at 60°C for about 15 min or at room temperature for 24 hours. Grind chip surface flat on 220 micron grinding disc. Grind glass slide to uniform thickness prior to mounting. Mount chip on glass slide with Locktite 354 or 349, Buehler Epoxide Resin (or equivalent). Depending on the mounting material used, curing may be at room temperature for 24 hours, on a 60°C hot plate for a minimum of 15 minutes, or for a minimum of 10 minutes under ultra- violet (UV) light. Cut section to about 1 mm thickness with trim saw, clean, impregnate and grind to about 45 micron thickness on grinder. Lap section by hand with 1000 grit carborundum abrasive on glass plate to about 35 micron thickness using tap water or kerosene as a lubricant. Clean, impregnate and grind sample to about 30 micron thickness with 9 micron diamond paste on polishing laps. Section thickness is evaluated by optical examination of quartz and/or feldspar mineral grains until characteristic gray birefringence is obtained. The section must be thin enough to allow examination of textures and minerals in transmitted light; precise grinding to 30 microns is not required for petrographic study. Clean, impregnate and polish with 1 micron diamond paste until high quality surface polish is obtained. All steps are done with a paper substrate, using kerosene as a lubricant. For delicate samples which require a high surface polish, the Kent 3 Automatic Lapping and Polishing Unit may be used for the final polish step. Sample is washed twice with isopropyl alcohol, acetone or ultrasonic detergent (depending on the sample and mounting media used) between all steps, and after final polishing.

At various stages sample is exposed to kerosene, tap water, acetone, and impregnating and mounting epoxies and resins. The epoxies are specifically designed and manufactured to not react with the rock samples. Kerosene and water are removed in an ultrasonic isopropyl alcohol, acetone or ultrasonic detergent-water bath, and the cleaning agent is removed by evaporation under ambient conditions or on the hot plate.

3.4 Safety

The only cause for concern regarding personnel safety lies in potentially toxic fumes generated by some of the epoxies and cementing agents; this concern is remedied by mixing and using these agents under a ventilating fume hood as discussed in section 3.3.

4. QUALITY ASSURANCE

4.1 Qualifications

Only personnel approved by the Director of the Institute of Meteoritics as qualified will be permitted to perform the work detailed in this procedure. This approval, and evidence of qualifications in the form specified in the governing EP(s), will be kept on file in the Institute and provided to the SNL PI upon request.

4.2 Calibration

None of the equipment used in this procedure requires calibration.

4.3 Maintenance of Sample Traceability

The Project Research Scientist will supply a portion of the rock sample in the form of a cut rock chip to the thin section preparer. The chip will be assigned a new sample ID in the following format:

ID-TSab

where:	ID	is the SNL ID in the format described in DOP 8-1, and detailed in the EP defining the work.
	TS	is a code phrase for "Thin Section".
	a	is an arabic numeral in sequence beginning with 1 for each chip from which thin sections will be made.
	b	is a lower case letter in sequence beginning with "a" for each thin section made from that chip.

For example, if the SNL ID for a sample is USW G-1-1259, and two polished sections from one chip are to be made, the resultant new sample numbers will be USW G-1-1259-TS1a and USW G-1-1259-TS1b.

In accordance with DOP 8-1, an individual chain-of-custody form will be completed for each unique sample number (i.e., for each thin section).

A sample preparation data sheet (SPDS) will be prepared for each sample or group of samples (up to 5) which details the start/complete date for each section prepared. Each thin section is labeled by scribing the glass slide with a diamond stylus, and due to limited space for this label, a shortened form of the SNL ID may be required; if this is the case, the complete and shortened ID are entered on both the SPDS and the chain-of-custody form.

5. RECORDS

5.1 Records Generated

A sample preparation data sheet is prepared by the polished thin section preparer for each sample or for a group of samples for which the same procedures were followed. A copy of this sheet is Appendix A. The data sheets reference this procedure and additionally reference the contract number, EP, start and completion dates for samples, and any deviations from process steps described in this procedure. Observations of any unexpected events during preparation of polished thin sections, as discussed in the EP, will also be recorded on the SPDS. A chain-of-custody form will also be generated and maintained for each thin section as detailed in Sect. 4.3. All forms and data sheets will be completed in black, indelible ink.

5.2 Maintaining and Reviewing Records

Sample preparation data sheets are reviewed and maintained on file in the IM by the Project Research Scientist. Chain-of-custody forms remain with the samples as specified in DOP 8-1, and the Project Research Scientist will monitor work on the samples and insure that the specified procedures are followed.

5.3 Transmittal of Records

Copies of completed sample preparation data sheets are transmitted to the SNL PI for distribution to the appropriate person in charge of maintaining such data. The original data sheets are kept on file with the other project data generated under the EP until such time as the SNL PI requests the data files be returned. Chain-of-custody forms will be returned with the samples when requested by the SNL PI in accordance with procedures outlined in DOP 8-1, and detailed in the EP defining the work.

6. REFERENCES

6.1 TP-59 Procedures for Laboratory Sample Petrology Determination.

6.2 DOP 8-1 SNL-NNWSI Project Department Operating Procedures for Sample Identification and Handling Requirements

7. APPENDICES

A. Sample Preparation Data Sheet

SAMPLE PREPARATION DATA SHEET FOR PREPARATION OF POLISHED THIN SECTIONS

Contract or P.R.#: ____________ Date of Contract: ____________

Operator Name: ____________ Operator Signature: ____________

Operator Location: ____________

EP Number & Rev.: ____________

SNL PI: ____________ Division: ________ Phone: ________

==

Form# ___ of ___ (A Maximum of 5 Samples are allowed per form. If more than one form is requred, note number here. A SEPARATE CHAIN OF CUSTODY FORM, IN ADDITION TO THIS FORM, MUST BE ATTACHED TO EACH SAMPLE.)

==

1. Materials Used, Machinery Used, Description of Process Steps and Exposure of Samples to Fluids or Solvents are detailed in "Procedures for Preparation of Polished Thin Sections" (TP-60). Any deviations from these procedures are detailed in Sections 3 and 4 below.

==

2. SNL Designated Sample ID, Short Form ID, and Start/Complete Dates:

SNL Sample ID	"Short Form" ID	Start Date	Complete Date

==

EP Number & Rev.: ____________________ Date of Contract: ____________

Form# ___ of ___

==

3. Deviation from Specifications: ______________________________

____

____

____

____

____

==

4. Additional Comments: ______________________________

____

____

____

==

UNCONTROLLED

NNA.880122.0034

SNL NNWSI Project Technical Procedure:
Laboratory Procedures for Mineralogic Analysis
by X-Ray Powder Diffraction Part 1: Data Gathering

Page	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	App. A
Rev.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Author: ______________________ 9/14/87
James R. Connolly Date
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UNM, Institute of Meteoritics

Approved: Klaus Keil 9/14/87
Klaus Keil Date
Director
UNM, Institute of Meteoritics

Approved: Francis B. Nimick 9/17/87
Francis B. Nimick, 6313 Date
SNL Principal Investigator

Approved: Carol L. Stein 9-17-87
Carol L. Stein, 6331 Date
Independent Technical Review

Approved: Thomas E. Blejwas 9/17/87
Thomas E. Blejwas, 6313 Date
Division Supervisor

SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT
Issued to: M.D. Cotter, SAIC
Copy Number: #012
RETURN TO 6310 RECORDS CENTER
WHEN NO LONGER NEEDED.

1.0 PURPOSE

This document describes the equipment and procedures used in the Institute of Meteoritics (IM) at the University of New Mexico (UNM) to collect X-ray powder diffraction (XRD) data for mineralogical analysis of samples provided by Sandia National Laboratories (SNL) as part of the Nevada Nuclear Waste Storage Investigations (NNWSI) Project.

XRD is used to identify crystalline compounds, and may be used either alone or in conjunction with other techniques (e.g., whole-rock chemical analysis, electron microprobe analysis, optical microscopy) to make a quantitative or semi-quantitative determination of the fractions of each crystalline phase in a sample. This document describes the operation of the Scintag Pad V XRD system used at UNM for gathering XRD data. Part 2 of these procedures (TP-102 - under development at this time) describes procedures followed in interpretation of these data. Detailed discussion of the theory and applications of XRD may be found in Cullity (1978).

2.0 SCOPE

This procedure applies to any rock or mineral sample or standard reference material (SRM) provided by SNL for study in conjunction with the NNWSI project.

The type of analysis required may vary, depending on the particular SNL task which the XRD data (and resultant interpretations) are to support. Analytical requirements are detailed in Experiment Procedures (EP) from the SNL Principal Investigator (PI) to UNM, and decisions regarding the most appropriate procedures to be followed in data gathering and analysis are made in consultation with the PI. General procedures used in the IM for petrologic analysis (including the procedure for preparation of the rock powders used in XRD analysis) are detailed in a separate document (TP-59).

3.0 EQUIPMENT

The Scintag Pad V XRD system consists of three groups of components integrated into an automated, microcomputer-controlled system. These groups are discussed in the following sections.

3.1 X-Ray Generating System

The X-ray generation system consists of (1) a high-voltage power supply; (2) an X-ray tube with a copper target (produces X-rays of the wavelength and energy characteristic of the element copper) with a graphite monochromator (filters out all but copper

K-alpha [Cu-Kα] X-rays) housed in a shielding tower; and (3) an automated shutter apparatus with exit port directed towards the sample holder through a pair of collimating slits (Fig. 1). The generator apparatus is a Type V.4 system manufactured by The Rich Seiffert Co. in West Germany. The tube is cooled by a water re-circulation system, utilizing a Haskris (Brand) water chiller; an interlock system will shut down the X-ray tube should water circulation fail.

The X-ray generator, goniometer (including the sample), and detector are housed in a cabinet with a leaded glass door designed to prevent all X-rays from entering the room. The cabinet is equipped with an interlock which automatically closes the shutter should the cabinet door be opened while the unit is in operation, and a system of warning lights which turn on whenever the shutter is open.

3.2 X-Ray Measurement System

The measurement system consists of:
-> A goniometer having an optimal step resolution of 0.0003125° (Fig. 1).
-> Two pairs of collimating slits, one pair to collimate the incident X-ray beam prior to interaction with the sample, and the second pair to collimate the diffracted beam (from the sample) prior to entering the detector (Fig. 1).
-> A Bicron Corp. Model IMXP.040B Scintillation Detector with preamplifier.
-> An EG&G Ortec Model 4001A NIM/BIN (electronic module rack) housing the other detector modules.
-> An EG&G Ortec Model 478 high-voltage power supply module (supplies bias to detector).
-> An EG&G Ortec Model 590A single-channel analyzer (SCA) with amplifier (sets detector window, converts pulses coming from detector into counts). Counts from the SCA are delivered to the Data General computer for processing via a standard RS-232 Serial Interface.
-> An EG&G Ortec Model 541 Ratemeter (provides analog display of counts per second; used for locating peaks, alignment, calibration, etc.).

3.3 Microcomputer-based Data Collection System

The data collection system consists of:
-> Data General Desktop Model 20 Computer with 256 kilobytes of random access memory (RAM), 15 megabyte Winchester hard disk, one 360 kilobyte floppy disk drive, keyboard and monochrome monitor. Serial # on central processing unit (CPU) is E8717-N.
-> Tektronix Model 4107 Color Graphics Terminal (Keyboard and Graphics Display) with Tektronix Model 4696 ink-jet color copier.

-> Data-General RDOS dual user operating system software (Version 1.3) with Fortran IV compiler.
-> Scintag Pad V XRD system software (Version 1) including the Scintag Interactive Graphics Software Package. System operation using this software is discussed in detail in the Pad V Manual which is available in the lab at all times.

4.0 PROCEDURES

The XRD procedures fall into three groups:

1. data collection
2. identification of mineral phases present
3. determination of amounts of mineral phases present.

The first group of procedures, described here, will be completed for all samples which require XRD analysis. Specifics concerning the analyses and interpretation to be completed are detailed in the EP governing the work. The second and third groups of procedures involve interpretation of previously obtained data, and are described in TP-102.

4.1 Uses and Limitations of XRD Analysis

XRD may be used to identify any crystalline materials including all minerals. Using the techniques described here, small amounts (<5%) of poorly crystalline minerals (i.e., some clays and zeolites) may be difficult to detect when well crystallized phases (quartz, feldspars, cristobalite) are abundant. Amorphous materials (i.e., glass) may not be reliably determined by routine XRD analysis, particularly when present in minor amounts in otherwise well crystallized samples; this is because the very broad, low intensity "peak" characteristic of glass is difficult to differentiate from background.

4.2 Collection of XRD Data

4.2.1 Introduction

The utility of XRD as a tool for identifying mineral phases in rock samples is based on the fact that crystalline materials possess groups of characteristic inter-planar distances (d-spacings) which are a function of the crystal structure and chemical composition. The XRD technique allows determination of the d-spacings in minerals and estimation of the regularity with which they occur (i.e., their abundance). This information then may be used to identify the mineral phase (or phases in the case of poly-mineralic samples) using the information in the Joint Committee on Powder Diffraction Standards (JCPDS) Powder Diffraction File.

In XRD, a beam of X-rays of known wavelength is generated, collimated, and directed toward the finely powdered specimen (particle size is always <150 µm, typically 50 µm or less). Solid samples which have been cut and/or ground to fit in the sample holder may also used as samples. Common wavelengths used for geological materials are 1.5406 angstroms (Cu-Kα radiation) and 1.9373 angstroms (Iron K-alpha or Fe-Kα). The Scintag Pad V system is equipped with an X-ray generator which produces Cu-Kα radiation.

The fundamental geometric principal governing the technique of X-ray diffraction is contained in the Bragg equation:

$$L = 2d_{hkl} \sin\theta_{hkl}$$

where L is the wavelength (in angstroms) of the incident x-rays, θ_{hkl} is an incident angle (in degrees) at which diffractions occur and d_{hkl} is a d-spacing (in angstroms) producing the diffractions. The beam is diffracted by crystals in the specimen whenever the Bragg equation is satisfied. (See Cullity, 1978, for a detailed discussion of application of the Bragg equation in XRD.) If the sample contains many randomly oriented crystals of the same phase, diffraction peaks are obtained which correspond to numerous crystal planes, each with a characteristic d-spacing. Individual phases have characteristic combinations of d-spacings which allow their identification.

The θ angles at which diffractions occur are measured using a moving scintillation detector. The x-ray source is fixed angles are measured on the goniometer relative to the position of the X-ray path from the generator (Fig. 1); this directly measurable angle is 2θ and is used to calculate d-spacings.

4.2.2 Sample

The sample holder may be either a glass slide (for mounts in which a preferred sample orientation is desirable or if a binder is used to "glue" the powder together) or a plexiglas holder with an indented cavity to hold the powdered sample. In some cases, solid samples cut to fit in the sample holder on the goniometer may be used. Mounting of powders in plexiglas holders is preferred for NNWSI Project samples because it is completely non-destructive, tends to minimize preferred orientation in finely ground powders (as long as the sample is not packed into the cavity), and permits different fractions of the same sample to be run at different times as a check on homogeneity. Single crystal holders may be used for very small samples.

4.2.3 Measurement Sequence

The sample is moved through a pre-selected range of 2θ (typically 2° to 52° for NNWSI Project samples) at a controlled rate (generally 1° or 2° per minute). The X-ray data are stored digitally on electronic disk by the Scintag Pad V diffractometer scan program (DA) in a raw data file (filename.RD) which includes 2θ, intensity and estimated counting error for each chopper increment (the 2θ interval over which counts are averaged and stored on disk; this is specified by the user and is typically .03, .02 or .01 °2θ) for the whole scan. The background correction program (BG) "strips off" $K\alpha_2$ peaks (by subtracting the $K\alpha_2$ component from each peak as a function of 2θ), subtracts the continuous X-ray background, and writes a background corrected file to the disk (filename.NI). The peakfinder program (PF) then uses the .NI file to locate peak positions (in °2θ) and calculate relative intensities of all peaks (with the strongest peak = 100); these data are stored on disk in a peak file (filename.PK). It is standard practice when running several samples to run only the DA, BG and PF programs while gathering data. The Search-Match Program (SM), used to aid in mineral identification, is usually run at a later time; use of this program is discussed in a separate document (TP-102).

4.2.4 Data-Gathering Procedures

This section outlines the procedures followed to gather XRD data from a powdered rock sample using the Scintag Pad V system. The procedures reference the "Pad Diffraction System Users Manual" (referred to as the "Pad Manual") furnished by Scintag, which provides details concerning operating procedures, and the UNM in-house "Step-by-Step Procedures for Operation of the Scintag Pad V X-Ray Diffraction System" by J.R. Connolly (referred to here as the "Scintag Op Manual"). These manuals are kept in the X-ray laboratory of the UNM Department of Geology at all times.

Procedures are presented below in sequential outline form:

4.2.4.1. A Scintag Pad V X-Ray Diffraction System Operations Checklist (Appendix A) is completed for each data collection session. Each completed checklist will become part of the experiment log book and will serve as the primary record of any any nonconformances as well as detailing compliance with the steps of this procedure. A data collection session is defined as beginning with data gathered from the in-house Silicon Powder Disk standard, data gathered from up to 6 SNL NNWSI Project samples, concluding with a rerun of the Silicon Powder Disk standard. Before beginning, the upper portion of Appendix A is completed to include:
-> The EP ID, date and revision under which the work is being done.
-> Operator's name, signature, date and location.
-> Name of the SNL PI, division and phone number

4.2.4.2. Startup: The Pad V system, including the Data General Desktop Computer (DG), is kept in a "powered-up" condition at all times (except when down for maintenance). The power-up sequence is executed only by the supervisor of the XRD lab or someone designated by the supervisor; procedures are outlined in the Pad Manual (pp. II-2 to II-8).

4.2.4.3. Check of Diffractometer Settings: Prior to any operation, the following items are to be checked on the X-ray unit, and noted on the XRD System Operations Checklist (Appendix A):

a. Main Panel Settings:
-> Key in and power on
-> Tube current set to 30 mA
-> Accelerating voltage set to 40 kV
-> Water flow and current indicator lights on
-> Timer off (set to infinity).
See lab supervisor if anything is not set correctly. These are standard settings which are not normally changed. Data will not be gathered if these are not set correctly.

b. Detector System Settings: Set by lab supervisor. Do not alter.
-> Note initial generator timer reading on the operations checklist and in the notebook kept in the lab for keeping track of equipment use.
-> Note XRD tube and detector ID#s on the operations checklist.

c. Collimating slits: To insure the most consistent results between samples, for routine data collection install the four collimating slits (Fig. 1) as follows:
-> Generator Side collimator, Slit A: 2.0 mm
-> Generator Side collimator, Slit B: 4.0 mm
-> Detector Side collimator, Slit C: 1.0 mm
-> Detector side collimator, Slit D: 0.5 mm.
Some specialized scans may use a different slit configuration. Slit configuration is noted on the operations checklist.

4.2.4.4. Goniometer Initialization and Calibration: The goniometer initialization/calibration routine (called by entering DA5 on the DG terminal) is completed as detailed in the Scintag Op Manual. Successful completion of this routine is noted on the XRD Operations Checklist (Appendix A). If initialization cannot be completed successfully, the problem will be noted on the checklist and the SNL PI and lab supervisor notified. No further data gathering will be attempted until this routine is completed successfully.

4.2.4.5. System Check Using Silicon Standard: Detector system settings (i.e., window settings on the single channel analyzer, and rate meter settings) are changed from time to time by the lab supervisor to optimize signal-to-noise ratio as the equipment ages. As a check on calibration and day-to-day repeatability, the empirical check described below is performed twice daily: first, after the routine calibration checks described in Section 4.2.4.4 (prior to collecting data on SNL NNWSI Project samples) and later, after sample data have been collected.

a. Run the Phillips Silicon X-Ray Standard Disk (Type #52131, Ser. #63-615) standard using the standard run parameters (Section 4.2.4.7). Store these data with the filename JCSyymmdd where JC are operator's initials, S indicates "starting run", and yymmdd are the date in numerical year-month-day format. The diffractometer, background correction and peakfinder routines are run as detailed in the Scintag Op Manual and Section 4.2.4.7.

b. When the run is completed, use the peakfinder output data to compare the two strongest peaks in the silicon with the silicon pattern run the previous session. Peak angles calculated by the peakfinder routines should compare within ±1% 2θ, and relative intensities calculated by the program for the 2 strongest peaks should compare within ±5%. This comparison is recorded on the System Operations Checklist (Appendix A). As a further check, the peak positions and relative intensities are also compared with the JCPDS card for Silicon (JCPDS Card 27.1402 for NBS SRM-640); peak positions should compare within ±1% 2θ, and relative intensities within ±5%.

If peak positions in the first standard run of the day fail to meet this specification, no further data will be collected. If the final standard run of the day (after collection of SNL NNWSI data) fails to meet the peak position specification, data will be flagged as suspect and not used. In either case, no further data will be collected until corrective action is taken (and documented to the SNL PI) and specifications are met during subsequent runs.

If relative intensities are not within specification but are within ±10%, the data will be flagged on the operations checklist as "Qualitative Only", allowing use for identification of phases present but not determination of proportions of those phases. If deviation between relative intensities in either the first or last standard run of the day are greater than 10%, data will be flagged as suspect and not used.

Should there be any question regarding the usability of the data collected, the SNL PI will be consulted immediately (by telephone) and a decision will be made; that decision will be documented by memorandum from the Project Research Scientist to the SNL PI within 5 days of the occurrence.

c. Copy the calibration files from the hard disk to floppy disk(s) used exclusively for backing up calibration data. This floppy disk is labeled using the following format:

UNM-EP#-XRD-CD-##

where EP# is Experiment Procedure number and revision,
XRD indicates X-ray Diffraction
CD indicates Calibration Data and
is sequential CD disk number for that EP

Only the raw data files (with an extension .RD) will be stored on the calibration data backup disk, and a list of all files stored on the disk will be kept with the disk at all times. The label on each CD disk will also include the identity of the software manufacturer, software title and version number used to collect the data. A copy of the "before" and "after" calibration run files (including the .RD, .NI and .PK files) will be copied to the working floppy disk used to store the data collected for that day.

4.2.4.6. Sample Preparation Prior to XRD Run. Preparation of the powdered sample is described in "Procedures for Laboratory Sample Petrology Determination" (SNL NNWSI Project Technical Procedure TP-59). To maximize homogeneity prior to XRD analysis, the powdered samples are agitated in the tightly closed sample container by vigorous shaking (by hand) for a minimum time of one minute to assure uniform distribution of components of varying density throughout the sample.

To minimize preferred orientation of platy minerals in the powder, sample holders are loaded by shaking an excess quantity of powder into the sample cavity. The upper surface of the sample is leveled by horizontally scraping with a stainless steel laboratory spatula, being careful not to exert any downward pressure on the powder to avoid packing of the cavity. Two plexiglas sample holders are used in rotation and wiped clean with a laboratory wiper (Kimwipe or similar brand) before filling with powder.

Sample powders are kept in screw-top glass containers. Plexiglas holders are loaded over a substrate of clean white paper (usually used computer printer paper) to catch any excess. Upon completion of the data collection for the sample, the powder is removed from the plexiglas holder and the analyzed powder and any excess on the paper is returned to the glass container and the top is screwed back on. The paper substrate then is discarded.

Prior to loading the sample into the diffractometer, the goniometer is moved (using the DA5 "DM" command) to the low-angle start position (usually $2\theta = 2°$). The sample is placed into the spring-loaded holder in the diffractometer with the surface to be analyzed facing up (Fig. 1). The diffractometer door is closed before proceeding. (A safety interlock prohibits running of any data collection routines with the door open.)

4.2.4.7. Data Collection. After the sample is loaded into the diffractometer sample holder and the door closed, all data collection operations are controlled from the DG Terminal. Step-by-step interaction for a standard data run is outlined in the Scintag Op Manual kept in the lab. Only those aspects of data collection specific to SNL NNWSI Project samples are discussed here.

-> Filenames used for SNL NNWSI Project samples will consist of the operator's (two) initials, followed by 7 characters which are a shortened version of the SNL sample ID. The full SNL ID, with or without a brief note about the sample, is entered when the user is prompted for the TITLE OF THE SAMPLE. Cross reference of full and shortened SNL IDs is made on the Operations Checklist (Appendix A) and on the appropriate Chain-of-Custody forms.

-> The angular range for scanning which will include all peaks of interest for most SNL NNWSI Project samples is 2° to 52° 2θ. Variation of this range, if not specified in a governing EP, will be decided by the project research scientist based on suspected presence of particular phases having peaks outside this range. The actual scan range use is noted on the Operations Checklist (Appendix A).

-> SCAN RATE will be 1° 2θ per minute and CHOPPER INCREMENT will be 0.03° for most SNL NNWSI Project samples, and the values used are noted on the Operations Checklist (Appendix A). A 1° per minute scan rate will give sufficiently high resolution for most work, particularly where semi-quantitative estimates of mineral proportions are to be made. A 2° per minute rate may be used for quick scans where only identification of phases present is required.

-> After the standard data described here are gathered, the project research scientist may decide that a higher resolution scan (with a smaller chopper increment and lower scan rate) is required to better resolve peaks within a smaller angular range; decisions regarding collection of supplemental XRD data are made in consultation with the SNL PI and confirmed in writing.

-> The SCAN TYPE selected will be 2-THETA/THETA. This is the scan type discussed above in which sample and detector are rotated by a system of gears so that the incident beam and detector input slits are always at the same angle, θ, relative to the sample.

-> As each sample is run, the operator's name, sample filename, start/stop time on the X-ray generator and date are entered in the logbook kept in the XRD lab for keeping a record of equipment usage.

-> The sample run numbers (integer beginning with 1 for the first sample of the day), filename and full sample ID are entered on the Operations Checklist completed for data collected each day (Appendix A). Because about 1 hour is required to collect data for each sample, generally no more than 5 or 6 SNL NNWSI Project samples will be run in a single day's data collection session.

4.2.4.8. Print of Sample Raw Data Files (Filename.RD). While data for samples are being collected, the Tektronix terminal and color plotter are used to print a representation of the raw data in the form of a standard 2θ vs. peak intensity graph for the sample. A copy of a typical graph is included (Figure 2). Details of the procedure for interaction with the Pad V software to plot these data are given in the Scintag Op Manual.

4.2.4.9. Rerun of Silicon Standard. At the end of the day, after collecting data from the last sample, the same silicon standard will be run under the same conditions using the filename JCFyymmdd with the F indicating "final run". As with the starting run check, the raw data (filename.RD) are backed up on the floppy disk used for storing calibration data, and all data files (.RD, .NI, .PK) are stored on the working disk containing data collected that day. Run information is recorded on the System Operations Checklist (Appendix A). The calibration check must meet the same requirements detailed in section 4.2.4.5.b. above.

4.2.4.10. System Shutdown. Shutdown procedures involve power-down of the X-ray generating system, copying of data files from the DG hard disk to floppy disks, and deletion of files from the hard disk. [Note that the DG terminal and the Scintag Pad V system are kept in a powered-up condition at all times, and are only shut down in the event of system failure or for maintenance.]

-> Power Down: The X-ray generator should be powered down after the last run of the day. This may be accomplished by entering yes (1) to the question POWER DOWN X-RAY GENERATOR AFTER RUN prior to the last run of the day, or from the DA5 program by entering the GD (Generator Down) command. After powered down, enter the final timer reading in the lab logbook and on the Operations Checklist (Appendix A).

-> Copying and Deletion of Files: All data files need to be transferred from the DG hard disk to user floppy disks and deleted from the hard disk. This is essential to maintain sufficient free space on the hard disk for program operation. Disks for storage of files are standard double-sided double-density 5 1/4 inch diameter disks formatted in special Data General format for 360 Kilobyte capacity. Formatted disks may be obtained from the lab supervisor.

To insure that data are not lost, each of the raw data files (.RD extension) will be copied to two floppy disks. One disk is designated a Working Disk (WD) and contains all sample data for one full day's data collection plus the calibration runs; this is the disk which will be used during subsequent data analysis. Another disk is designated a Raw Data Backup Disk (RD), and it contains only the sample raw data (.RD) files which may be used to create new peak and net intensity files should the working disk(s) become damaged; this disk will contain raw data from several days' runs. A third disk is used to back up Silicon-standard calibration run raw data files.

To facilitate efficient copying and deletion of files, all filenames will begin with a unique two-letter code, usually the operator's initials, so that file wild cards (the "-" character) may be used to move and delete groups of files efficiently. The procedure outlined below first copies the files and verifies that successful copies have been made prior to deletion of those files from the hard disk. File manipulations are done from the "R" prompt, and in the example which follows, it is assumed that a group of files beginning with "JC" are being copied. A formatted floppy disk is placed in the disk drive, notched side up, and the drive door closed.

See: R. Enter: DIR DJ0 [Changes to Floppy Directory].
See: R. Enter: DISK [Checks Floppy for available space and correct formatting, reporting blocks available. One floppy disk can hold complete data for 8-10 runs, but is limited to 5 or 6 plus the standard runs so that room is available to add mineral identification information or new files generated from the data].
See: R. Enter: DIR DE0 [Change to Hard Disk Directory].
See: R. Enter: MOVE/V DJ0 JC-.- [Copies all files beginning with JC to the Floppy Disk. The /V option causes the names of all copied files to be written to the screen and printer, so that the user is informed exactly what files were successfully copied.]
See: R. Enter: DIR DJ0, followed by LIST/A [This lists the files on the floppy disk alphabetically allowing another check on the success of the copy process. Each filename should have a .NI, .RD, and .PK file stored on

the disk. Unnecessary files (i.e., batch files JCBATCH.XB, JC-.PP, JC-.BP used by the program in processing) may be deleted from the floppy disk since they are not used again.]

See: R. Enter: DIR DE0 [Hard Disk Directory].

See: R. Enter: RELEASE DJ0 [Releases Floppy Disk from Drive. After a few seconds the drive light will go out and the disk may be removed from the drive.]

Note: The working disks are labeled as follows:

UNM-EP#-XRD-WD-##

where EP# is Experiment Procedure number and revision,
XRD indicates X-ray Diffraction
WD indicates Working Data Disk and,
is sequential WD disk number for that EP

The label on each working disk will also include the identity of the software manufacturer, software title and version number used to collect the data. The label (or a separate listing included in the disk sleeve) will also contain the sample filenames on the disk and the dates on which the data were collected (mm/dd/yy). These filenames are traceable to the full SNL ID on the Operations Checklist (Appendix A) and Chain-of-Custody forms.

See R. Put raw data backup disk in floppy drive and enter: MOVE/V DJ0 JC-.RD. [All JC files with .RD extension will be copied to the disk and verified to the screen. Follow the same LIST/A sequence used above for the working disks as a second check on the success of the copy process.]

Note: The format for the raw data backup disk label is:

UNM-EP#-XRD-RD-##

where EP# is Experiment Procedure number and revision,
XRD indicates X-ray Diffraction
RD indicates a raw data backup disk and
is a sequential RD disk number for that EP

Each raw data backup disk can contain data for approximately 20 samples. As with other data disks, the label on each RD disk will also include the identity of the software manufacturer, software title and version number used to collect the data.

See R. Put calibration data disk in floppy drive and enter MOVE/V DJ0 JCSyymmdd.RD then enter MOVE/V DJ0 JCFyymmdd.RD, where yymmdd is the date in year-month-date in numerical format. [All Silicon standard raw data files will be copied to the disk and verified to the screen. Follow the same LIST/A sequence used above for the working disks as a second check on the success of the copy process. The format for the calibration data disk label is detailed in Section 4.2.4.5.]

IMPORTANT: NEVER Release DE0 as this will cause a system crash.

The "moved" data files are deleted from the hard disk as follows:
See: R. Enter: DELETE/V JC-.- [This will delete all files on the hard disk which begin with JC and will print a list of the deleted filenames to the screen and the printer. Using the same filename and wildcards assures that all of the files previously moved will be deleted.]
See: R. Turn Screen Display Down on Terminal.

5.0 DOCUMENTATION REQUIREMENTS

Data collection using the Pad V system as described here will generate the following records:

-> Computer printouts, which form a record of interaction with the Pad V software through the DG Terminal. All interaction during setup of runs as well as the output of the data as specified in that interaction is simultaneously echoed on the DG Terminal screen and the printer. Printouts for a full day's data collection (from starting to final quartzite run) will be kept in an "unseparated" condition. The printouts include details of the module version numbers for the Scintag Pad V software which are printed by the printer as the modules are executed.

-> A plot of 2θ vs. peak intensity for each SNL NNWSI Sample Raw Data file printed on the Tektronix color copier. Axes will be labeled in black indelible ink as follows:
-> lower horizontal axis is labeled 2θ
-> upper horizontal axis is labeled d-spacing
-> left vertical axis is labeled intensity (units are CPS for counts per second)
-> right vertical axis gives relative intensity in percent

-> Floppy disks in Data General format containing data collected as follows:

1. A working disk for each day's data including all files generated for both the quartzite standard runs and each SNL NNWSI Project sample.

2. A backup disk for the SNL NNWSI Project sample data including only the raw data (filename.rd) files for the samples. This disk may include data from several days' data collection sessions.

3. A calibration data-backup disk used to store the raw data files from the Silicon standard runs done prior to and following data collection (JCSyymmdd.RD and JCFyymmdd.RD).

-> A completed Scintag Pad V X-Ray Diffraction System Operations Checklist (Appendix A).

All records generated during the use of this TP will be made using black indelible ink. Color plots mentioned above may be photocopied with no loss of information. If any color plots are generated for which this is not the case, appropriate labels will be added for clarification.

The EP governing the work will specify how the above data will be incorporated in experiment logbook(s) and SNL NNWSI Project data files.

6.0 SAFETY

The safety interlock system on the Scintag Pad V system virtually precludes the exposure of an operator to X-rays. However, because of the dangers inherent in the use of X-ray diffraction equipment, the equipment is operated only by personnel who have attended the Radiation Safety course conducted by the Radiological Safety Office at the University of New Mexico and passed a written examination concerned with that topic. All operators are required to wear whole-body dosimeters; these are exchanged monthly by the Radiological Safety Office, which maintains exposure records for all certified operators. The Radiological Safety Office also conducts periodic checks of all XRD equipment for X-ray leakage.

7.0 REFERENCES

Connolly, J.R., Step-by-Step Procedures for Operation of the Scintag Pad V X-Ray Diffraction System, UNM Geology Department In-House Document, 1987.

Cullity, B.D., Elements of X-Ray Diffraction (Second Edition), Addison-Wesley Pub. Co., 555 p., 1978.

SNL NNWSI Project TP-59, Procedures for Laboratory Sample Petrology Determination.

List of Figures for TP-62 (XRD Tech Procedure):

Figure 1: Photograph of Scintag Goniometer Showing Path of Incident and Diffracted X-Ray Beam (Arrows), plus Location of 2θ Scale, X-Ray Source, Collimating Slits, Sample Holder, and (Part of) Detector. Relationship between θ and 2θ is shown.

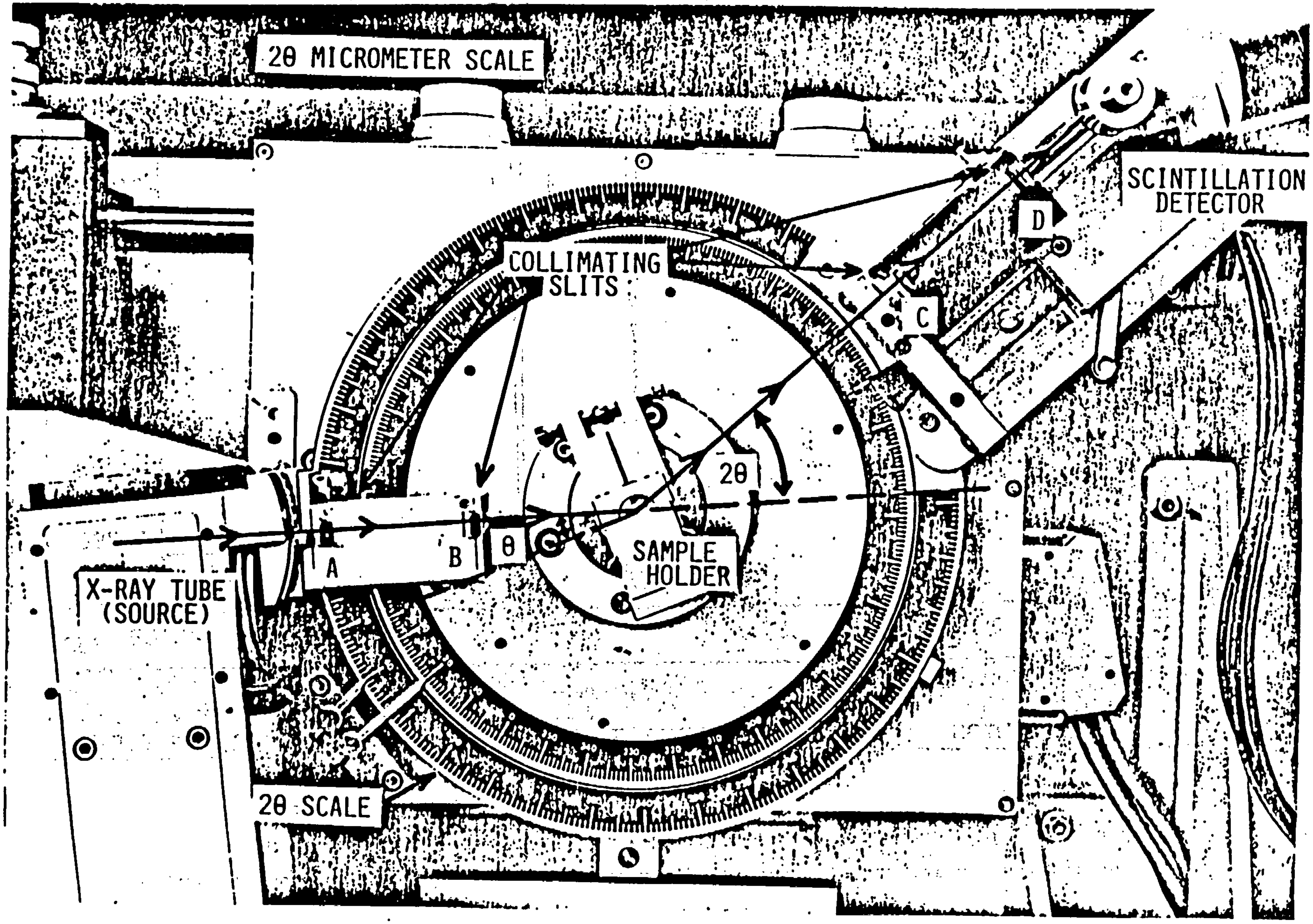
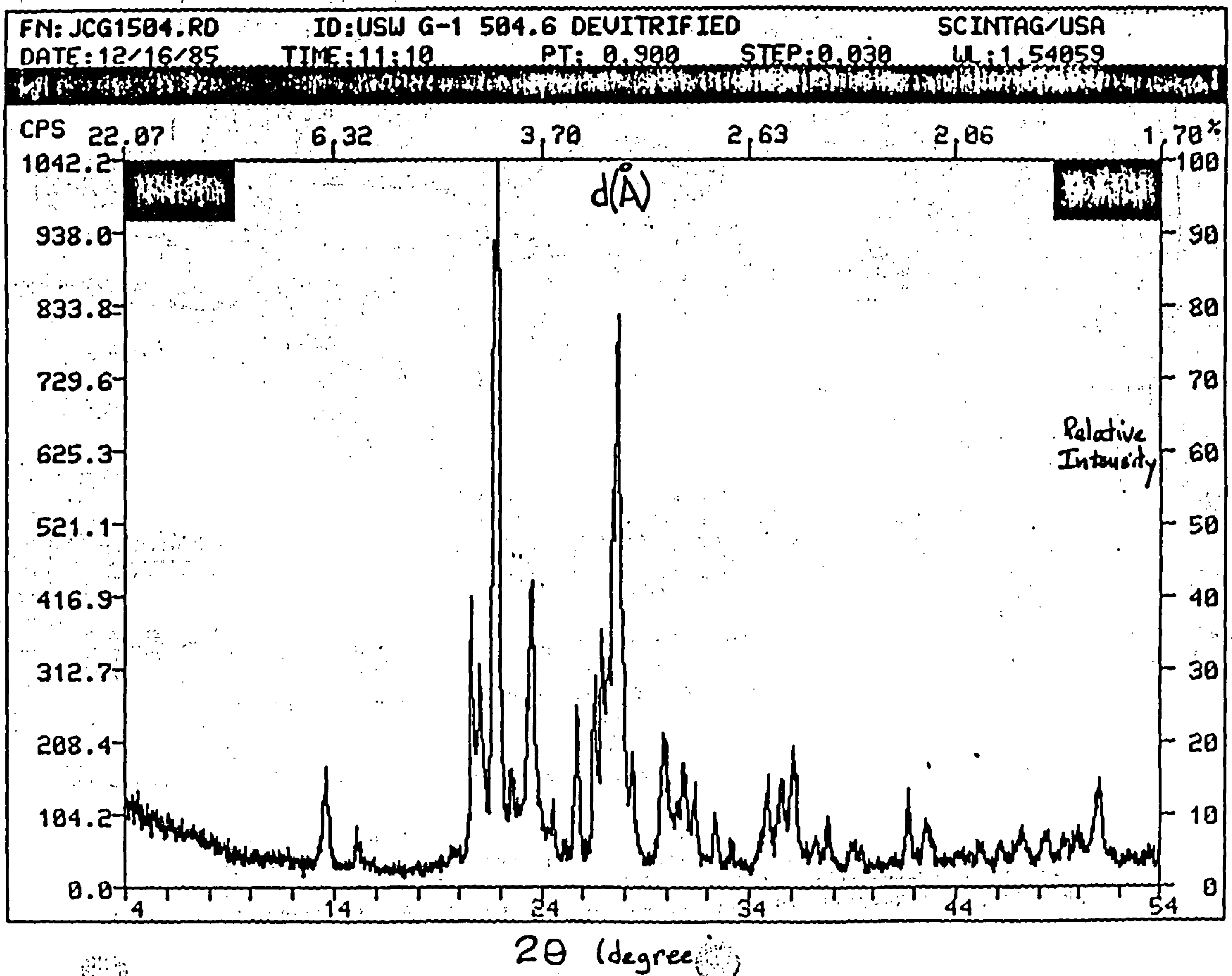


Figure 2: Copy of Typical 2θ vs. Peak Intensity (in CPS - Counts per second) for an NNWSI Project Sample Raw Data (.RD) File. WL is wavelength of X-rays and step is the chopper increment used.

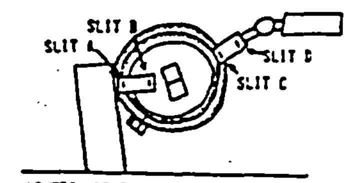


Scintag Pad V X-Ray Diffraction System Operations Checklist

EP ID & Rev.:______________________________ EP Date:____________
Operator Name:______________________________ Signature:____________
Date:____________ Operator Location: ______________________________
SNL PI:____________________ Division:____________ Phone:____________

Checks Prior to Startup:

Main Panel Settings: Accel. Voltage (kV):________ Tube Current (mA):________
Water Flow On:____ Current Ind. On:____ Timer Off:____
Generator/Goniometer: Startup Timer Reading:____________
XRD Tube ID #:______________________________
Detector ID#:______________________________
Collimating Slits (Locations on sketch at right.)
A:________ B:________ C:________ D:________
DAS Calibration completed successfully:________



SKETCH OF FRONT OF GONIOMETER WITH COLLIMATING SLIT LOCATIONS

Standard Run Prior to Sample Data Gathering:

(Filename is JCSyymmdd where S=starting run, yymmdd is date.
Phillips Silicon X-Ray Standard is used for all runs.)
Previous Silicon Filename for Comparison:____________________
Filename this run: ____________________
Angular Range of Scan: Start (°2θ):________ Final (°2θ):________
Scan Rate (°2θ/min):________ Chopper Increment (°2θ):________

Comparison of 2 strongest peaks between standard runs:

This Run Filename:____________________

	Peak 1	Peak 2
Rel. Intensity	______	______
2θ (°)	______	______
Calc. d-Spacing(Å)	______	______

Previous Run Filename:____________________

	Peak 1	Peak 2
Rel. Intensity	______	______
2θ	______	______
Calc. d-Spacing(Å)	______	______

Values for JCPDS CARD 27.1402 (Silicon)	
Peak 1	Peak 2
100	55
28.44	47.31
3.136	1.920

% Deviation Between Runs [(Prev. Value-Today Value)/(Prev. Value) x 100]

	Compare with Previous Run		Compare with JCPDS Card 27.1402	
	Peak 1	Peak 2	Peak 1	Peak 2
Rel. Intensity	______	______	______	______
2θ	______	______	______	______
Calc. d-Spacing	______	______	______	______

Check here if calibration within limits specified in TP-62:____ If out of limits discuss here: ________
____
____

Working disk (WD)with calibration files (Name & #):____________________
Calib. backup disk (CD) with calib. files (Name & #):____________________

Data Collection on NNWSI Samples:

(Note: Check here _____ if angular range of scan, scan rate, and chopper increment, as detailed above, are identical for samples and standard. Note any deviations here:______________________________________
____
____)

Sample Run #	Filename	SNL Sample ID	Pre-load Agitation (check)
________	____________	______________________________	__________
________	____________	______________________________	__________
________	____________	______________________________	__________
________	____________	______________________________	__________
________	____________	______________________________	__________
________	____________	______________________________	__________

Working disk (WD) on which data are stored (Name & #):____________________
Backup disk (BD) on which data are stored (Name & #):____________________

Standard Run After Sample Data Gathering:

(Filename is JCFyymmdd where F=final run, yymmdd is date. Standard and all operating parameters are identical with those for starting run.)
Filename this run: ______________________________

Comparison of 3 strongest peaks between runs:

This Run Filename:____________________________

	Peak 1	Peak 2
Rel. Intensity	__________	__________
2θ	__________	__________
Calc. D-Spacing	__________	__________

Pre-sample and post-sample calibration check data using silicon standard:

Pct. Deviation Between Runs [(Before Value-After Value)/(Before Value) x 100]

	Peak 1	Peak 2
Rel. Intensity	__________	__________
2θ	__________	__________
Calc. D-Spacing	__________	__________

Check Here if Calibration within Limits Specified in TP-62:_____ If out of limits discuss here:__________
____
____

Working disk (WD)with calibration files (Name & #):____________________
Calib. backup disk (CD) with calib. files (Name & #):____________________

Shutdown Procedures Checklist:

Sample and Standard Data Files Copied to Floppy Disk(s): ________
Sample and Standard Data Files Deleted from Hard Disk: ________
X-Ray Generator Powered Down: ____________
Tektronix Terminal Turned Off: ____________
DG Terminal Screen Intensity Turned Down:_________
Enter Final X-Ray Generator Timer Reading Here:______________________

UNCONTROLLED

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NNA.870717.0044

SNL NNWSI Project Technical Procedure

Procedure for Vacuum Saturation of Geologic Core Samples

Page	1	2	3	4	5	6	7	8	App A
Rev.	0	0	0	0	0	0	0	0	0

Approved by:

Barry M. Schwartz — 3/19/87

B. M. Schwartz, 6313 — Date
Author

F. B. Nimick — 3/20/87

F. B. Nimick, 6313 — Date
Technical Review

E. A. Klavetter — 3/23/87

E. A. Klavetter, 6313 — Date
Technical Review

T. E. Blejwas — 3/31/87

T. E. Blejwas, 6313 — Date
Division Supervisor

SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT

Issued to: NNWSI (TRC)

Copy Number: 011

RETURN TO 6310 RECORDS CENTER
WHEN NO LONGER NEEDED.

1.0 Scope

This Technical Procedure (TP) applies to the vacuum saturation of geologic core samples. The procedure was developed using vacuum saturation data from cores having diameters of less than or equal to 2.125 inches. This TP is intended for implementation in a laboratory environment, in conjunction with the SNL NNWSI Project Experiment Procedure (EP) requiring the vacuum saturation.

2.0 Definitions

Constant Weight - A sample weight which changes by less than or equal to 0.05 percent of the total sample weight between successive vacuum saturation cycles.

3.0 Activity Objective

To vacuum saturate geologic samples to constant weight. If vacuum saturation does not saturate the sample to the level desired, pressure saturation should be considered (1).

4.0 Description of Activity

Samples are weighed, submerged in water, and vacuum is applied. Air in the sample is removed by the vacuum and replaced by the water. A sequence of saturating and weighing is repeated until the sample reaches constant weight.

5.0 Operations

5.1 Description of Set Up

5.1.1 A schematic of the apparatus is given in Figure 1.

5.1.2 The following items are necessary to perform vacuum saturations:

1. A vacuum chamber large enough for the sample to be completely submerged in the water. The vacuum chamber must be capable of safely maintaining a vacuum of 1 X 10 E-3 Torr.

2. Vacuum pump capable of evacuating the vacuum chamber to 5 X 10 E-3 Torr.

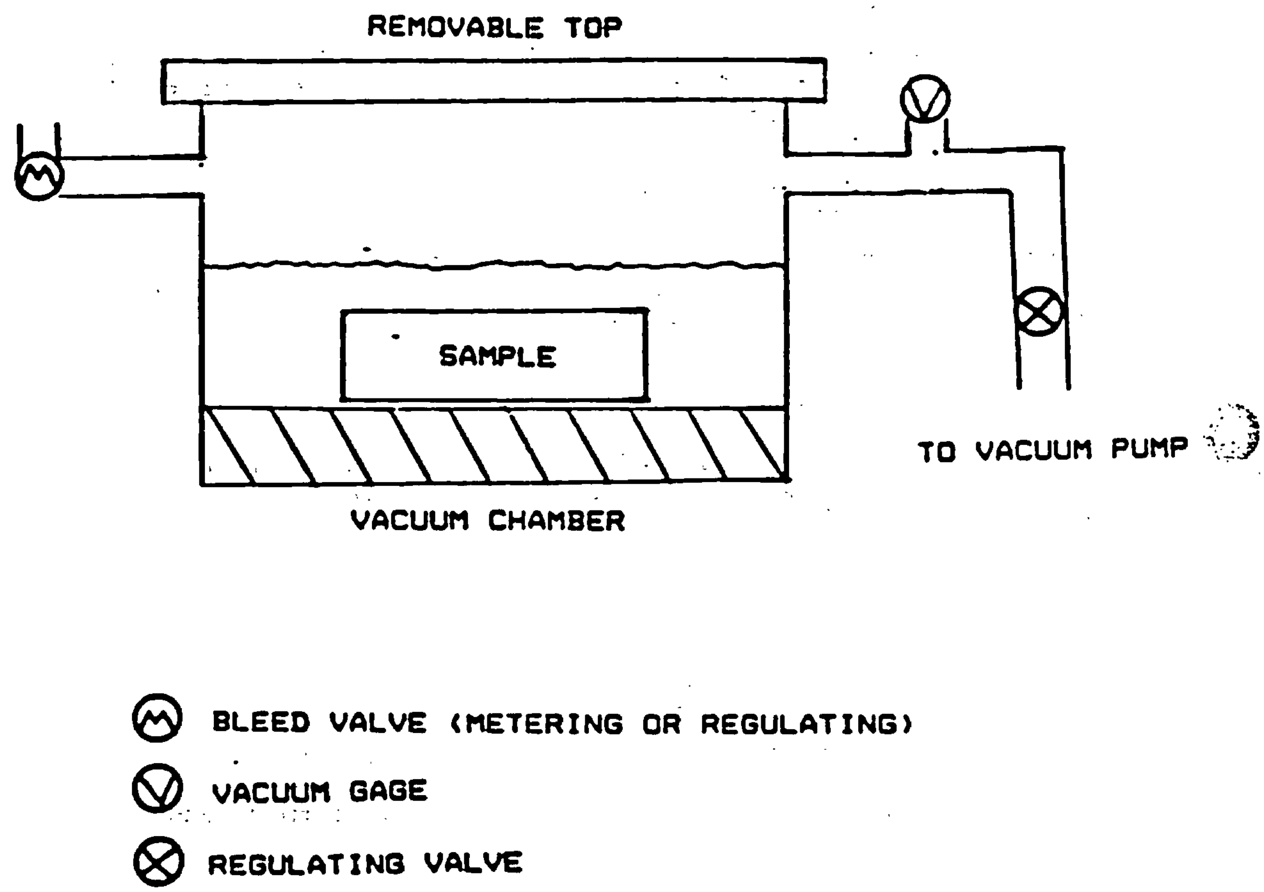

FIGURE 1 SCHEMATIC OF VACUUM SATURATION APPARATUS

3. Vacuum gage and/or corresponding pressure indicator capable of reading between ambient pressure and 1 X 10 E-3 Torr. The gage and/or corresponding pressure indicator will be marked with the following notation:

   "For Indication Only".

4. Temperature indicating device for measuring room temperature. The device should have a range of 15 to 30 degrees C (inclusive) and will be readable to 1 degrees C. The temperature indicating device will be marked with the following notation:

   "For Indication Only".

5. Top loading balance(s) having a range greater than the weight of the saturated samples with an accuracy greater than or equal to 0.01 percent of the pre-vacuum saturation sample weight. The EP requiring the vacuum saturation will define the expected weights of the saturated samples.

6. A sufficient quantity of water to cover the sample in the vacuum chamber and maintain coverage as the sample saturates. The EP will define the type, purity, and other requirements regarding source and/or origin of the water.

The manufacturer/make, model and serial number of the above items will be documented on the Vacuum Saturation Data Sheet or in a logbook. If available, property or inventory control numbers will be documented. If make, model, or serial number are unavailable, an identifier will be defined, consistent with the EP requiring the vacuum saturation.

5.1.3 Vacuum Saturation Procedure

5.1.3.1 Prerequisites

Verify that:

- The revision of the TP which is specified in the current version of the EP is being used.
- The sample identification and sample custody requirements defined in the EP are being followed.
- The laboratory temperature is between 18 and 30 degrees C.
- The items listed in Section 5.1.3 are ready and available.
- The balance(s) are calibrated in conformance to EP requirements.

- Samples are identified in a manner which will be visible at the conclusion of the process. The use of a black indelible marker is recommended. The identifier must be consistent with sample identification requirements in the EP. This is especially important when more than one sample are in the vacuum chamber at one time.

5.1.3.2. Part 1 of the Vacuum Saturation Data Sheet

This section of the Vacuum Saturation Data Sheet (Appendix A) provides documentation of initial conditions. Data recording may consist of one or more pages of the Vacuum Saturation Data Sheet.

The following information should be recorded on the first page of single or multiple data sheets:

- EP Identifier and revision
- Sample Identification (ID)
- Make/manufacturer, model and serial number of balance(s).
- Verification of calibration of the balance(s), consisting of date of last calibration and the due date of the next calibration.

Only the sample ID needs to be recorded in Part 1 of subsequent pages when multiple data sheets are generated for a sample.

5.1.3.3 Step-By-Step Operating Procedures

Note: This section has the corresponding lines of the Vacuum Saturation Data Sheet in parentheses. Lines A-F of the Vacuum Saturation Data Sheet are used for the first vacuum saturation cycle only. Subsequent vacuum saturation cycles use lines G-M.

1. Place the sample(s) to be saturated in the vacuum chamber.

2. Fill the vacuum chamber with enough ambient temperature water to completely cover the sample(s), anticipating that some water will be lost by evaporation and imbibed into the sample during the vacuum saturation process.

3. Close the vacuum chamber and the vacuum chamber bleed valve.

4. Apply vacuum by slowly opening the regulating valve from the closed position. This will cause the water to bubble, and the vacuum must be applied slowly so that bubbling will not be vigorous enough to allow water to enter the vacuum lines. When the bubbling rate decreases, continue to slowly open the regulating valve until it is completely open, then close one half-turn.

5. Record the date and time at which the vacuum is applied (line A).

6. Vacuum saturate for 30-32 hours.

7. Close the valve which supplies the vacuum to the vacuum chamber.

8. Open the bleed valve, allowing laboratory air to enter the vacuum chamber. Verify that the sample(s) are still completely submerged in water.

9. Record the date and time at which the vacuum is removed (line B).

10. Keep the sample(s) submerged at ambient pressure for 16-48 hours. During this time, the water temperature will rise to ambient.

11. Record the date and time at which ambient pressure phase ends (line C).

12. Remove one sample at a time from the vacuum chamber. Within 15 seconds of sample removal, blot the sample with a lint-free paper or cloth towel.

13. Weigh the sample within 15 seconds of blotting. Record all weights to the maximum resolution of the balance (line D).

14. Return the sample to the vacuum chamber, and cover completely with water, anticipating that some water will be lost by evaporation and imbibed into the sample during the vacuum saturation process. Keep the sample in the vacuum chamber for between 5 and 15 minutes before performing step 15.

15. Weigh the sample again, per steps 12 and 13 (line E).

16. Calculate and record the mean value of the weights recorded during steps 13 and 15. Round the mean weights to the same decimal point they were recorded. Numbers less then 5 are rounded to the next lowest number. Numbers greater than or equal to 5 are rounded up (line F).

    Note: If these data are from a vacuum saturation cycle other than the first, go to step no. 18.

17. Repeat steps 1 - 16, recording data on lines G - L.

18. Calculate the weight change for each sample, i.e., the change in sample weight between the vacuum saturation cycles (line M).

    The percent weight change of the sample is calculated by dividing the change in sample weight by the mean sample weight measured immediately prior to the most recent vacuum saturation. If the percent weight change is within plus or minus 0.05 percent, the process has met the specification and vacuum saturation of the sample is terminated. If the percent weight change is greater than plus or minus 0.05 percent, vacuum saturation should continue until the weight change specification has been met.

19(a) For Each Sample Meeting the Specification:

- Remove from the vacuum chamber and store per instructions in the EP.
- Number multiple vacuum saturation data sheets used for each individual sample sequentially, i.e., page 1 of 2, page 2 of 2, etc.
- Verify that Parts 1 and 2 of the vacuum saturation data sheets are complete, including any comments or reference to notations in a logbook.
- Complete Part 3 of the Vacuum Saturation Data Sheet.

19(b) For Each Sample Not Meeting the Specification:

- Initiate an additional Vacuum Saturation Data Sheet.
- Transfer the mean weight values from line L of the completed Vacuum Saturation Data Sheet to line F of the new data sheet.
- Go to step 17.

20. Discard the water in the vacuum chamber when the last sample in the vacuum chamber has met the specification (unless the EP requests that the water be saved).

5.1.3.4 Postrequisites

Verify that:

- All samples have been processed in accordance with the EP requiring the vacuum saturation.
- All significant events which may affect sample quality are documented in accordance with Section 5.3 of this TP and the EP requiring the vacuum saturation.
- Action has been initiated for record transmittal to the SNL PI, as specified in the EP.

5.2 Safety

The vacuum saturation apparatus should be operated in accordance with safety requirements of the facility where the work is being performed and that of the employer of person(s) performing the work.

5.3 Documentation Requirements

5.3.1 All records generated during the use of this TP will be made using black indelible ink.

5.3.2 Records generated during the use of this TP consist of completed Vacuum Saturation Data Sheets (Appendix A), certificates of calibration of devices, and logbook entries. Logbook entries are used to record significant events relating to the use of the TP which are not documented on the data sheets.

5.3.3 The EP will define the following:

- The types of records to be transmitted.
- The identity and mailing address of the SNL PI to which records are to be transmitted.

6.0 References

1. Klavetter, E. A., and B. M. Schwartz (both SNL 6313), "Saturation Procedures", memo dated April 3, 1984.

Vacuum Saturation Data Sheet

PART 1

EP ID and Rev ______________________
Sample ID ______________________
Make/manufacturer of balance ______________________
Model and serial # of balance ______________________
Date of last balance calibration ____________ Due date ____________
Sample Weight ____________g Repeat of Sample Weight ____________g
Mean value of pre-vacuum-saturation sample weights ____________g

PART 2

A) Date and time vacuum saturation begins. Date________ Time________
B) Date and time vacuum saturation ends & ambient pressure phase begins. Date________ Time________
C) Date/time ambient pressure phase ends. Date________ Time________
D) First sample weight ____________g

E) Second sample weight____________g
F) Mean sample weight from lines D and E. ____________g

G) Date and time vacuum saturation begins. Date________ Time________
H) Date and time vacuum saturation ends & ambient pressure phase begins. Date________ Time________
I) Date/time ambient pressure phase ends. Date________ Time________
J) First sample weight ____________g

K) Second sample weight____________g
L) Mean sample weight from lines J and K. ____________g

M) Sample weight change: $\frac{100 \text{ (Line L - Line F)}}{\text{line F}}$ = ________%

Sample Disposition (check one)
In Specification ______ (weight change is within ± 0.05%)

Out of Specification ______ (weight change is not within ± 0.05%)

Comments: ______________________
____

PART 3

Work performed by ______________________ ____________
Printed - Signed Date

Affiliation of Employee ______________________
Location of Work ______________________

NNA.880531.0025

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SNL NNWSI Project Technical Procedure

Drying Geologic Samples to Constant Weight

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Rev	A	A	A	A	A	A	A

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Division Supervisor

1.0 SCOPE

This Technical Procedure (TP) applies to oven drying geologic samples to constant weight. The procedure was developed using oven-drying data from cores composed predominately of nonhydrous mineral phases having diameters of 2.125 in. or less. This TP is intended for implementation in a laboratory environment, in conjunction with the SNL NNWSI Project Experiment Procedure (EP) requiring the drying of samples.

2.0 DEFINITIONS

Constant Weight--A sample weight that changes by 0.05% or less of the total sample weight between successive oven-drying cycles.

3.0 ACTIVITY OBJECTIVE

The objective of this procedure is to oven dry geologic samples to constant weight while minimizing thermal shock. This procedure is based in part on the results of drying experiments run at SNL [1,2].

4.0 DESCRIPTION OF ACTIVITY

Samples are heated and cooled at ambient pressure in a ventilated oven or with a vacuum applied. A sequence of weighing, heating, and cooling is repeated until a sample reaches constant weight.

5.0 OPERATIONS

5.1 Description of Set-Up

5.1.1 Devices Used

The following are necessary to oven dry samples:

- A ventilated (or vacuum) oven must meet the following requirements in addition to any imposed by the EP requiring the oven-drying: (1) have a temperature range including 30 to 115°C, (2) have heating and cooling rates controlled to ≤ 2°C/min, (3) have temperature stability within ± 5°C at the minimum and maximum temperature hold points, and (4) be capable of housing a temperature-indicating device for verifying heating and cooling rates and hold-point temperatures.

- A temperature-indicating and recording device(s) for measuring oven temperatures. The recording device must be capable of providing hard copy documentation of temperature (°C) versus time (sec or min) during the time that the oven is heating or cooling and at all temperature hold points. The accuracy of the temperature-indicating and recording devices should be within 1°C for temperatures between 25 and 115°C.

- A top loading balance(s) having a range greater than the initial weight of the samples with an accuracy greater than or equal to 0.01% of the predried sample weight. The EP requiring the oven drying will define the expected weights of the oven-dried samples.

- A vacuum pump and a vacuum gauge (or corresponding pressure indicator) having a range including ambient pressure to 1 millitorr. Any unit of pressure may be used. The unit used must be noted in Part 1 of the oven-drying data sheets. The gauge or corresponding pressure indicator will be marked with the notation "FOR INDICATION ONLY." This is necessary only if vacuum drying is used.

The manufacturer/make, model, serial number, date of last calibration, and calibration due date of the balance will be documented on the Oven-Drying Data Sheet (Appendix A). Calibration of the oven temperature-indicating and recording device and other devices specified in the EP will be documented in a logbook. If available, property or inventory control numbers will be documented. If make, model, or serial number are unavailable, an identifier will be defined, consistent with the EP requiring the oven drying.

5.1.2 <u>Oven-Drying Procedure</u>

5.1.2.1 <u>Prerequisites</u>

Verify that the following prerequisites have been met.

- The revision of the TP that is specified in the current version of the EP is being used.
- The sample identification and sample custody requirements defined in the EP are being followed.
- Samples are identified in a manner that will be visible at the conclusion of the process. The use of a black indelible marker is recommended. This is especially important when more than one sample is in the drying oven at one time.
- The items listed in Section 5.1.1 are ready and available.
- Heating and cooling profiles for the drying oven have been documented in accordance with requirements in the EP.
- The balance(s) should be operated (warmed up, leveled, etc,) in accordance with the owner's manual, and calibrations and calibration checks should be performed in accordance with EP requirements.

5.1.2.2 <u>Part 1 of the Oven-Drying Data Sheet</u>

This section of the Oven-Drying Data Sheet provides documentation of initial conditions. Data recording may consist of one or more Oven-Drying Data Sheets.

The following information should be recorded on the first page of single or multiple data sheets:

- EP identification and revision.
- Sample identification (ID).
- Make/manufacturer, model, and serial number of balance(s).
- Verification of calibration of the balance(s), i.e., date of last calibration and the due date of the next calibration.

- Weight of the sample to be dried (taken three times), including calculation of the mean weight.
- Nominal heating and cooling rates.
- Nominal pressure inside the drying oven (if vacuum is applied).

The sample ID and the nominal heating and cooling rates need to be recorded in Part 1 of all Oven-Drying Data Sheets.

5.1.2.3 Step-By-Step Operating Procedures

NOTE: The corresponding lines of the Oven-Drying Data Sheet are given in parentheses. Lines A-F of the Oven-Drying Data Sheet are used for the first oven-drying cycle. Subsequent oven-drying cycles use Lines F-M.

1. Place the sample(s) to be dried in the oven. The temperature in the oven should be between ambient and 40°C.

2. Record the date, time, and temperature of the oven at the time the samples are placed in the oven (Line A).

3. Heat at $\leq$ 2°C/min until the oven reaches a temperature of 110 $\pm$ 5°C.

4. Record the date and time the drying cycle begins, which is when the oven temperature reaches 110 $\pm$ 5°C (Line B).

5. Heat the sample at 110 $\pm$ 5°C for between 120 and 128 hr. Monitor the oven temperature continuously during this time, using the recording device specified in Section 5.1.3.2. In a logbook, note any time periods and/or oven temperatures that fall outside of this range.

6. Record the date, time, and temperature of the oven when the drying cycle ends (Line C).

7. Cool the oven at $\leq$ 2°C/min until the oven temperature is between ambient and 40°C (the cooling temperature).

8. Record the date, time, and temperature of the oven when the oven reaches the cooling temperature (Line D).

9. Let the sample(s) equilibrate in the oven (at the cooling temperature) for between 30 and 60 min. If vacuum was applied, record the pressure in the oven and then return the pressure in the oven to ambient.

10. Remove one sample at a time from the drying oven and weigh it three times. Record all weights to the maximum resolution of the balance (Line E). Samples should be weighed within 15 min of the cooling cycle.

11. Calculate and record the mean value of the weights recorded during Step 10. Round the mean weights to the same decimal point to which they were recorded (numbers less than 5 are rounded down; numbers greater than or equal to 5 are rounded up) (Line F).

    Note: If the data are from an oven-drying cycle other than the first, go to Line 13.

12. Repeat Steps 1 through 11, recording data on Lines G-L instead of Lines A-F.

13. Calculate the weight change for each sample, i.e., the change in sample weight between the oven-drying cycles (Line M).

    The percent weight change of a sample is calculated by dividing the change in sample weight by the mean sample weight measured immediately before the most recent oven drying. If the percent weight change is within ± 0.05%, the sample has met the specification and oven drying of the sample is terminated (go to Step 14a). If the percent weight change is greater than ± 0.05%, the sample has not met the specification (go to Step 14b).

    If weight gain by water adsorption or weight loss resulting from material instability occurs and is significant compared to the weight-change specification, the process should be repeated or terminated for the sample. In either case, instructions in the EP regarding nonconformances should be followed.

14(a) The following should be done for each sample meeting the specification.

- Remove the sample from the drying oven. The EP will provide instructions for handling the sample(s) from this point on.
- Sequentially number the Oven-Drying Data Sheets used for each sample, e.g., Page 1 of 2, Page 2 of 2.
- Verify that Parts 1 and 2 of the Oven-Drying Data Sheets are complete, including any comments or reference to notations in a logbook.
- Complete Part 3 of the Oven-Drying Data Sheet.

14(b) The following should be done for each sample not meeting the specification.

- Initiate an additional Oven-Drying Data Sheet.
- Transfer the mean-weight values from Line L of the completed Oven-Drying Data Sheet to Line F of the new data sheet.
- Go to Step 12.

5.1.2.4 <u>Postrequisites</u>

Verify that the following postrequisites have been met.

- All samples have been processed or preparations are being made to process them in accordance with the EP requiring the oven drying.
- All significant events that may affect sample quality have been documented in accordance with Section 5.3 of this TP and the EP.
- The units of time used to calculate the heating and cooling rates have been documented on Part 1 of the Oven-Drying Data Sheets.

- If vacuum drying was used, the unit of pressure has been documented in Part 1 of the the Oven-Drying Data Sheets.
- Action has been initiated for transmittal of data sheets, logbooks, oven-drying temperature profiles (including heating and cooling rates and temperature-hold points), and certificates of calibration in accordance with the EP requiring the drying of samples.
- When the last sample in the oven has met the constant weight specification, the oven has been turned off and returned to ambient temperature and pressure.

5.2 Safety

Because samples are not to be handled at temperatures above 40°C or at pressures below about 1 millitorr, there should be no safety hazards other than the normal hazards of the equipment.

5.3 Documentation Requirements

5.3.1 Black indelible ink should be used for all records generated.

5.3.2 Records generated during the use of this TP typically consist of completed Oven-Drying Data Sheets, certificates of device calibration, hard copy documentation of heating and cooling rates and temperature-hold points, including any additional logbook entries. Logbook entries are used to record significant events relating to the use of the TP, which are not documented on the Oven-Drying Data Sheet, such as instrument settings for the drying oven and oven-temperature recording device(s).

6.0 REFERENCES

1. Memo to F. B. Nimick, 6313, from B. M. Schwartz, 6313, "Determination of Drying Procedures for Densely Welded Busted Butte NX Size Test Specimens," August 8, 1983.

2. Memo to F. B. Nimick, 6313, from B. M. Schwartz, 6313, "Drying Procedure for NX Size or Smaller Samples," March 30, 1984.

APPENDIX A

OVEN-DRYING DATA SHEET

PART 1:
EP ID and Rev ________________ Sample ID ____________________
Make/manufacturer of balance ______________________________
Model and serial number of balance __________________________
Date of last balance calibration ______________ Due date ______________
Sample weight 1. ____________g 2. ____________g 3. ____________g
Mean value of sample weights before oven-drying ________________g
Heating rate _______°C/ sec or min Cooling rate _______°C/ sec or min
Nominal pressure inside drying oven ____________

PART 2:
A. Date, time, and temperature at the onset of the temperature rise
Date ______________ Time ______________ Temp __________°C
B. Date and time when the drying cycle begins
Date ______________ Time ______________
C. Date, time, and temperature at the end of the drying cycle
Date ______________ Time ______________ Temp __________°C
D. Date, time, and temperature at the end of the cooling cycle
Date ______________ Time ______________ Temp __________°C
E. Sample weight 1. ____________g 2. ____________g 3. ____________g
F. Mean sample weight from Line E ________________g

- -

G. Date, time, and temperature at the onset of the temperature rise
Date ______________ Time ______________ Temp __________°C
H. Date and time when the drying cycle begins
Date ______________ Time ______________
I. Date, time, and temperature at the end of the drying cycle
Date ______________ Time ______________ Temp __________°C
J. Date, time, and temperature at the end of the cooling cycle
Date ______________ Time ______________ Temp __________°C
K. Sample weight 1. ____________g 2. ____________g 3. ____________g
L. Mean sample weight from Line K ________________g

- -

M. Sample weight change: $\frac{100\ (\text{Line F} - \text{Line L})}{\text{Line F}}$ = ____________%

- -

Sample Disposition (check one)

In Specification _____ (weight change within ± 0.05%)

Out of Specification _____ (weight change not within ± 0.05%)

Comments: ____
____

PART 3:

Work performed by ______________________________ ______________
Printed - Signed Date

Company/Division ____
Location of Work ____

RMS NO. SL * 000530
ACC NO. SL * 100582

NNWSI PROJECT

Procedures for Acquiring, Digitizing, Processing, Storing and Retrieving Ground Motion Data from Underground Nuclear Explosions

Approved by:

J. W. Long Author, SNL Division 7111	2/17/87 Date
J. S. Phillips Principal Investigator, SNL Div 7111	2/17/87 Date
L. J. Vortman Principal Investigator, SNL Div 7111	2/17/87 Date
J. R. Banister Division Supervisor, 7111	2/20/87 Date
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TABLE OF CONTENTS

I. INTRODUCTION

This Technical Procedure describes the procedures necessary to obtain, digitize, process, store and retrieve ground motion data from Underground Nuclear Explosions (UNEs) in support of the Nevada Nuclear Waste Storage Investigations (NNWSI) project. The procedures described herein are not UNE specific, i.e., they will be the same for every UNE. The Quality Assurance Level of the procedures described herein has been designated at Q1.

This procedure is divided into four sections. Section II contains the data acquisition procedures, Section III discusses the data digitizing procedures, Section IV contains the data processing procedures and Section V presents the storage and retrieval procedures. These sections provide a step by step "checklist" description of what is to be done. For more detail on these tasks, Appendix A should be consulted. Cross reference between Appendix A and Sections II through V is given in parentheses throughout the procedures. In addition, the gage calibration procedures are presented in Appendix B. All equipment used to measure the data are listed in Appendix C.

All personnel involved in performing the tasks described in this technical procedure are required to be certified in accordance with NNWSI DOP 2-6 and to follow the instructions described herein. In the event that any of these instructions cannot be followed, the personnel involved will prepare a "Non-conformance Report" in accordance with NNWSI DOP 15-1. This will be filed with the appropriate data sheet in the Event Data Book. In addition, the 7111 Principal Investigator (PI) will be notified of the deviation as soon as practicable. The responsibility of adherence to these procedures lies with all personnel involved in this work.

In this procedure there are several personnel who are categorized as "supporting staff". For the sake of clarity, the activity (as listed on approved Form DOP 2-6(1)) of the personnel required to perform the specific task will be given in parenthesis. This activity is consistent with and can be cross referenced with the approved "Personnel Certification for Staff Supporting Weapons Test Seismic Activities in WBS 1.2.4.1.2" dated 23 September 1986.

II. DATA ACQUISITION

II.1.0 Purpose

II.1.1 The purpose of this section is to state the procedures for aquiring ground motion data for the NNWSI project.

II.2.0 Scope

II.2.1 This section describes the methods to be used to accomplish the following tasks involved in data acquisition:

a. Event Selection
b. Determination of Canister Settings
c. Pre-shot Preparation
d. Event Recording
e. Post-shot Activities

II.3.0 Definitions

II.3.1 Canister - A container with three orthogonally oriented accelerometers.

II.3.2 Canister Settings - This term refers to the procedure of setting the ranges of the accelerometers for a particular event. The gains of the three accelerometers in one canister cannot be set individually (as currently set up), therefore only one set of ranges for a particular canister is specified.

II.3.3 Station - A single canister location.

II.3.4 Post calibration sequence - the process of putting a calibration signal on the data record after the ground motion from the UNE has ceased.

II.4.0 Data Acquisition Procedures

II.4.1 Event Selection (Appendix A, Section A.I)

II.4.1.1 The 7111 PI will select events from the classified "NV Master Test Schedule" which, in his opinon, have locations, depths and yields suitable for generating data which will contribute to the objectives of the NNWSI project. At least 10 weeks prior to the shot date the PI will notify the supporting staff (Field Technician) of the shot participation decision.

II.4.1.2 The 7111 PI will decide which stations to operate on the event and whether or not to move or install additional stations.

II.4.2 Determination of Canister Settings (Appendix A, Section A.II)

II.4.2.1 The supporting staff (Scientific Investigator) will obtain the event information necessary to determine canister settings from the "Containment Evaluation Panel" document. That information includes event coordinates, depth of burial, surface elevation, design yield and hole number.

II.4.2.2 The supporting staff (Scientific Investigator) will select a recent event in the vicinity of the current event as a predictor event. The official yield of the predictor event will be obtained from the classified "Selected Event Data" document (LLNL) and the ratio of the cube root of the yields of the current event to the predictor event will be determined. The peak accelerations from the predictor event and this ratio will be used as input to a computer program (SETRNG) which determines the gage settings for the canister. (Note, this program is strictly for ranging gages and does not affect the quality of data returned. The only adverse effect would be that data might not be returned if gages were ranged improperly.) If a particular station was inactive on the predictor event, an estimate of the peak vector acceleration will be made from a nearby station or stations. The input to and output from SETRNG will be retained on the computer.

II.4.2.3 The supporting staff (Scientific Investigator) will verify that the output from the SETRNG program (Canister Settings Sheet, Exhibit A, Appendix A) is reasonable and will then sign it and date it. The 7111 PI will then review, sign and date. This form will then be transmitted to the supporting staff (Field Technician) responsible for recording the data. A copy of this form will be filed by the 7111 PI in the 7111 "Coordinates Book".

II.4.3 Pre-shot Preparation (Appendix A, Section A.III)

II.4.3.1 Upon notification from the 7111 PI that data will be recorded on a particular event, the supporting staff (Field Technician) will send a letter to SNL/NTS office stating the intention to participate. The SNL/NTS office will in turn send an Event Participation Request to the appropriate fielding agency (LLNL or LASL). Notification of intent to participate is required by the fielding agencies at least six weeks prior to the scheduled shot date.

II.4.3.2 The supporting staff (Field Technician) will note the date of receipt and review the Canister Settings Sheet. At this time the Track Sheet (Exhibit E, Appendix A) will be begun. Any discrepancies or problems noted by the supporting staff receiving the form (Field Technician) will be resolved with the 7111 PI or supporting staff (Scientific Investigator) who generated the form before the gage ranges are set.

II.4.3.3 The supporting staff (Field Technician) will request a location survey from Holmes and Narver at NTS for any new station locations. The orientation and installation instructions are given in Section A.III.A-B in Appendix A.

II.4.3.4 Prior to installing a canister at a new location or reinstallation of a canister at an existing location, the supporting staff (Field Technician) will check the gages for mechanical damage by connecting them to the system and rotating them in a 1g field. The supporting staff (Field Technician) will check the calibration of ground motion gages in accordance with the procedures in Section A.III.A in Appendix A and Appendix B. Diagnostic laboratory equipment used to check other components in the ground motion measurement system will be calibrated in accordance with NNWSI DOP 12-1.

II.4.3.5 The supporting staff (Field Technician) will perform a preliminary field check of equipment. This will include an electrical and visual inspection of equipment at the stations to be used on a particular event. The supporting staff (Field Technician) will note any problems with equipment on the Track Sheet (Exhibit F, Appendix A). If major corrective action is required, the supporting staff (Field Technician) will document the action on either the Canister Log or the TM Box Setup Checklist (Exhibits B and C respectively, Appendix A) whichever is most appropriate.

II.4.3.6 Prior to the shot, the supporting staff (Field Technicians) will perform a station by station check of the total system. This will require at least two persons; one located in the recording center, the other at the station location. The following tasks will be accomplished and documented on the Station Track Assignment Sheet (Exhibit E, Appendix A) by the supporting staff (Field Technicians):

a. The stations will be commanded on one at a time.
b. The frequency, channel and track assignments will be verified.
c. Recording equipment will be powered on to verify satisfactory operation.
d. A ground motion signal and a calibrate signal will be generated at the station and observed in the recording center to verify that all equipment is performing satisfactorily.
e. Settings on the discriminators will be checked to verify that at a voltage of near zero the counts are zero and that band edge to band edge occurs at approximately 5 volts.
f. The VCO output will be monitored with a spectrum analyzer to verify that it is performing satisfactorily.

II.4.3.7 Tape machines will be inspected by the Manufacturer's Field Representative at a minimum of twice yearly or as needed to verify that the recorders operate properly at shot time. The details of this inspection will be documented in writing with the signature of the Field Representative and date. The supporting staff (Field Technician) will transmit a copy for the 7111 files to the 7111 PI and file the original in the QA files at NTS.

II.4.3.8 Batteries required to power the stations will be checked and replaced, if necessary, approximately 48 hours prior to shot time. At this point the supporting staff (Field Technician) will turn on the station to verify that it is operational and a check at the command station will be performed to verify its satisfactory operation.

II.4.3.9 The supporting staff (Field Technician) will participate in dry runs as required by the NTS Test Director.

II.4.4 Event Recording (Appendix A, Section A.IV)

II.4.4.1 The supporting staff (Field Technician) will accomplish the following tasks during the recording of the event:

a. At least one hour prior to the shot time the equipment will be powered on to allow time for warm up.
b. The tuning on all recievers at the recording center will be verified.
c. A scan of all frequencies that will be required to record data will be performed to identify any interference. If interference is observed, the OCC will be notified. (Note, the OCC will try to identify the interference and clear the frequencies but may not always be successful.)
d. The tape heads will be cleaned, the tape will be Degaussed and the tape will be loaded onto the machine. The tape machine will be run to record the timing signal. The recording of this signal will be played back and inspected to ensure that the tape is loaded correctly and that the recorder is operating properly.
e. The satellite time and the local time will be synchronized approximately 10 minutes prior to shot.
f. A final visual check will be performed on all equipment in the recording center.
g. The stations will be commanded on at approximately 5 minutes prior to shot time by RF signal or tone barrel.
h. The recorders will be started at approximately 3 minutes prior to shot time.
i. The zero tone, if transmitted from the CP on the voice channel, will be recorded on tape. In addition, the satellite time and the local time will be recorded on tape.

j. The post calibration sequence will begin at the appropriate time as determined by circumstances and the judgement of the supporting staff (Field Technician) (usually at 5 minutes after zero time) and turned off 10 seconds later. The calibration time on and off and the step calibration voltage will be recorded on the Summary Sheet, Station Track Assignment and the Track Sheet (Exhibits D, E and F respectively, Appendix A) by the supporting staff (Field Technician).
k. Recorders will be allowed to run until out of tape and the tapes rewound.

II.4.5 Post Shot Activities (Appendix A, Section A.V)

II.4.5.1 The supporting staff (Field Technician) will accomplish the following tasks after the event has been recorded:

a. Paper playbacks of each channel will be made and inspected to determine whether acceptable data has been recorded. If data has been lost or problems found, repairs to equipment will be instituted as soon as possible. The supporting staff (Field Technician) will place comments concerning the problems on the Track Sheet (Exhibit F, Appendix A) to notify the 7111 PI.
b. The post-shot records which include the Summary Sheet, Station Track Assignment, and the Track Sheet forms (Exhibits D, E and F respectively, Appendix A) will be prepared and copies filed at NTS.
c. All tapes, paper playbacks and field data sheets will be transmitted to 7111 with tapes containing duplicate data being transported via separate carriers.

II.4.5.2 Upon reciept of the data from the field, a member of the supporting staff (Scientific Investigator) will transmit the tapes and copies of all field data sheets to another member of the supporting staff (Data Reduction Clerk). All information from the field data sheets will be entered into the Weapons Test Seismic Investigations (WTSI) data base by the supporting staff (Computer Programmer) for permanent retention on the SNL CCF open NOS computer. A dump of this data base will be transmitted to the SNL Department 6310 NNWSI Data Records Management System (DRMS) on an annual basis by the 7111 PI.

III. DATA DIGITIZING

III.1.0 Purpose

III.1.1 The purpose of this section is to state the procedures for digitizing ground motion data for the NNWSI project.

III.2.0 Scope

III.2.1 This section describes the methods to be used to convert analog records into digital records to facilitate computer processing of ground motion data for the NNWSI project.

III.3.0 Definitions

III.3.1 MACRO - A computer file containing standard instructions which may be executed by typing in the name of the MACRO.

III.4.0 Data Digitization Procedures (Appendix A, Section A.VI)

III.4.1 Upon receipt of a classified TWX announcing that a nuclear event has been conducted at the Nevada Test Site (NTS), the Data Crib Custodian will enter the event information in the classified listing of nuclear events and at that time will assign a test number to the event regardless of whether or not ground motion data has been recorded for the event.

III.4.2 Upon receipt of the analog tapes and field data sheets, the supporting staff (Data Reduction Clerk) will perform the following functions in preparation for digitizing the data:

a. Create an Event Data Book and file all paper work received from the field in it. (per NNWSI DOP 11-2)
b. Select an analog tape to be digitized and have it logged in and numbered by the Data Crib Custodian.
c. Prepare a Data Summary Sheet which will contain all of the necessary information to complete the digitizing process.
d. Request paper playbacks of all calibrate and data signals.
e. Visually scan the paper playbacks to identify problems that may develop in the digitizing process.

III.4.3 The supporting staff (Data Reduction Clerk) will execute a set of MACROs to generate the computer output and files necessary for the Digitizer Operator to produce the digitized data files.

III.4.4 A member of the supporting staff (Data Reduction Clerk) will deliver the computer output to another member of the supporting staff (Digitizer Operator) and enter the job in the Work Log.

III.4.5 A member of the supporting staff (Digitizer Operator) will review the output, produce computer files containing the digitized calibration and shot data, plot the files and deliver the plots to another member of the supporting staff (Data Reduction Clerk).

III.4.6 The supporting staff (Data Reduction Clerk) will check the plots for any obvious problems. If there are none, the computer output generated by the tasks described in III.4.4 and III.4.5 will be filed by the supporting staff (Data Reduction Clerk) in the Event Data Book for permanent retention.

III.4.7 The supporting staff (Data Reduction Clerk) will execute a second set of MACROs which create the necessary computer files that are used to apply engineering units to the digitized data.

III.4.8 The supporting staff (Data Reduction Clerk) will check the computer files generated in III.4.7 before proceeding to III.4.9.

III.4.9 The supporting staff (Data Reduction Clerk) will execute a final set of MACROs which apply engineering units to the digitized data, write the resulting files on magnetic tapes, and rewind and scan the tapes.

III.4.10 The supporting staff (Data Reduction Clerk) will check the tape scans for completeness and file them and all other paperwork generated in III.4.9 in the Event Data Book.

III.4.11 A member of the supporting staff (Data Reduction Clerk) will inform another member of the supporting staff (Scientific Investigator) that the digitizing process is complete and that the digital tapes are ready for use. In addition, this supporting staff member (Data Reduction Clerk) will transmit the analog tapes, the Event Data Book, and paper playbacks to the other supporting staff member (Scientific Investigator), who will file the information in the 7111 event files for permanent retention.

III.4.12 The supporting staff (Data Reduction Clerk) will dump all MACROs used in the digitizing process to a magnetic tape marked with the event name. This tape will be stored by this supporting staff member (Data Reduction Clerk) for a period of six months. After this period, the tape will be transferred to the supporting staff (Scientific Investigator) who will archive the tape in the 7111 archives.

IV. DATA PROCESSING

IV.1.0 Purpose

1.1 The purpose of this section is to state the procedures for processing ground motion data for the NNWSI project.

IV.2.0 Scope

IV.2.1 This section describes the methods to be used to prepare the ground motion data for analysis and addition to the data base of the NNWSI project.

IV.3.0 Definitions

IV.3.1 Auto-adjust - A method of data adjustment which forces the first integral of acceleration to end with zero magnitude.

IV.3.2 PROCFIL - A computer file containing a series of job control commands which may be executed with varying input parameters.

IV.3.3 Pseudo Relative Response Velocity Spectra - The response of an elastic, single degree of freedom system to a given transient input as a function of the system natural frequency.

IV.3.4 Repair - The removal of obvious noise spikes that might adversely affect the band pass filtering of the data.

IV.4.0 Data Processing Procedures
(Appendix A, Sections A.VII.A and A.VII.B)

IV.4.1 The supporting staff (Data Processing Clerk) will create additional volumes of the Event Data Book started in the digitization process (Section III) which will contain the information generated in the processing sequence.

IV.4.2 The supporting staff (Data Processing Clerk) will execute a computer program that auto-adjusts the data, creates plots of acceleration and velocity and creates the raw acceleration data files which will be written to magnetic tape for permanent retention.

IV.4.3 The supporting staff (Data Processing Clerk) will inspect the data plots to identify the best data for futher processing and to determine if repairs to the data will be required.

IV.4.4 The supporting staff (Data Processing Clerk) will execute a computer program to repair the data where necessary.

IV.4.5 The supporting staff (Data Processing Clerk) will execute a program to generate expanded acceleration time histories of the data at signal arrival to facilitate accurate determination of signal arrival times.

IV.4.6 The supporting staff (Data Processing Clerk) will execute a computer program (SPEC) which calculates, for every channel on the event, the power spectrum of the combined signal plus noise and of the noise alone and presents the results for each channel on a separate plot. The supporting staff (Data Processing Clerk) will examine the results to determine the frequency cutoffs that will be used in band pass filtering for that event. (Note, program SPEC has been in use for several years. The existing version was recently validated in SAND86-2201. It has also been converted to the NOS/VE system. Documentation is currently being prepared.)

IV.4.7 The supporting staff (Data Processing Clerk) will execute a PROCFIL which executes the programs which perform the band pass filtering, modify the sampling rate, perform frequency domain integrations, and plot and save the resulting files. (The SAM program does the filtering, sampling and integration manipulation. This program has been used for several years. The existing version was recently validated in SAND86-2201. It has also been converted to the NOS/VE system. Documentation is currently being prepared.)

IV.4.8 The supporting staff (Data Processing Clerk) will execute a PROCFIL which uses the output files from IV.4.7 to produce time history plots of 3-D vector magnitudes and 2-D vector magnitudes in the horizontal plane.

IV.4.9 The supporting staff (Data Processing Clerk) will execute a PROCFIL which uses the horizontal component output files from IV.4.7 to produce, plot and save time history files which are rotated into event-specific radial and tangential components.

IV.4.10 The supporting staff (Data Processing Clerk) will execute a computer program which calculates Pseudo Relative Response Velocity Spectra (PSRVs) and plots the results (The computer code used to calculate PSRVs is a standard implementation of a well known procedure. The current version has been used for several years. This version is currently being converted to NOS/VE and documentation and validation will be prepared prior to its use on this system).

V. DATA STORAGE AND RETRIEVAL

V.1.0 Purpose

V.1.1 The purpose of this section is to state the procedures for the storage and retrieval of ground motion data for the NNWSI project.

V.2.0 Scope

V.2.1 This section describes the methods to be used in storing and retrieving the ground motion data.

V.3.0 Definitions

V.3.1 Dayfile - A computer listing of all job control commands and responses associated with a particular tape generation job.

V.3.2 Tape scan - A listing of identifing information for each file on a tape.

V.4.0 Data Storage and Retrieval Procedures

V.4.1 Data Storage (Appendix A, Sections A.VII.C - A.VII.F)

V.4.1.1 The supporting staff (Tape Librarian) will obtain the processed data files from the supporting staff (Data Processing Clerk) (Ref. Section IV).

V.4.1.2 The supporting staff (Tape Librarian) will arrange the data files into categories of raw, filtered and rotated data.

V.4.1.3 The supporting staff (Tape Librarian) will save three copies of the processed data on three magnetic tapes. Two tapes will be stored at the SNL Central Computing Facility (CCF) and one tape will be stored in the archived tape library in Division 7111 for permanent retention.

V.4.1.4 The supporting staff (Tape Librarian) will generate tape scans for the tapes created in V.4.1.3 and verify that the information is on tape. The supporting staff (Tape Librarian) will then retain the tape scans on hard copy in the 7111 files and file one copy with the data tape in the possesion of 7111.

V.4.1.5 The supporting staff (Tape Librarian) will generate a microfiche copy of the tape scans and dayfiles from the tape writing operation. This microfiche will be permanently retained in the 7111 files. A copy of this microfiche will be transmitted to the DRMS by the 7111 PI as they are produced.

V.4.1.6 The supporting staff (Tape Librarian) will maintain and update a catalog of the general data storage information for all data tapes stored in 7111 for NNWSI. This catalog will be kept on the SNL CCF open NOS computer.

V.4.2 Data Retrieval

V.4.2.1 The supporting staff (Tape Librarian) will retrieve data as requested.

APPENDIX A

SEQUENCE OF ACTIVITIES IN THE WEAPONS TEST SEISMIC INVESTIGATIONS

This appendix is intended to be a comprehensive description of all activities in the Weapons Test Seismic Investigations (WTSI) from conceptualization to reporting. Where documents will be prepared and where they will be maintained is also included.

A.I. Test Conceptualization

A. Nevada Operations Office (NVO) publishes weekly a classified "NV Master Test Schedule" listing planned underground nuclear tests, their locations, depths, yields, planned dates, and other information. Files of these schedules will be maintained in 7111 and 7100, although they have no value after an event has been fired. The schedule shows events planned for the next 6 to 8 months. The schedule is an ever-changing document as each item of information is subject to change until actual detonation.

B. The Principal Investigator (PI) will choose from the schedule those events where locations, depths, and yields are suitable for information contributing to NNWSI objectives.

A.II. Arrange Event Participation

A. Based on locations and yields from A.I-B, the PI will determine what stations are to be activated. All stations have been surveyed by Holmes and Narver (H&N) survey and the coordinates are in the WTSI data base.

B. The Assistant Principal Investigator (API) will then determine the following:

1. The coordinates and surface elevation of the Surface Ground Zero (SGZ) of the event. These will be obtained by phone from H&N at 311-5-3487. They are also in the classified event prospectus for each event, but not necessarily with the same precision. Surveyed locations are usually given to the nearest 0.01 foot. It should be emphasized that accuracy of the survey has essentially no effect on the ground motion data because the survey data is used to determine the straight-line distance from the explosion source to the station. The actual travel path of the ground motion can depart from that straight line by hundreds of meters. The geologic structure is not known well enough to permit actual ray paths to be determined.
2. Predicted peak vector accelerations. This can be done by noting peak vector accelerations on previous events at nearby locations. If there are none, a more conservative choice of bandedge values and amplifier gain settings will be used; that is, a predicted value will be assigned a smaller portion of available band width to allow for more excursion beyond predicted peaks.
3. Amplifier gain settings and bandedge values. There are several types of telemetry (TM) boxes available; each contains a series of amplifier settings. The times 1 setting (no amplification) is set for 0.5 g. Thus, bandedge on the proportional-bandwidth subcarrier channels (±7-1/2%) is set for 0.5 g, and 2.5 volts. One, and sometimes two, additional sensitivity choices are available. A program called SETRNG5 will be used to compute the bandedge values and amplifier gain settings. Inputs to the program are stations to be activated, shot coordinates, surface elevation (A.II-B-1), depth of burst (A.I-A), predicted peak vector accelerations

(A.II-B-2), and the ratio of the cube-root of the yield of the planned event to that of the event from which the predictions were estimated. By using a yield ratio, no classified information is revealed. The program has stored the coordinates and elevation of each station, the type of TM box located at each station, and the available amplifier gain settings in that TM box. The program then computes slant distance, azimuth, bandedge, intermediate gain (if there is one), and final gain. Since the amplifier settings are based on peak vector accelerations and the settings are the same for all three components (vertical and two horizontal), there is additional conservatism introduced.

C. The above information will be prepared in a standard format about 4 to 6 weeks before each event (Exhibit A). The form will be signed by the API and reviewed by the PI for final signature. It will then be transmitted to the field via computer terminal, followed by hardcopy transmittal. Copies will be filed in the field in the field data book, and at 7111 in the coordinates book. This information will not be entered into the data base at this point, but at a later time.

A.III. Field Preparation

A. Gage calibrations will be checked on a level table with the gages installed in the canister. The canister will be oriented for each gage until the gage output is 1g and then -1g. The individual gage readings will then be averaged to get a calibrate value. There is no fixed schedule for gage calibration. Gages are calibrated and certified by the manufacturer, and copies of those calibrations are on file in 7111 and at NTS. Interim calibrations will be done in

Exhibit A

Canister Settings Sheet

EVENT: SERENA (FROM KAPPEL) DATE RECEIVED____________________

STATION #	RANGE (KM)	AZIMUTH (DEG)	PRED.	BANDEDGE HZ B	INTER. GAIN	TOTAL GAIN
W-8	52.85	187.34	41.8	500./97.8/19.2	1/5.11	26.1
W-7	50.15	185.15	10.3	500./11.9	1	42.0
W18 TOP	58.49	186.33	3.8	500./9.78/4.77	1/51.1	104.8
W14	48.80	179.81	7.9	500./50.0/9.78	1/10.	51.1
W21	48.82	182.86	8.1	500./9.78	1	51.1
W22	47.14	184.50	11.8	500./11.9	1	42.0
W23	45.78	180.52	11.8	500./11.9	1	42.0
W25 TOP	47.81	182.81	14.2	75.34/15.29	0.2 V/6 POS 2	1.950/9.850
W25 BOTTOM	47.82	182.81	2.5	30.54/6.118	0.5 V/6 POS 2	1.950/9.850
W26 TOP	49.42	178.27	7.5	500./9.78	1	51.1
W28 TOP	45.28	182.30	14.5	75.34/15.29	0.2 V/3 POS 2	1.950/9.850
W28 BOTTOM	45.28	182.31	7.8	80.24/11.98	0.5 V/6 POS 1	1.00 /5.020
W29 TOP	50.37	178.07	7.5	500./9.78	1	51.1
W29 BOTTOM	50.37	178.07	4.0	500./4.77	1	104.8
W30 TOP	53.26	182.52	4.1	30.93/6.155	0.2 V/6 POS 3	4.870/24.46
W30 BOTTOM	53.27	182.52	2.3	12.37/2.482	0.5 V/6 POS 3	4.870/24.46
A	51.50	187.40	50.2	500./97.8	1	5.11
B	49.61	188.86	17.2	500./19.2	1	26.1
C	47.89	187.37	28.1	500./24.4	1	20.5
D	45.89	187.70	18.3	500./19.2	1	26.1
E	54.73	188.98	17.9	500./19.2	1	26.1
F	56.61	186.85	12.3	500./19.2	1	26.1
G	60.37	188.04	25.3	500./97.8/19.2	1/5.11	26.1
H	52.85	169.32	30.2	500./50.0	1	10.0
I	52.72	185.37	22.6	500./24.4	1	20.5

PRINCIPAL INVESTIGATOR DATE 7-12-85 REVIEWER DATE 7-10-85 accordance with the procedures in Appendix B by EG&G Las Vegas as required. Those calibration records will also be on file at NTS and 7111. The cost of a downhole installation is too large to permit gages to be brought up for calibration. In one case a downhole canister was in place for 61 months at a depth of 2500 feet under a water head of 1500 feet with no sign of malfunction. Such an installation requires a major drilling rig and when brought up, several thousand dollars worth of electrical cable are destroyed which must be replaced when reinstalled. Dates of all calibrations will be maintained in the WTSI data base. There will be no field calibrations of the gages. However, after being connected, the gages will be rotated 180 degrees in a 1 g field as a check against mechanical damage. Guidelines for calibrating gages are as follows.

1. Before installing any canister, the gages in the canister will be recalibrated if the last calibration was more than one year earlier.
2. After removing a canister, the gages will be recalibrated where the last calibration was more than one year earlier.
3. Any gage removed because of a suspected malfunction will be recalibrated.
4. Any surface canister containing gages whose last calibration is more than two years earlier will be replaced and the gages recalibrated.
5. Gages in downhole canisters will be recalibrated only when the canister is removed because of gage malfunction or when removed for another reason and the calibration was more than 1 year earlier.
6. Gages which are malfunctioning or which cannot be recalibrated will be sent to the manufacturer for repair or will be retired.

B. The field crew will prepare a canister log. Each canister will contain three orthogonally-oriented gages. When the canister is placed in the ground, it will be oriented so that the connector end of the canister is pointed true east. This will result in one horizontal component having a positive excursion to the west (270° clockwise from north), and the other having a positive excursion to the north (0°). When gages are installed in a canister they will be given a bench check and the canister log will be prepared. It will show the serial number of each gage, the values of resistors used to bring the unamplified signal to 0.5 g, and the output in volts per g. It also will show where the canister was installed as of the date of the last entry. Copies of canister logs will be on file at NTS and 7111. Canister assignments to stations will be included in the WTSI data base by date. An example canister log is shown in Exhibit B.

C. The field crew will prepare a TM box set-up checklist. An example checklist is shown in Exhibit C. The checklist will be prepared when the gages in the canister are hooked up to the TM box. The TM box contains the voltage-controlled oscillators (VCOs) for the subcarriers used for each channel and the amplifiers. (In downhole canisters the first stage of amplification may be in the canister.) The TM checklist will show the Event and Station for which the installation was made. Each TM box is numbered and the number will be entered in the checklist. The RF frequency used for transmission from the gage station to the recording station will be shown with the cal voltage and canister number. The recording system is set up so that a calibration signal will be recorded on the tape after the ground motion signal. The proportional-bandwidth subcarrier frequencies available are (in kilohertz): 70, 52.5, 40, 30, 22, 14.5, 10.5, 7.35, 5.4, 3.9, 3.0, and 2.3. The first three frequencies will be used

Exhibit B

WI-21

CANISTER LOG

Canister # 9B   Date Checked 12/8/84   Employee BKG

	SERIAL #	RL	RG	g Range	V per g	+V	-V	-2 gV
3037F AVHI g	210	20.450K Ω	149.57K Ω	.4925	5.0759	-.0031		-10.155
(Range Change) AVLO g								
3038 AR	5710	20.421K Ω	178.671K Ω	.4922	5.0790	+4.918	-5.240	
303T111 AT	208	20.377K Ω	163.93K Ω	.4952	5.0475	+5.041	-5.054	

List Canister assignments and any changes. Initial and date each entry.

12/8/84 This log supercedes the previous one of 9/7/84. See calibration sheets on these gages for more information. Canister bench checked and calibrated using TM box # 16 - BKG

Exhibit C

TM BOX SETUP CHECK LIST

APR 2 2 1980

EVENT Colwick DATE 3-21-80

STATION A OPERATOR C. CROW

TM SERIAL #18

TM FREQUENCY 218.5

CAL VOLTAGE 2.50 v

CANISTER #20

VCO FREQUENCY	VCO DECK POSITION	FUNCTION	0V CAL FREQUENCY	+ 2.5V CAL. FREQUENCY
70. KC	1	AVHF	70.042	75.262
52.5 KC	3	ARHF	52.500	56.444
40. KC	5	ATHF	40.001	43.009
KC	13			
30. KC	9	AVLF	30.010	32.258
22. KC	10	ARLF	22.006	23.662
14.5 KC	11	ATLF	14.508	15.591
~~9.0KC~~	7	Range		
2.3KC	8	Battery	2.127	2.500

	SERIAL #	RL	RG	g Range	V per g	+V	-V	-2.5v
(Event) AVHI g (Range Change)	209	20.5K	116K	.5		5.21	-4.99	11.21
AVLO g		20.5k	116K	.5				
AR	227	20.5K	116K	.5		4.92	-5.25	
AT	230	20.5K	116K	.5		5.23	-5.00	

CALIBRATOR ______

COMMAND RECEIVER ______

MUX. VOLTAGE ______

TRANSMITTER OUTPUT ______ WATTS

for the three gages in the high frequency mode, usually the times 1 (unamplified) output. The second three will be used for the low frequency mode, usually for the amplified signal. If there is an intermediate amplification, the second set of three will be used for it, and the third set of three will be used for the final amplification. Where canisters are installed at the bottom of a hole, the first set of three frequencies will be used for the gages at the surface and the third and fourth set of three frequencies will be used for the gages at the bottom of the hole. Still lower frequencies will be used for other functions such as monitoring battery voltage, timing signals, and voice countdown. The latter two will be input to the tape at the recording station. The VCO subcarrier frequencies used are a proportional-bandwidth system with a ±7.5% deviation to band edge. Center band (zero volts) is rarely precisely the nominal frequency, hence the zero volt frequency will be measured and recorded on the checklist. Similarly, the 7.5% frequency is seldom precisely that, and the corresponding +2.5 volt frequency representing the 7.5% deviation and bandedge will be measured and recorded. Note that bandedge is not a hard limit. Signals may extend beyond and still be valid provided they do not interfere with signals on the adjacent subcarrier. Large excursions beyond bandedge can sometimes be recovered by using 15% discriminators instead of 7.5%. The checklist also will duplicate some of the information of the canister log. As will be seen later, most of the information on the checklist will be transferred to the track sheets from which it will be entered into the WTSI data base. The checklist will remain on file at NTS and in 7111 as a backup document. The TM set-up requires one operator at the gage station and one at the recording station, communicating via voice radio.

A.IV. Event Participation. The following actions will occur at event time:

A. The stations will be commanded on at -5 minutes by RF signal or tone barrel, the latter being a LANL Radio Command System.

B. Recorders will be started at -3 minutes. Signals from each station will have subcarrier signals multiplexed, transmitted on a single RF frequency, and then recorded on a single track.

C. Since no zero time signal is obtained from the fire set, a zero tone from the CP will be transmitted on the voice channel and recorded on the tape on the 40 khz channel on track 14. In addition, satellite time will be recorded on the 70 khz channel on track 14. Also, a timing signal from a clock in the recording station will be recorded on the 52.5 khz channel on the same track. Both are IRIG B formats.

D. Two, and sometimes three, recorders will be used to provide backup. If the number of stations is greater than the number of available tracks, some of the stations may be recorded on only one machine.

E. At +5 minutes the post cal will be turned on and 10 seconds later turned off. This will put a 2.5 volt signal on tape. Since bandedge for most channels is 2.5 volts, this will provide a backup measure.

F. The recorders may be stopped manually several minutes after cal off but will usually be allowed to run to end of tape.

A.V. Post-test Field Activities. The Field Technician performs the following actions which will occur after the event:

A. Visicorder paper records will be made of each channel. These should show that data was, in fact, obtained, and will indicate whether or not the data had the expected amplitudes. The records will also be useful in guiding the digitizing effort.

B. There will be three records prepared following the event: the Summary Sheet, the Station Track Assignment, and the Track Sheets. As these have evolved, there is some redundancy.

1. Summary sheet. (See Exhibit D.) The summary sheet will show information on the recorders used, and will contain the following information:
   a. Test name.
   b. Test date.
   c. Recording station location.
   d. Number of recorders and hence of tapes.
   e. Data start time.
   f. Length of recording. Stop time or end of tape.
   g. Serial number and type of recorder.
   h. Tape speed.
   i. Reference frequency.
   j. Operator initials.
   k. Recorder start and stop times.
   l. Post-cal time on and time off.

   Items a, b, c, d, e, g, k, and l will eventually appear in the WTSI data base.

2. Station Track Assignment. (See Exhibit E.) This sheet will show the following:

SUMMARY SHEET

TEST NO.:

TEST NAME: SALUT

TEST DATE: 6-12-85

RECORDING SITE: BLD 3153 LOCATION: NRDA

RECORDING DATE: 6-12-85

TAPE HEAD CONFIGURATION IRIG

TOTAL NUMBER OF TAPES: 3

CALIBRATION: STEP CAL

MODE: DC

CAL DURATION: 10 SEC

STEPS: EACE, 0v, ... 2.5v

DATA START TIME: 08:15

LENGTH OF RECORDING: EOT

TIME OF RANGE CHANGE: HRS.

	MACH. NO. 1	MACH. NO. 2
TRANSPORT NO.	8210707	8180693
TRANSPORT TYPE	2230	2230

TAPE NO.	TAPE IPS	DATE	REF FREQ	OPER. INITIAL	MACH. NO. 1 START	MACH. NO. 1 STOP	MACH. NO. 2 START	MACH. NO. 2 STOP	TAPE ORIG.	TAPE DUB.	REWOUND YES	REWOUND NO	NOTES ON	NOTES OFF
1	60	6-12-85	100KC	GL	08:12	08:2			✓		✓		POST CAL: 08:20	CAL: 08:20:10
2	60	6-12-85	100KC	GL			08:12	08:2	✓		✓		POST CAL: 08:20	CAL: 08:20:10
3														
4														
5														
~~6~~ 3	60	6-12-85	100KC	GL	1287 (28 TRACK)								SAME AS ABOVE	
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														

Exhibit D

Exhibit D

Exhibit E

Station Track Assignment

EVENT BALUT Date: 6-12-85

RECORDING LOCATION D. Lu

NRDA

Tape Start Time 08:12	Tape Start Time 08:12
Cal On 08:20 Cal Off 08:20:10	Cal On 08:20 Call Off 08:20:10
Data Start Time 08:15	Data Start Time 08:15
Tape Stop Time 08:26	Tape Stop Time 08:25

Tape Machine S/N 8210707 | Tape Machine S/N 8180693

Track	Station No.		Track	Station No.	
1	F		1	F	
2	WI-29		2	WI-29	
3	D		3	D	
4	B		4	B	
5	E		5	E	
6	I		6	I	
7	WI-14		7	H	
8	WI-21		8	WI-7	
9	WI-23		9	A	
10	WI-22		10	WI-25	
11	WI-26		11	WI-28	
12	WI-30		12	WI-6	
13	REF.		13	REF.	
14	Timing		14	Timing	

Comments: STATION "F" WAS OPERATED IN PLACE OF STATION "C" BECAUSE STATION "C" WAS INOPERATIVE ON THE FINAL DRY RUN AND WE COULD NOT GET TO STATION "C" TO REPAIR IT. ST "A" GAGE "AR" DID NOT WORK

a. Test name.

b. Test date.

c. Recording location.

d. Tape start time.

e. Time cal on and cal off.

f. Data start time.

g. Tape stop time.

h. Tape machine serial number.

i. Stations recorded on each of 12 or 27 tracks. (Tracks 13 and 14 or 28 will be used for the reference frequency and timing, respectively.)

j. Operator's comments.

All the above will later be entered into the WTSI data base.

3. One track sheet will be prepared for each gage station. (See Exhibit F.) Track sheets contain the following:

a. Test name.

b. Test date.

c. Station number.

d. Station location.

e. Station coordinates and elevation.

f. Canister number and orientation.

g. RF transmission frequency.

h. TM box number.

i. Step cal voltage and duration.

j. Channel subcarrier assignments.

k. Gage information

aa. Manufacturer and type

bb. Gage serial number

cc. Gage volts per g

dd. Gage range in g's

ee. Amplifier gains

ff. System volts per g

TRACK SHEET

PAGE: ___ OF ___

TEST NO:	TEST NAME: SALUT	TEST DATE: 6-12-85
STATION INFORMATION	CANISTER INFORMATION	T.M. BOX INFORMATION
STATION NO. WI-6 ETS1	ACCEL. CAN. NO. 23	FREQ. 2250.5
STATION LOCATION NRDS		NO. 23
STATION COORDINANTS: N. 758,081	E. 604,499	ELEV: 3806.2
CAL START TIME:	CAL TYPE:	STEP CAL: 0v, 2.5v
DIST FROM GZ: / CAL DURATION: 10 SEC	CAL MODE: DC	REVISED 11/28/84

CANISTER ORIENTATION; RADIAL TOWARD: TRUE EAST

RANGE CHANGE TIME DAY_____ TIME_____

RECORD INFORMATION				EVENT TIME GAGE DATA							LONG TERM GAGE DATA						
TRACK NO.	CHAN. ID	FREQ.	DEV.	MFCR GAGE TYPE	S/N NO	GAGE V/G	G RANGE	AMP YS NO	AMP GAIN	SYSTEM V/G		V/CM	GAGE V/G	G RANGE	AMP YS NO	AMP GAIN	SYSTEM V/G
	AV	70	7.5%	303T	5209	5.010	.4990	O O	1	5.010					O O		
	270°	52.5		303 B	5721	5.290	.4726	O O	1	5.290					O O		
	0°	40		303B	5704	5.310	.4708	O O	1	5.310					O O		
	AV	30		303T	5209	5.010	.0976	O O	5.11	25.60					O O		
	270°	22		303B	5721	5.290	.0925	O O	5.11	27.03					O O		
	0°	14.5		303B	5704	5.310	.0921	O O	5.11	27.13					O O		
	AV	10.5		303T	5209	5.010	.0171	O O	26.1	130.8					O O		
	270°	7.35		303B	5721	5.290	.0181		26.1	138.1							
	0°	5.4		303B	5704	5.310	.0180		26.1	138.6							
13	REF			100 KHz													
14	IRIG B	22.0		ORIGINATES NRDS FIRE ST.													
14	IRIG B	30.0		ORIGINATES NRDS FIRE ST.													
14	VOICE	40.0		NTS NET 8													
14	IRIG B	52.5	7.5%	ORIGINATES NRDS FIRE ST.													
14	IRIG B	70		ORIGINATES NRDS FIRE ST.													

REMARKS:
INSTALLED RECALIBRATED GAGES 10/30/84

OPERATOR: J. Lee	DATE: 6-12-85

l. Timing channels on track 14 or 28.

m. Operator's remarks.

n. Operator's signature and date.

All of the above information except the operator's name and signature will be later entered into the WTSI data base. The system permits all of this information to be entered into the data base from terminals at the NTS, but the workload in the field has prevented implementation.

C. All tapes, paper playbacks, and post-shot records will be shipped to Albuquerque for digitizing.

A.VI. Data Digitizing.

A. Upon receipt of the analog tapes and field data sheets at Sandia National Laboratories in Albuquerque, the Scientific Investigator will select a tape from which the data will be digitized. This is usually a 28-track tape containing all of the data, the 14-track tapes being used only when the data is not available on the 28-track tape or is known to be bad on the 28-track tape. Each tape to be used will be logged into the 7522 data crib and assigned a unique number by the Data Crib Custodian so it may be easily identified in their operating system.

B. A classified TWX will be received by the Data Crib Custodian who will assign a sequential number to the event and enter pertinent information about the event in a classified listing of nuclear events. (See Exhibit G.)

Exhibit G

N No.	Name	Area	Date	Time	Collapse Time	Depth
617	EXAMPLE1	U20aj	9-3-84	07:00:00.081	H + 10 HRS 42 m	428 m TUFF
618	EXAMPLE2	U19kl	10-12-84	08:00:00.076	H + 1 HR 16 m	399 m WELDED TU
619	EXAMPLE3	U2oj	10-16-84	06:30:00.124	None by H + 48 HRS	328 m ALLUV
620	EXAMPLE4	U3bk	11-2-84	08:00.00.092	H + 6 HR 03 m	429 m ALLUV

This listing is unclassified because entries are hypothetical.

C. To simplify the processing task, a work sheet containing all necessary information for the digitizing procedure will be filled out on each event by a Data Reduction Clerk. (See Exhibit H.) This work sheet will be compiled from various locations. The four-letter code word will be assigned as the first four letters of the event name. The event number will be taken from the classified listing of events described in A.VI-B, above. The chronological day of the year will be read from a table available to the data reduction clerk. The exact time of the event will be taken from the classified TWX. The cal time on and off will be taken from the track sheets, although it is always supposed to be on at zero time +300 seconds and off at zero time +310 seconds. The tape machine number will be taken from the track sheets. The analog tape number will be obtained from the data crib custodian's log book. The station identifications will be taken from the track sheets as will be the number of channels recorded for each track. The file numbers will be filled in later in the data processing sequence.

D. Paper playbacks will be requested by the Data Reduction Clerk for all channels of each track of data recorded. These playbacks will be made from 10 seconds before event zero time to 25 seconds after event zero time at 1 inch of paper record per second. (See Exhibit I.) Because all times are recorded on the analog tape as a chronological day, hour, minutes, and seconds, the computer will not accept a tape without the correct chronological day and event time being inserted by the digitizing computer operator. Immediately after the data, the calibrate for that channel will be played back for the entire period of calibration at 1 inch of paper record per second. (See Exhibit J.) The time-code channels and the voice channel will be played back from 2 seconds before event

Exhibit H

USE 70 Kc TIMING

EVENT NAME HERMOSA # LTR HERM NUMBER 636

DATE/CHRONO # 02APR1985 # C92

EXACT TIME 12:00:00.090

CAL TIME ON 12:05:00 OFF 12:05:10

TAPE MACHINE # 52107C7 TAPE # A6549

STA	TRK	LTR	# CHAN	FILE#1	FILE#2	FILE#3	FILE#4
298T	01	A	12(62)	9582D01	9582D02		
~~14~~	02	B	9 (1)	~~9583D01~~			
~~21~~	03	C	~~6~~	~~9584D01~~			
~~23~~	04	D	~~6~~	~~9585D01~~			
~~22~~	05	E	~~6~~	~~9586D01~~			
~~26~~	06	F	~~6~~	~~9587D01~~			
~~300T~~	07	G	~~12~~	~~9588D01~~	~~9588D02~~		
~~16 TOP~~	08	H	~~9~~	~~9589D01~~			
~~7~~	09	I	~~6~~	~~9590D01~~			
~~258T~~	10	J	~~12(62)~~	~~9591D01~~	~~9591D02~~		
~~288T~~	11	K	~~12(62)~~	~~9592D01~~	~~9592D02~~		
~~6~~	12	L	~~9~~	~~9593D01~~			
	13	M					
	14	N					
	15	O					
	16	P					
	17	Q					
	18	R					
	19	S					
	20	T					

11175

11297

11406

*** Because of noisy cal,
cal times used for second step
were changed on channels
2 305. TO 306.
5 305. TO 305.5
6 304.56 TO 304.77
Channel 6 first step 301. TO 302.

11486, 11297, 11404

H

Exhibit I

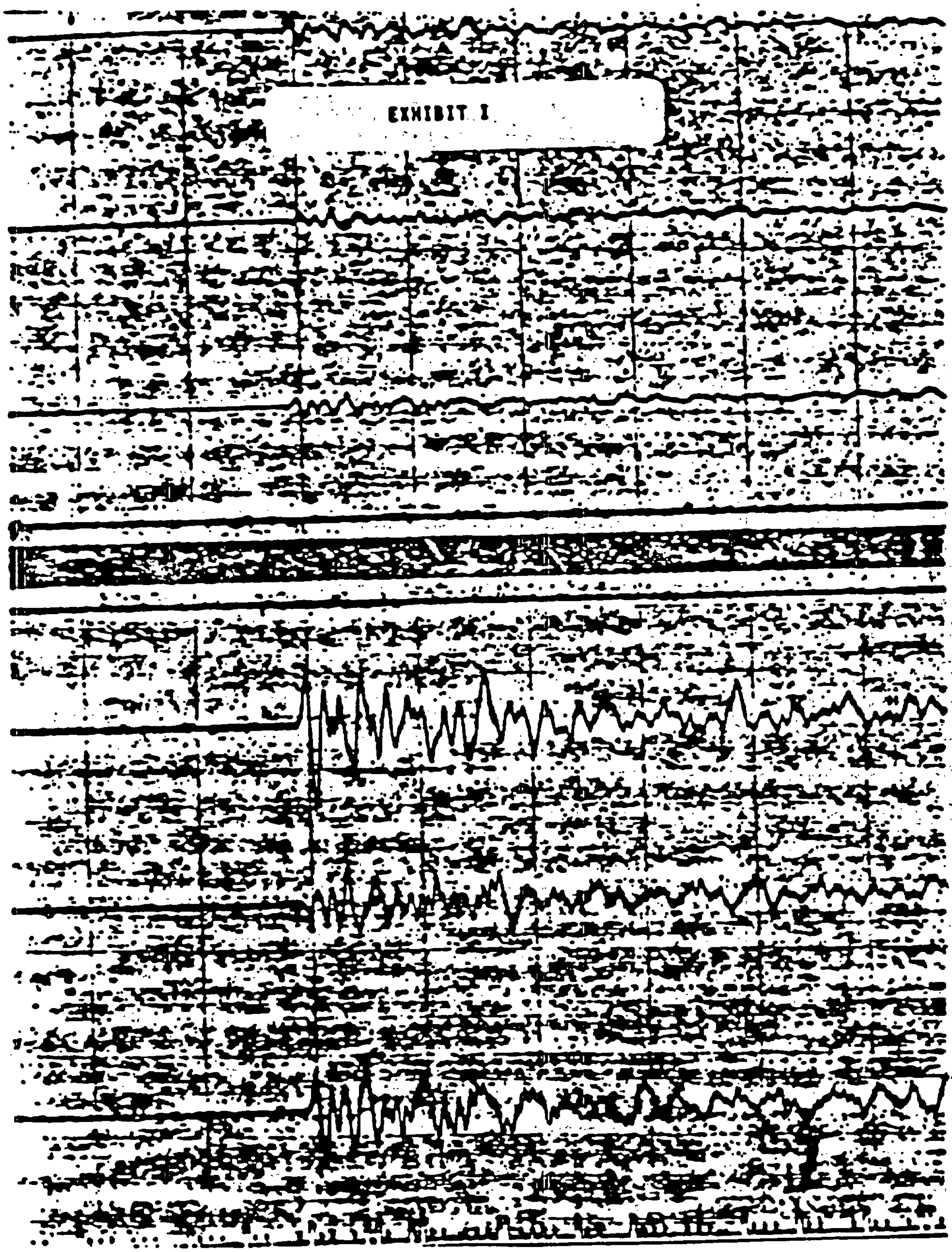
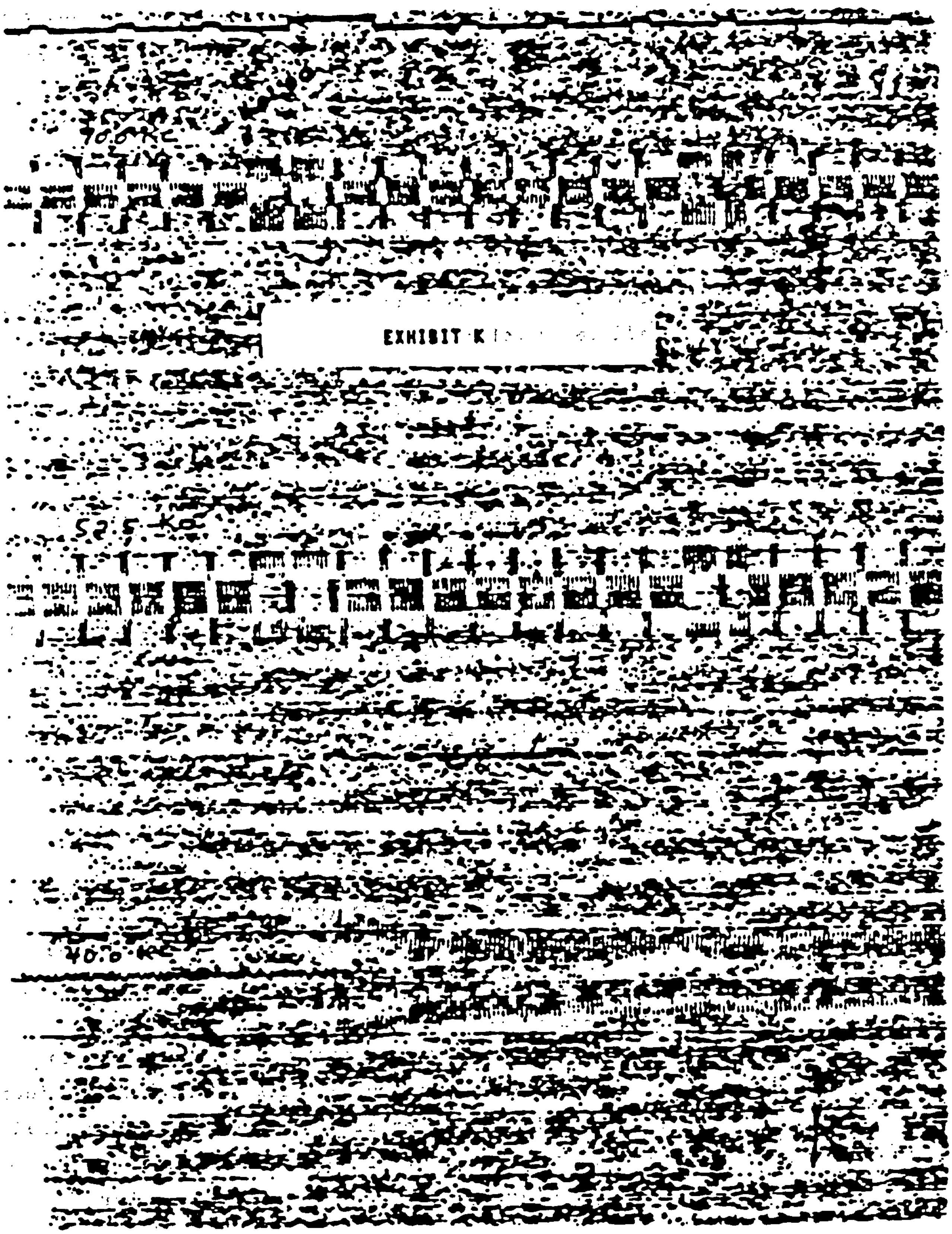


Exhibit J

EXHIBIT J

zero time to 2 seconds after event zero time at 40 inches of paper record per second. (See Exhibit K.) The paper record of the time-code channels will be inspected to determine if the time code was being received and recorded correctly. If there is any problem with the 70 KC time-code channel which makes it unreadable by the computer, the 52.5 KC channel must be used to sync the digitizer with the analog tape. In this event a time difference will be determined between the 70 KC channel and the 52.5 KC channel if the 70 KC channel is readable at all. If it is not readable, the 52.5 KC channel will be assumed to be correct as is. The voice channel has a pulse that comes on at zero time and may be used to identify zero time if the 70.0 KC channel is bad. Actual detonation occurs about 100 milliseconds later, so the pulse on the voice channel may be used to verify that the 52.5 KC time channel is approximately correct. The time difference (if there is one) will be listed on the work sheet as a time correction to be used in a later phase of the data processing sequence. The paper playbacks of the data will be visually scanned by the data reduction clerk to identify problems that may develop in the digitizing process. These may be signal losses in the field, noisy data records, noisy calibration records, etc. If problems are found, the other tapes will be checked to see if they contain better data. The best record available will be selected for each channel to be digitized. If the calibrate is of such a poor quality that it cannot be used, then station calibrate will be applied to digitize the data. Station calibrate is just as accurate as the automatic calibrate but it requires digitizer operator intervention and so is used only where absolutely necessary. It involves the operator manually setting up so that the 7.5% deviation is equal to 2.5 volts rather than the automatic method where the calibrate level is set to 2.5 volts.

Exhibit K



E. When all of the best input has been selected, the Data Reduction Clerk will log in on the computer and prepare files containing instructions for the digitizing computer. These files will be prepared through the use of a set of MACROS (procedure files) which will lead the Data Reduction Clerk through a series of editing sessions where the appropriate information for this particular event must be entered. The information that must be entered by the Data Reduction Clerk is kept to a minimum in order to eliminate human error as much as possible. Information that must be entered at that time will be as follows:

1. The name of the data reduction clerk.
2. The test date.
3. The event name.
4. The chronological test day. If this does not match the analog tape number, the computer will reject the job.
5. The exact time of the event in hours, minutes, seconds, and microseconds. If the computer cannot find this time on the tape, the job will be rejected.
6. The analog tape number which was assigned by the data crib custodian. It is the operator's responsibility to mount the correct tape.
7. The frequency of the time code to be used.
8. The frequency deviation of the time code to be used.
9. The number of tracks recorded on the tape being used.
10. The four-letter event code (usually the first four characters of the event name). This is used in the computer so that files from different events cannot get mixed together.
11. The event number that was assigned by the data crib custodian. This event number will be incorporated into a unique identifier for each channel of data digitized. The number generated will consist of the two-digit track number followed by the three-digit event number,

followed by a two-digit number identifying the frequency digitized.

At this point the MACROS will take over and enter all of the above information where it needs to be to make the programs generate the files which tell the digitizer what data to digitize and how to do it. This will be accomplished with a program named XDIRECT which was written to simplify the work done by the Data Reduction Clerk and keep errors to a minimum. The program has been thoroughly bench-mark checked and used for many years by the data reduction clerks. Failure to enter the proper information will usually result in an aborted run, forcing the Data Reduction Clerk to start over and enter the correct information. When the digitizing is done, the files will be printed out and the printouts (Exhibit L) delivered to the personnel who will run the digitizing computer. These printouts will be used for their visual reference while the computer reads the information from the files it has stored.

F. When the digitizing has been completed, the printouts will be returned to the Data Reduction Clerk who will file them in a data book where the work sheet and track sheets have already been filed. In addition, the Data Reduction Clerk will be given printouts indicating the manner in which the data were grouped in the digitizing process and the identification numbers which were assigned to the files thus created. These sheets are coded but are familiar to both the Data Reduction Clerk and the digitizing personnel. These will be filed in the data book for permanent retention. (See Exhibit M.) Plots of the entire digitized record and of the entire calibrate file as digitized will also be produced and filed in the data book and kept as a permanent record. (See Exhibits N and O.) These also contain coded identification. The data plots will be checked to be sure there are no

Exhibit L

EXHIBIT L

PB#62-1
3 FEB 86

A⌀9765.P⌀1

A ⌀9765.P⌀2

```
8101200,28-DEC-85,NTS,GOLDRTONE,PALMER,362110100.089000,
16A86,GOLDA,
60.000,,,,,,1,70,000,5,250,1,200,1,2A

#1,2,01,
0.500,1,C0165123  ,2,300,0,173,0,110,1,
,,,,0.500,2,
362110600,0890/362110607,0890,
362[illegible],0890/362110301,0890,
   110020,
#2,2,01,
0.500,1,C0165103  ,3,000,0,225,0,110,1,
,,,,0.500,2,
362110600,0890/362110607,0890,
362[illegible],0890/362110301,0890,
   110020,
#3,2,01,
0.500,1,C0165139  ,3,900,0,293,0,110,1,
,,,,0.500,2,
362110600,0890/362110607,0890,
362[illegible],0890/362110301,0890,
   110020,
#4,2,01,
0.500,1,C0165154  ,5,400,0,405,0,110,1,
,,,,0.500,2,
362110600,0890/362110607,0890,
362[illegible],0890/362110301,0890,
   110020,
#5,2,01,
0.500,1,C0165173  ,7,350,0,550,0,110,1,
,,,,0.500,2,
362110600,0890/362110607,0890,
362[illegible],0890/362110301,0890,
   110020,
#6,2,01,
0.500,1,C0165110  ,10,500,0,788,0,110,1,
,,,,0.500,2,
362110600,0890/362110607,0890,
362[illegible],0890/362110301,0890,
   110020,
#7,2,01,
0.500,1,C0165114  ,14,500,1,088,0,110,1,
,,,,0.500,2,
362110600,0890/362110607,0890,
362[illegible],0890/362110301,0890,
   110020,
#8,2,01,
0.500,1,C0165122  ,22,000,1,650,0,110,1,
,,,,0.500,2,
362110600,0890/362110607,0890,
362[illegible],0890/362110301,0890,
   110020,
#9,2,01,
0.500,1,C0165130  ,30,000,2,250,0,110,1,
,,,,0.500,2,
362110600,0890/362110607,0890,
362[illegible],0890/362110301,0890,
   110020,
#10,2,01,
0.500,1,C0165140  ,40,000,3,000,0,110,1,
,,,,0.500,2,
362110600,0890/362110607,0890,
362[illegible],0890/362110301,0890,
   110020.
```

Exhibit M

```
**************************************************
              PROCESSING PARAMETERS
**************************************************

      *         A09583D01X.DPP1             *
      *      PROCESSING PARAMETERS          *
      *    FOR CHANNEL  1 -- INTVL  1       *
      *        REQUESTOR: LONG              *
      * --------------------------------    *
 CALFILE = A09583D01X.CAL,
 DATAFILE = A09583D01X.DAT1 ,
 IF = A09583D01X.DAT1 ,
 OF = A09583D01X.PLB1 ,
 OFG = OLDP,DPP1 ,
 NCHAN = 9,
 CAL_LVLS =  2,
 ACT = R941012,
 DIG_DATE = 29-OCT-85,
 DIG_TIME = 13:33:48,
 TEST_DATE = 02-APR-85,
 IRIG =  092,12,00,00,000000 ,
 MUX_NO = 1 ,
 CHAN = 1 ,
 DATA_RATE =       500.,
 TRANSDUCER_ID = 'C0263654  ',
 DATA_VCO_CENTER_FREQ = 5.400 ,
 DATA_VCO_DEVIATION = 0.405    ,
 DATA_VCO_LPF = 0.110    ,
 DATA_VCO_FILTER_TYPE = CD,
 CAL_RATE =       500.,
 CAL_TYPE = AUTO    ,
 STARTDIGCAL =      300.000000,
 STOPDIGCAL =       307.000000,
 STARTDIGDAT =       62.000000,
 STOPDIGDAT =       121.000000,
 KEYNAME = A,
 OFFSET_FLG = ' ',
 OFFSET_TIME = ' ',
 REF_LVL = ' ',
 HALF_AVG = ' ',
 NUMCALZONES = ' ',
 CAL_START/STOP = ' ',
 CAL_ORDER = ' ',
 NCALS = ' ',
 CAL_VALUE/PCT = ' ',
 DATA_START/STOP = ' ',

      *         A09583D01X.DPP2             *
      *      PROCESSING PARAMETERS          *
      *    FOR CHANNEL  2 -- INTVL  1       *
      *        REQUESTOR: LONG              *
      * --------------------------------    *
 CALFILE = A09583D01X.CAL,
 DATAFILE = A09583D01X.DAT1 ,
 IF = A09583D01X.DAT1 ,
 OF = A09583D01X.PLB2 ,
 OFG = OLDP,DPP2 ,
 NCHAN = 9,
 CAL_LVLS =  2,
```

EXHIBIT M

Exhibit N

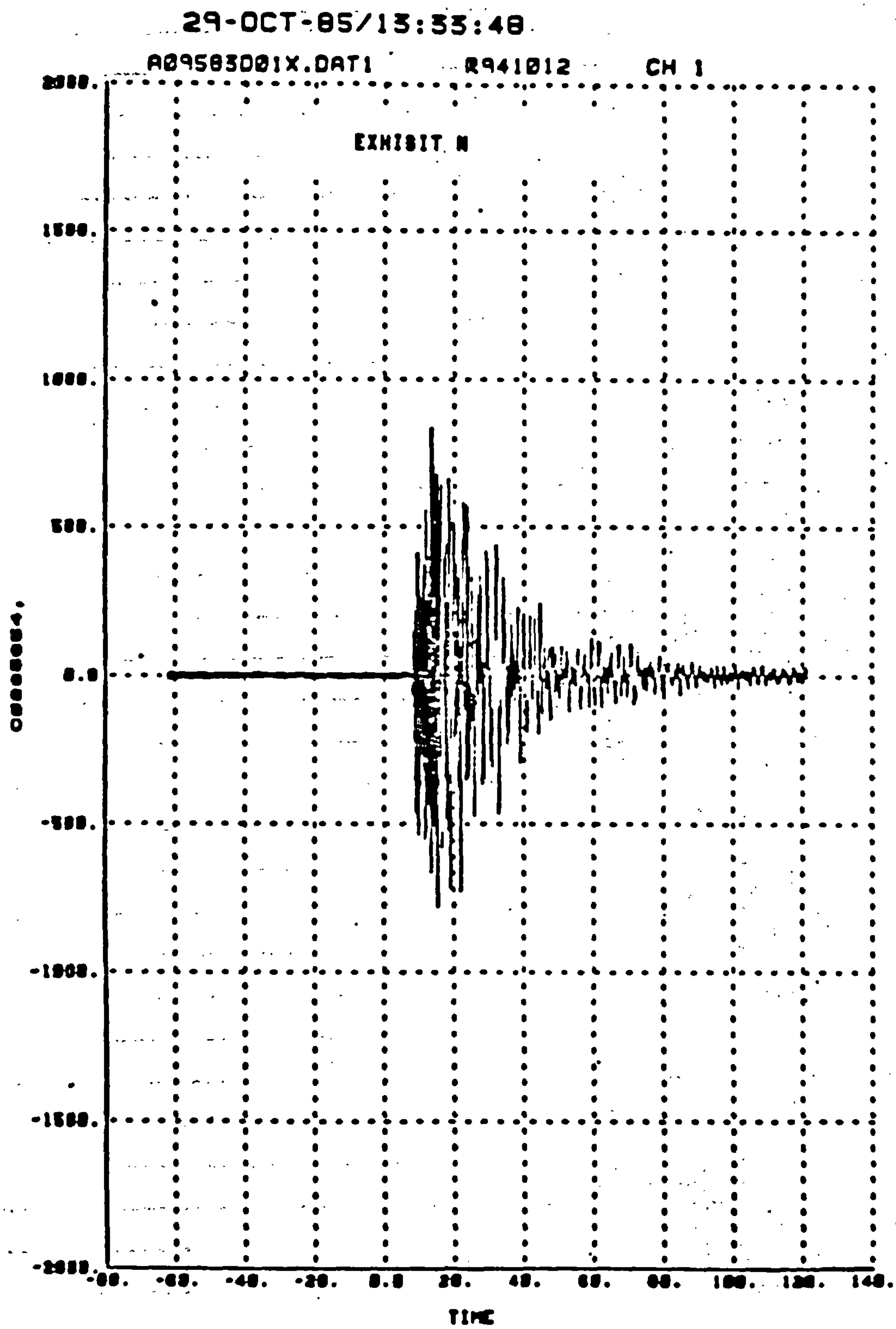
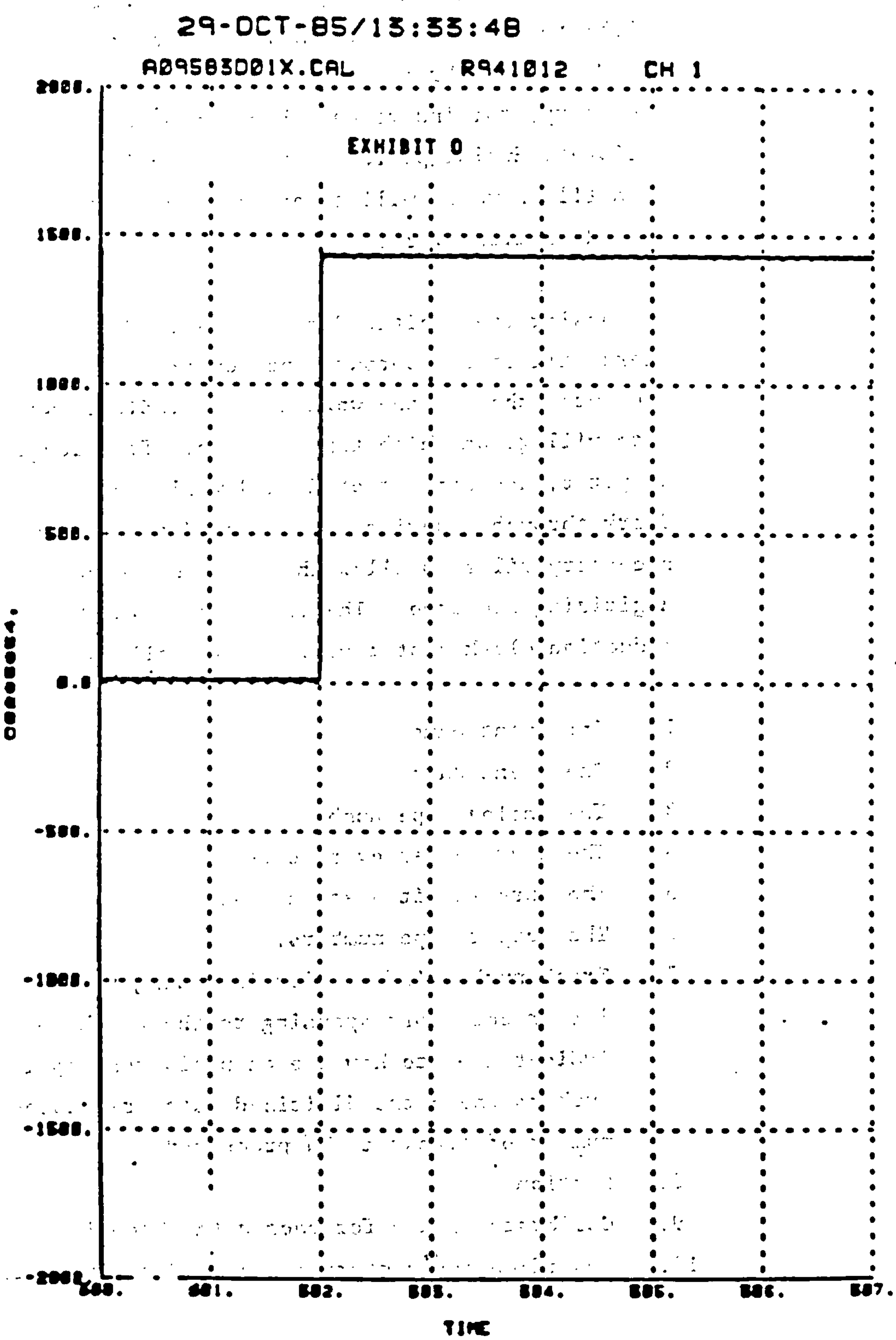

29-OCT-85/13:53:48
A09583D01X.DAT1
R941012
CH 1
EXHIBIT N
2000.
1500.
1000.
500.
0.0
-500.
-1000.
-1500.
-2000.
-80.
-60.
-40.
-20.
0.0
20.
40.
60.
80.
100.
120.
140.
TIME

Exhibit O


29-OCT-85/13:33:48
A09583D01X.CAL R941012 CH 1
EXHIBIT O
2000.
1500.
1000.
500.
0.0
-500.
-1000.
-1500.
-2000.
500.
501.
502.
503.
504.
505.
506.
507.
TIME

obvious problems in the data selected or in the digitizing process. If problems are found, the digitizer will be checked and, if necessary, the data redigitized. The calibrate plots will be checked for noise and if noise is found, the calibrate selection times will be modified, if necessary, for individual channels of data to avoid sampling calibrate during periods containing noise. The digitized data file numbers will be entered on the worksheet by the Data Reduction Clerk.

G. Processing the digitized data files. The Data Reduction Clerk will obtain output tape numbers from the 7111 personnel and enter them on the worksheet to indicate which channels of data will go on which tapes. Then, after logging onto the computer, another set of MACROS will guide the Data Reduction Clerk through a series of screen edits which will set up the necessary files to allow the computer to complete the data digitizing sequence. The information which the data reduction clerk must type in is as follows:

1. The event name.
2. The event date.
3. The analog tape number.
4. The four-letter event code.
5. The three-digit event number.
6. The output tape numbers.
7. Track number information including the track number, a letter code corresponding to the track number, an indicator as to how the channels were split, the file numbers where the digitized data are stored, and the number of tracks to be processed.
8. Station names.
9. Calibrate values for each data channel.
10. Amplification factors for each data channel.

When the Data Reduction Clerk has completed entering the above information into the computer, the MACROS will take over and complete the process of setting up the necessary files. When the computer is finished, the Data Reduction Clerk will inspect the files and make modifications if errors are found in the event information that has been supplied.

When it has been verified that the files are properly set up, the data reduction clerk will type in an instruction and the computer will execute the necessary programs to create the output tapes containing the data in engineering units. The primary program executed in this sequence is a program named PLBRD (playback reduce). It has been in existence for many years and has been modified as each new computer and digitizing system has been installed. Each time it is modified it is thoroughly bench-mark checked both with known values and by hand calculator. The purpose of PLBRD is to split the digitized data into separate channels and, based upon the calibrate sample amplitudes and the calibrate values typed in by the data reduction clerk, convert the digitizer units into engineering units--usually acceleration in g's.

Once The data are converted to engineering units, another program named SAT will be run to rewrite the data in ASCII format. This program has been checked by dumping the data created by the PLBRD program and comparing it with the output of the SAT program.

The next step will be to run a program called NTAPEINFO, which simply sets up the parameters to run the next program called ASCITAPE. If NTAPEINFO has a problem, ASCITAPE will abort. ASCITAPE will write the data on the final tape. This program has been checked by reading the data back into the computer and comparing it with the files that were to be written.

Note that the output file identification records will contain the calibrate values as entered by the Data Reduction Clerk so that if there is ever a question as to whether the calibration values for a particular channel were typed in correctly, it may be verified by looking at any tape scan. (See Exhibit P.) Also note that the calibration values will be typed in only once so that the same value must be used in converting the data and for entry into the identification record.

H. The computing process. The MACROS will process one file of data at a time. This may be an entire track of data or a part of a track, depending on how the digitizing personnel split the tracks. As each file is processed, the data will be written on tape and a tape listing (Exhibit Q) will be printed out so the Data Reduction Clerk can keep track of how the processing is progressing. When a tape is finished, the data reduction clerk will have that tape removed from the digitizing computer area and returned to the main computer area where it may be accessed for the final processing and analysis. The final tape listing will be filed in the data book for permanent retention.

A.VII. Data Processing

A. Exhibit R is a block diagram of the processing sequence. The following describes the sequence using a letter keyed to the letter in the block diagram. Examples are shown in exhibits.

1. An auto-adjust plot will be the first visual presentation of the digitized data. The automatic adjustment causes the first and last points of the first

Exhibit P

TAPE NO. 66A   86/04/04. 14.03.25.
JBLONG::   BOX 137

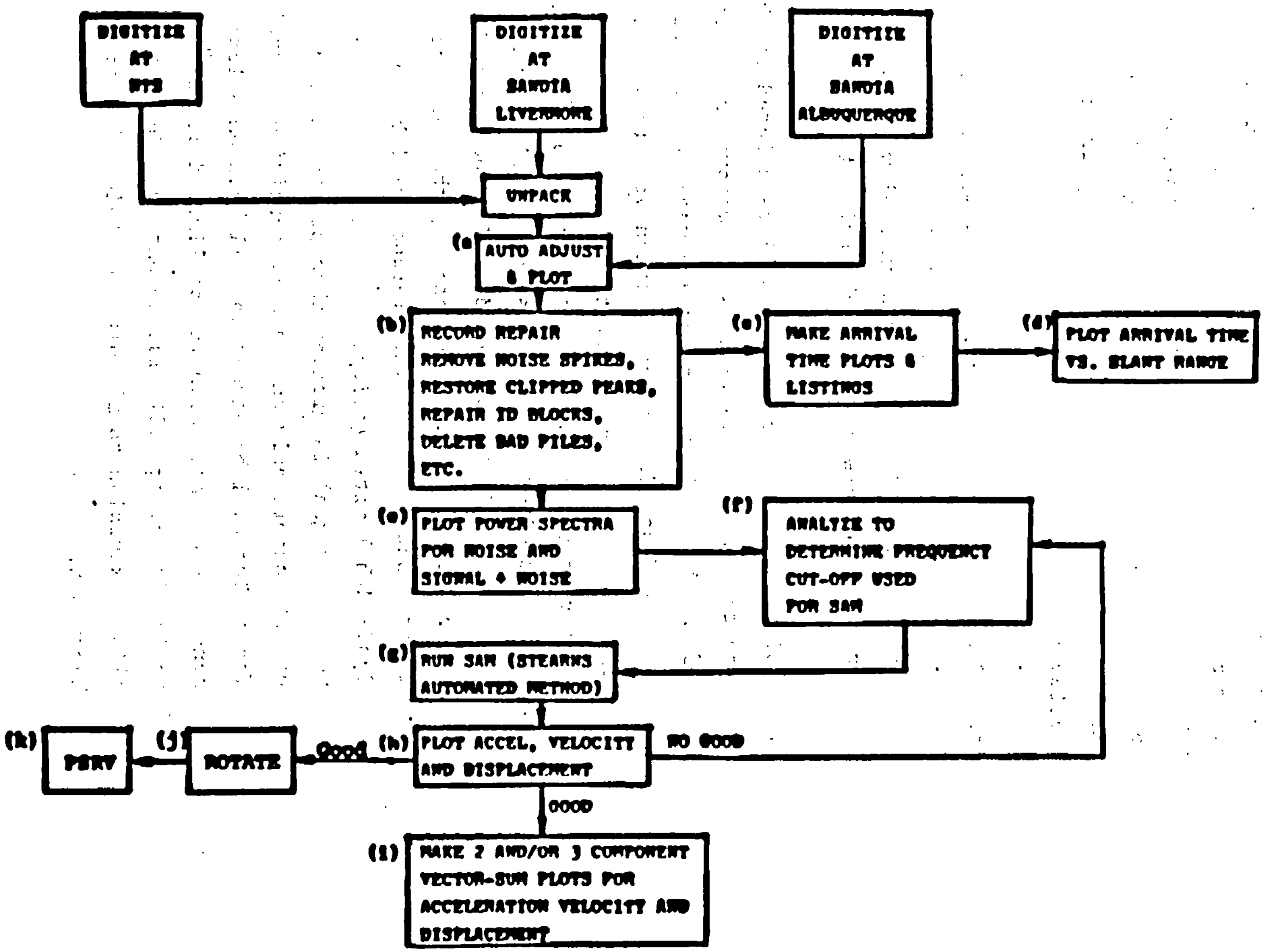
NO. OF RECORDS	FILE NO.	ID WORDS (1)	(2)	(3)	(4)	(5)	(6
41	1	*AUTO	*1	*W-6	*A-0.	*GOLDSTONE	*+.113
41	2	*AUTO	*1	*W-6	*A-270.	*GOLDSTONE	*+.124
41	3	*AUTO	*1	*W-6	*AV	*GOLDSTONE	*+.119
1	4	*FFFFFFFFFFF	*FFFFFFFFFF	*FFFFFFFFFFF	*FFFFFFFFFFF	*FFFFFFFFFFF	*FFFFFF

APPROXIMATELY 0 FEET OF NINE TRACK TAPE REQUIRED.

Exhibit Q

```
PROGRAM TAPESCAN BEGINS
THE TAPE BEING SCANNED IS A LABELED TAPE
THE VOLID = 012590

NUMBER OF BYTES IN FILE C1365150.SAT        =    1056004
END OF FILE C1365150.SAT        REACHED

NUMBER OF BYTES IN FILE C1365173.SAT        =    1056004
END OF FILE C1365173.SAT        REACHED

NUMBER OF BYTES IN FILE C1365110.SAT        =    1056004
END OF FILE C1365110.SAT        REACHED

NUMBER OF BYTES IN FILE C1365114.SAT        =    1056004
END OF FILE C1365114.SAT        REACHED

NUMBER OF BYTES IN FILE C1365122.SAT        =    1056004
END OF FILE C1365122.SAT        REACHED

NUMBER OF BYTES IN FILE C1365130.SAT        =    1056004
END OF FILE C1365130.SAT        REACHED

NUMBER OF BYTES IN FILE C1365140.SAT        =    1056004
END OF FILE C1365140.SAT        REACHED

NUMBER OF BYTES IN FILE C1365152.SAT        =    1056004
END OF FILE C1365152.SAT        REACHED

NUMBER OF BYTES IN FILE C1365170.SAT        =    1056004
END OF FILE C1365170.SAT        REACHED

NUMBER OF BYTES IN FILE C1465114.SAT        =    1056004
END OF FILE C1465114.SAT        REACHED

NUMBER OF BYTES IN FILE C1465122.SAT        =    1056004
END OF FILE C1465122.SAT        REACHED

NUMBER OF BYTES IN FILE C1465130.SAT        =    1056004
END OF FILE C1465130.SAT        REACHED

NUMBER OF BYTES IN FILE C1465140.SAT        =    1056004
END OF FILE C1465140.SAT        REACHED

NUMBER OF BYTES IN FILE C1465152.SAT        =    1056004
END OF FILE C1465152.SAT        REACHED

NUMBER OF BYTES IN FILE C1465170.SAT        =    1056004
END OF FILE C1465170.SAT        REACHED

END OF TAPE REACHED
```

Exhibit R



Block Diagram of Data Processing Sequence integral of an acceleration record to be set to zero. Exhibit S is an acceleration record; its auto-adjusted integral is shown in Exhibit T. Without the auto-adjustment, the departure of the acceleration base line from zero could cause the integral to be so large as to obscure the signal in the integral. Auto-adjust plots provide an opportunity to evaluate the quality of the data. The more typical limits on quality are the following:

a. Poor signal-to-noise ratio. This will usually be on the times 1 (5 volts/g) channel, and can be improved by filtering. This channel will be used only if the more sensitive channel fails.

b. Noise spikes. Noise spikes will be deleted if they are few and their deletion will improve the quality of the data. If the spikes are many, the record will be discarded, since deletion of spikes is a time-consuming manual operation.

c. RF interference. If the interference occurs within the first 40 or so seconds after signal arrival, the record will be discarded. If it occurs before arrival or after about 40 seconds, that part of the record containing the interference will be deleted.

d. Bandwidth limited (clipped). Bandwidth is exceeded when the signal is greater than predicted, and usually occurs only on the more sensitive channel. The choice will be either to fall back on a less sensitive channel which is not limited or to redigitize using ±15% discriminators. The latter allows excursion to ±5 volts, or twice the normal bandwidth.

Exhibit S

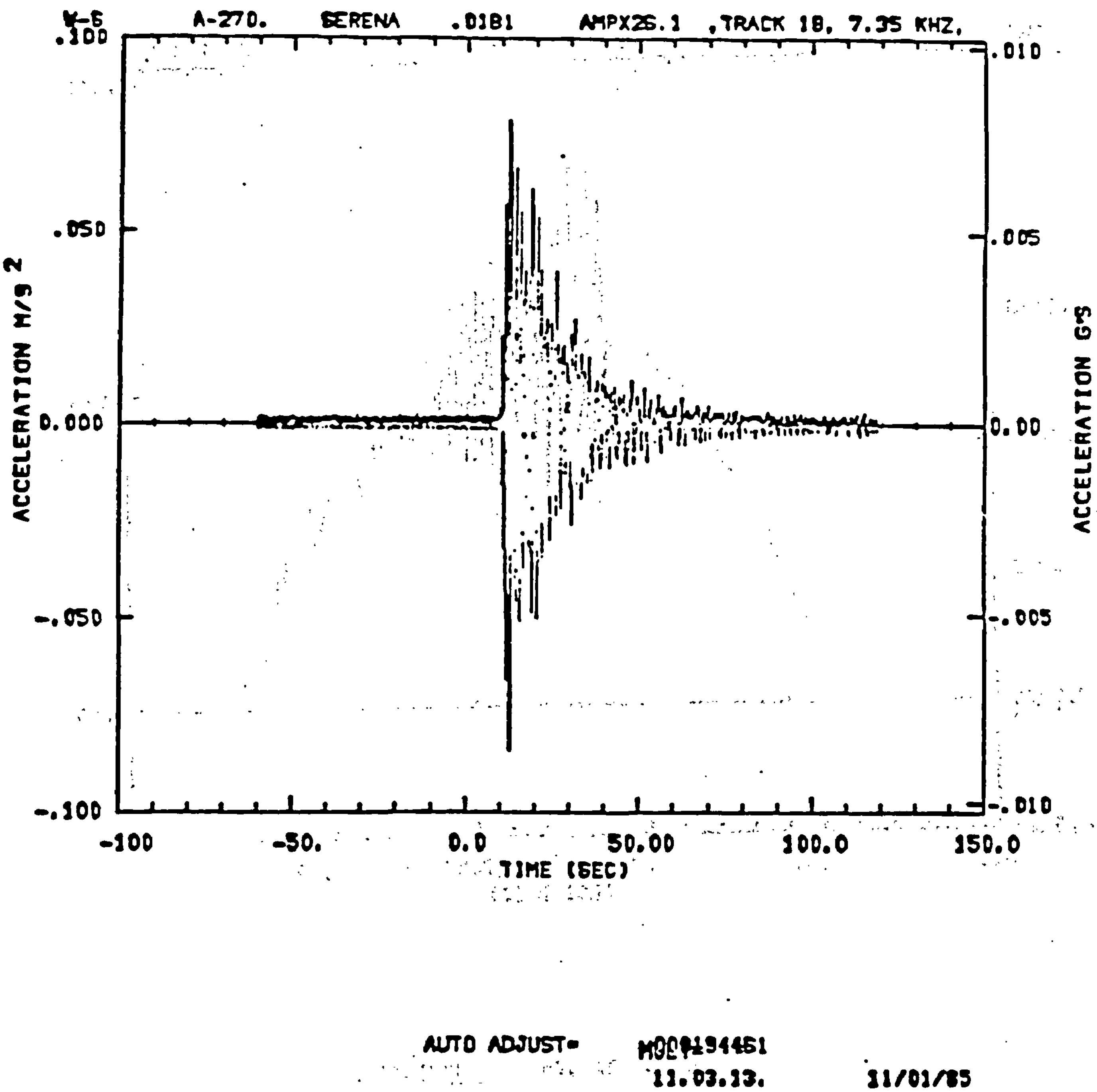
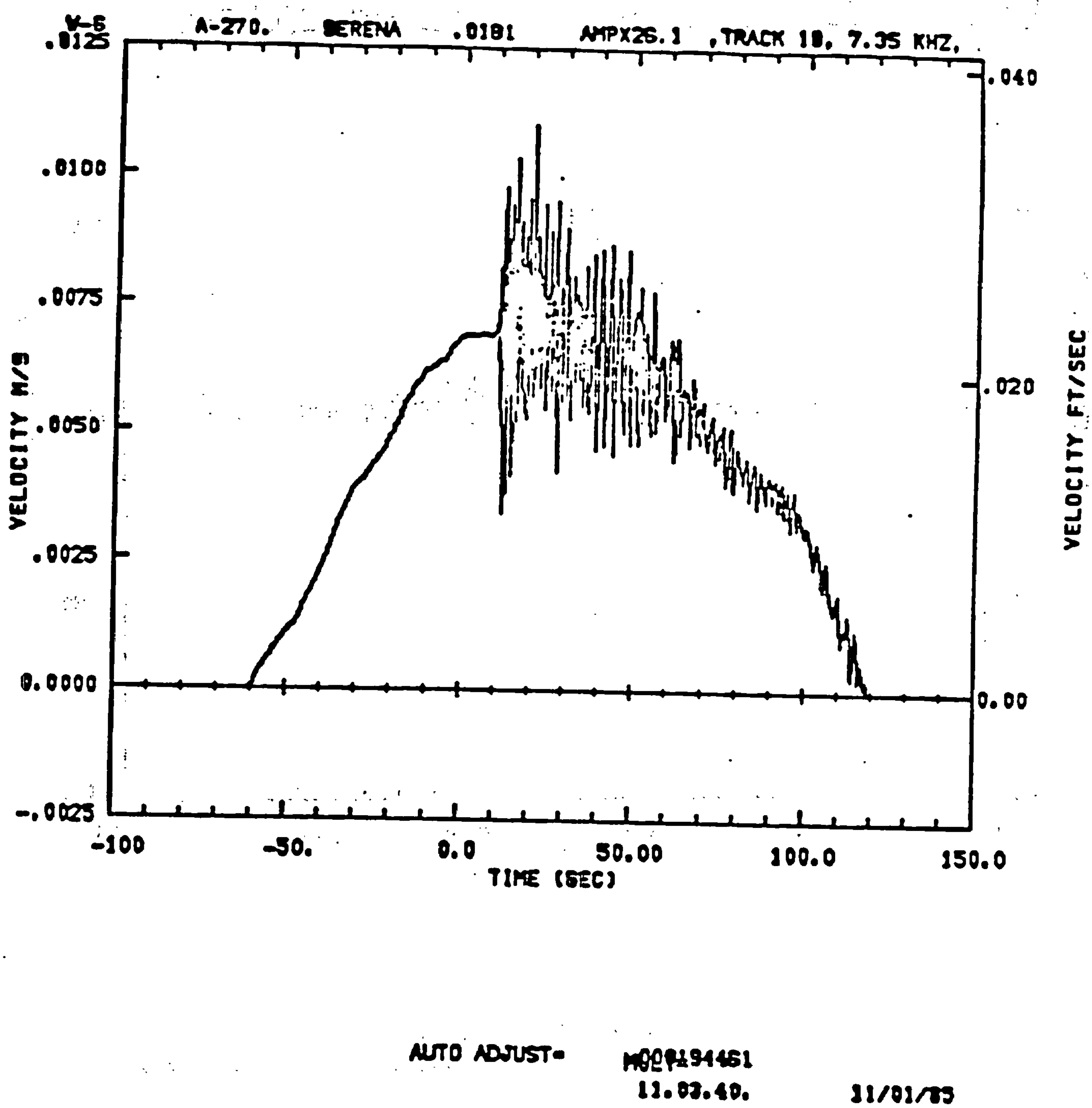
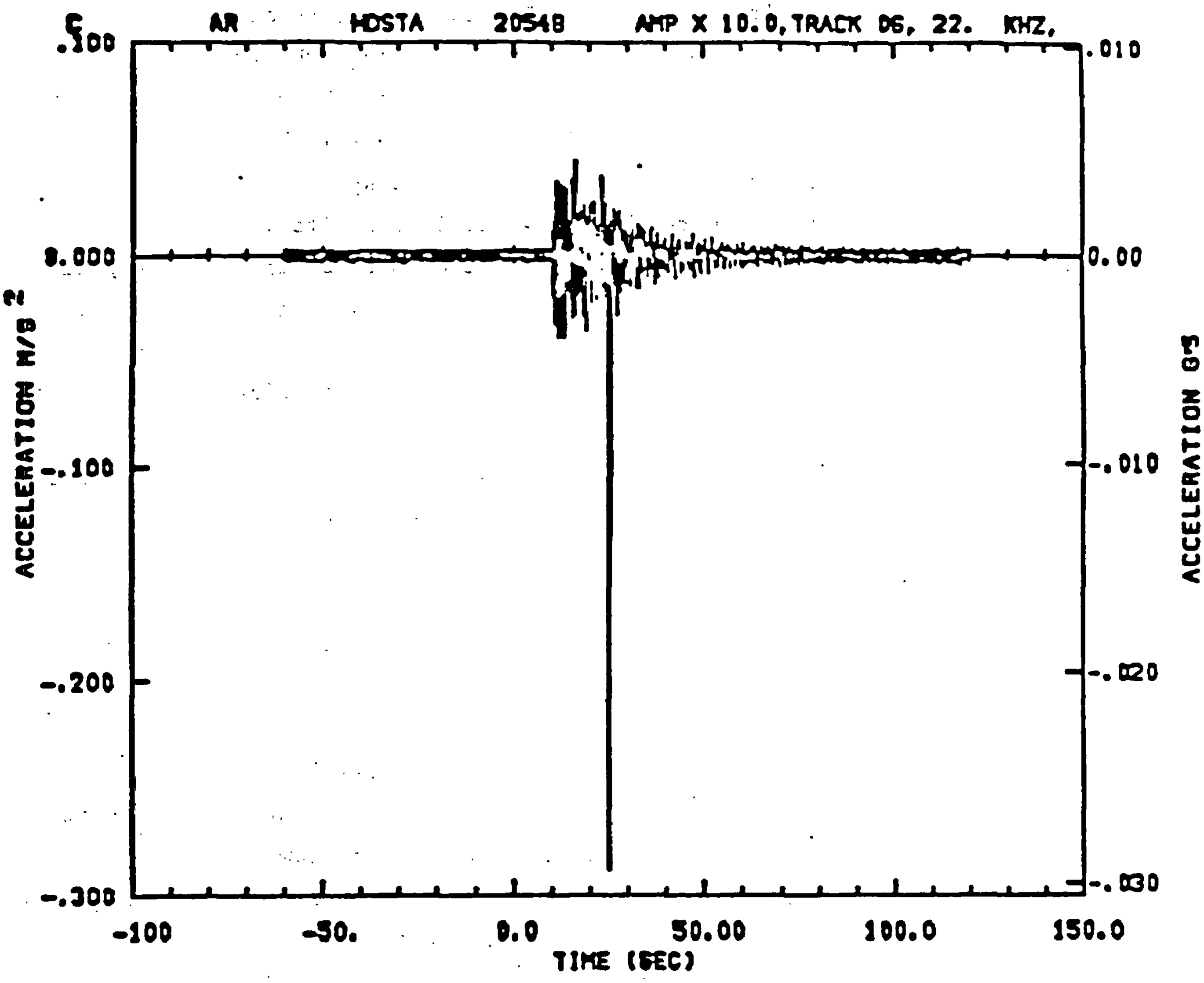

A-270. SERENA .01B1 AMPX26.1 ,TRACK 18, 7.35 KHZ,
.100
.050
0.000
-.050
-.100
.010
.005
0.00
-.005
-.010
ACCELERATION M/S 2
ACCELERATION G'S
-100
-50.
0.0
50.00
100.0
150.0
TIME (SEC)
AUTO ADJUST=
11.03.13.
11/01/85

Exhibit T


V-S
A-270. SERENA .0181 AMPX26.1 ,TRACK 18, 7.35 KHZ,
.0125
.0100
.0075
.0050
.0025
0.0000
-.0025
VELOCITY M/S
.040
.020
0.00
VELOCITY FT/SEC
-100
-50.
0.0
50.00
100.0
150.0
TIME (SEC)
AUTO ADJUST=
MULT=.00194461
11.03.40.
31/01/85

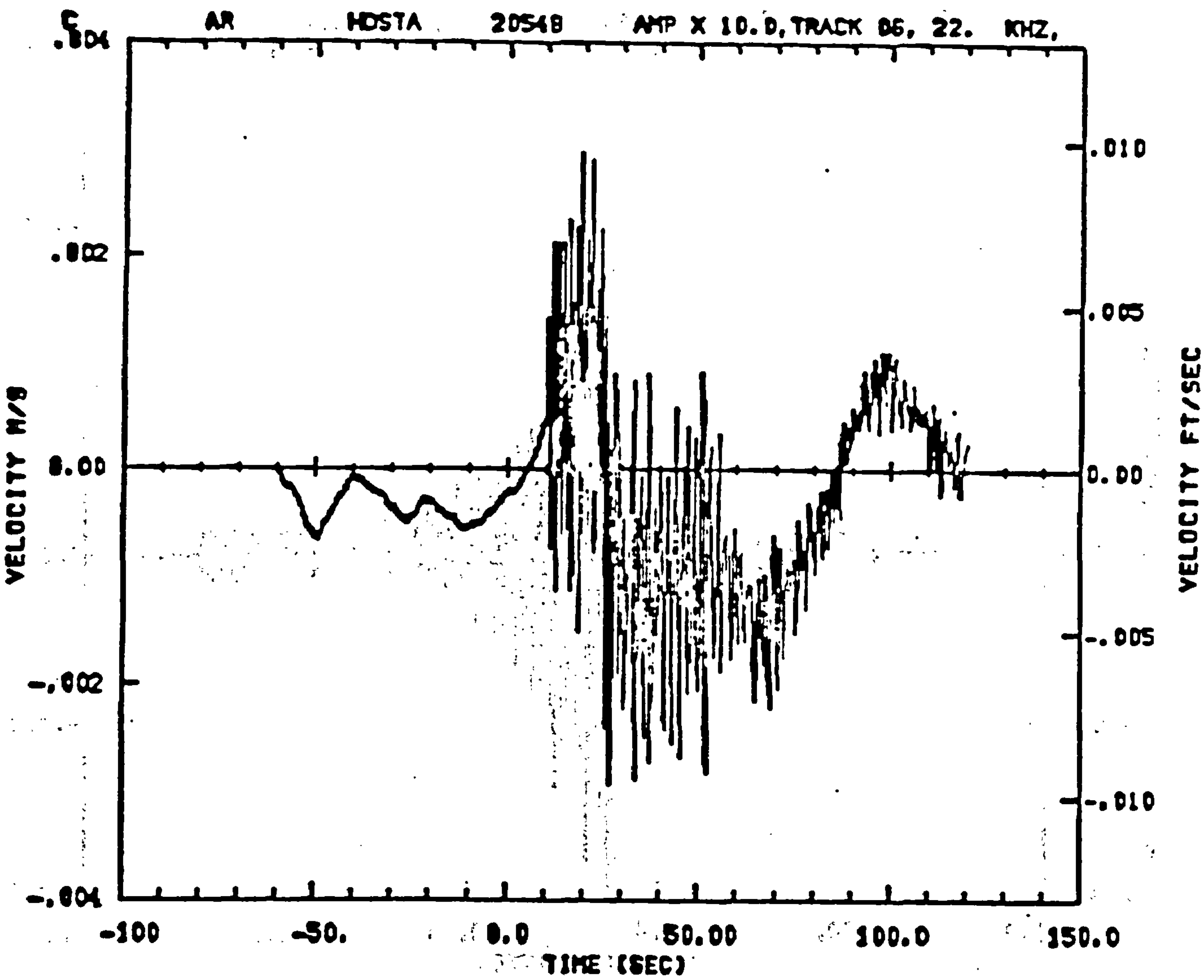
2. Record repair will ordinarily be performed on the record of the measurement rather than on the integral. For most repairs it will be necessary to expand the time in the vicinity of the repair to be able to achieve the desired precision. The purpose is to salvage data which otherwise could not be put through the subsequent processing steps. Exhibits U and V show a record with noise spikes and Exhibits W and X with the noise spikes removed. To see why the noise spike must be removed one may compare the integrals in Exhibits V and X.
3. Arrival times represent the onset of the first signal and will be determined from plots of acceleration with the time scale greatly expanded. (See Exhibit Y.) Listings of acceleration-time aid in picking the arrival time even more precisely.
4. Arrival time plotted against the slant range is useful for determining apparent seismic velocity and determining whether arrivals are from direct or refracted paths.
5. Power spectra will be plotted for the noise (o symbols in Exhibit Z) and for the signal plus noise (x symbols). The data will be digitized from -1 min to provide resolution of noise frequencies as low as 0.1 Hz.
6. Where the two curves in Exhibit Z separate defines at what frequency the signal emerges from the noise and will be used to set the high-pass and low-pass frequency cut-offs required for the next step.
7. The Stearns Automated Method (SAM) is described in Exhibit AA. Ordinarily, digitized acceleration data are the input. Where velocity data were processed they were first differentiated and then treated as an acceleration record. This provided acceleration-time histories where acceleration was not measured directly. (There have

Exhibit U



AUTO ADJUST= -.02253150
04.25.21. 06/25/82

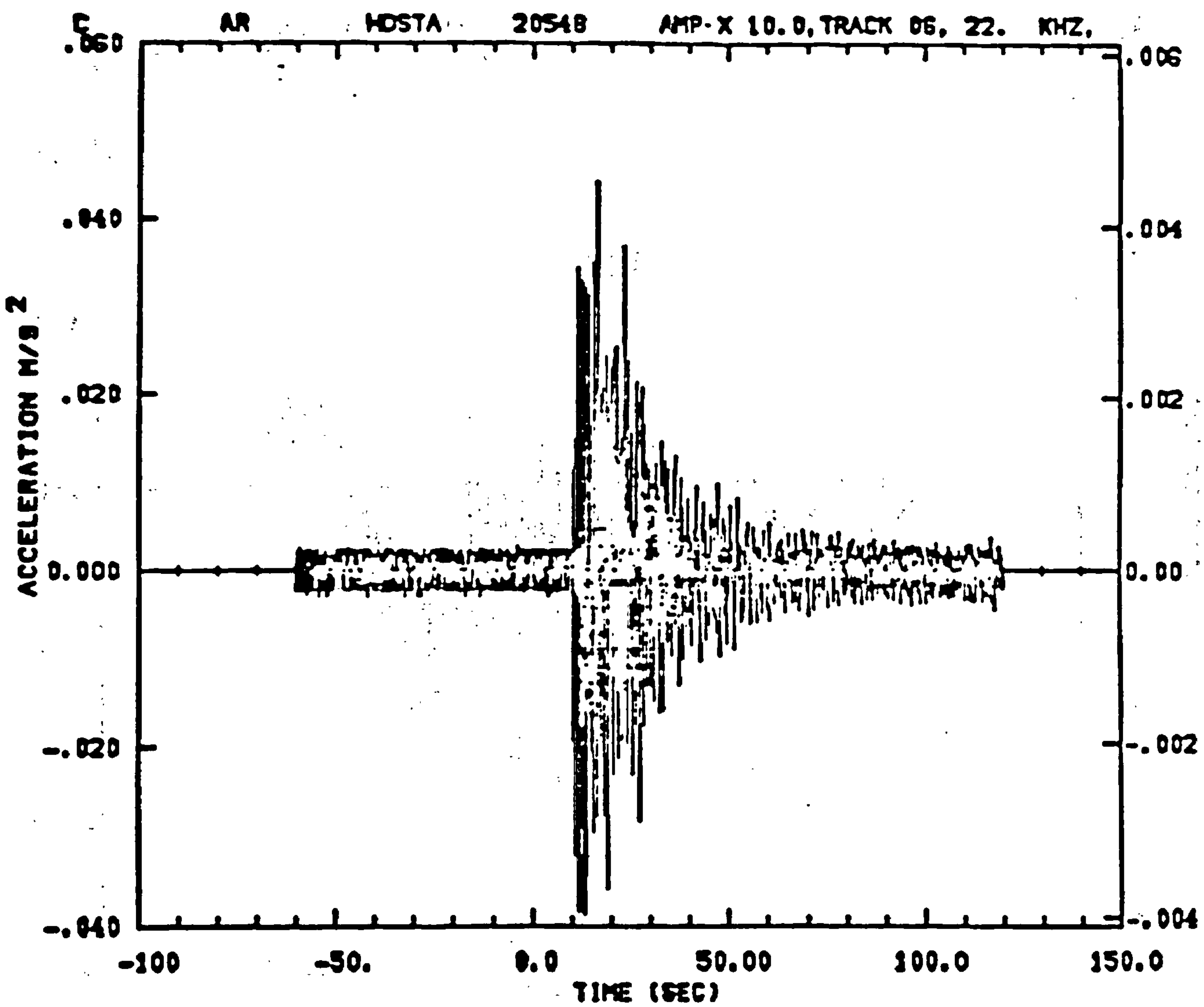
Exhibit V



AUTO ADJUST= -.02253150

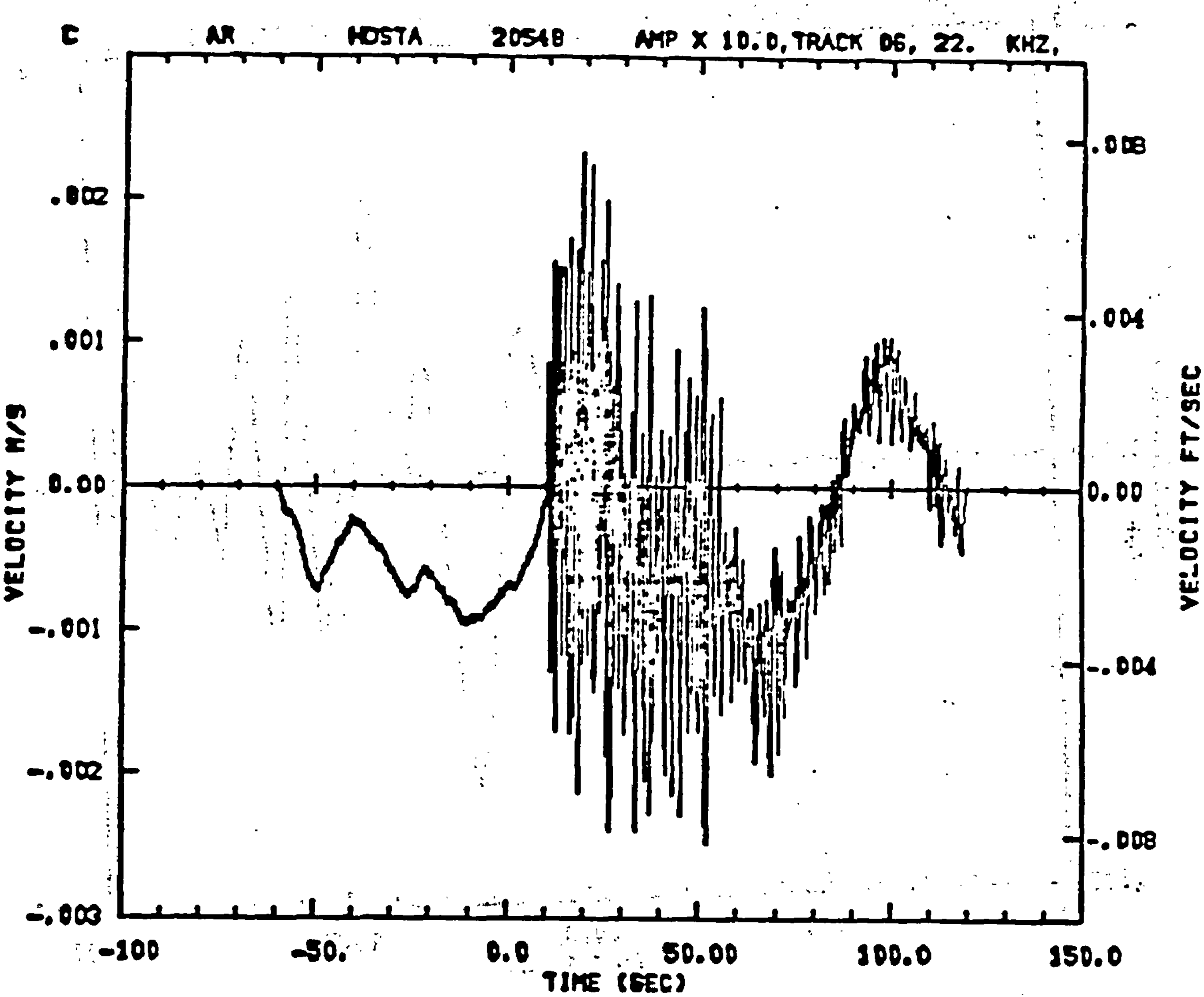
04.25.33. 06/25/82

Exhibit W



AUTO ADJUST= -.00003240 MULT=NONE
13.56.51. 06/06/03.

Exhibit X



AUTO ADJUST= -.00003240 MULT=NONE
13.57.16. 06/06/03.

Exhibit Y

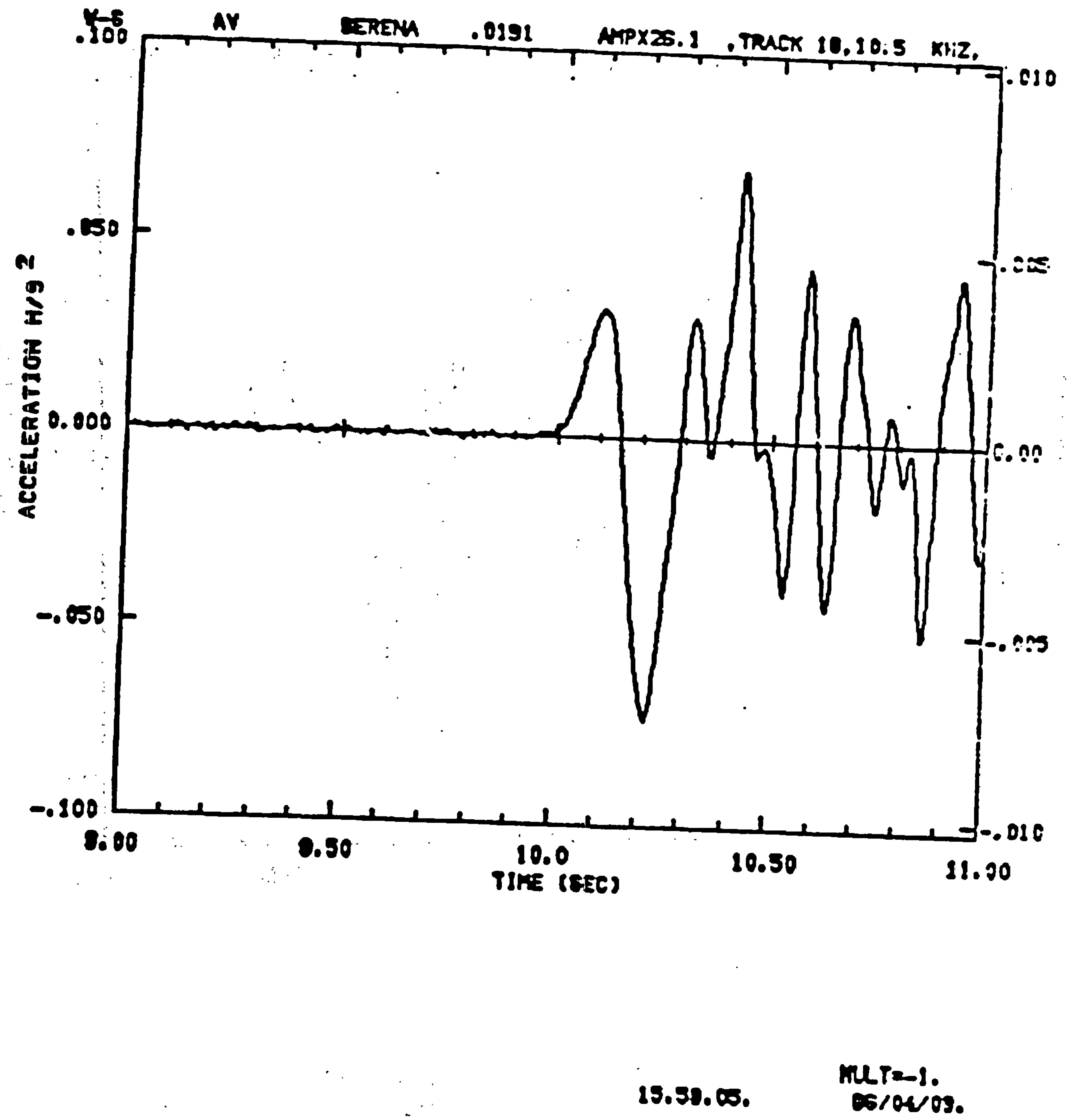
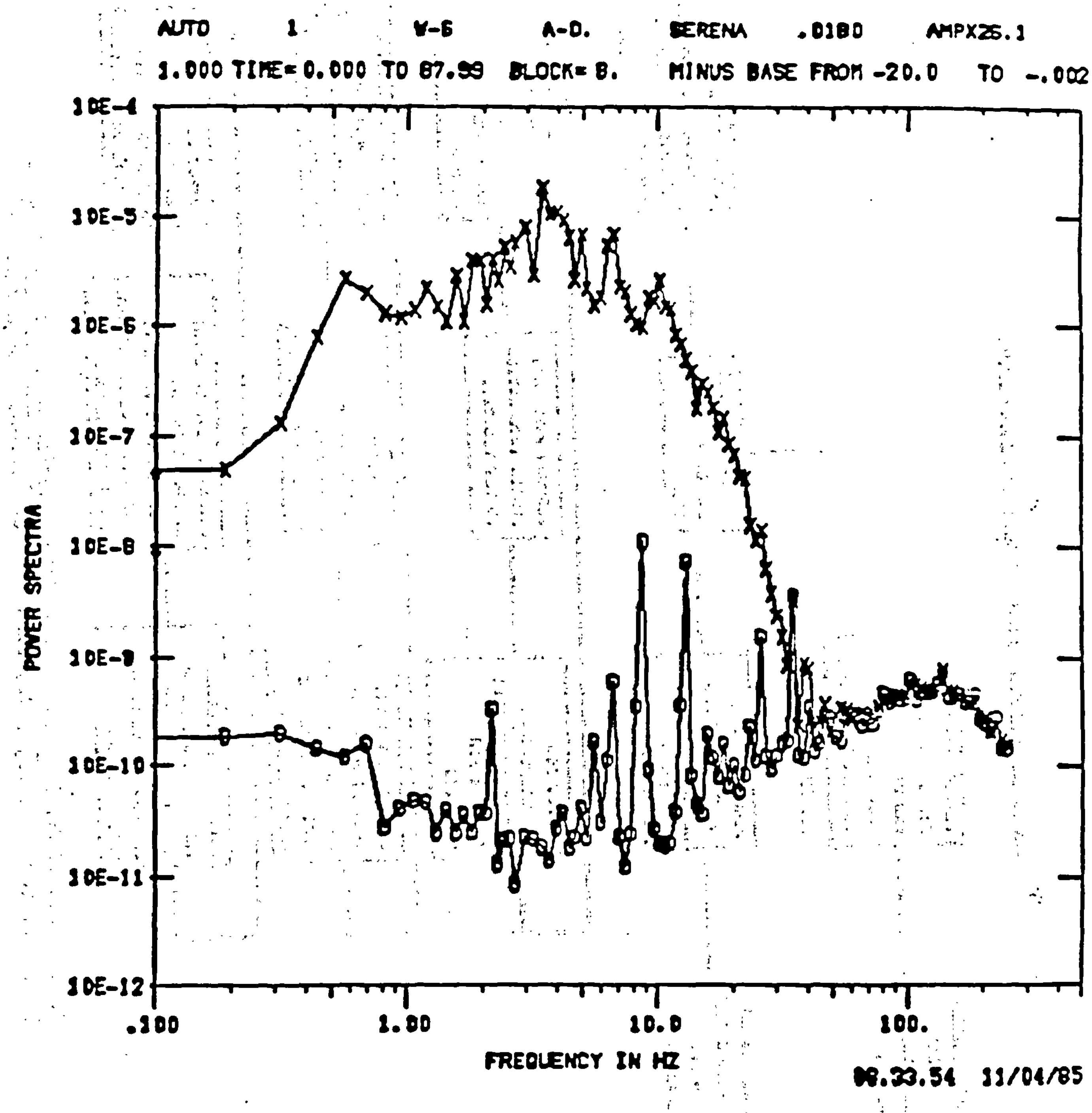
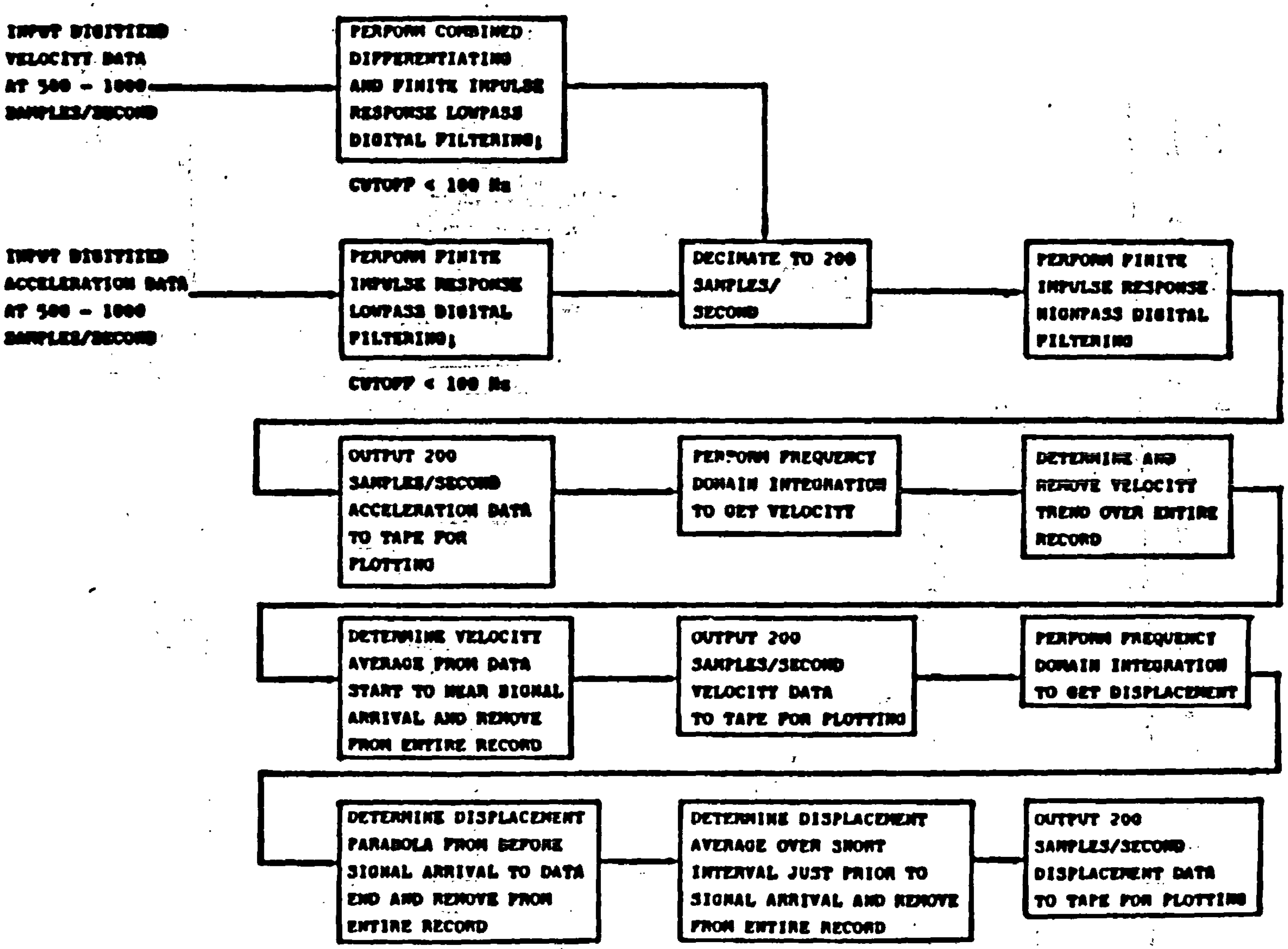

V-S
AV
SERENA
.0191
AMPX2S.1
.TRACK 10,10.5 KHZ,
.100
.050
0.000
-.050
-.100
.010
0.00
-.005
-.010
ACCELERATION M/S 2
ACCELERATION G'S
9.00
9.50
10.0
10.50
11.00
TIME (SEC)
15.59.05.
MULT=-1.
06/04/09.

Exhibit Z


AUTO 1 W-6 A-D. SERENA .0180 AMPX25.1
1.000 TIME= 0.000 TO 87.99 BLOCK= 8. MINUS BASE FROM -20.0 TO -.002
10E-4
10E-5
10E-6
10E-7
10E-8
10E-9
10E-10
10E-11
10E-12
POWER SPECTRA
.100
1.00
10.0
100.
FREQUENCY IN HZ
08.33.54 11/04/85

SAM (STEARNS AUTOMATED METHOD) DATA PROCESSING SCHEME



From SAND77-1643, Integration and Interpolation of Sampled Waveforms, S. D. Stearns, January 1978, Sandia Laboratories, Albuquerque NM been no direct measurements of velocity since January 1976.) After sample decimation and low- and high-pass or band-pass filtering, the acceleration-time data will be put on tape for later plotting. They will then be put through a frequency domain integration and trend removal. After taking out any residual baseline shift, that output will be put on tape for later plotting of velocity-time histories and will be followed by another Exhibit AA frequency domain integration. Removal of a parabola and baseline shift will provide the displacement-time data, which also will be put on tape for later plotting.

8. The output of the SAM procedure will be used to plot acceleration, velocity, and displacement, each as a function of time (Exhibits AB, AC, and AD). Note that these are the same records as Exhibits U through X where the noise spike was removed. If the plots appear satisfactory, processing will move to the next step. If not, it will usually be because the frequency cut-offs chosen in Step 6 were not suitable. In order to achieve batch processing in Step 7, a single value will be chosen for high-pass frequency cut-off, a single value for low-pass cut-off, and a single value for the cut-off bandwidth (Δf) after examining spectra from all gages on a single nuclear event. These values will then be used for all gages. This will result in a compromise in some cases, and occasionally it may later prove necessary to choose a different set of frequency cutoffs to process a channel of data for which the general choice was not suitable. Time-expanded plots of the above will be made from 0-25 seconds and 25-50 seconds to permit detailed examination of the coda.

Exhibit AB

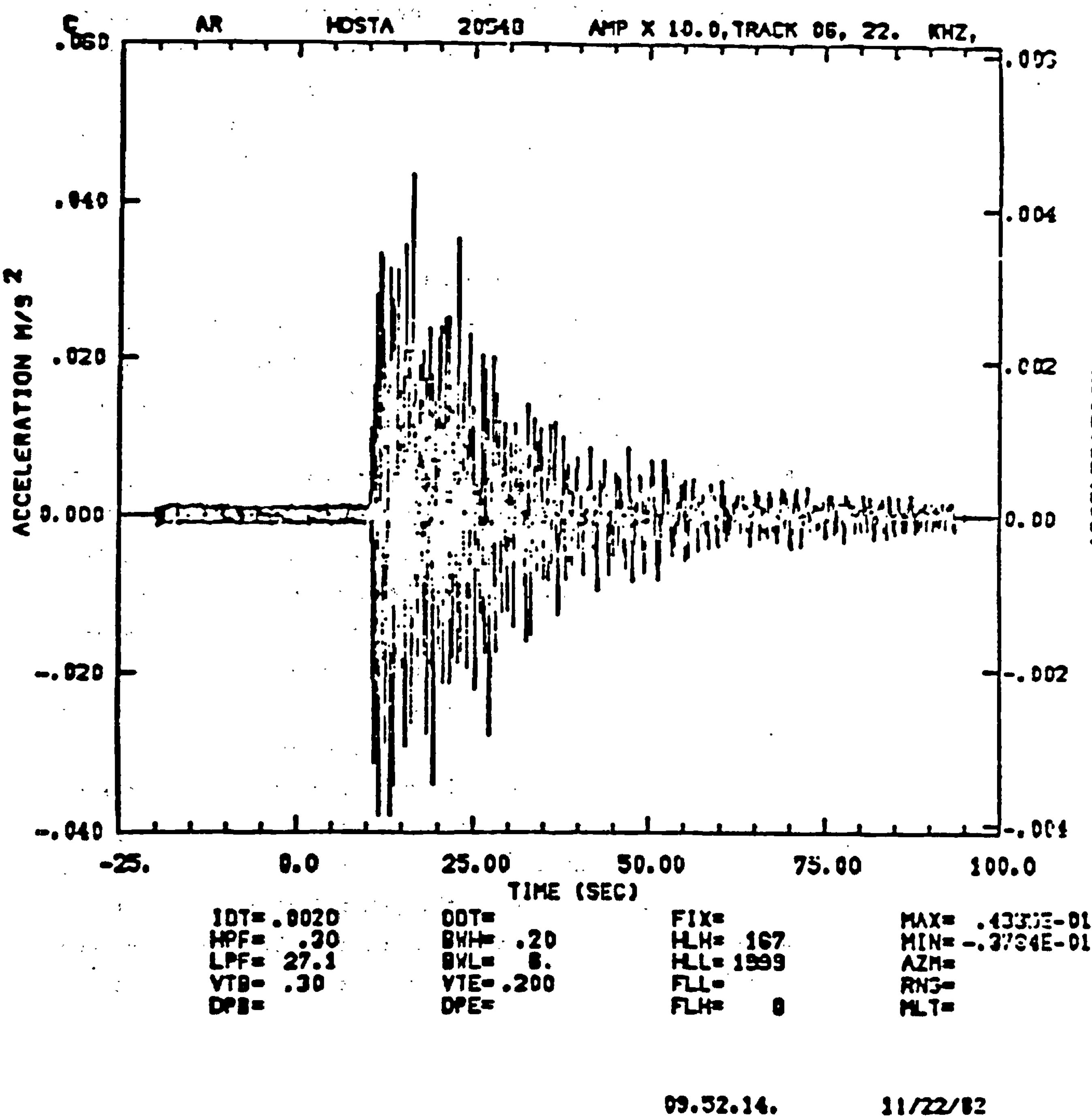
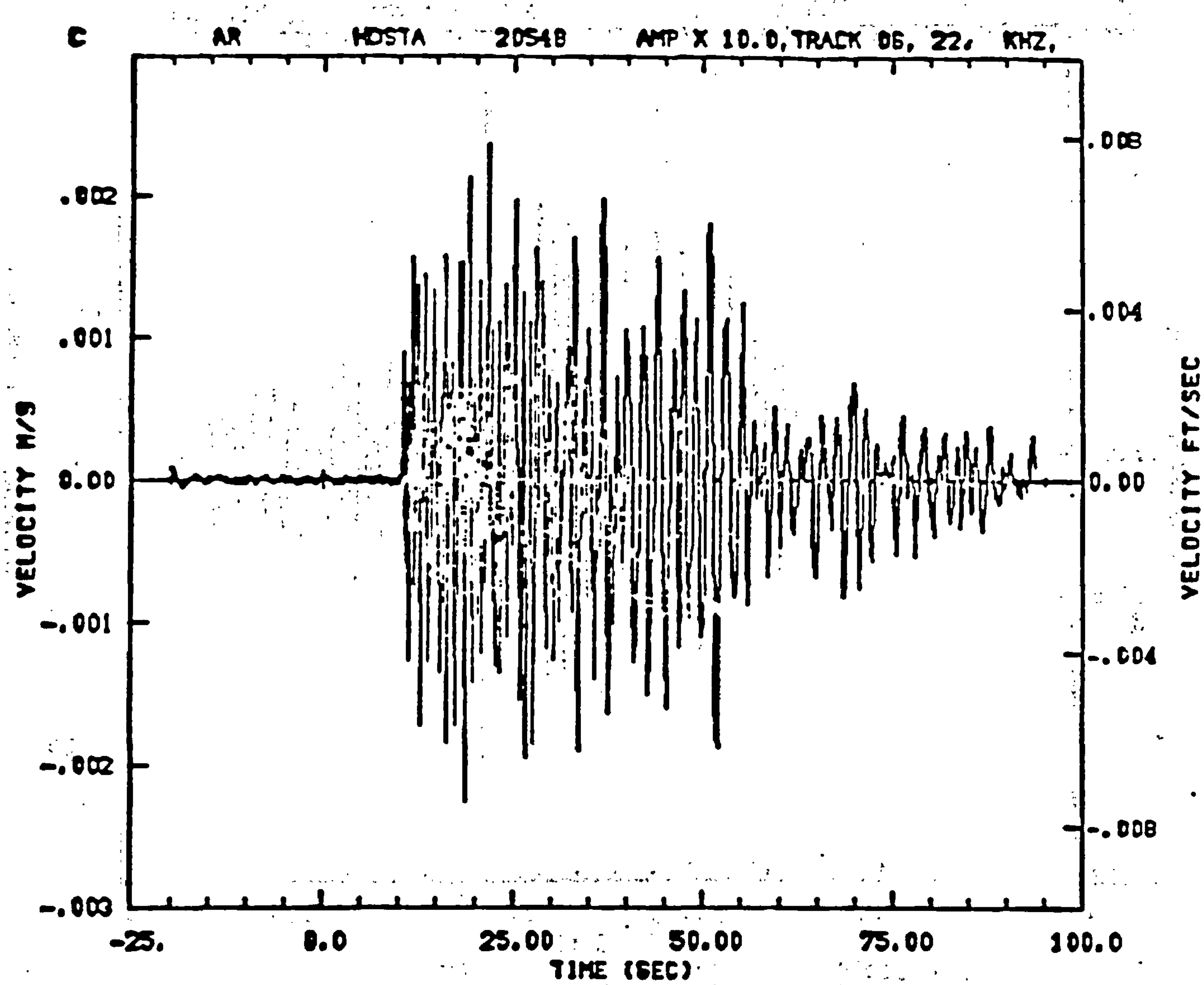

AR HOSTA AMP X 10.0, TRACK 06, 22. KHZ,
ACCELERATION M/S 2
ACCELERATION G'S
TIME (SEC)
-25. 0.0 25.00 50.00 75.00 100.0
IDT= .0020
HPF= .30
LPF= 27.1
VTB= .30
DPB=
DDT=
BWH= .20
BWL= 8.
VTE= .200
DPE=
FIX=
HLH= 167
HLL= 1999
FLL=
FLH= 0
MAX=
AZM=
RNG=
MLT=
09.52.14. 11/22/82

Exhibit AC



IDT= .0020 HPF= .30 LPF= 27.1 VTB= .30 DPB=

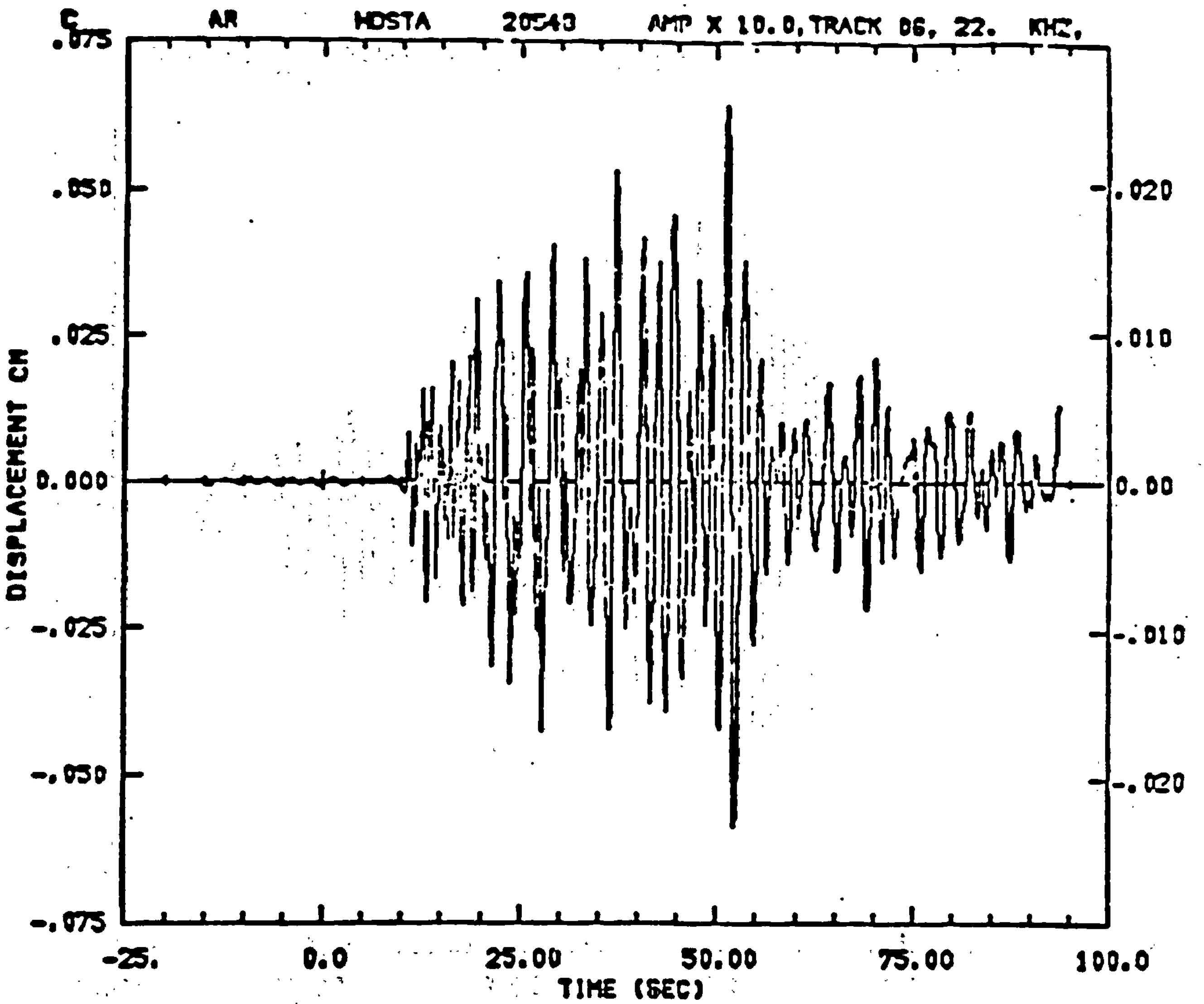
DOT= BWH= .20 BWL= 6. VTE= .200 DPE=

FIX= HLH= 167 HLL= 1999 FLL= FLH= 0

MAX= .2375E-02 MIN= -.2252E-02 AZM= RNG= MLT=

09.52.17. 11/22/82

Exhibit AD



IDT= .0020	ODT=	FIX=	MAX= .6400E-01
HPF= .30	BWH= .20	HLH= 167	MIN= -.5865E-01
LPF= 27.1	BWL= 8.	HLL= 1999	AZM=
VTB= .30	VTC= .200	FLL=	RNG=
DPB=	DPE=	FLH= 0	MLT=

09.52.20. 11/22/82

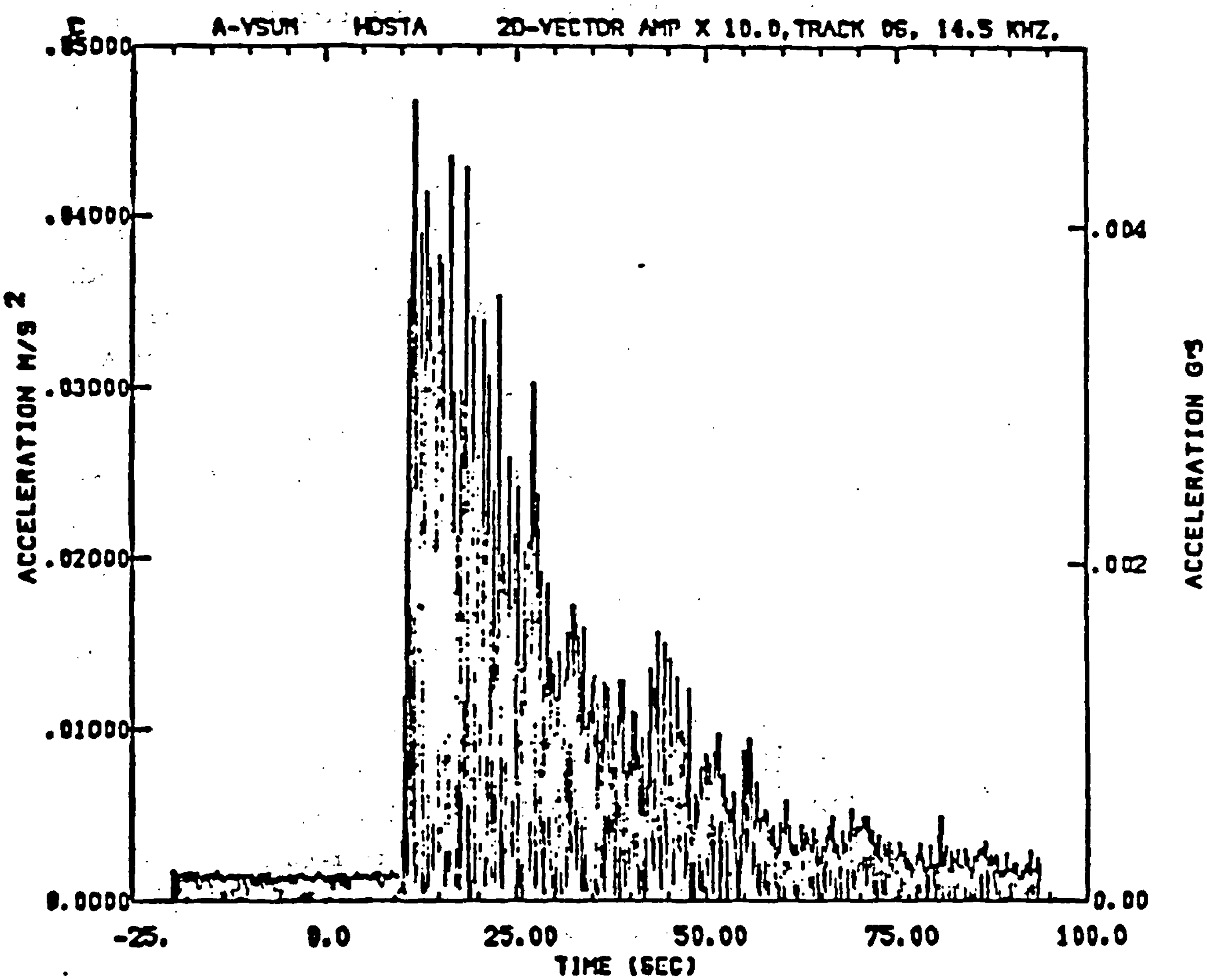
9. Plots of 2- and 3-component vector-sums will be made for acceleration, velocity, and displacement as functions of time. Peak 3-component vector-sum values were used for the Environmental Research Corporation (ERC) prediction equations and for those developed for NNWSI, and it is this motion which is most appropriately applied in the response of underground structures. For surface structures, which are designed to be strong with respect to vertical forces, the 2-component vector-sums for the horizontal motion are often preferred. Either or both can be provided. Exhibits AE, AF, and AG illustrate acceleration, velocity, and displacement; Exhibits AH, AI, and AJ are for 3-component vectors.

10. Gage canisters will be oriented so that the positive directions of the horizontal components are north (0°) and west (270°). Later analysis will require the use of radial and tangential components. The records will be converted using the ROTATE program which will make use of shot and station coordinates stored in the WTSI data base.

11. Plots of Pseudo Relative Response Velocity also will be made (Exhibit AK). These are useful because this is the form in which NRC usually specifies the structural response criteria which designs are required to meet. These are separate plots for vertical, radial, and tangential components.

B. Based on the above processing there will be 20 hard-copy plots prepared for each channel of data--60 per station. This can be doubled or tripled if one or two additional sensitivities are processed, something which ordinarily is not done. Hard-copy plots will be kept on file in 7111. No back-ups will be provided because additional plots can be made from digital tapes as needed.

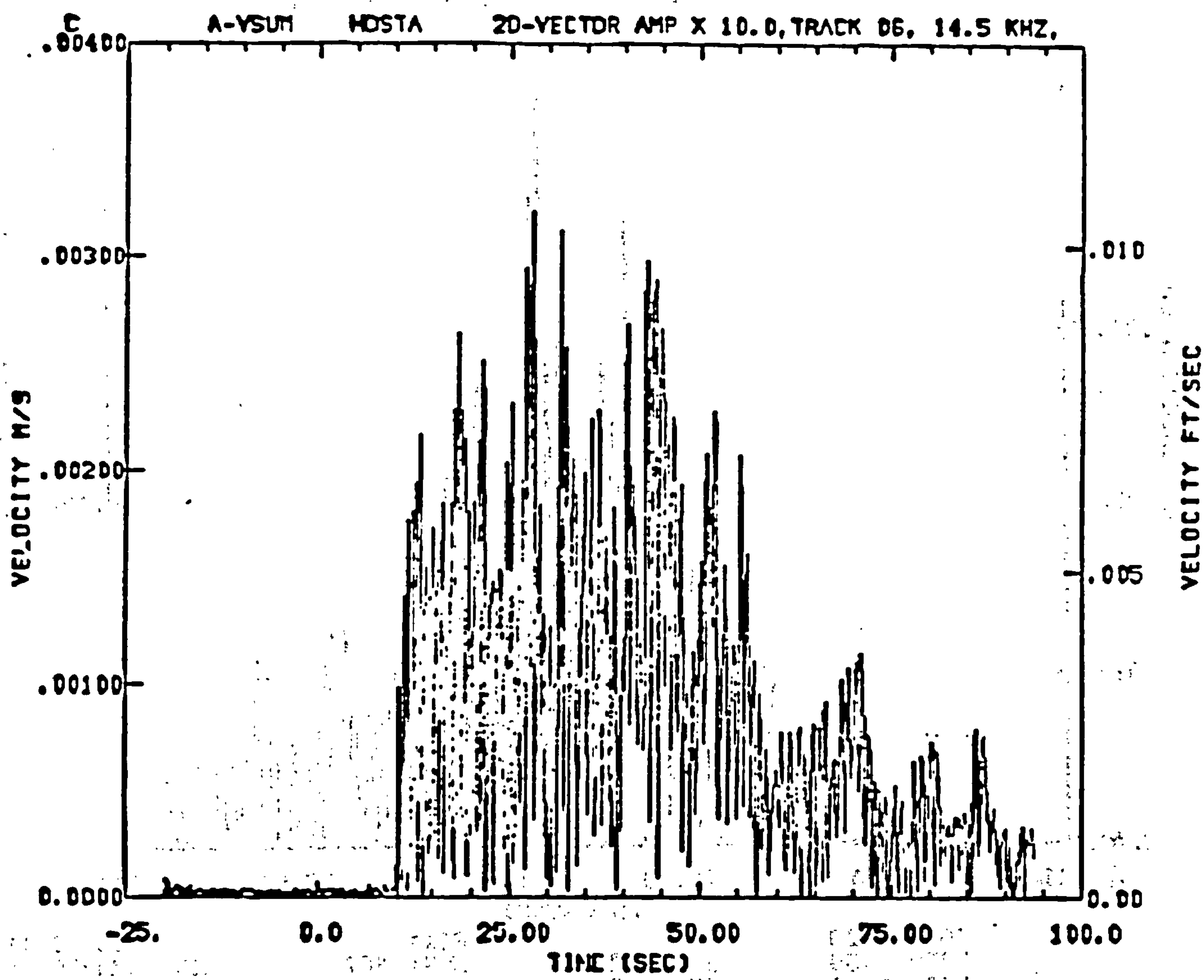
Exhibit AE



IDT= .0020	DDT=	FIX=	MAX= .4667E-01
HPF= .30	BWH= .20	HLH= 167	MIN= .6247E-05
LPF= 27.1	BWL= 8.	HLL= 1999	AZM=
VTB= .30	VTE= .200	FLL=	RNG=
DPO=	DPE=	FLH= 0	MLT=

07.54.30. 11/24/82

Exhibit AF



IDT= .0020 HPF= .30 LPF= 27.1 VTD= .30 DPB=
ODT= BWH= .20 BWL= 0. VTC= .200 UPE=
FIX= ILH= 167 ILL= 1909 FLL= FLH= 0
MAX= .3200E-02 MIN= .1890E-06 AZM= RNG= MLT=

07.54.35. 11/24/82

Exhibit AG

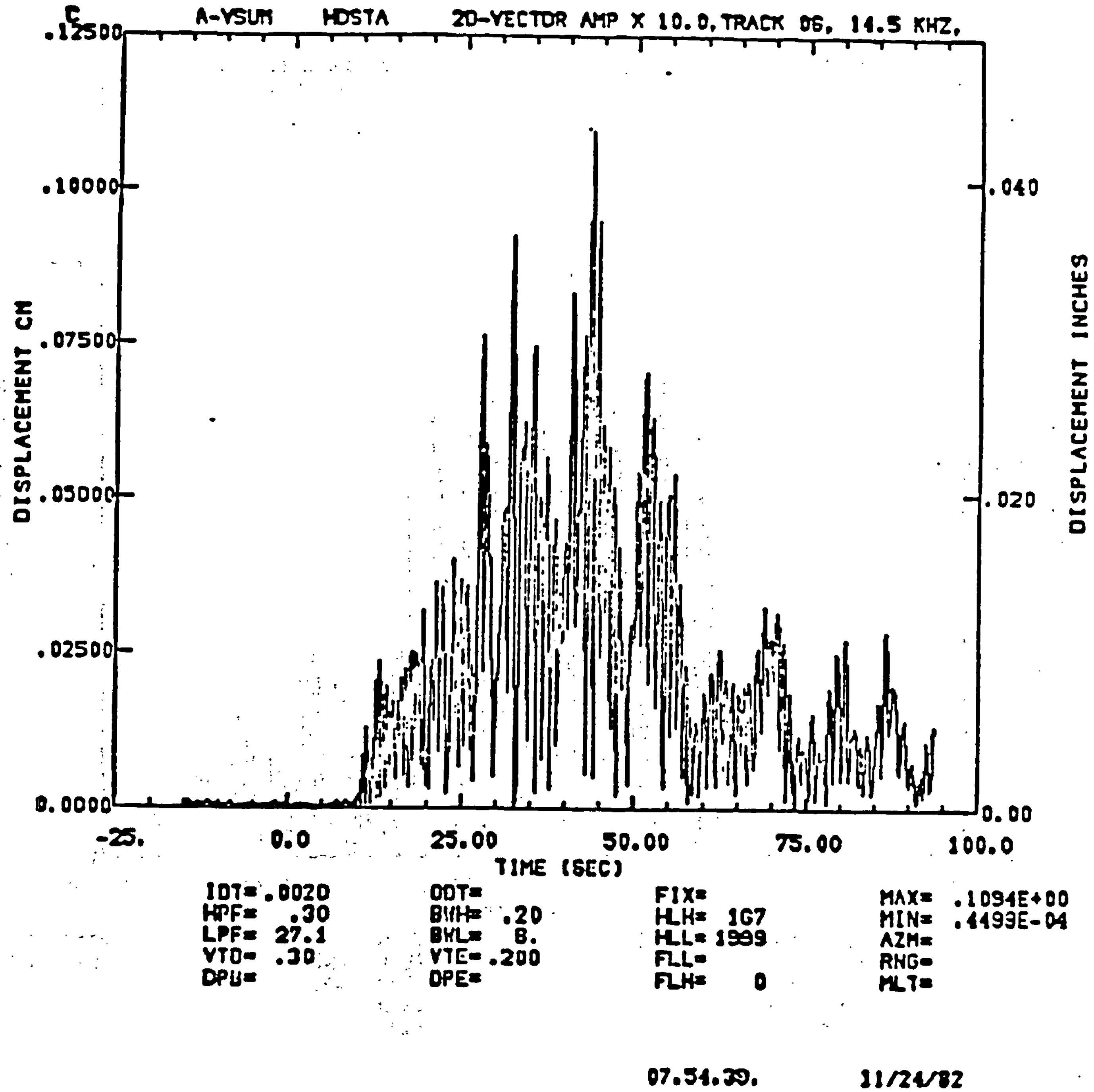

C
A-VSUM HDSTA 2D-VECTOR AMP X 10.0, TRACK 06, 14.5 KHZ,
.12500
.10000
.07500
.05000
.02500
0.0000
DISPLACEMENT CM
.040
.020
0.00
DISPLACEMENT INCHES
-25.
0.0
25.00
50.00
75.00
100.0
TIME (SEC)
IDT= .0020
HPF= .30
LPF= 27.1
VTD= .30
DPU=
ODT=
BWH= .20
BWL= 8.
VTE= .200
DPE=
FIX=
HLH= 1G7
HLL= 1999
FLL=
FLH= 0
MAX= .1094E+00
MIN= .4493E-04
AZM=
RNG=
MLT=
07.54.39.
11/24/82

Exhibit AH

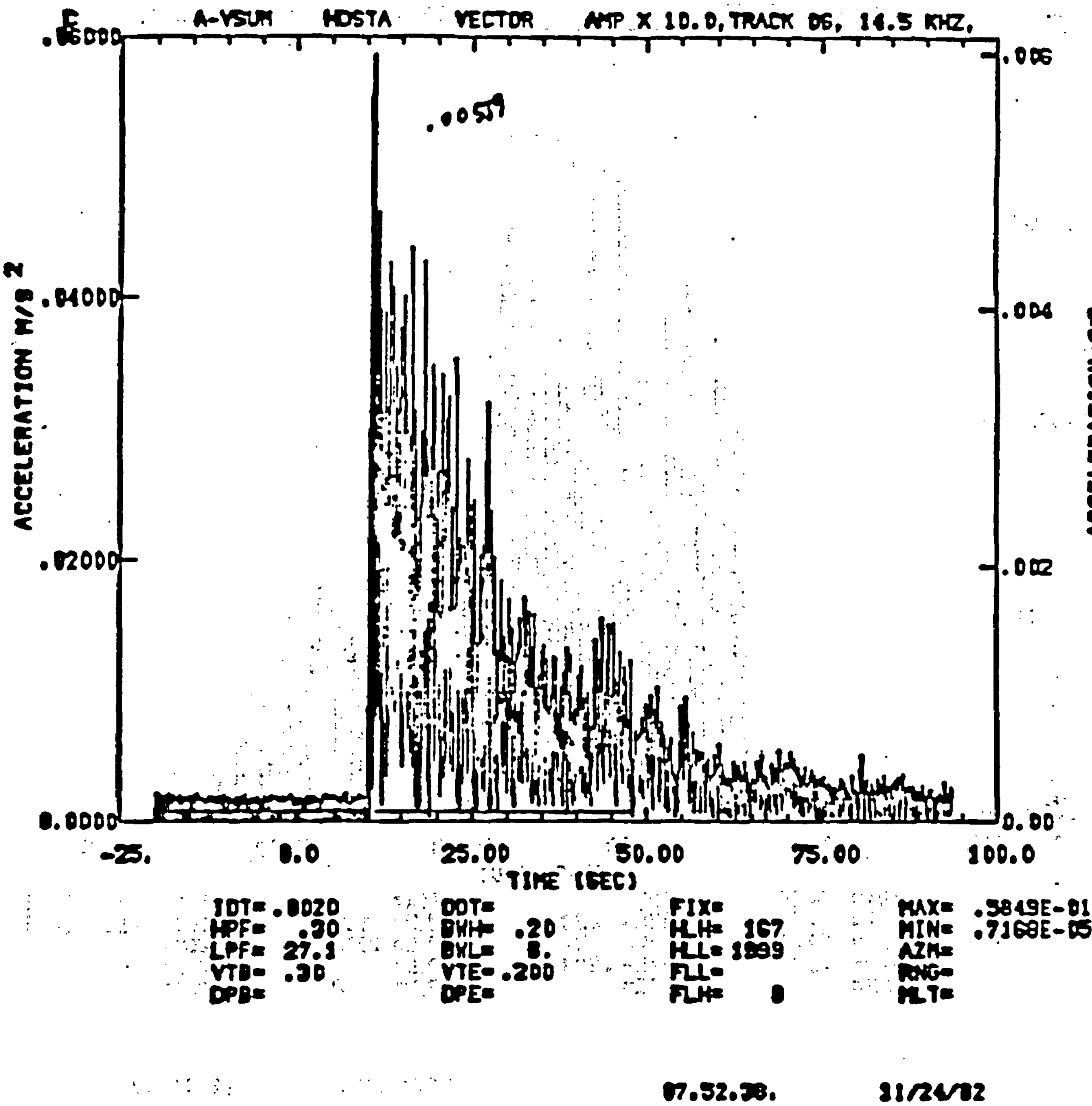

A-VSUM HDSTA VECTOR AMP X 10.0, TRACK 06, 14.5 KHZ,
.0537
ACCELERATION M/S 2
ACCELERATION G'S
.04000
.02000
0.0000
.006
.004
.002
0.00
-25.
0.0
25.00
50.00
75.00
100.0
TIME (SEC)
IDT= .0020
HPF= .30
LPF= 27.1
VTB= .30
DPB=
DDT=
BWH= .20
BWL= 8.
VTE= .200
DPE=
FIX=
HLH= 167
HLL= 1899
FLL=
FLH= 8
MAX= .5849E-01
MIN= .7168E-05
AZM=
RNG=
MLT=
07.52.38. 11/24/82

Exhibit AI

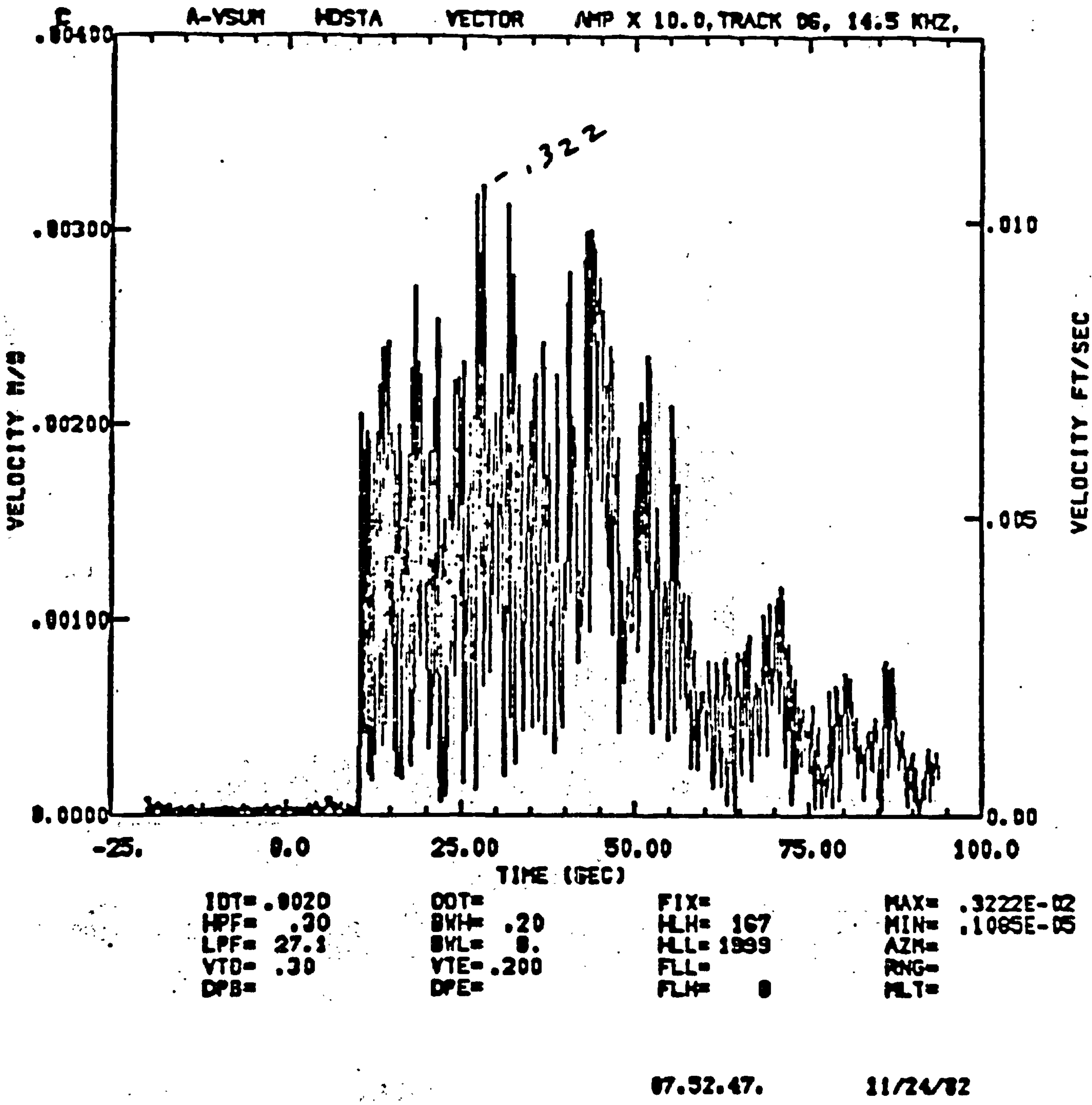
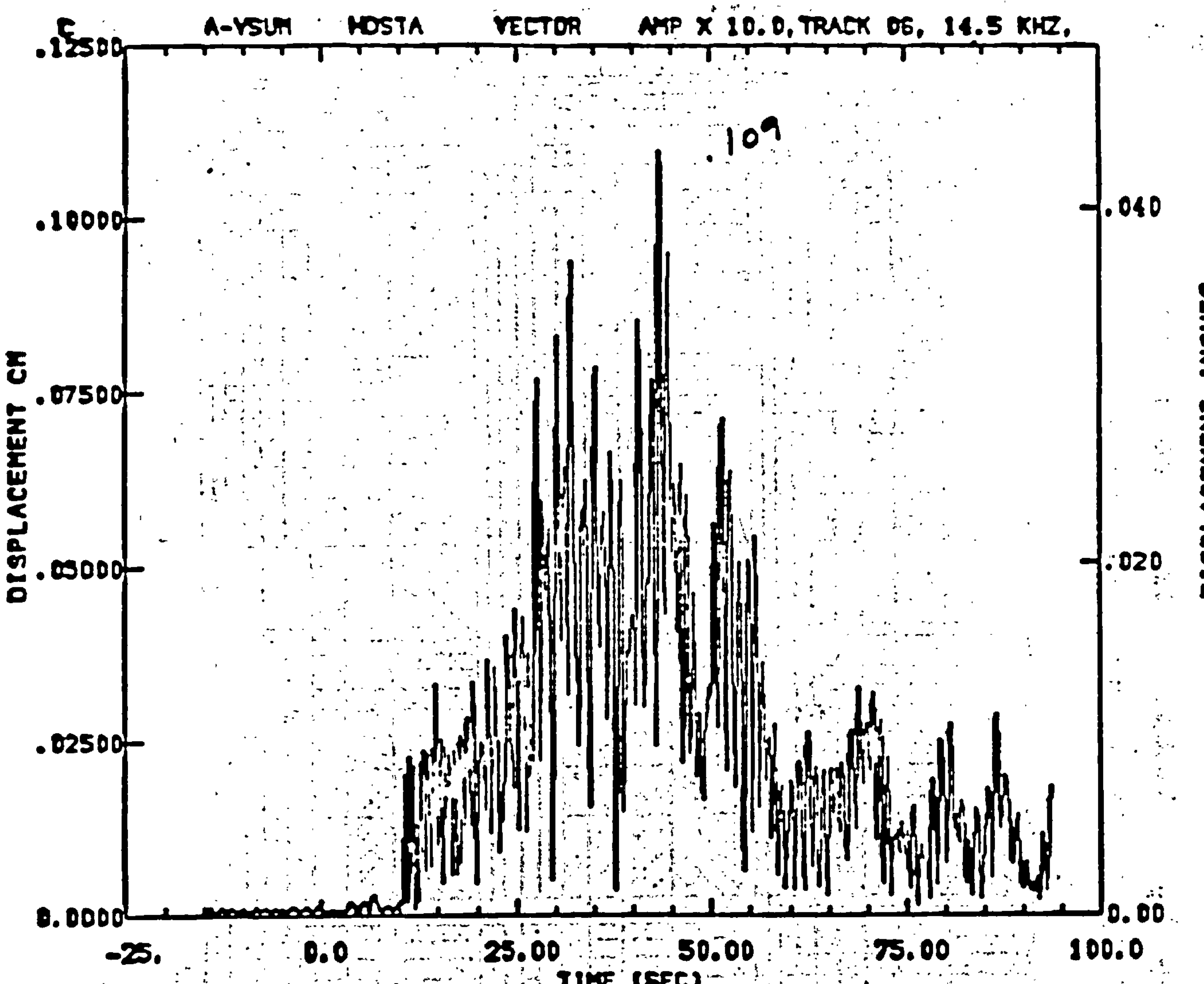

A-VSUM HDSTA VECTOR AMP X 10.0, TRACK 06, 14.5 KHZ,
.00400
.00300
.00200
.00100
0.0000
.010
.005
0.00
VELOCITY M/S
VELOCITY FT/SEC
-25.
0.0
25.00
50.00
75.00
100.0
TIME (SEC)
.322
IDT= .0020
HPF= .30
LPF= 27.1
VTD= .30
DPB=
DOT=
BWH= .20
BWL= 0.
VTE= .200
DPE=
FIX=
HLH= 167
HLL= 1999
FLL=
FLH= 0
MAX= .3222E-02
MIN= .1085E-05
AZM=
RNG=
MLT=
07.52.47.
11/24/82

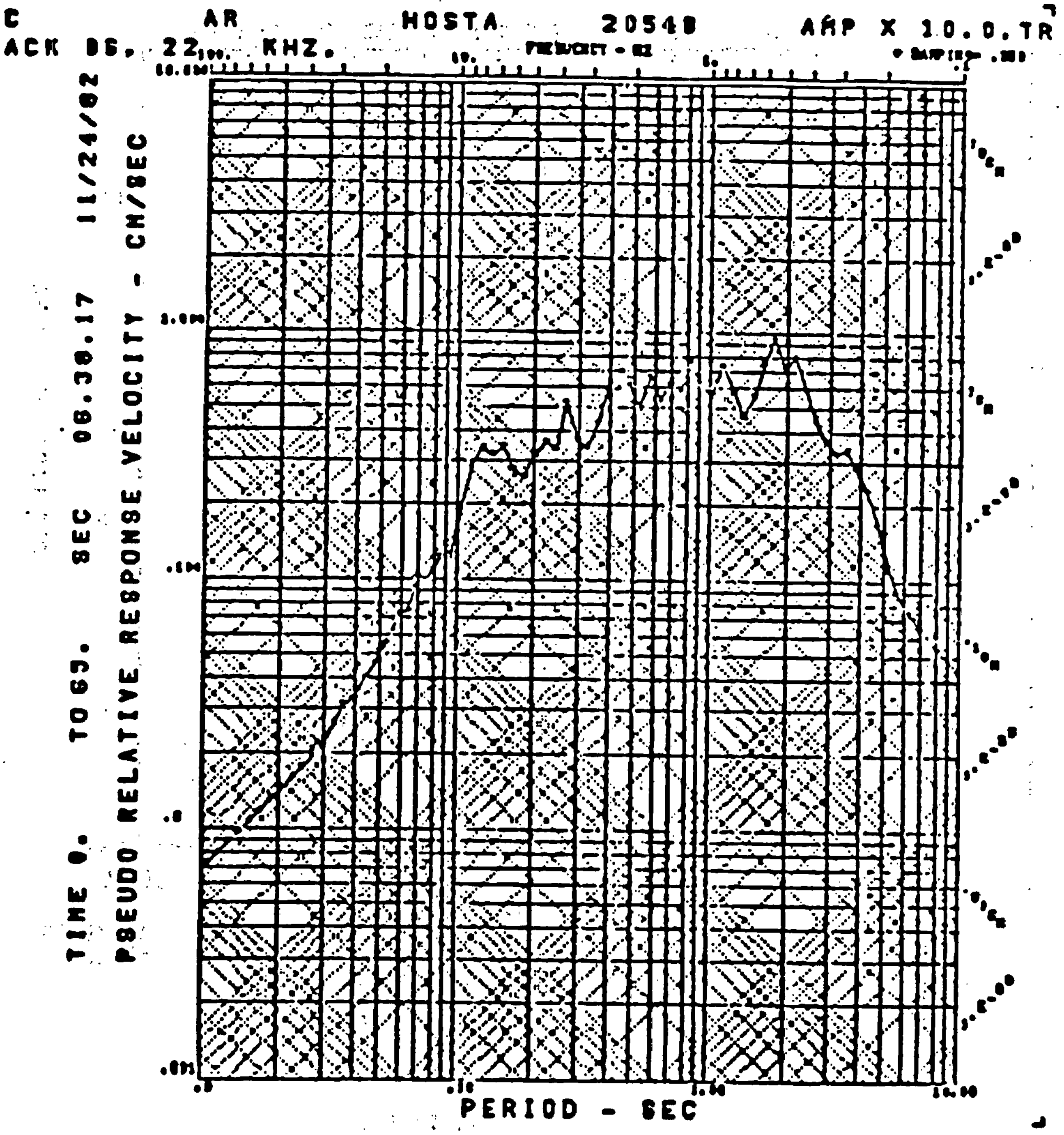
Exhibit AJ



IDT= .0020	DDT=	FIX=	MAX= .1094E+00
HPF= .30	BWH= .20	HLH= 167	MIN= .6734E-04
LPF= 27.1	BWL= 8.	HLL= 1899	AZM=
VTB= .30	VTE= .200	FLL=	RNG=
DPB=	DPE=	FLH= 8	MLT=

07.53.03. 11/24/82

Exhibit AK


C AR HOSTA 20548 AMP X 10.0, TR
ACK BS. 22 KHZ.
TIME 0. TO 63. SEC 08.38.17 11/24/82
PSEUDO RELATIVE RESPONSE VELOCITY - CM/SEC
PERIOD - SEC

C. The analog tapes from which the digitized data are obtained will be archived as a part of the Nuclear Weapons Test Archive in 7111.

D. The final digital tape(s) for each shot will contain the following information.

1. All information for each station in the order of station number followed by lettered stations.
2. For each station the order of data will be ROTATE, SAM (FILTER), and raw (AUTO).
3. For each item in 2, the order will be AV, AR, and AT, or AV, A-270, and A-0.
4. For each item in 3, the order will be acceleration, velocity, and displacement.

E. Three copies of each digital tape will be made.

1. One copy will go to 7111 for the Nuclear Weapons Test Archive.
2. One copy will remain in the tape library in 2631-2.
3. The third copy will also be in the tape library in 2631-2 as backup in the event of damage to the above tape.

F. A tape scan will be prepared in two copies, one to be kept on file in 7111, and the other to be filed with the archived tape (E-1, above). The scans will provide the information listed below. A sample scan is shown in Exhibit AL.

1. Tape number
2. Date of scan
3. Time of scan
4. Data processor
5. Clerk making scan
6. Number of records and file number

TP-82
REV 0
Page 74 of 123

Exhibit AL

[illegible] NO. [illegible] [illegible], 10,22,19,

[illegible] [illegible]

NO. OF RECORDS	FILE NO.													
[illegible]	1	AUTO	01	U-5	A-0.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	2	AUTO	01	U-5	A-270.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	3	AUTO	01	U-6	A-V	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	4	AUTO	01	U-5	A-0.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	5	AUTO	01	U-6	A-270.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	6	AUTO	01	U-5	A-V	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	7	AUTO	01	U-6	A-0.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	8	AUTO	01	U-5	A-270.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	9	AUTO	01	U-6	AV	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	10	AUTO	01	U-7	A-0.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	11	AUTO	01	U-7	A-270.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	12	AUTO	01	U-7	AV	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	13	AUTO	01	U-7	A-0.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	14	AUTO	01	U-7	A-270.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	15	AUTO	01	U-7	AV	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	16	AUTO	01	U16	A-0.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	17	AUTO	01	U16	A-270.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	18	AUTO	01	U16	A-V	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	19	AUTO	01	U16	A-0.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	20	AUTO	01	U16	A-270.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	21	AUTO	01	U16	AV	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	22	AUTO	01	U21	A-0.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	23	AUTO	01	U21	A-270.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	24	AUTO	01	U21	AV	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	25	AUTO	01	U22	A-0.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	26	AUTO	01	U22	A-270.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	27	AUTO	01	U22	AV	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	28	AUTO	01	U22	A-0.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	29	AUTO	01	U22	A-270.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	30	AUTO	01	U22	AV	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	31	AUTO	01	U23	A-0.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	32	AUTO	01	U23	A-270.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	33	AUTO	01	U23	AV	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	34	AUTO	01	U23	A-0.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	35	AUTO	01	U23	A-270.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	36	AUTO	01	U23	AV	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	37	AUTO	01	U23 TOP	A-0.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	38	AUTO	01	U23 TOP	A-270.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	39	AUTO	01	U23 TOP	AV	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	40	AUTO	01	U23 TOP	A-0.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	41	AUTO	01	U23 TOP	A-270.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	42	AUTO	01	U23 TOP	AV	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	43	AUTO	01	U23 BOTTOM A-0. [illegible]		SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	44	AUTO	01	U23 BOTTOM A-270. [illegible]		SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	45	AUTO	01	U23 BOTTOM AV		SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	46	AUTO	01	U23 BOTTOM A-0. [illegible]		SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	47	AUTO	01	U23 BOTTOM A-270. [illegible]		SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	48	AUTO	01	U23 BOTTOM AV		SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	49	AUTO	01	U25	A-0.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
46	50	AUTO	01	U25	A-270.	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00
[illegible]	51	AUTO	01	U25	AV	SALUT	[illegible]	AMP [illegible]	TRACK [illegible]	[illegible]	7.5	DEV	0	-60.00

EXHIBIT AL

7. Data identifier [AUTO, INTEG (vel), INTEG2 (disp), SAM (FILTER), ROTATE]
8. Run number
9. Station number
10. Gage orientation
11. Event name
12. Calibration values (rotate angles for ROTATE)
13. Amplification
14. Track number
15. Subcarrier frequency
16. Subcarrier percentage deviation
17. Digitizing start time

APPENDIX B. Procedures for Laboratory Calibration of Ground Motion Gages

This appendix contains the procedures presently used by EG&G Las Vegas for the laboratory calibration of the ground motion accelerometers. Note that the personnel at EG&G Las Vegas are certified through DOE/NVOO. These procedures will also be followed in future calibrations. Note, pages in this appendix marked "Preliminary" will be replaced as soon as they have been updated by EG&G.

DEPT. 1262 SUNDSTRAND QA1300 SERVO ACCELEROMETER
INCOMING INSPECTION PROCEDURE
2 DEC 82

The following test equipment or equivalent, in current calibration, is required for this inspection.

GR 1864 Megohmmeter
Fluke 8030A Multimeter
Fluke 8860A Digital Voltmeter (2)
ENCO Surface Plate (Grade B)
EG&G .1g/.2g/.5g Sine Plates
CHALLENGE LH-101 Angle Blocks (2)
MB Elect. MP-50 Shaker System
ENDEVCO SC-116-215 'g' Monitor
ENDEVCO 28350 Vibration Monitoring System
EG&G QA1300 Test Box
ENDEVCO MB-116-15b/-15c Adapters
STARRETT 3-way 12-inch Spirit Level
Incoming Inspection Form Q1300I-FRM

APPLICABILITY

This procedure is applicable for all Sundstrand QA1200-XXX, QA1300-XXX and QA1400-XXX servo accelerometers.

VISUAL INSPECTION:

Verify that data sheets are enclosed, that markings coorelate, that data recorded on the data sheets meets specifications, and the units received are the units ordered, were correctly packed, and have no apparent damage. Insure that units will fit the mounting blocks and connector.

ELECTRICAL CHARACTERISTICS:

Measure insulation resistance at 50 VDC with the 1864 megohmmeter from each pin to the case. The minimum reading should be 100 megohms.

INCOMING INSPECTION:

NOTE: Record all readings to 4 decimal places.

1. Connect the QA-1300 test box to the SC-116-2M 'g' monitor SENSOR Jack. Set 'g' RANGE switch on monitor to '20'. Switch FM-116-6 filter to OUT.

2. Plug a 1000 ohm resistor in the LOAD Jacks.

3. Connect the 8060A digital voltmeter to the test box SIGNAL Jacks. Set the 8860A to 20 volt DC range. Connect a ground lead from the CHASSIS Jack on the SC-116-2m monitor to the input LO Jack of the 8860A.

4. Connect the 8030A multimeter to test box CURRENT Jack. Set the

8030A to 20 mA range.

5. Mount the QA1300 accelerometer in the MB-116-15b mounting block and connect the transducer jack.

6. With the transducer on the level surface in the +1g position (connector up), apply power to the monitor. Allow the transducer to warm up at least 10 minutes.

7. Read and record the transducer current drain in the +1g, 0g and -1g positions on the 8030A. Remove the CURRENT plug from the test box before proceeding.

8. Perform the self-test by depressing in turn the + and - SELF-TEST buttons on the test box. Depressing the + button should produce a negative change of at least 5 volts. Depressing the - button should produce a positive change of at least 5 volts. An inconsistant reading indicates an incorrect hookup or damaged transducer. A typical reading for a good transducer is +/- 12 volts.

9. Test the mounting orientation by rocking the mounting block slightly. Maximum output indicates the +1g position and must be attained with the block sitting on the level surface.

10. Record the transducer output in the +1g, 0g and -1g positions.

11. Place the transducer in the -1g position and record the output. In turn, record the output for the 0g and +1g positions and return to 0g. This documents the hysteresis error. The +1g and -1g readings should be equal +/-0.005 volts.

12. Test the repeatibility of the transducer by removing power for 2 seconds. Turn power on and record the initial output voltage. The difference in output voltage between that initial output voltage at turn-on and the previous output voltage is the repeatibility error voltage. The reading should be equal to the previous output voltage +/-0.015 volts.

13. Perform the noise test by placing the transducer in a foam-lined insulating box in a quiet atmosphere and recording the output noise voltage. Plug the 8860A voltmeter, in AC mode, into the SIGNAL jacks on the QA1300 test box and record the broadband noise level output voltage. This level should be less than 15 mV. Plug the 8860A into the FILTER jacks on the test box, switch the FM-116-6 filter to '50 Hz' and ON. Record the filtered noise level which should be less than 4 mV AC. (Review for expansion.)

14. Run BASIC program QFLEX1.BAS and enter requested data to produce the calculated parameters for entry on the INCOMING INSPECTION Form Q1300I-FRM. If the program is not available, perform the following calculations manually and record the result.

15. Calculate and record transducer sensitivity (scale factor in V/g) by numerically adding the +1g and -1g output voltages and dividing by 2.

16. Calculate and record zero output voltage by numerically subtracting

the -1g readings from the +1g and dividing by 2 times the sensitivity.

17. Calculate and record the current scale factor (in mA-per-g) by dividing the sensitivity (scale factor in V/g) by the load resistance in Kohms.

18. Calculate and record the bias voltage by algebraically subtracting the sensitivity (scale factor in V/g) from the +1g reading.

19. Divide this bias voltage by the sensitivity (scale factor in V/g) to obtain bias-in-g's. Multiply bias-in-g's by 1000 and record in mg's.

FREQUENCY RESPONSE TEST

1. Connect the QA-1300 test box to the SC-116-2M 'g' monitor SENSOR jack. Set 'g' RANGE switch on monitor to '20'. Switch FM-116-6 filter to OUT.

2. Plug a 1000 ohm resistor in the LOAD jacks.

3. Connect the 8860A digital voltmeter to the test box SIGNAL jacks. Connect a ground lead from the CHASSIS jack on the SC-116-2m monitor to the input LO jack of the 8860A.

4. Plug the second 8860A into the CHAN. 3 OUTPUT jacks for the 28350 system. Set Channel 3 to 1000 mV/g. Mount the 28350 standard accelerometer and the QA1300 on the shaker. Plug the 5103N oscilloscope leads into the CHAN. 3 OUTPUT jacks and the test box SIGNAL jacks. Connect a ground lead from the 28350 system to the oscilloscope and screw down the grounding sleeve on the standard accelerometer.

NOTE: Record all readings to 3 decimal places.

5. In steps of 15/35/50/100/200/300/400/500, shake the standard accelerometer for a 28350 system output of 1.000 volt RMS (1.414 peak 'g'). Record the QA1300 output as SHAKER RMS. Observe the accelerometer waveforms on the oscilloscope for distortion.

NATURAL FREQUENCY TEST

1. Replace the 5D10N TIME BASE module in the oscilloscope with the Channel 1 5A20N DIFFERENTIAL AMPLIFIER module.

2. The lissajous pattern for zero Hz is a left-diagonal line. Increase the frequency of the test oscillator until the lissajous pattern is a circle. Record this 90-degree PHASE-SHIFT frequency.

2 Attachments:

1. QFLEX1.BAS program listing
2. Form Q1300I.FRM

Approved: ----------

DEPT. 1262 SUNDSTRAND QA1300 SERVO ACCELEROMETER
FIELD CALIBRATION PROCEDURE
2 DEC 82

The following test equipment or equivalent, in current calibration, is required for this calibration:

- WAVETEK 183 Frequency Generator
- TEK 5103N Oscilloscope
  - 5A20N Differential Amplifier (2)
  - 5B10N Time Base/Amplifier
- Fluke 8860A Digital Voltmeter (2)
- ENCO Surface Plate (Grade B)
- EG&G .1g/.2g/.5g Sine Plates
- CHALLENGE LH-101 Angle Blocks (2)
- MB Elect. MP-50 Shaker System
- ENDEVCO SC-116-215 'g' Monitor
- ENDEVCO 28350 Vibration Monitoring System
- EG&G QA1300 Test Box
- ENDEVCO MB-116-15b/-15c Adapters
- STARRETT 3-way 12-inch Spirit Level
- Field Calibration Form Q1300C.FRM

APPLICABILITY

This procedure is applicable for the calibration of all QA1300-XXX servo accelerometers for use with SC116-2M 'g' Monitors.

STATIC GRAVITY TEST

NOTE: Record all readings to 4 decimal places.

1. Mount the QA1300 in the MB-116-5c adapter. Plug the 8860A into the OUTPUT jacks on the rear of the SC-116-2M monitor. Set the RANGE to '1g'. Turn the FM-116-6 filter OFF. Set the SENSITIVITY pot to 250-270 mV/g. Remove the 1000 ohm resistor from the LOAD jacks of the test box Select, measure, record and install a load resistor on the connector to be supplied with the transducer. The resistor nominal value should be determined from the following table:

Nom. Resistor (ohms)	Current Scale Factor from Incoming Inspection (mA-per-g)
82.5	3.1 to 3.3
90.9	2.85 to 3.1
100	2.7 to 2.85

2. Place the QA1300 against the vertical angle block and adjust the OFFSET pot for 0g. Place the QA1300 on the surface plate and adjust the SENSITIVITY pot for 2.500 volt output. Repeat these adjustments until a 0.000 - 2.500 volt span is achieved. Record the SENSITIVITY pot set point.

3. Record the DC TEST steps using the angle blocks and surface plate

for +1g, 0g and -1g and the sine plates vertically against the vertical angle block for +/-.1g, +/-.2g and +/-.5g.

FREQUENCY RESPONSE TEST

NOTE: Record all readings to 3 decimal places.

1. Plug an 8860A into the OUTPUT jacks on the rear of the SC-116-2M monitor. Plug the second 8860A into the CHAN. 3 OUTPUT jacks for the 28350 system. Set Channel 3 to 1000 mV/g. Mount the 28350 standard accelerometer and the QA1300 on the shaker. Plug the 5103N oscilloscope leads into the CHAN. 3 OUTPUT jacks and the SC-116-2M OUTPUT jacks. Connect a ground lead from the 28350 system to the oscilloscope and screw down the grounding sleeve on the standard accelerometer.

2. In steps of 15/35/50/100/200/300/400/500, shake the standard accelerometer for a 28350 system output of 1.000 volt RMS (1.414 peak 'g'). Record the QA1300 output as SHAKER RMS. Observe the accelerometer waveforms on the oscilloscope for distortion.

NATURAL FREQUENCY TEST

1. Replace the 5B10N TIME BASE module in the oscilloscope with the Channel 1 5A20N DIFFERENTIAL AMPLIFIER module.

2. The lissajous pattern for zero Hz is a left-diagonal line. Increase the frequency of the test oscillator until the lissajous pattern is a circle. Record this 90-degree PHASE-SHIFT frequency.

NOISE TEST

1. Perform the noise test by placing the transducer in a foam-lined insulating box in a quiet atmosphere and recording the output noise voltage. Plug the 8860A voltmeter, in AC mode, into the OUTPUT jacks on the SC116-2M monitor and record the broadband noise level output voltage. This level should be less than ... mV. Switch the FM116-6 filter to ON and '50 Hz' and record the filtered noise level which should be less than ... mV AC.
(Review for expansion.)

1 Attachment

Field Calibration Form Q1300C.FRM

4-JUN-85

E.G.& G. DEPT. 1262 SERVO ACCELEROMETER INCOMING INSPECTION REPORT

MANUFACTURER:	PART NO.:	SERIAL NO.:	USER:	PROGRAM:	LOCATION:
SUNDSTRAND	979- -	.			

GAGE RANGE:	MODEL NO.:	IS ALL TEST EQUIPMENT TO BE USED IN-DATE?
+/- _____ g	QA -	(See Test Equipment List.) YES NO

!! !Endevco Sc116-2M 's'Monitor as power supply & filter
!! !H.P.6228B Dual Pwr. Sup. & Wavetek Model 432 Filter

Conn.	Insulation resistance:	Specification:
All-case	x 10 ohms	Resistance > 50 megohms at 50 V.

MEASURED:	TEST RESULTS (Rload = 1000 ohms)			
Current Drain	+1g . mA	0g . mA	-1g . mA	
Self-Test	(+)- . V	(-)+ . V		
Output	+1g . V	0g . V	-1g . V	
Hysteresis	-1g . V	0g . V	+1g . V	0g . V
Repeatability	+1g . V	+1g . V	Error: . Volts	
Noise Test:	. Volts (Broadband)		. V (50 Hz Filter)	

CALCULATED:	RESULTS	FREQ. RESPONSE @ __ g RMS (No Signal Conditioning) Freq. (Hz)	Volts (RMS)
Sensitivity in Volts-per-g	. V/g	35	.
Zero g Output	. V	50	.
Current Scale Factor (Isf)	. mA/g	70	.
Bias Voltage	. V	100	.
Bias in g/1000	. mg	150	.
90-degree Phase Shift measured @ Hz.		200	.
		300	.
		400	.
		500	.

Technician:	Date:	Checked by:	Date:

4-JUN-85

E.G.& G. DEPT. 1262 SERVO ACCELEROMETER FIELD CALIBRATION REPORT

MANUFACTURER:	PART NO.:	SERIAL NO.:	USER:	PROGRAM:	LOCATION:
SUNDSTRAND	979- -				

GAGE RANGE:	MODEL NO.:	IS ALL TEST EQUIPMENT TO BE USED IN-DATE?
+/- g	QA -	(See Test Equipment List.) YES NO

Calibration performed using [ ] Endevco SC116-2M 'g' Monitor.
[ ] EG&G L-SC-2 Signal Conditioner.

Local gravity: 979.58671	Gravity correction factor: 1.00115

STATIC GRAVITY TEST		FREQ. RESPONSE @ __ g RMS		
g Level	SC116-2M Output	Freq. (Hz)	Volts (RMS)	V/g (peak)
0	. V	35	.	.
+0.1	. V	50	.	.
-0.1	- . V	70	.	.
+0.2	. V	100	.	.
-0.2	- . V	150	.	.
+0.5	. V	200	.	.
-0.5	- . V	300	.	.
+1	. V	400	.	.
-1	- . V	500	.	.

Noise Test:	. Volts (Broadband)	90-degree Phase Shift
	. Volts (50 Hz filter)	measured at Hz.

Sensitivity setting = _______________mV/g
Current Scale Factor (Isf) = ________ mA/g
Load Resistance (Rl) = ______________ ohms
Calc. Sensitivity (Sc) = ____________ V/g (peak) [Sc = Isf x Rl/1000]

Technician:	Date:	Checked by:	Date:

Approved: ____________

DEPT. 1262 SUNDSTRAND QAXXXX SERVO ACCELEROMETER
INCOMING INSPECTION PROCEDURE
21 AUG 86

PRELIMINARY

The following test equipment or equivalent, in current calibration, is required for this inspection.

GR 1864 Megohmmeter
Fluke 8030A Multimeter
Fluke 8506A Thermal RMS Meter (2)
ENCO Surface Plate (Grade B)
CHALLENGE LH-101 Angle Blocks (2)
MB Elect. MP-50 Shaker System
ENDEVCO 28350 Vibration Monitor System
EG&G "Q-FLEX" Test Box
ENDEVCO MB-116-15b/-15c Amplifiers
STARRETT 3-way 12-inch Spirit Level
Incoming Inspection Form [illegible]001-FRM
H.P. 6228B Dual D.C. Power Supply
Wavetek 442 Dual Hi/Lo Filter
Enco 73010 Rotary Table or Equivalent
GR 1433F Deacde Resistance Box or Equavalent
H.P. 3456A DVM

APPLICABILITY

This procedure is applicable for all Sundstrand QA1200-XXX, QA1300-XXX and QA1400-XXX servo accelerometers.

VISUAL INSPECTION:

1. Verify that data sheets are enclosed, that markings coorelate, that data recorded on the data sheets meets specifications, and the units received are the units ordered, were correctly packed, and have no apparent damage. Insure that units will fit the mounting blocks and connector.

2. Determine which units have a header card installed. Units that have a header card are to be left intact. Also units that have a header card will not and cannot have the self-test check performed.

ELECTRICAL CHARACTERISTICS:

Measure insulation resistance at 50 VDC with the 1864 megohmmeter from each pin to the case. The minimum reading should be 100 megohms.

INCOMING INSPECTION:

NOTE: Record all readings to 4 decimal places except for the frequency response which is recorded to three decimal places.

1. Connect the "Q-FLEX" test box to:
   a. The H.P.6228B Pwr.Sup. via cable marked "J1" as per

PRELIMINARY

figure #1.

b. A Decade Resistance Box to the "LOAD RESISTOR" Jack and adjust for 1000 ohms at the "OUTPUT" Jack using the H.P. 3456A DVM.

c. A current meter to the "CURRENT I1" Jack.

d. A thermal RMS meter to the "OUTPUT" Jack.

NOTE:

a. All wiring to be used is to be two conductor shielded.

b. Shields, guards and grounds as per figure #1.

2. Insure that the "I1" switch is in the down position and that the "BIAS" switch is in the center position.

3. Select the appropriate hookup cable depending on whether or not the unit has a header card installed.

4. Connect the "P2" connector to the "J2" connector of the "Q-FLEX" test box.

5. Mount the accelerometer on the MB-116-15b mounting block and connect the transducer to the "P2" cable.

6. With the transducer on the level surface in the +1g position (connector up), apply power. Allow the transducer to warm up at least 10 minutes. The excitation will be set to +&- 15VDC prior to the connection of the transducer.

7. Position switch "I1" to up position.

8. Read and record the transducer current drain in the +1g, 0g and -1g positions on the 8030A. Position switch "I1" to the down position before proceeding.

NOTE: If unit has a header card installed then the next test can not be done.

9. Perform the self-test by depressing in turn the + and - SELF-TEST buttons on the test box. Depressing the + button should produce a negative change of at least 5 volts. Depressing the - button should produce a positive change of at least 5 volts. An inconsistant reading indicates an incorrect hookup or damaged transducer. A typical reading for a good transducer is +/- 12 volts.

9. Test the mounting orientation by rocking the mounting block slightly. Maximum +output indicates the +1g position and must be attained with the block sitting on the level surface.

10. Record the transducer output in the +1g, 0g and -1g positions.

11. Place the transducer in the -1g position and record the output. In turn, record the output for the 0g and +1g positions and return to 0g. This documents the hysteresis error. The +1g and -1g readings should be equal +/-0.005 volts.

12. Test the repeatibility of the transducer by removing power for

2 seconds. Turn power on and record the initial output voltage. The difference in output voltage between that initial output voltage at turn-on and the previous output voltage is the repeatibility error voltage. The reading should be equal to the previous output voltage +/-0.015 volts.

13. Perform the noise test by placing the transducer in a foam-lined insulating box in a quiet atmosphere and recording the output noise voltage. Plug the 8506A voltmeter, in AC mode, into the "OUTPUT" jack on the "Q-FLEX" test box and record the broadband noise level output voltage. This level should be less than 15 mV.

14. Connect the "OUTPUT" jack to the input of the Wavetek filter, and connect the output of the Wavetek filter to the 8506A voltmeter, in the AC mode and measure the noise level from the transducer. It should not exceed 4Mv AC. The Wavetek filter should be set up for "50 HERTZ CUTOFF FREQUENCY", "Odb GAIN, "FLAT AMPL." and "LOW PASS". Use either filter 1 or 2.

PRELIMINARY

15. Run BASIC program QFLEX1.BAS and enter requested data to produce the calculated parameters for entry on the INCOMING INSPECTION Form 01300I-FRM. If the program is not available, perform the following calculations manually and record the result.

16. Calculate and record transducer sensitivity (scale factor in V/g) by numerically adding the +1g and -1g output voltages and dividing by

17. Calculate and record zero output voltage by numerically subtracting the -1g reading from the +1g and dividing by 2 times the sensitivity.

18. Calculate and record the current scale factor (in mA-per-g) by dividing the sensitivity (scale factor in V/g) by the load resistance in Kohms.

19. Calculate and record the bias voltage by algebraically subtracting the sensitivity (scale factor in V/g) from the +1g reading.

20. Divide this bias voltage by the sensitivity (scale factor in V/g) to obtain bias-in-g's. Multiply bias-in-g's by 1000 and record in mg's.

FREQUENCY RESPONSE TEST

1. Connect the "Q-FLEX" test box as per the preceeding instructions for the DC tests.

2. Plug the second 8506A into the CHAN. 3 OUTPUT jacks for the 28350 system. Set Channel 3 to 1000 mV/g. Mount the 28350 standard accelerometer and the transducer on the shaker. Plug the 5103 oscilloscope leads into the CHAN. 3 OUTPUT jacks and the test box "OUTPUT" jacks. Connect a ground lead from the 28350 system to the oscilloscope and screw down the grounding sleeve on the standard accelerometer.

NOTE: Record all readings to 3 decimal places.

5. In steps of 15/35/50/100/200/300/400/500, shake the standard

accelerometer for a 7H350 system output of 1.000 volt RMS (1.414 PKG). Record the QA1300 output as SHAKER RMS. Observe the accelerometer waveforms on the oscilloscope for distortion.

NATURAL FREQUENCY TEST

1. Replace the 5B10N TIME BASE module in the oscilloscope with the Channel 1 5A20N DIFFERENTIAL AMPLIFIER module.

2. The lissajous pattern for zero Hz is a left-diagonal line. increase the frequency of the test oscillator until the lissajous pattern is a circle. Record this 90-degree PHASE-SHIFT frequency.

2 Attachments:

1. QFLEX1.BAS program listing
2. Form Q1300I.FRM

PRELIMINARY

Approved: ____________

DEPT. 1262 SUNDSTRAND QA1400 SERVO ACCELEROMETER
FIELD CALIBRATION PROCEDURE
7 DEC 82

The following test equipment or equivalent, in current calibration, is required for this calibration:

WAVETEK 183 Frequency Generator
TEK 5103N Oscilloscope
    5A20N Differential Amplifier (2)
    5B10N Time Base/Amplifier
Fluke 8860A Digital Voltmeter (2)
ENCO Surface Plate (Grade B)
EG&G .1g/.2g/.5g Sine Plates
CHALLENGE LH-101 Angle Blocks (2)
MB Elect. MP-50 Shaker System
ENDEVCO SC-116-215 'g' Monitor
ENDEVCO 28350 Vibration Monitoring System
GR 1433G Decade Resistor
EG&G QA1300 Test Box
EG&G QA1400 Mounting Adapter
STARRETT 3-way 12-inch Spirit Level
Field Calibration Form Q1400C.FRM

APPLICABILITY

This procedure is applicable to all QA1400-XXX servo accelerometers.

STATIC GRAVITY TEST

NOTE: Record all readings to 4 decimal places.

1. Mount the QA1400 in the mounting adapter. Plug the 8860A into the OUTPUT Jacks on the QA1300 Test Box. Remove the 1000 ohm resistor from the LOAD Jacks of the test box. Adjust the 1433G Decade Box (Rload) to 1000 ohms.

2. Connect the test equipment to the Test Box as follows:

TEST EQUIPMENT	FUNCTIONING AS	JACKS
SC-116-2M 'g' Monitor	Excitation Supply	SENSOR
1433G Decade Box	Load Resistor	LOAD
8860A Multimeter	Output Monitor	OUTPUT
5103N Oscilloscope	Output Monitor	OUTPUT

. The oscilloscope can be more conveniently paralleled at the DVM input plug.

3. Turn the SC-116-2M 'g' Monitor ON and place the transducer on the surface plate in the 1g (vertical) position. Adjust the 1433G decade box (Rload) for the output requested by the user in V/g. Place the transducer in the 0g position and note the output voltage. Subtract this zero offset voltage from the +g voltage and adjust the

decade box to produce the calculated value in the +1g position. Place the transducer in the -1g position and note the output voltage.

4. Add the +1g and -1g readings, disregarding the signs. The optimum adjustment of the load resistor will produce a sum of the two readings of twice the requested output. The difference between zero and each output reading should approximate the amount of zero offset. Remove the 1433G decade resistor.

5. Select a precision resistor as close as possible to the optimum and, after measuring and recording the value, install the resistor between the appropriate terminals on the connector.

6. Perform the Frequency Response test, observing the RMS output on the 8860A DMM and the peak-to-peak value on the 5103N Oscilloscope. Adjust the standard accelerometer output to 1.000 Volts RMS. Measure the frequency response at 15/35/50/100/200/300/400/500 Hz.

7. Mount the transducer in the mounting adapter and perform the DC outpu tests utilizing the surface plate, angle blocks and sine plates to generate the desired 'g' levels while observing the output on the 8860A DMM.

NATURAL FREQUENCY TEST

1. Replace the 5B10N TIME BASE module in the oscilloscope with the Channel 1 5A20N DIFFERENTIAL AMPLIFIER module.

2. The lissajous pattern for zero Hz is a left-diagonal line. Increase the frequency of the test oscillator until the lissajous pattern is a circle. Record this 90-degree PHASE-SHIFT frequency.

NOISE TEST

1. Perform the noise test by placing the transducer in the foam-lined isolation box in a quiet atmosphere and recording the output noise voltage. Plug the 8860A voltmeter, in AC mode, into the OUTPUT jacks on the test box and record the broadband noise level output voltage.

1 Attachment:

Field Calibration Form Q1400C.FRM

E.G.& G. DEPT. 1262 SERVO ACCELEROMETER FIELD CALIBRATION REPORT

MANUFACTURER: SUNDSTRAND	PART NO.: 979-1400-	SERIAL NO.:	USER:	PROGRAM:	LOCATION:
GAGE RANGE: +/- 60 g	MODEL NO.: QA1400-	IS ALL TEST EQUIPMENT TO BE USED IN-DATE? (See Test Equipment List.) YES NO			

Calibration performed using Endevco SC116-2M 'g' Monitor as +/- 15 VDC power supply only.

Local gravity: 979.58671 | Gravity correction factor: 1.00115

STATIC GRAVITY TEST		FREQ. RESPONSE @ __ g RMS		
g Level	Voltage Output	Freq. (Hz)	Volts (RMS)	V/g (peak)
0	. V	15	.	.
+0.1	. V	35	.	.
-0.1	- . V	50	.	.
+0.2	. V	100	.	.
-0.2	- . V	200	.	.
+0.5	. V	300	.	.
-0.5	- . V	400	.	.
+1	. V	500	.	.
-1	- . V	90-Degree Phase Shift @ . Hz		

Noise Test: . Volts (Broadband)

Current Scale Factor (Isf) = ________ mA/g
Load Resistance (Rl) = ______________ ohms
Calc. Sensitivity (Sc) = ____________ V/g (peak) [Sc = Isf x Rl/1000]

Technician:	Date:	Checked by:	Date:

!================^================^=================^==================!
29 NOV 82

DEPT. 1262 KISTLER MODEL 303B/T SERVO ACCELEROMETER CALIBRATION PROCEDURE

The following test equipment or equivalent, in current calibration status, is required for the calibration of these accelerometers:

S.D.C. Publication, "Model 303....Servo Accelerometers"
GR 1864 Megohmmeter
H-P 6114A or 6228B Power Supply
Fluke 8860A Digital Multimeter (2)
Fluke 8030A Digital Multimeter
TEK 5103N Oscilloscope
 5A20N Differential Amplifier (2)
 5B10N Time Base/Amplifier
GR 1433-F Resistance Decade Box
GR 1433-G Resistance Decade Box
Sundstrand 300A12 & 300A3 Adapters & 300A1 Clamp
or Endevco MB116-15C & MB116-15B
Endevco 28350 Vibration Monitor System or
Endevco 7751 or QA116 Std.
Enco Surface Plate (Grade B)
Challenge LH-101 Angle Blocks (2)
Enco Rotary Head, Manual or Newport Rotary Head Sys.
MB Elect. MP-50 Shaker System
Wavetek 183 Frequency Generator or H.P. 3325A Function Generator
Isolation Box
Kistler 303B/T Test Box
Field Calibration Report KI303C.FRM

PRELIMINARY

1. Perform a visual and a mechanical inspection.

2. Solder lead wires to appropriate terminals on the accelerometer, using care not to overheat terminals, to facilitate hook-up to the Test Box. Use 24 AWG stranded wire in colors designated below:

SIGNAL	COLOR	303B	303T	303BF	303TF
+28VDC Ex.	Red	1	1	1	1
Power Ground	Black	3	2	3	2
Signal/Hi-Z Output **	Green	2	6	2	6
Lo-Z Output **	Yellow	4	3	4	3
Signal Ground	White	5	4	5	4
Gain	Brown	6	5	6	5
+Test	Blue	--	7	--	7
-Test	-----	--	8	--	8

NOTE:

A. The recommended wire size for these transducers is 28 AWG. but larger wire can be used with proper care. Always clean the excess flux and solder from terminals to keep up insulation resistance.
** Refer to Sundstrand Data Control manual Pg.3-7 Para. 3.2.4

B. Short pins 2, 4, 8 for model 303T/TF
C. Short pins 3, 5 for model 303B/BF
D. Wire per instructions from J.Lee

PRELIMINARY

3. Measure the insulation resistanc[illegible] case and input (red) to output ([illegible] allowable resistance is 50 megohms.

4. Mount the Transducer in the Endevco MB116-15b Adapter and attach the color-coded lead wires to the Test Box terminal strip. The xducer should be in the horizontal position after mounting.

5. Adjust the 1433-G Decade Box (Rgain) to 120 Kohms. Adjust the 1433-F Decade Box (Rload) to 21 Kohms. Adjust the Power Supply to 28.00 volts DC. Turn the CURRENT knob to limit for 50 ma. Turn the Power Supply OFF after adjustment.

6. Connect the test equipment to the Test Box as follows:

TEST EQUIPMENT	FUNCTIONING AS	JACKS
Power Supply	Excitation Supply	EXCIT.
1433-F Decade Box	Load Resistor	LOAD
1433-G Decade Box	Gain Resistor	GAIN
Digital Multimeter	Output Monitor	OUTPUT
Digital Multimeter	Current Monitor	CURRENT
Oscilloscope	Output Monitor	OUTPUT

The Oscilloscope can be more conveniently paralleled at the Digital Multimeter input connector.

NOTE:
To change from high to low impediance output simply move the jumper to the correct treminal ,either 4 or 9, on the Kistler 303 B/T breakout box. All other connections remain the same for either xducer.

7. Connect the shield from the single pair shielded wire from pwr. suppl Gnd. to guard on the DMM. The guard should be set for open to low.

8. Turn the Power Supply ON and place the Transducer on the Surface Pla in the 1g (vertical) position. Measure the current at +1g, 0g and -1 and record. Unplug the current plug from the Test Box. Adjust the 1433-F Decade Box (Rload) for the output specified by the user in mV/ or V/g as appropriate. Reduce the gain at lower mV/g settings to avo Transducer oscillation. Place the Transducer in the 0g position and note the output voltage. Subtract this zero offset voltage from the specified output and adjust the Decade Box to produce the calculated value in the +1g position. Place the Transducer in the -1g position note the output voltage.

9. Add the +1g and -1g readings, disregarding the signs. The optimum adjustment of the load resistor will produce a sum of the two readings of twice the specified output. The difference between zero and each output reading should approximate the amount of zero offset as per figure #1.

Figure #1

PRELIMINARY

Model #	Zero G Tol.
303 B	+- [illegible]
303 T	+- 0.[illegible]50 g
303 BF	+- 0.300 g
303 TF	+- 0.500 g

Zero in mv = the zero G Tol. times the sensitivity required.

NOTE:

If the user has more than one sensitivity selected per unit then you must do step 10 for one sensitivity and then install the resistor and repeat step 10 for the second sensitivity. These resistors are not to be mounted on the xducer. They are to supplied to the user. They are to be found by putting the second value in parallel with the first.

NOTE:

Check with the user about which order the resistors are to be selected.

10. Turn off power to unit.

11. Select a precision resistor as close as possible to the optimum. After measuring and recording the value, install the load resistor between the appropriate terminals below the eyelets. Unplug the Decade Box from the Test Box LOAD jacks.

12. Place the Transducer on the shake table, adjust the frequency Generator to 20 Hz and the 'mV/g' switch on the 28350 System Channel 3 amplifier to '1000 mV/g'. Increase the amplitude of generator to 'G' level=1/2Pk of D.C. max. output of the accelerometer measured on the Digital Multimeter. Note the output of the test test accelerometer. Decrease the amplitude of the input signal and set the frequency to 400 Hz. Increase the amplitude to 'G' level =1/2 Pk of D.C. max. output and note the output of the test transducer. If the readings are not the same, adjust the 1433-G Decade Box until the test Transducer outputs are the same at 20 and 400 Hz..

NOTE:

A. When shaking these units, shake to either 1/2 of full scale range or 5g Pk, whichever is appropriate.

B. When installing resistors use 1%, 1/8 W, [illegible] ppm/oC or equivalent.

PRELIMINARY

13. Turn off power to unit.

14. Select, record and install a precision resistor, as determined in th previous step, between the appropriate terminals. Unplug the Decade from the Test Box Gain Jacks.

15. Place the transducer in the Isolation box and measure the RMS noise level. Verify that the noise level does not exceed the the maximum listed in figure #2.

NOTE:

If unit has excessive noise level, check for external sources suc as the Riehle Load Test Machine running, before you reject the unit.

Figure #2

This data applies to models 303B, 303BF, 303T, 303TF
Noise: 1MHz to 8 MHz (less than) 5mv, rms
below 1 MHz (less than) 1mv, rms
DC to 1 Hz (resolution) 5 micro-g

16. Perform the Frequency Response test, observing the RMS output on the Digital Multimeter and looking for distortion on the Oscilloscope. Adjust the Standard Accelerometer output to the appropriate level fo the requested sensitivity at 1000 mV/g range:

	Sensitivity	Level
10G FS	0.5 V/g	5.00g RMS (5.0 V x correction factor for Standard)
5G FS	1.0 V/g	2.50g RMS
2G FS	2.5 V/g	1.00g RMS
1G FS	5.0 V/g	0.50g RMS

NOTE:
These are not the only sensitivities that can be selected by the user. The correction factor stated above still applies.

- Measure the frequency response at 15/20/30/50/70/100 Hz.

17. Perform the 90 degree phase shift check by removing power to the oscilloscope (O-scope). Then remove the Time Base/Amp.plug in from t O-scope and replace with one of the remaining Differential Amp. plug in's. Turn the O-scope power on. At this point you should get a lissajous wave shape. Making sure that you don't physically over range the unit, increase the frequency until you see the phase shift (90 degrees typically a circle) Record the frecuency on the data sheet.

18. Mount the Transducer in the -15b adarter and rerform the DC outrut tests utilizing the Rotary Head to generate the desired 's' levels. Mount the Transducer on the Rotary Head with the terminals facing the 180-degree rosition. Set the index on the Rotary Head to the 90-degree mark. This rlaces the Transducer in the 0s rosition. Rotate the Transducer urward to:

84.16 deg. (0.1g)
78.28 deg. (0.2g)
60.00 deg. (0.5g)
0.00 deg. (1.0g)

PRELIMINARY

recording Transducer outrut at each rosition. Return to 90 deg. (0s
Rotate the Transducer downward to:

95.44 deg. (-0.1g)
101.32 deg. (-0.2g)
120.00 deg. (-0.5g)
180.00 deg. (-1.0g)

recording the Transducer outrut at each rosition.

19. Remove the transducer from the mounting fixture.

1 Attachment:

Field Calibration Rerort KI303C.FRM

12-JUN

E.G.& G. DEPT. 1262 SERVO ACCELEROMETER FIELD CALIBRATION REPORT

MANUFACTURER:	MODEL NO.:	SERIAL NO.:	USER:	PROGRAM:	LOCATION:
SUNDSTRAND	303______		SANDIA		

GAGE RANGE:	CAL. RANGE	IS ALL TEST EQUIPMENT TO BE USED IN-DATE?
+/- 40 g	_______V/g	(See Test Equipment List.) YES NO

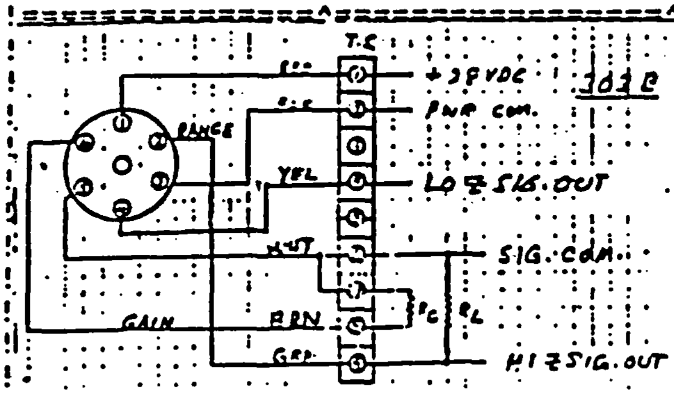
Load resistance:#1	Load resistance:#2	Gain resistor:	Excitation:
. Kohms	. Kohms	. Kohms	28.000 VDC

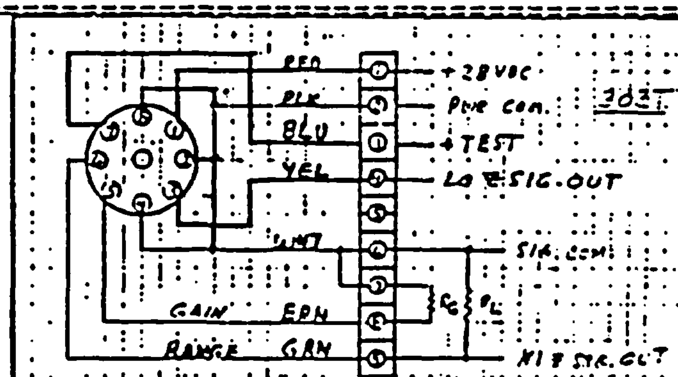
Insulation Resistance @ 50 volts ! all pins to case: X10 Ohms

Insulation Resistance @ 50 volts ! Input to Output red/grn: X10 Ohms

Local gravity: 979.58671 ! Gravity correction factor: 1.00115

STATIC GRAVITY TEST (Lo-Z Out)		FREQ. RESPONSE @ __ g RMS (Lo-Z)		
g Level	Voltage Output	Freq. (Hz)	Volts (RMS)	V/g (peak)
0	. V	15	.	.
+0.1	. V	20	.	.
-0.1	- . V	30	.	.
+0.2	. V	50	.	.
-0.2	- . V	70	.	.
+0.5	. V	100	.	.
-0.5	- . V	Noise level: . V (Broadband)		
+1	. V	90-degree Phase Shift @ Hz		
-1	- . V			





Curr. Readings:0.040 Amp. Max. +1g= . mA 0g= . mA -1g= . mA

Technician:	Date:	Checked by:	Date:

ACCELEROMETER TEST EQUIPMENT LIST

AS OF: 02-SEP-86

Pase __ of _

Equipment used to calibrate transducers between 02-SEP-86 and 02-SEP-86.

USE	NOMENCLATURE	MFR	MODEL	SERIAL #	S.C.L.#	CAL. DU
[ ]	ACCELEROMETER, P.E.	KISTL	808A	5024	EG0045	31-MAR-
[ ]	ACCELEROMETER, P.E.	KISTL	8002	C17448	03072	31-JUL-
[✓]	ACCELEROMETER, STD.	ENDEV	2270	BB42	EG0026	19-DEC-
[ ]	ACCELEROMETER, STD.	ENDEV	7751-500	AD81	03090	23-DEC-
[ ]	AMPLIFIER, CARRIER	NATEL	2088-1MR	38000		N.P.C.
[ ]	AMPLIFIER, CARRIER	NATEL	2088-LD	2089-04-4		N.P.C.
[ ]	BIN, CARRIER SYSTEM	NATEL	2088	35096		N.P.C.
[✓]	BLOCK, ANGLE	CHLGE	LH-101	1	LV405	19-JAN-
[✓]	BLOCK, ANGLE	CHLGE	LH-101	2	LV406	19-JAN-
[ ]	CALIPER, DIAL, 7.5 IN.	MITUT	505-705	RN-81	LV421	05-FEB-
[ ]	CALIPER, DIAL, 12 IN.	MITUT	505-628	RN-82	LV422	05-FEB-
[ ]	COMPRESSOR, SIGNAL	TRIG	801B	229	03486	19-MAR-
[ ]	CONDITIONER, SIGNAL	ECTRON	776CM-2-3	-----		N.P.C.
[ ]	CONDITIONER, SIGNAL	ECTRON	776CM-2-3	-----		N.P.C.
[ ]	CONDITIONER, SIGNAL	EG&G	L-SC-2	261		N.P.C.
[ ]	CONDITIONER, SIGNAL	EG&G	L-SC-2	265		N.P.C.
[ ]	CONDITIONER, SIGNAL	EG&G	L-SC-2	266		N.P.C.
[ ]	CONDITIONER, SIGNAL	EG&G	L-SC-2	271		N.P.C.
[ ]	COUNTER, FREQUENCY	H-P	5345A	1932A05899	02763	16-JAN-
[ ]	COUNTER, FREQUENCY	FLUKE	7220A	2770018	05377	30-JUN-
[ ]	COUNTER, FREQUENCY	FLUKE	7220A	2770037	02617	19-DEC-
[ ]	COUPLER, GAGE	EG&G	W-TS-11	1352		N.P.C.
[✓]	DECADE, RESISTOR	G.R.	1433-F	7710	03370	06-MAY-
[ ]	DECADE, RESISTOR	G.R.	1433-F	15625	00774	09-SEP-
[ ]	DECADE, RESISTOR	G.R.	1433-G	990	01325	01-OCT-
[ ]	DECADE, RESISTOR, PROGRAM	TIME	9811	246A3	03848	14-APR-
[✓]	FILTER, DUAL HI/LO	WAVTK	442	1286105	05804	11-AUG-
[ ]	GENERATOR, FREQUENCY	WAVTK	183	C5000402	03322	21-FEB-
[ ]	GENERATOR, FREQUENCY	WAVTK	183	C5100087	01392	02-OCT-
[✓]	GENERATOR, FUNCTION	H-P	3325A	1748A08271	05378	02-JUL-
[ ]	GENERATOR, SWEEP	TRIG	701B	215	03485	19-MAR-
[ ]	INTERFACE, IEEE, FILTER	PREFL	602-____	-----		N.P.C.
[✓]	LEVEL, SPIRIT	STARR	12-INCH	3-WAY		N.P.C.
[ ]	MAIN FRAME, FILTER	PREFL	602-R	10103		N.P.C.
[ ]	MEGOHMMETER	G.R.	1864	4368	01622	04-MAY-
[✓]	MEGOHMMETER	G.R.	1864	5652	01326	01-OCT-
[ ]	METER, IMPEDANCE	E.S.I.	251	549018	00245	13-FEB-
[ ]	METER, LCR	H-P	4262A	2022J04141	03880	12-APR-
[ ]	MONITOR, VIBRATION	TRIG	610B	189	03484	19-MAR-
[✓]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2675070	00144	10-JAN-
[ ]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2735040	01393	24-MAR-
[✓]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2675053	02490	04-SEP-
[ ]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2735042	00247	22-OCT-
[ ]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2540051	EM1326	09-JUN-
[✓]	MULTIMETER, THERMAL RMS	FLUKE	8506A	3225008	02966	__-___-
[ ]	OSCILLATOR, CARRIER	NATEL	2088-2RN	35095		N.P.C.

[✓]	OSCILLOSCOPE, RACK-MOUNT	TEK	R5113	B116797	00996	19-[illegible]
[ ]	OSCILLOSCOPE, DIGITAL #1	NICOLET	4094-2	280167	02923	22-JAN-
[ ]	OSCILLOSCOPE, DIGITAL #2	NICOLET	4094-2	84B0035B	03990	11-AUG-
[ ]	PLATE, SURFACE	ENCO	18X24	1474	LV416	08-MAR-
[✓]	PLUG-IN, DIFF. AMP.	TEK	5A21N	B084882	00997	19-SEP-
[✓]	PLUG-IN, DIFF. AMP.	TEK	5A21N	B084892	00998	19-SEP-
[✓]	PLUG-IN, TIME BASE	TEK	5B10N	B105654	00999	19-SEP-
[✓]	ROTARY HEAD, MANUAL	ENCO	73010	2100	LV417	17-SEP-
[ ]	SCALE, DIGITAL, 5 KILOGRAM	COLE	1043-10	176	LV2029	14-SEP-
[ ]	SYSTEM, SHAKER	ACOUS	113	180		N.P.C.
[✓]	SYSTEM, SHAKER	M-B	MP-50	SCL0034		N.P.C.
[ ]	SYSTEM, SHAKER	V.T.S.	--------	--------		N.P.C.
[✓]	SYSTEM, VIBRATION CALIB.	ENDEV	28350-F	SCLEG0026	EG0026	19-DEC-
[ ]	TABLE, SPIN	GNSCO	A-903	52		N.P.C.
[✓]	TRANSLATOR, IEEE	FLUKE	1120A	2800018		N.P.C.
[ ]	VOLTAGE SOURCE, D.C.	SYSTR	M107	4037-0	00887	14-APR-
[ ]	VOLTAGE SOURCE, D.C.	SYSTR	M107	6046-0	01000	05-DEC-
[ ]	VOLTAGE SOURCE, D.C.	SYSTR	M107	8004-4	00775	23-NOV-
[ ]	VOLTMETER, DIGITAL	H-P	3456A	2201A0832302408		03-DEC-
[✓]	VOLTMETER, DIGITAL	H-P	3456A	7201A0832900776		03-DEC-
[✓]	VOLTMETER, DIGITAL	H-P	3456A	2512A1485201694		22-NOV-
[✓]	WRENCH, TORQUE, 0- 25 IN/#	STURT	F-25-1	TT-57	LV414	27-DEC-
[ ]	WRENCH, TORQUE, 0-100 IN/#	STURT	DM-110	8106724	LV430	27-DEC-
[ ]	WRENCH, TORQUE, 0-100 IN/#	STURT	DM-110	1262-C2	LV431	27-DEC-
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CHANNEL	GAGE S/N	TECHNICIAN	CAL. DATE	CHECKED BY:
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SERVO ACCELEROMETER TEST EQUIPMENT LIST

AS OF: 25-JUN-85 Page __ of __

Equipment used to calibrate transducers between 20-JUN-85 and 25-JUN-85.

USE	NOMENCLATURE	MFR	MODEL	SERIAL #	S.C.L.#	CAL. DUE
[ ]	BLOCK, ANGLE	CHLGE	LH-101	1	MECH.	31-JAN-87
[ ]	BLOCK, ANGLE	CHLGE	LH-101	2	MECH.	31-JAN-87
[ ]	COUNTER, FREQUENCY	FLUKE	7220A	2770018	EC0460	10-JUN-86
[ ]	COUNTER, FREQUENCY	FLUKE	7220A	2770037	EC0461	13-DEC-85
[ ]	COUNTER, FREQUENCY	H-P	5335A	2202A02528	EC0517	24-APR-86
[X]	DECADE, RESISTOR	GR	1433-F	7710	EI0690	11-FEB-86
[X]	DECADE, RESISTOR	GR	1433-F	15625	EI0515	04-SEP-85
[ ]	DECADE, RESISTOR	GR	1433-G	990	EI0542	25-SEP-85
[ ]	GENERATOR, FREQUENCY	WAVTK	183	C5000402	ES1057	22-AUG-85
[ ]	GENERATOR, FREQUENCY	WAVTK	183	C5100087	ES1058	04-OCT-85
[X]	GENERATOR, FUNCTION	H-P	3325A	1748A08271	ES1108	17-JUN-86
[X]	LEVEL, SPIRIT	STARR	12-INCH	3-WAY		N.P.C.R.
[X]	MEGOHMMETER	GR	1864	1842A	EM0775	26-SEP-85
[ ]	MEGOHMMETER	GR	1864	4368	EM0653	21-OCT-85
[X]	MONITOR, G-LEVEL	ENDEV	SC116-2M	AB82	EG0031	17-SEP-85
[ ]	MULTIMETER, DIGITAL	FLUKE	8030A	940150	EM1080	28-NOV-85
[X]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2675070	EM1431	04-JUL-85
[ ]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2735040	EM1430	01-OCT-85
[X]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2675053	EM1429	28-NOV-85
[ ]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2735042	EM1434	19-JUL-85
[ ]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2540051	EM1326	31-MAY-86
[X]	OSCILLOSCOPE, RACK-MOUNT	TEK	5113	B116797	E02991	17-SEP-85
[ ]	OSCILLOSCOPE, RACK-MOUNT	TEK	5113	B116798	E02965	08-APR-86
[ ]	PLATE, SINE	EG&G	RN79 .1G	1	MECH.	13-JUN-88
[ ]	PLATE, SINE	EG&G	RN79 .2G	2	MECH.	13-JUN-88
[ ]	PLATE, SINE	EG&G	RN79 .5G	3	MECH.	13-JUN-88
[X]	PLATE, SURFACE	ENCO	GRADE B	1474	METROLAB	08-MAR-86
[ ]	PLUG-IN, DIFF. AMP.	TEK	5A20N	B046951	E01132	15-AUG-85
[ ]	PLUG-IN, DIFF. AMP.	TEK	5A20N	B046959	E01133	15-AUG-85
[ ]	PLUG-IN, DIFF. AMP.	TEK	5A21N	B074856	A00096	08-APR-86
[ ]	PLUG-IN, DIFF. AMP.	TEK	5A21N	B084881	A00100	08-APR-86
[X]	PLUG-IN, DIFF. AMP.	TEK	5A21N	B084882	EA0099	17-SEP-85
[X]	PLUG-IN, DIFF. AMP.	TEK	5A21N	B084892	EA0105	17-SEP-85
[ ]	PLUG-IN, TIME BASE	TEK	5B10N	B074245	E01131	15-AUG-85
[X]	PLUG-IN, TIME BASE	TEK	5B10N	B105654	E02886	17-SEP-85
[ ]	PLUG-IN, TIME BASE	TEK	5B10N	B105799	E02885	08-APR-86
[ ]	POWER SUPPLY, BIPOLAR	H-P	6826A	2439A01002	EP1089	11-JUN-86
[ ]	POWER SUPPLY, BIPOLAR	H-P	6826A	2439A01003	EP1090	11-JUN-86
[ ]	POWER SUPPLY, D.C., 0-40	H-P	6114A	1928A02206		N.P.C.R.
[ ]	POWER SUPPLY, D.C., 0-40	H-P	6114A	1928A02196		N.P.C.R.
[ ]	POWER SUPPLY, D.C., 0-40	H-P	6114A	2110A02534		N.P.C.R.
[ ]	POWER SUPPLY, D.C., 0-40	H-P	6114A	2110A02538		N.P.C.R.
[ ]	POWER SUPPLY, D.C., 0-50	H-P	6218A	8M1447		N.P.C.R.
[ ]	POWER SUPPLY, D.C., DUAL	EG&G	01-01-82	1		N.P.C.R.
[X]	ROTARY HEAD, MANUAL	ENCO	73010	2100	METROLAB	08-MAR-86
[ ]	SYSTEM, SHAKER	ACOUS	113	180		N.P.C.R.

[X]	SYSTEM, SHAKER	M-B	MP-50	SCL0034		N.P.
[ ]	SYSTEM, SHAKER	VTS				N.P.
[X]	SYSTEM, VIBRATION CALIB.	ENDEV	2B350-F	SCLEG0026	EG0026	25-FEB-86
[X]	System, Monitor	ENDEV	SC 1143M	AB 82		17 SEP 85
[ ]						
[ ]						
[ ]						
[ ]						

CHANNEL	GAGE S/N	TECHNICIAN	CAL. DATE	CHECKED BY:
	209	B10	21 Jun 85	
	215			
	230			
	5802			
	205	B10	04 Jun 85	
	208			
	322			

E.G.& G. DEPT. 1262 SERVO ACCELEROMETER FIELD CALIBRATION REPORT

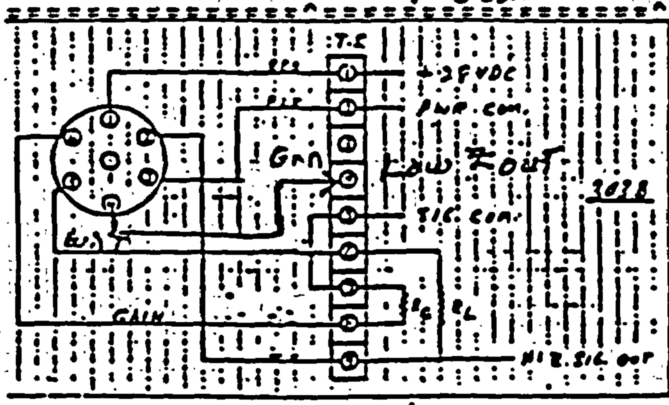
MANUFACTURER:	PART NO.:	SERIAL NO.:	USER:	PROGRAM:	LOCATION:
SUNDSTRAND	303 B	5802	SANDIA		

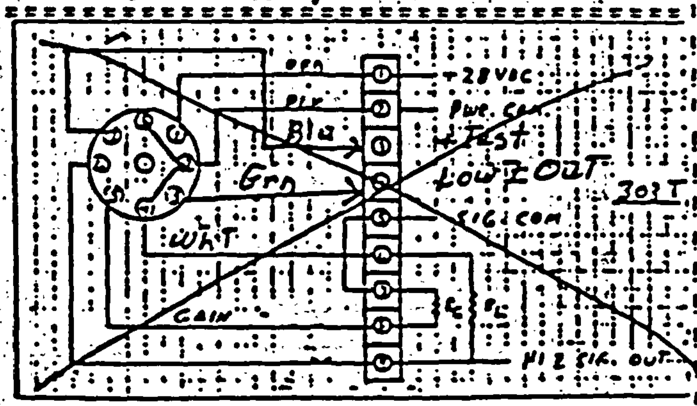
GAGE RANGE:	CAL. RANGE	IS ALL TEST EQUIPMENT TO BE USED IN-DATE? (See Test Equipment List.)
+/- 40 g	5 V/g	YES NO

Insul. res. @ 50 VDC:	Load resistance:	Gain resisitor:	Excitation:
1X 10[7] ohms	20.030 Kohms	113.540 Kohms	28.000 VDC

Local gravity: 979.58671	Gravity correction factor: 1.00115

STATIC GRAVITY TEST g Level	Voltage Output	FREQ. RESPONSE @ 1 g RMS Freq. (Hz)	Volts (RMS)	V/g (peak)
0	0.4003 V	15	5.124	.
+0.1	0.8986 V	20	5.118	.
-0.1	- 0.09710 V	30	5.117	.
+0.2	1.3953 V	50	5.111	.
-0.2	- 0.5936 V	70	5.113	.
+0.5	2.8898 V	100	5.117	.
-0.5	- 2.0880 V	Noise level: 0.005 V (Broadband)		
+1	5.3763 V	90-degree Phase Shift @ 720 Hz		
-1	- 4.5821 V	Current 30,450 ma		





Pins 1 & 2 315 X 10[6] Ω at 50 VDC
9 X 10[6] Ω at 28 VDC

ZERO out of SPEC
Neg Sluggish (Drifts To Reading)

Technician:	Date:	Checked by:	Date
BH	21 JUN 85	[signature]	6/28/85

3 DEC 82

E.G.& G. DEPT. 1262 SERVO ACCELEROMETER FIELD CALIBRATION REPORT

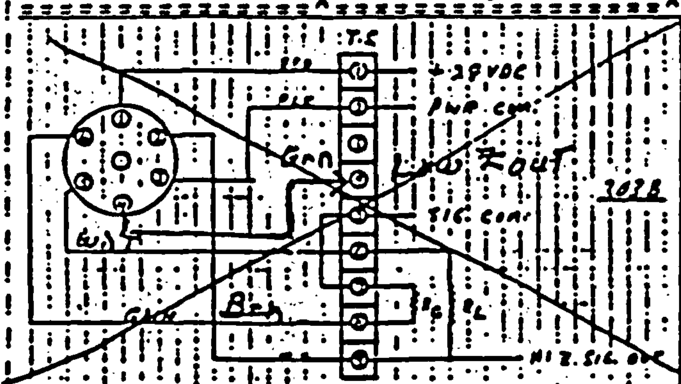
MANUFACTURER:	PART NO.:	SERIAL NO.:	USER:	PROGRAM:	LOCATION:
SUNDSTRAND	303 T III	209	SANDIA		

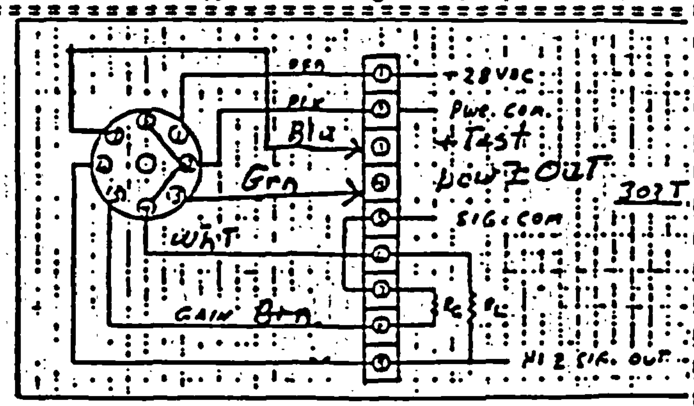
GAGE RANGE:	CAL. RANGE	IS ALL TEST EQUIPMENT TO BE USED IN-DATE? (See Test Equipment List.)
+/- 40 g	5 V/g	YES NO

Insul. res. @ 50 VDC:	Load resistance:	Gain resisitor:	Excitation:
1X 10^9 ohms	20.024 Kohms	100.079 Kohms	28.000 VDC

Local gravity: 979.58671 ! Gravity correction factor: 1.00115

STATIC GRAVITY TEST		FREQ. RESPONSE @ 1 g RMS		
g Level	Voltage Output	Freq. (Hz)	Volts (RMS)	V/g (peak)
0	0.1735 V	15	5.131	.
+0.1	0.6710 V	20	5.125	.
-0.1	- 0.3244 V	30	5.123	.
+0.2	1.1706 V	50	5.110	.
-0.2	- 0.8237 V	70	5.002	.
+0.5	2.6679 V	100	5.092	.
-0.5	- 2.3208 V	Noise level: 0.0033 V (Broadband)		
+1	5.1594 V	90-degree Phase Shift @ 760 Hz		
-1	- 4.8201 V	Current 24.860 ma		





Pin 1, 2, 4, 8 1.5x10⁶ Ω at 50VDC
4 x 10⁶ Ω " " 28VDC

Technician:	Date:	Checked by:	Date:
BLO	21 JUN 85	[signature]	6/28/85

3 DEC 82

E.G.& G. DEPT. 1262 SERVO ACCELEROMETER FIELD CALIBRATION REPORT

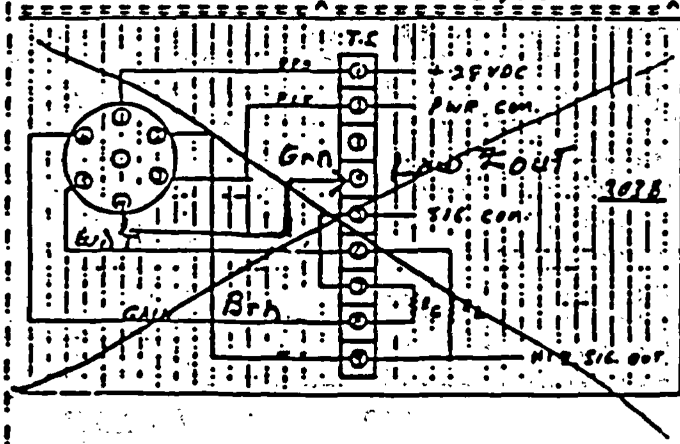
MANUFACTURER:	PART NO.:	SERIAL NO.:	USER:	PROGRAM:	LOCATION:
SUNDSTRAND	303_TT____	215	SANDIA		

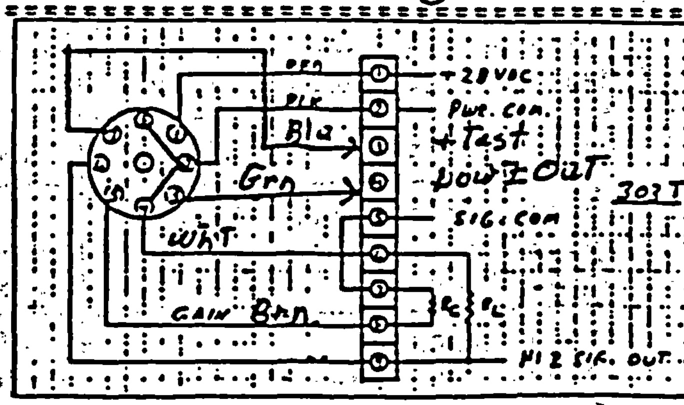
GAGE RANGE:	CAL. RANGE	IS ALL TEST EQUIPMENT TO BE USED IN-DATE? (See Test Equipment List.)
+/- 40 g	_____5_V/g	YES NO

Insul. res. @ 50 VDC:	Load resistance:	Gain resisitor:	Excitation:
5 x 10[11] ohms	20.023 Kohms	259.420 Kohms	28.000 VDC

Local gravity: 979.58671	Gravity correction factor: 1.00115

STATIC GRAVITY TEST		FREQ. RESPONSE @ 1 g RMS		
g Level	Voltage Output	Freq. (Hz)	Volts (RMS)	V/g (peak)
0	0.6370 V	15	5.145	.
+0.1	1.1378 V	20	5.141	.
-0.1	+ 0.1361 V	30	5.139	.
+0.2	1.6370 V	50	5.133	.
-0.2	- 0.3652 V	70	5.133	.
+0.5	3.1414 V	100	5.129	.
-0.5	- 1.8670 V	Noise level: 0.0045 V (Broadband)		
+1	5.6437 V	90-degree Phase Shift @ 720 Hz		
-1	- 4.3710 V	Current 28.923		





Technician:	Date:	Checked by:	Date:
BJO	21 JUN 85	[signature]	6/21/85

3 DEC 82

E.G.& G. DEPT. 1262 SERVO ACCELEROMETER INCOMING INSPECTION REPORT

MANUFACTURER:	PART NO.:	SERIAL NO.:	USER:	PROGRAM:	LOCATION:
SUNDSTRAND	979-1400-001	205	SANDIA		

GAGE RANGE:	MODEL NO.:	IS ALL TEST EQUIPMENT TO BE USED IN-DATE?
+/- ____ g	QA1400-AA01-8	(See Test Equipment List.) YES NO

Inspection performed using Endevco SC116-2M 'g' Monitor as +/- 15 VDC power supply only except for self-test voltage source and 50 Hz filter used in the filtered-noise test.

Conn.	Insulation resistance:	Specification:
All-case	2 x 10^{10} ohms	Resistance > 50 megohms at 50 V.

MEASURED:	TEST RESULTS	(Rload = 1000 ohms)		
Current Drain	+1g -0.692 mA	0g 0.687 mA	-1g 2.070 mA	
Self-Test	(+)- . V	(-)+ . V		
Output	+1g 1.2482 V	0g -0.0002 V	-1g -1.2513 V	
Hysteresis	-1g -1.2513 V	0g -0.0008 V	+1g 1.2481 V	0g -0.0001 V
Repeatibility	+1g 1.2481 V	+1g 1.2481 V	Error: 0.0000 Volts	
Noise Test:	0.0021 Volts (Broadband)			
	0.0014 Volts (50 Hz filter)			

CALCULATED:	RESULTS	FREQ. RESPONSE @ 1 g RMS (No Signal Conditioning) Freq. (Hz)	Volts (RMS)
Sensitivity in Volts-per-g	1.2498 V/g	15	1.289
Zero g Output	-0.0012 V	35	1.294
Current Scale Factor (Isf)	1.2498 mA/g	50	1.294
Bias Voltage	-0.0016 V	100	1.311
Bias in g/1000	-1.2402 mg	200	1.306
		300	1.265
		400	1.268
		500	1.324
		90-Degree Phase Shift measured at 2300 Hz	

Technician:	Date:	Checked by:	Date:
BTO	24 JUN 85	[signature]	6/28/85

29 NOV 82

E.G.& G. DEPT. 1262 SERVO ACCELEROMETER FIELD CALIBRATION REPORT

MANUFACTURER:	PART NO.:	SERIAL NO.:	USER:	PROGRAM:	LOCATION:
SUNDSTRAND	979-1400-01	205	SANDIA		

GAGE RANGE:	MODEL NO.:	IS ALL TEST EQUIPMENT TO BE USED IN-DATE?
+/- 60 g	QA1400-AA01-b	(See Test Equipment List.) YES NO

Calibration performed using Endevco SC116-2M 'g' Monitor as +/- 15 VDC power supply only.

Local gravity: 979.58671 | Gravity correction factor: 1.00115

STATIC GRAVITY TEST		FREQ. RESPONSE @0.25 g RMS		
g Level @.2V/g	Voltage Output 5V/g	Freq. (Hz)	Volts (RMS)	V/g (peak)
0 0.0004	0.01550V	15	1.289	.
+0.1 0.0200	0.5169V (5169)	35	1.290	.
-0.1 -0.0188	- 0.4858V	50	1.298	.
+0.2 0.0394	1.0176V	100	1.277	.
-0.2 -0.0382	- 0.9879V	200	1.183	.
+0.5 0.0976	2.5206V	300	1.035	.
-0.5 -0.0966	- 2.4940V	400	0.9385	.
+1 0.1939	5.0093V	500	0.9960	.
-1 - 0.1944	- 5.0215V	90-Degree Phase Shift @ 1490.00 Hz		

Noise Test: 0.0003 Volts (Broadband)

Current Scale Factor (Isf) = 1.2498 mA/g 0.2V/g Resistor = 161.7Ω
Load Resistance (Rl) = 4024 ohms
Calc. Sensitivity (Sc) = 5.0292 V/g (peak) [Sc = Isf x Rl/1000]

Technician:	Date:	Checked by:	Date:
BT	24 Jun 85	[signature]	6/28/85

E.G.& G. DEPT. 1262 SERVO ACCELEROMETER INCOMING INSPECTION REPORT

MANUFACTURER:	PART NO.:	SERIAL NO.:	USER:	PROGRAM:	LOCATION:
SUNDSTRAND	979-1200-001	107	SANDIA		

GAGE RANGE:	MODEL NO.:	IS ALL TEST EQUIPMENT TO BE USED IN-DATE?
+/- _____ g	QA 1200-AA01-12	(See Test Equipment List.) YES NO

Inspection performed using Endevco SC116-2M 'g' Monitor as +/- 15 VDC power supply only except for self-test voltage source and 50 Hz filter used in the filtered-noise test.

Conn.	Insulation resistance:	Specification:
All-case	1 x 10^10 ohms	Resistance > 50 megohms at 50 V.

MEASURED:	TEST RESULTS (Rload = 1000 ohms)			
Current Drain	+1g 0.165 mA	0g 1.908 mA	-1g 3.659 mA	
Self-Test	(+)- . V	(-)+ . V		
Output	+1g 1.3762 V	0g 0.0053 V	-1g -1.3665 V	
Hysteresis	-1g -1.3665 V	0g 0.0049 V	+1g 1.3762 V	0g 0.0053 V
Repeatibility	+1g 1.3762 V	+1g 1.3762 V	Error: 0.0000 Volts	
Noise Test:	0.0029 Volts (Broadband)			
	0.0020 Volts (50 Hz Filter)			

CALCULATED:	RESULTS	FREQ. RESPONSE @ 1 g RMS (No Signal Conditioning) Freq. (Hz)	Volts (RMS)
Sensitivity in Volts-per-g	1.3714 V/g	15	1.406
Zero g Output	0.0035 V	35	1.410
Current Scale Factor (Isf)	1.3714 mA/g	50	1.417
Bias Voltage	0.0049 V	100	1.441
Bias in g/1000	3.5367 mg	200	1.472
		300	1.435
		400	1.377
		500	1.401

90-Degree Phase Shift measured at 1350 Hz

Technician:	Date:	Checked by:	Date:
BID	21 Feb 85	[signature]	2/21/85

29 NOV 82

E.G.& G. DEPT. 1262 SERVO ACCELEROMETER FIELD CALIBRATION REPORT

MANUFACTURER:	PART NO.:	SERIAL NO.:	USER:	PROGRAM:	LOCATION:
SUNDSTRAND	979-~~1400~~-1BCC-001	107	SANDIA		

GAGE RANGE:	MODEL NO.:	IS ALL TEST EQUIPMENT TO BE USED IN-DATE? (See Test Equipment List.)
+/- 60 g	QA1400-1BCC-BAOL-12	YES NO

Calibration performed using Endevco SC116-2M 'g' Monitor as +/- 15 VDC power supply only.

Local gravity: 979.58671 | Gravity correction factor: 1.00115

STATIC GRAVITY TEST		FREQ. RESPONSE @ 1 g RMS		
g Level	Voltage Output	Freq. (Hz)	Volts (RMS)	V/g (Peak)
0	0.0185 V	15	5.189	.
+0.1	0.5254 V	35	5.190	.
-0.1	- 0.4871 V	50	5.191	.
+0.2	1.0318 V	100	5.187	.
-0.2	- 0.9945 V	200	4.958	.
+0.5	2.5520 V	300	4.430	.
-0.5	- 2.5137 V	400	3.870	.
+1	5.0951 V	500	3.631	.
-1	- 5.0489 V	90-Degree Phase Shift @ 1030 Hz		

Noise Test: 0.0025 Volts (Broadband)

Current Scale Factor (Isf) = 1.3714 mA/g
Load Resistance (Rl) = 3703 ohms
Calc. Sensitivity (Sc) = 5.0783 V/g (peak) [Sc = Isf x Rl/1000]

Technician:	Date:	Checked by:	Date:
[signature]	21 Feb 85	[signature]	2/21/85

29 NOV 82

SERVO ACCELEROMETER TEST EQUIPMENT LIST

AS OF: 19-FEB-85 Page __ of

Equipment used to calibrate transducers between 19-FEB-85 and 28-FEB-85.

USE	NOMENCLATURE	MFR	MODEL	SERIAL #	S.C.L.#	CAL. I
[✓]	BLOCK, ANGLE	CHLGE	LH-101	1	MECH.	31-JAN
[✓]	BLOCK, ANGLE	CHLGE	LH-101	2	MECH.	31-JAN
[ ]	COUNTER, FREQUENCY	FLUKE	7220A	2770018	EC0460	28-MAY
[ ]	COUNTER, FREQUENCY	FLUKE	7220A	2770037	EC0461	13-DEC
[ ]	COUNTER, FREQUENCY	H-P	5335A	2202A02528	EC0517	15-APR
[✓]	DECADE, RESISTOR	GR	1433-F	15625	EI0515	04-SEP
[ ]	DECADE, RESISTOR	GR	1433-G	990	EI0542	25-SEP
[ ]	GENERATOR, FREQUENCY	WAVTK	183	C5100087	ES1058	19-MAR
[✓]	GENERATOR, FUNCTION	H-P	3325A	1748A08271	ES1108	22-MAY
[✓]	LEVEL, SPIRIT	STARR	12-INCH	3-WAY		N.P.C
[✓]	MEGOHMMETER	GR	1864	1842A	EM0775	26-SEP
[ ]	MEGOHMMETER	GR	1864	4368	EM0653	21-OCT-
[✓]	MONITOR, G-LEVEL	ENDEV	SC116-2M	AB82	EG0031	17-SEP-
[ ]	MULTIMETER, DIGITAL	FLUKE	8800A	720005	EM1021	06-MAY-
[ ]	MULTIMETER, DIGITAL	FLUKE	8030A	940150	EM1080	28-NOV-
[ ]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2675070	EM1431	04-[illegible]
[✓]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2735040	EM1430	01-OCT-
[ ]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2735042	EM1434	08-APR-
[ ]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2540051	EM1326	13-MAY-
[✓]	MULTIMETER, THERMAL RMS	FLUKE	8506A	3225008	EM1623	21-JUN-
[ ]	MULTIMETER, THERMAL RMS	FLUKE	8506A	3435006	EM1771	12-JUN-
[ ]	OSCILLOSCOPE, RACK-MOUNT	TEK	5113	B116798	E02965	03-APR-
[✓]	OSCILLOSCOPE, RACK-MOUNT	TEK	5113	B116797	E02991	17-SEP-
[ ]	PLATE, SINE	EG&G	RN79 .1G	1	MECH.	13-JUN-
[ ]	PLATE, SINE	EG&G	RN79 .2G	2	MECH.	13-JUN-
[ ]	PLATE, SINE	EG&G	RN79 .5G	3	MECH.	13-JUN-
[ ]	PLATE, SURFACE	ENCO	GRADE B	1474	METROLAB	08-MAR-
[ ]	PLUG-IN, DIFF. AMP.	TEK	5A20N	B046951	E01132	15-AUG-
[ ]	PLUG-IN, DIFF. AMP.	TEK	5A20N	B046959	E01133	15-AUG-
[ ]	PLUG-IN, DIFF. AMP.	TEK	5A21N	B074856	A00096	03-APR-
[ ]	PLUG-IN, DIFF. AMP.	TEK	5A21N	B084881	A00100	03-APR-
[✓]	PLUG-IN, DIFF. AMP.	TEK	5A21N	B084882	EA0099	17-SEP-
[✓]	PLUG-IN, DIFF. AMP.	TEK	5A21N	B084892	EA0105	17-SEP-
[ ]	PLUG-IN, TIME BASE	TEK	5B10N	B074245	E01131	15-AUG-
[✓]	PLUG-IN, TIME BASE	TEK	5B10N	B105654	E02886	17-SEP-
[ ]	PLUG-IN, TIME BASE	TEK	5B10N	B105799	E02885	03-APR-
[ ]	POWER SUPPLY, D.C., 0-40	H-P	6114A	1928A02206		N.P.C.
[ ]	POWER SUPPLY, D.C., 0-40	H-P	6114A	1928A02196		N.P.C.
[ ]	POWER SUPPLY, D.C., 0-40	H-P	6114A	2110A02538		N.P.C.
[ ]	POWER SUPPLY, D.C., 0-50	H-P	6218A	8M1447		N.P.C.
[ ]	POWER SUPPLY, D.C., DUAL	EG&G	01-01-82	1		N.P.[illegible]
[✓]	ROTARY HEAD, MANUAL	ENCO	73010	2100	METROLAB	08-MAR-
[ ]	SYSTEM, SHAKER	ACOUS	113	180		N.P.C.F
[✓]	SYSTEM, SHAKER	M-B	MP-50	SCL0034		N.P.C.F
[ ]	SYSTEM, SHAKER	VTS				N.P.C.F
[✓]	SYSTEM, VIBRATION CAL	ENDEV	2335O-F	SCLEG0036		21 Feb 8[illegible]
[ ]						
[ ]						
[ ]						

[ ]

CHANNEL	GAGE S/N	TECHNICIAN	CAL. DATE	CHECKED BY:
	332			
	335	BLD	27 Feb 85	
	337			
	369	BLD	8 Oct 86	
	368			
	372		27 Feb 85	
	109	BLD		
	399			
	107			

4-JUN-85

E.G.& G. DEPT. 1262 SERVO ACCELEROMETER INCOMING INSPECTION REPORT

MANUFACTURER:	PART NO.:	SERIAL NO.:	USER:	PROGRAM:	LOCATION:
SUNDSTRAND	979-1300-007	211	SANDIA		

GAGE RANGE:	MODEL NO.:	IS ALL TEST EQUIPMENT TO BE USED IN-DATE?
+/- 5 V/g	QA -	(See Test Equipment List.) YES NO

Inspection performed using Endevco SC116-2M 'g' Monitor as +/- 15 VDC power supply only except for self-test voltage source and 50 Hz filter used in the filtered-noise test.

Conn.	Insulation resistance:	Specification:
All-case	1 x 10¹¹ ohms	Resistance > 50 megohms at 50 V.

MEASURED:	TEST RESULTS (Rload = 1000 ohms)			
Current Drain	+1g -1.20 mA	0g 2.06 mA	-1g 5.31 mA	
Self-Test	(+)- . V	(-)+ . V		
Output	+1g 2.7805 V	0g 0.0072 V	-1g 2.7627 V	
Hysteresis	-1g 2.7627 V	0g 0.0072 V	+1g 2.7805 V	0g 0.0072 V
Repeatibility	+1g 2.7805 V	+1g 2.7805 V	Error: 0.0 Volts	
Noise Test:	0.017 Volts (Broadband)		0.010 V (50 Hz Filter)	

CALCULATED:	RESULTS	FREQ. RESPONSE @ 1 g RMS (No Signal Conditioning) Freq. (Hz)	Volts (RMS)
Sensitivity in Volts-per-g	2.7716 V/g	35	2.840
Zero g Output	0.0032 V	50	2.852
Current Scale Factor (Isf)	2.7716 mA/g	70	2.878
Bias Voltage	0.0089 V	100	2.919
Bias in g/1000	3.2111 mg	150	2.975
90-degree Phase Shift measured @ Hz.		200	2.981
RED - SIG. OUT		300	2.923
BRN - - EXCIT.			
BLK - + EXCIT.		400	2.792
WHT - COMMON			
		500	2.672

Technician:	Date:	Checked by:	Date:
C Nuhlld	17-OCT-85	[signature]	10/21/85

4-JUN-85

E.G.& G. DEPT. 1262 SERVO ACCELEROMETER FIELD CALIBRATION REPORT

MANUFACTURER:	PART NO.:	SERIAL NO.:	USER:	PROGRAM:	LOCATION:
SUNDSTRAND	979-1300-607	211	SANDA		

GAGE RANGE:	MODEL NO.:	IS ALL TEST EQUIPMENT TO BE USED IN-DATE? (See Test Equipment List.)
+/- 5 V/g	QA -	YES NO

Calibration performed using [X] Endevco SC116-2M 'g' Monitor.
[ ] EG&G L-SC-2 Signal Conditioner.

Local gravity: 979.58671 | Gravity correction factor: 1.00115

STATIC GRAVITY TEST XDUCER		FREQ. RESPONSE @ 1 g RMS		
g Level	~~SC116-2M~~ Output	Freq. (Hz)	Volts (RMS)	V/g (peak)
0	0.012 V	35	5.105	.
+0.1	0.508 V	50	5.136	.
-0.1	- 0.487 V	70	5.172	.
+0.2	1.007 V	100	5.235	.
-0.2	- 0.987 V	150	5.277	.
+0.5	2.508 V	200	5.254	.
-0.5	- 2.485 V	300	5.032	.
+1	5.009 V	400	4.694	.
-1	- 4.976 V	500	4.362	.

Noise Test: 0.017 Volts (Broadband) | 90-degree Phase Shift
0.010 Volts (50 Hz filter) | measured at 1090 Hz.

~~Sensitivity setting = ____________ mV/g~~
~~Current Scale Factor (Isf) = ________ mA/g~~
Load Resistance (Rl) = ______1804__ ohms
~~Calc. Sensitivity (Sc) = ___________ V/g (peak)~~ [Sc = Isf x Rl/1000]

Technician:	Date:	Checked by:	Date:
C.H. Wills	12-OCT-85	[signature]	10/21/85

SERVO ACCELEROMETER TEST EQUIPMFNT LIST

AS OF: 17-OCT-85 Page 1 of

Equirment used to calibrate transducers between 17-OCT-85 and 25-OCT-85\.

USE	NOMENCLATURE	MFR	MODEL	SERIAL #	S.C.L.#	CAL. I
[X]	BLOCK, ANGLE	CHLGE	LH-101	1	LV411	31-JAN
[X]	BLOCK, ANGLE	CHLGE	LH-101	2	MECH.	31-JAN
[ ]	COUNTER, FREQUENCY	FLUKE	7220A	2770018	EC0460	10-JUN
[ ]	COUNTER, FREQUENCY	FLUKE	7220A	2770037	EC0461	13-DEC
[ ]	COUNTER, FREQUENCY	H-P	5335A	2202A02528	EC0517	24-APF
[ ]	DECADE, RESISTOR	GR	1433-F	7710	EI0690	11-FEE
[ ]	DECADE, RESISTOR	GR	1433-F	15625	00774	09-SEF
[X]	DECADE, RESISTOR	GR	1433-G	990	00774	01-OCT
[ ]	GENERATOR, FREQUENCY	WAVTK	183	C5000402	ES1057	21-FEE
[ ]	GENERATOR, FREQUENCY	WAVTK	183	C5100087	01392	02-OCT
[X]	GENERATOR, FUNCTION	H-P	3325A	1748A08271	ES1108	17-JUN
[X]	LEVEL, SPIRIT	STARR	12-INCH	3-WAY		N.P.C
[X]	MEGOHMMETER	GR	1864	1842A	01326	01-OCT
[X]	MONITOR, G-LEVEL	ENDEV	SC116-2M	AB82	EG0031	18-SEP
[ ]	MULTIMETER, DIGITAL	FLUKE	8030A	940150	EM1080	28-NOV
[ ]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2675070	EM1431	09-[illegible]
[ ]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2675053	EM1429	28-[illegible]
[ ]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2735042	EM1434	17-JAN
[ ]	MULTIMETER, DIGITAL (IEEE)	FLUKE	8860A	2540051	EM1326	31-MAY-
[ ]	MULTIMETER, DIGITAL (PROG)	FLUKE	8860A	2540049	00723	28-FEB-
[X]	MULTIMETER, THERMAL RMS	FLUKE	8506A	3225008	EM1623	22-JAN-
[ ]	OSCILLOSCOPE, ROLL-AROUND	TEK	5103N	B074862	00496	13-AUG-
[X]	OSCILLOSCOPE, RACK-MOUNT	TEK	5113	B116797	F00996	19-SEP-
[ ]	OSCILLOSCOPE, RACK-MOUNT	TEK	5113	B116798	E02965	08-APR-
[ ]	OSCILLOSCOPE, RACK-MOUNT	TEK	5440	B098909	00500	13-AUG-
[ ]	PLATE, SINE	EG&G	RN79 .1G	1	LV419	13-JUN-
[ ]	PLATE, SINE	EG&G	RN79 .2G	2	LV419	13-JUN-
[ ]	PLATE, SINE	EG&G	RN79 .5G	3	LV419	13-JUN-
[X]	PLATE, SURFACE	ENCO	GRADE B	1474	LV416	08-MAR-
[ ]	PLUG-IN, DIFF. AMP.	TEK	5A20N	B046951	00497	13-AUG-
[ ]	PLUG-IN, DIFF. AMP.	TEK	5A20N	B046959	00498	13-AUG-
[ ]	PLUG-IN, DIFF. AMP.	TEK	5A21N	B074856	EA0098	08-APR-
[ ]	PLUG-IN, DIFF. AMP.	TEK	5A21N	B084881	EA0100	08-APR-
[X]	PLUG-IN, DIFF. AMP.	TEK	5A21N	B084882	00997	19-SEP-
[X]	PLUG-IN, DIFF. AMP.	TEK	5A21N	B084892	00998	19-SEP-
[ ]	PLUG-IN, DUAL DIFF. AMP.	TEK	5A26	B052673	00501	13-AUG-
[ ]	PLUG-IN, DUAL TRACE	TEK	5A38	B022235	00502	13-AUG-
[ ]	PLUG-IN, TIME BASE	TEK	5B40	B043934	00503	13-AUG-
[ ]	PLUG-IN, TIME BASE	TEK	5B10N	B074245	00499	13-AUG-
[X]	PLUG-IN, TIME BASE	TEK	5B10N	B105654	01000	19-SEP-
[ ]	PLUG-IN, TIME BASE	TEK	5B10N	B105799	E02885	08-APR-
[ ]	POWER SUPPLY, BIPOLAR	H-P	6826A	2439A01002	EP1089	11-[illegible]
[ ]	POWER SUPPLY, BIPOLAR	H-P	6826A	2439A01003	EP1090	11-JUN-
[ ]	POWER SUPPLY, D.C., 0-40	H-P	6114A	1928A02206		N.P.C.
[ ]	POWER SUPPLY, D.C., 0-40	H-P	6114A	1928A02196		N.P.C.
[ ]	POWER SUPPLY, D.C., 0-40	H-P	6114A	2110A02534		N.P.C.

[ ]	POWER SUPPLY, D.C., 0-40	H-P	6114A	2110A02538		N.P.C.R
[ ]	POWER SUPPLY, D.C., 0-50	H-P	6218A	8M1447		N.P.C.R
[ ]	POWER SUPPLY, D.C., DUAL	EG&G	01-01-82	1		N.P.C.R
[X]	ROTARY HEAD, MANUAL	ENCO	73010	2100	METROLAB	08-MAR-8
[ ]	SYSTEM, SHAKER	ACOUS	113	180		N.P.C.R
[X]	SYSTEM, SHAKER	M-B	MP-50	SCL0034		N.P.C.R
[ ]	SYSTEM, SHAKER	VTS	________	________		N.P.C.R
[X]	SYSTEM, VIBRATION CALIB.	ENDEV	28350-F	SCLEG0026	EG0026	25-FEB-8
[ ]	VOLTMETER, DIGITAL	H-P	3456A	2201A08323	EM1604	28-NOV-8
[X]	VOLTMETER, DIGITAL	H-P	3456A	2201A08329	00776	10-SEP-8

CHANNEL	GAGE S/N	TECHNICIAN	CAL. DATE	CHECKED BY:
SUNDSTRAND CA1500	211	[illegible signature]	17-OCT-85	[illegible signature]

APPENDIX C: List and Location of Equipment Used to Measure and Record UNE Ground Motion Data

This appendix contains a description of all equipment used to measure and record ground motion at the Yucca Mountain stations. The equipment used in this effort can be classified in three different groups. These are, equipment used in the measuring and transmitting the ground motion data, equipment used in calibrating the TM Boxes and finally the supporting equipment. In the list that follows, the equipment used to measure and transmit the data comes first (i.e., accelerometers and TM Boxes). The second group, used for calibration of the TM Boxes, is noted with an asterisk in the "Description/Manufacturer" column. The third group of equipment is listed next. Note that the first two groups have the last calibration date specified in the table ("Last Cal Date" column). The third group has an "N" in this column (signifying that calibration is not required to ensure Q/A level I standards). Some of this equipment (such as recievers, tuners, and tape recorders) does not require calibration. Other equipment in this group would, under normal circumstances, require calibration (e.g. Fluke digital multi-meters or spectrum analyzers)). However, this equipment is used for a quick visual diagnostic rather than a quantitative check. Therefore, it is not necessary to have this equipment calibrated on a rigorous schedule. Owner's Manuals and Manufacturer's specifications are kept in the files at NTS. The column in the table entitled "Reference Documents at NTS?" indicates whether or not the manufacturer's data exists in these files (T means it does, F means it does not). Note that there is a reasonably large amount of spare equipment not included in this list and as pieces of equipment are replaced or calibrated this list will be updated.

LIST OF EQUIPMENT USED IN RECORDING GROUND MOTION DATA AT YUCCA MOUNTAIN

DESCRIPTION/ MANUFACTURER	EQUIPMENT LOCATION	MODEL NUMBER	SERIAL NUMBER	LAST CAL DATE	REFERENCE DOCUMENTS AT NTS?
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-30 Top - AV	QA1400-AA01-0	Q14339	05/14/85	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-30 Top - AR	QA1400-AA01-0	Q14269	12/07/82	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-30 Top - AT	QA1400-AA01-0	Q14301	11/12/83	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-30 Bot - AV	QA1400-AA01-0	QA14464	01/28/85	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-30 Bot -- AR	QA1400-AA01-0	Q14465	01/29/85	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-30 Bot -- AT	QA1400-AA01-0	Q14466	01/28/85	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-25 Top -- AV	QA1400	Q14209	08/12/83	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-25 Top -- AR	QA1400	Q14220	08/17/83	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-25 Top -- AT	QA1400	Q14283	08/18/83	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-25 Bot -- AV	QA1400	Q14169	08/12/83	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-25 Bot -- AR	QA1400	Q14213	08/12/83	.T.

LIST OF EQUIPMENT USED IN RECORDING GROUND MOTION DATA
AT YUCCA MOUNTAIN

DESCRIPTION/ MANUFACTURER	EQUIPMENT LOCATION	MODEL NUMBER	SERIAL NUMBER	LAST CAL DATE	REFERENCE DOCUMENTS AT NTS?
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-25 Bot -- AT	QA1400	Q14222	08/12/83	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-26 -- AV	QA1200-AA01-12	Q12107	02/21/85	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-26 -- AR	QA1200-AA01-12	Q12399	02/21/85	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-26 -- AT	QA1200-AA01-12	Q12109	02/21/85	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-28 Top -- AV	QA1400-AA01-0	Q14205	06/24/85	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-28 Top -- AR	QA1400	Q14208	06/24/85	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-28 Top -- AT	QA1400	Q14340	06/24/85	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-28 Bot -- AV	QA1400	Q14255	11/21/83	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-28 Bot -- AR	QA1400-AA01	Q14309	04/02/84	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-28 Bot -- AT	QA1400-AA01	Q14316	04/02/84	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-29 Top -- AV	QA1400-001	Q14311	04/12/84	.T.

LIST OF EQUIPMENT USED IN RECORDING GROUND MOTION DATA AT YUCCA MOUNTAIN

DESCRIPTION/ MANUFACTURER	EQUIPMENT LOCATION	MODEL NUMBER	SERIAL NUMBER	LAST CAL DATE	REFERENCE DOCUMENTS AT NTS?
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-29 Top -- AR	QA1400-AA01	Q14317	04/13/84	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-29 Top -- AT	QA1400-AA01-0	Q14318	04/13/84	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-29 Bot -- AV	QA1400-AA01-0	Q14332	02/19/85	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-29 Bot -- AR	QA1400-AA01-0	Q14335	02/19/85	.T.
SUNDSTRAND Q-FLEX ground motion accelerometer	STA W-29 Bot -- AT	QA1400-AA01-0	Q14337	02/19/85	.T.
SNL Telemetry box	STA W-30		PFTU-54	/ /	.T.
SNL Telemetry box	STA W-25		PFTU-52	/ /	.T.
SNL Telemetry Box	STA W-26		TM BOX-4	/ /	.T.
SNL Telemetry box	STA W-28		PFTU-50	/ /	.T.
SNL Telemetry box	STA W-29 Top		TM BOX-14	/ /	.T.
SNL Telemetry box	STA W-29 Bot		TM BOX-12	/ /	.T.
				/ /	.F.
HP Counter *	NRDA Fire station	5342A	A02066	/ /	.T.
HP Counter *	NRDA Fire station	5233L	45001256	/ /	.T.
HP DC Multi function *	NRDA Fire station	3444A		/ /	.F.
HP Multi-meter *	NRDA Fire station	3466A		/ /	.T.
AMPEX 14 Track analog tape recorder	NRDA Fire station	PR2230	8210707	N	.T.

LIST OF EQUIPMENT USED IN RECORDING GROUND MOTION DATA AT YUCCA MOUNTAIN

DESCRIPTION/ MANUFACTURER	EQUIPMENT LOCATION	MODEL NUMBER	SERIAL NUMBER	LAST CAL DATE	REFERENCE DOCUMENTS AT NTS?
AMPEX 14 Track analog tape recorder	NRDA Fire station	PR2230	8180693	N	.T.
DATA TAPE 28 Track analog tape recorder	NRDA Fire station	VR3700J	1289	N	.T.
MICRODYNE Receiver	NRDA Fire station	1100AR	2978	N	.T.
MICRODYNE Receiver	NRDA Fire Station	1100AR	2793	N	.T.
MICRODYNE Receiver	NRDA Fire station	1100AR	2791	N	.T.
HARTMAN Receiver	NRDA Fire station	TMR74A	H005	N	.F.
HARTMAN Receiver	NRDA Fire station	TMR74A	H004	N	.F.
MICRODYNE RF Tuner	NRDA Fire station	1115VT	1037	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1112VT	712	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1114VT	411	N	.T.
KINEMETRIC Time code generator	NRDA Fire station	468DC	355	N	.T.
MOXON Time code generator	NRDA Fire station	540		N	.T.
HP Spectrum analyzer display	NRDA Fire station	141T	A23321	N	.T.
HP Spectrum analyzer PI	NRDA Fire station	8552B	A22380	N	.T.
HP Signal generator	NRDA Fire station	8614A	42400421	N	.F.
TRF Down converter	NRDA Fire station	TC302L	6	N	.F.
AVANTEK Amplifier	NRDA Fire station	UTC23-104	none	N	.F.
B&H Degausser	NRDA Fire station	TMR74A	TD500	N	.T.
DATA TAPE Degausser	NRDA Fire station	12-911	1215	N	.F.
FLUKE Digital multi-meter	NTS Building 10	8020	947876	N	.T.

LIST OF EQUIPMENT USED IN RECORDING GROUND MOTION DATA AT YUCCA MOUNTAIN

DESCRIPTION/ MANUFACTURER	EQUIPMENT LOCATION	MODEL NUMBER	SERIAL NUMBER	LAST CAL DATE	REFERENCE DOCUMENTS AT NTS?
FLUKE Digital multi-meter	NRDA Fire station	8020A		N	.T.
FLUKE Digital multi-meter	NTS Building 10	8020A	0686687	N	.T.
EMI Oscillograph	NRDA Fire station	6300	1700	N	.T.
MOTOROLLA Base station	NRDA Fire station	L54JJB1130CM	447HHQ0224	N	.F.
MICRODYNE Spectral display	NRDA Fire station	1161S	1625	N	.F.
PANORAMIC Spectrum analyzer	NTS Building 315	TMI-1B	02-268-142	N	.F.
TEKTRONIX Sine wave generator	NTS Building 10	SG503	B052106	N	.T.
TEKTRONIX Mainframe	NTS Building 10	TM503	B106937	N	.F.
TEKTRONIX Oscilloscope	NTS Building 10	7403N	B073155	N	.F.
CEC Oscillograph	NTS Building 10	5-133	4116	N	.T.
HP Oscilloscope	NRDA Fire station	180 AR	93609603	N	.T.
MONITOR TM Calibrator	NTS Building 10	838A	018	N	.T.
TEKTRONIX Oscilloscope	NRDA Fire station	R7403N	B073159	N	.F.
TEKTRONIX Oscilloscope	NTS Building 10	7403N	B073170	N	.F.
TEKTRONIX Oscilloscope	NTS Building 315	7403N	B073169	N	.F.
HP IF PI Spectrum analyzer	NRDA Fire station	8552B	A22378	N	.F.
HP LF PI Spectrum analyzer	NRDA Fire station	8556A	A05444	N	.F.

LIST OF EQUIPMENT USED IN RECORDING GROUND MOTION DATA AT YUCCA MOUNTAIN

DESCRIPTION/ MANUFACTURER	EQUIPMENT LOCATION	MODEL NUMBER	SERIAL NUMBER	LAST CAL DATE	REFERENCE DOCUMENTS AT NTS?
HP LF PI Spectrum analyzer	NRDA Fire station	8556A	A05442	N	.F.
HP RF PI Spectrum analyzer	NRDA Fire station	8555A	A13439	N	.F.
TEKTRONIX Amplifier	NRDA Fire station	7A16A		N	.T.
TEKTRONIX Time base	NRDA Fire station	7B50		N	.F.
TEKTRONIX Multimeter	NRDA Fire station	DM-502		N	.T.
HP Function generator	NRDA Fire station	3310A		N	.F.
BEEKMAN WWV Revr	NRDA Fire station	905		N	.F.
TEKTRONIX Multimeter	NRDA Fire station	DM501		N	.F.
PHILCO Bi-directional power monitor	NRDA Fire station	164B		N	.T.
ESI Dekabox	NRDA Fire station	DB655		N	.F.
TEKTRONIX Oscilloscope	NRDA Fire station	324		N	.F.
ANALOGIC DC Voltage standard	NRDA Fire station	AN3100		N	.F.
LAMBDA Power supply		LPD421FM		N	.F.
HARRISON Power supply		510A		N	.F.
PANORAMIC Power supply		TMP-1b		N	.F.
POWER DESIGNS Power supply		3650R		N	.F.
HARRISON Power supply		6266A		N	.F.
HARRISON Power supply		520A		N	.F.
HARTMAN Receiver	NRDA Fire station	TMR74A	H002	N	.T.
HARTMAN Receiver	NRDA Fire station	TMR74A	H003	N	.T.

LIST OF EQUIPMENT USED IN RECORDING GROUND MOTION DATA AT YUCCA MOUNTAIN

DESCRIPTION/ MANUFACTURER	EQUIPMENT LOCATION	MODEL NUMBER	SERIAL NUMBER	LAST CAL DATE	REFERENCE DOCUMENTS AT NTS?
HARTMAN Receiver	NRDA Fire station	TMR74A	H0Q7	N	.T.
HARTMAN Receiver	NRDA Fire station	TMR74A	H001	N	.T.
MICRODYNE Receiver	NRDA Fire station	1100AR	2792	N	.T.
MICRODYNE Receiver	NRDA Fire station	1100AR	2789	N	.T.
MICRODYNE Receiver	NRDA Fire station	1100AR	2799	N	.T.
MICRODYNE Receiver	NRDA Fire station	1100AR	2786	N	.T.
MICRODYNE Receiver	NRDA Fire station	1100AR	2788	N	.T.
MICRODYNE Receiver	NRDA Fire station	1100AR	398	N	.T.
MICRODYNE Receiver	NRDA Fire station	1100AR	2794	N	.T.
MICRODYNE Receiver	NRDA Fire station	1100AR	2796	N	.T.
MICRODYNE Receiver	NRDA Fire station	1100AR	2787	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1112VT	715	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1114VT	408	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1115VT	082	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1115VT	074	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1115VT	077	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1115VT	080	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1115VT	076	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1115VT	081	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1114VT	415	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1115VT	1036	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1112VDT	705	N	.T.

LIST OF EQUIPMENT USED IN RECORDING GROUND MOTION DATA AT YUCCA MOUNTAIN

DESCRIPTION/ MANUFACTURER	EQUIPMENT LOCATION	MODEL NUMBER	SERIAL NUMBER	LAST CAL DATE	REFERENCE DOCUMENTS AT NTS?
MICRODYNE RF Tuner	NRDA Fire station	1112VDT	716	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1112VDT	711	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1112VDT	713	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1112VDT	706	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1114VT	409	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1114VT	410	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1114VT	412	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1114VT	413	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1114VT	414	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1112VDT	707	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1112VDT	709	N	.T.
MICRODYNE RF Tuner	NRDA Fire station	1112VDT	710	N	.T.
HARTMAN Receiver	NRDA Fire station	TMR74A	H006	n	.T.

UNCONTROLLED

NNWSI PROJECT

Verification of PNE Amplifier Gains & Frequency Response

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1.0 Purpose

1.1 The purpose of this TP is to measure and verify the frequency response and gain of the PNE seismic amplifier and associated components from the input to the canister interconnect cable to the output of the PNE amplifier.

2.0 Scope

2.1 This TP applies to the PNE seismic amplifiers installed in T. M. boxes Serial #1 thru #28. Reference SNLA Drawing #CK-T34672.

3.0 Definitions

3.1 Terms:

A.	PNE	An acronym for a project these amplifiers were originally designed for.
B.	Gage Canister	A container designed to mount and protect the accelerometer gages.
C.	T.M. Control Box (PNE Seismic)	A box containing the seismic amplifiers and other electronic components necessary to relay the measured signals to the recording facility.
D.	Canister Interconnect Cable	A multiconductor cable used to connect the gage canister to the T.M. box.
E.	AV	Acceleration (vertical axis)
	AR	Acceleration (radial axis with respect to the point of initiation)
	AT	Acceleration (tangental axis with respect to the point of initiation)

4.0 List and Description of Needed Minimum Equipment Requirements

4.1 True RMS Reading Voltimeter

A. Accuracy of +/- 1%

4.2 SINE Wave Generator

A. Variable output level from 0.0 to 1.77 V RMS

B. Variable frequency from 1 Hz to 30 Hz

4.3 Frequency Counter

A. Accuracy of +/- 0.5 Hz from 1 Hz to 30 Hz

4.4 Oscilloscope

A. DC input

B. Sensitivity 0.02V/Div to 2V/Div

C. Sweep speed adjustable such that a frequency from 1 Hz to 30 Hz may be clearly displayed.

4.5 T.M. Box

4.6 Canister Interconnect Cable

4.7 Cables and connectors necessary for interconnecting the test equipment

5.0 Test Environment

5.1 These tests are normally conducted in a laboratory environment where power and stable room temperature are available. However, the tests are not dependent on these surroundings. The tests may be conducted anywhere under any conditions that the tested equipment might be subject to as long as the accuracy of the measuring equipment is not affected.

6.0 Test Procedure

6.1 Initial Test Equipment Setup

A. Turn all test equipment on and allow it to stabalize for a minimum of 15 minutes.

B. Connect the RMS voltmeter and frequency counter to the SINE wave generator, set the SINE wave generator output for 30 Hz +/- 0.5 Hz. Set the output amplitude for 0.5 V RMS +/- 0.1 V RMS.

C. Disconnect the RMS voltmeter and counter from the SINE wave generator, connect the oscilloscope to the SINE wave generator. Set the oscilloscope to D.C. input. Set the oscilloscope sensitivity at a level where 0.1 V D.C. resolution is readily readable but not so sensitive that the peaks of the SINE wave cannot be seen. Set the oscilloscope sweep speed so that several cycles of the SINE wave are visable. Switch the oscilloscope from D.C. input to A.C. input and observe if there is a vertical shift of the SINE wave of more than 0.1 V D.C. If there was more than 0.1 V D.C. shift then adjust the D.C. offset of the SINE wave generator while switching the oscilloscope from D.C. input to A.C. input until there is +/- 0.1 V D.C. or less vertical shift. Disconnect the oscilloscope from the SINE wave generator.

D. Connect the RMS voltmeter and frequency counter to the SINE wave generator. Set the SINE wave generator output to 1 Hz +/- 0.5Hz. Set the output amplitude to 1.77 V RMS +/- 0.1 V RMS. Disconnect the RMS voltmeter from the signal generator. Leave the frequency counter connected to the generator.

6.2 Initial T.M. Box Setup

A. Connect the canister interconnect cable to the T.M. box.

B. Set the gain of the amplifier to 10 x 10.

C. Determine from SNLA Schematic #CK-T34672 which pins on the canister interconnect cable to use as the signal input for the amplifier being tested.

D. Refer to SNLA Schematic #CK-T34672 to locate the amplifier output monitor points and connect the oscilloscope to these points.

E. Apply power to the T.M. box and turn the T.M. box on.

F. Locate the signal input pins of the appropriate amplifier on the end of the canister interconnect cable and connect a resistance of 100 Ohms or less to these pins.

G. Set the oscilloscope for D.C. input and the sensitivity for 0.1 V/Div or less. Set the sweep speed so a horizontal trace is easily visible.

H. Observe the output of the amplifier on the oscilloscope and adjust the amplifier balance control for zero output from the amplifier. Remove the low resistance from the signal input pins. Leave the oscilloscope connected to the amplifier output monitor points.

7.0 Frequency Response Measurements

7.1 Obtain a copy of TP-83, page 10 of 11 Rev 0, Table #1 (Frequency Response Measurements). List the test equipment used along with related information indicated in this table.

7.2 A. Set the gain of the PNE amplifier to 1 x 1.

B. Connect the SINE wave generator output previously set at 1 Hz and 1.77 V RMS to the appropriate signal input pins of the canister interconnect cable for the amplifier being tested.

C. Connect the RMS voltmeter to the amplifier output monitor points. Adjust the output of the SINE wave generator to yield an output of 1.77 V RMS +/- 0.1 V RMS as indicated by the RMS voltmeter. This measurement is the output of the amplifier and is to be recorded on the 1 Hz line output volts column of TP-83 Table 1 "Frequency Response Measurements". Observe the output of the amplifier on the oscilloscope to be sure there is no clipping or distortion of the SINE wave.

D. Remove the RMS voltmeter from the output of the amplifier and connect it to the input of the amplifier. Measure the RMS SINE wave input voltage to the amplifier. Record this measurement on the 1 Hz line input volts column of TP-83 Table 1 "Frequency Response Measurements".

E. Divide the RMS output volts by the input volts. The result is the gain of the amplifier at 1 Hz and is recorded on the 1 Hz line amplifier gain column of TP-83 Table 1 "Frequency Response Measurements".

F. Change the output frequency of the SINE wave generator to the next one listed in the input frequency column of TP-83 Table 1 "Frequency Response Measurements". Repeat steps 7.2C thru 7.2F for the remaining frequencies listed in Table 1 "Frequency Response Measurements".

G. The measured gains should not vary more than +/-0.05V RMS from the 1 Hz measurement to the 30 Hz measurement. If the gains do not fall within these limits, then there is a problem in the system to be corrected, and the frequency response measurements redone.

8.0 Amplifier Gain Measurements

8.1 Obtain a copy of TP-83, page 11 of 11 Rev 0 Table #2 Amplifier Gain Measurements. List the test equipment used along with related information indicated in this table.

8.2 Preliminary Equipment Setup

A. Setup the test equipment and T.M. box as specified in 4.0 thru 6.2D.

B. Set the frequency of the SINE wave generator to 20 Hz +/- 0.5 Hz and output of the SINE wave generator to 1.77 V +/- 0.1 V RMS.

C. Set the gain of the amplifier being measured to 1 x 1.

D. Connect the osciloscope and RMS voltmeter to the output of the amplifier. Adjust the SINE wave generator to yield an output from the amplifier of 1.77 +/- 0.1 V RMS measured with the RMS voltmeter. This measurement is the output of the amplifier and is recorded on 1 x 1 patch position line, output volts column of TP-83 Table #2 "Amplifier Gain Measurements". Observe the output of the amplifier on the oscilloscope to be sure there is no clipping or distortion of the SINE wave.

E. Remove the RMS voltmeter from the output of the amplifier and connect it to the input of the amplifier. Measure the RMS SINE wave input voltage to the amplifier. Record this value in TP-83 Table #2, 1 x 1 patch position line, input volts RMS column.

F. Divide the RMS output volts by the RMS input volts. The result is the gain of the amplifier at 20 Hz and is recorded in TP-83 Table #2 "Amplifier Gain Measurements" on line 1 x 1 patch position, amplifier gain column.

G. Leave the oscillatar set at 20 Hz +/- 0.5 Hz and repeat steps 8.2D thru 8.2F for the remaining gain patch position combinations listed in TP-83 Table #2 "Amplifier Gain Measurements".

8.3 Compare the measured amplifier gain in TP-83 Table #2 to those listed in TP-83, 8.4 (Gain Verification Table). The upper and lower limits listed in this table represent +/-3% deviation from the ideal gain of the amplifier. If the gains do not fall within these limits then there is a problem in the system to be corrected and the frequency and gain measurements redone.

8.4 GAIN VERIFICATION TABLE

A 1 PATCH POS	A 2 PATCH POS	GAIN LOWER LIMIT	GAIN UPPER LIMIT	GAIN NOMINAL
1	1	0.97	1.03	1.0
2	1	1.988	2.111	2.05
5	1	4.957	5.263	5.11
10	1	9.700	10.30	10.0
20	1	19.88	21.11	20.5
1	2	1.988	2.111	2.05
1	5	4.957	5.263	5.11
1	10	9.700	10.30	10.0
1	20	19.88	21.11	20.5

9.0 Safety - "The activities and associated equipment covered by this technical procedure have been determined to have no significant or unusual safety hazards. Review and approval by the SNL Safety Engineering Department and/or appropriate organizations are not required".

PNE AMPLIFIER
AMPLIFIER FREQUENCY MEASUREMENTS

IDENTIFICATION
AMPLIFIER MEASUREMENT AXIS________
TELEMETRY BOX #________________
STATION #______________________
SURFACE______ DOWNHOLE___________

DATE________________
OPERATORS NAME (print)
____
OPERATORS INITIALS___

TABLE #1
FREQUENCY RESPONSE MEASUREMENTS

A-1 PATCH POSITION	A-2 PATCH POSITION	INPUT FREQ. HZ	SINE WAVE INPUT VOLTS R.M.S.	SINE WAVE OUTPUT VOLTS R.M.S.	AMPLIFIER GAIN
		1 Hz	.	.	.
		2 Hz	.	.	.
X1	X1	5 Hz	.	.	.
		10 Hz	.	.	.
		20 Hz	.	.	.
		30 Hz	.	.	.

FREQUENCY RESPONSE TEST EQUIPMENT LIST

DESCRIPTION	MFGR	MODEL	SERIAL #	SANDIA PROPERTY #	CALIBRATION EXPIRATION DATE
________	____	_____	_______	_________	_________
________	____	_____	_______	_________	_________
________	____	_____	_______	_________	_________
________	____	_____	_______	_________	_________

COMMENTS: ____
____

PNE AMPLIFIER
AMPLIFIER GAIN MEASUREMENTS

IDENTIFICATION
AMPLIFIER AXIS________________
TELEMETRY BOX #______________
STATION #____________________
SURFACE______ DOWNHOLE_______

DATE______________________
OPERATORS NAME (print)
____
OPERATORS INITIALS_______

TABLE #2
AMPLIFIER GAIN MEASUREMENTS

A-1 PATCH POSITION	A-2 PATCH POSITION	INPUT FREQ. HZ	SINE WAVE INPUT VOLTS R.M.S.	SINE WAVE OUTPUT VOLTS R.M.S.	AMPLIFIER GAIN
X1	X1		.	.	.
X2	X1		.	.	.
X5	X1		.	.	.
X10	X1		.	.	.
X20	X1	20 Hz	.	.	.
X1	X2		.	.	.
X1	X5		.	.	.
X1	X10		.	.	.
X1	X20		.	.	.

GAIN MEASUREMENT TEST EQUIPMENT LIST

DESCRIPTION	MFGR	MODEL	SERIAL #	SANDIA PROPERTY #	CALIBRATION EXPIRATION DATE
__________	____	_____	_______	_________	__________
__________	____	_____	_______	_________	__________
__________	____	_____	_______	_________	__________
__________	____	_____	_______	_________	__________

COMMENTS: ____

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NN.870917.0047

NNWSI PROJECT

Verification of Tamarac-B Amplifier Gains and Frequency Response

Page	1	2	3	4	5	6	7
Rev	0	0	0	0	0	0	0

Approved by:

Jimmy G. Lee — 7-13-87
Jimmy G. Lee, 7125 — Date
Author

Robert L. Rutter — 7/20/87
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Subramanian — 7/28/87
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Principal Investigator

Al Stevens — 7/30/87
AL. Stevens, 6313 — Date
Supervisor, SNL

SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT
Issued to: NNWSI (TRC)
Copy Number: 009
RETURN TO 6310 RECORDS CENTER WHEN NO LONGER NEEDED.

1.0 Purpose

1.1 The purpose of this TP is to measure and verify the frequency response and gain of the "Tamarac" B amplifiers.

2.0 Scope

2.1 This TP applies to the "Tamarac" B amplifiers that are installed in selected waste isolation seismic measurement installations.

3.0 Definitions

3.1 Terms:

A.	"Tamarac" B	Designation for an amplifier originally used in a "three axis multi range accelerometer canister".
B.	PFTU	Programmable field telemetry unit.
C.	T.M. Control Box (PFTU)	A box containing the seismic amplifiers and other electronic components necessary to relay the measured signals to the recording facility.
D.	Gage Canister	A container designed to mount and protect the accelerometer gages.
E.	Canister Interconnect Cable	A multiconductor cable used to connect the gage canister to the "Tamarac" B amplifiers.
F.	Amplifier Interconnect Cable	A multiconductor cable used to connect the "Tamarac" B amplifiers to the T.M. box.
G.	AV	Acceleration (vertical axis)
	AR	Acceleration (radial axis with respect to point of initiation).
	AT	Acceleration (tangential axis with respect to point of initiation).
	P.P.	Peak to Peak

4.0 List and Description of Minimum Needed Equipment

4.1 True RMS Reading Voltmeter

A. Accuracy of +/- 1%

4.2 Sine Wave Generator

A. Variable output level from 0.0 to 1.77 volts RMS

B. Variable frequency from 1 Hz to 30 Hz

4.3 Frequency Counter

A. Accuracy of +/- 0.5 Hz from 1 Hz to 30 Hz

4.4 Oscilloscope

A. DC input

B. Sensitivity 0.02 to 2V/Div

C. Sweep speed adjustable such that a frequency from 0.5 Hz to 30 Hz may be clearly displayed.

4.5 T.M. Box

4.6 Canister interconnect cable if used in the instrumentation installation.

4.7 Amplifier Interconnect Cable

4.8 Cables and connectors necessary for interconnecting the test equipment.

5.0 Test Environment

5.1 For comfort and convenience these tests are normally done in a laboratory environment; however, they are not dependent on this environment. The tests may be conducted anywhere under any conditions that are within the range of acceptable conditions for operating the equipment, as specified by the manufacturer.

6.0 Test Procedure

6.1 Initial Test Equipment Setup

A. Turn all test equipment on and allow it to stabilize for a minimum of 15 minutes.

B. Connect the RMS voltmeter and frequency counter to the sine wave generator output. Set the sine wave generator output to 30 Hz +/- 1 Hz. Set the output amplitude to 0.2V +/- .05V RMS.

C. Disconnect the RMS voltmeter and counter from the sine wave generator. Connect the oscilloscope to the sine wave generator output. Set the oscilloscope to DC input. Set the oscilloscope sensitivity to 0.02V/DIV or a sensitivity that will allow the input signal to almost fill the screen top to bottom, but not so sensitive that the peaks of the sine wave cannot be seen. Set the oscilloscope sweep speed so that several cycles of the sine wave are visible and any vertical shift of the signal is easily seen. Switch the oscilloscope input back and forth from DC input to AC input while observing the signal on the oscilloscope. If there is any vertical shift of the signal adjust the DC offset control on the sine wave generator until there is no detectable shift of the signal when switching from DC input to AC input. Disconnect the oscilloscope from the sine wave generator.

D. Connect the frequency counter to the sine wave generator output. Connect A x 10 attenuator in series with the sine wave generator output.

6.2 Initial "Tamarac" B Amplifier Setup

A. In actual installations there may or may not be a canister interconnect cable and the length of the amplifier interconnect cable may vary by several hundred feet from one installation to another. The test should be conducted with the cables that will be used in the actual installation. If a canister interconnect cable is used the amplifier input will be at the end of the cable that connects to the gage canister. Otherwise the amplifier input will be right at the Tamarac "B" amplifier input. The amplifier output will be measured at the T.M. box input test points with the appropriate amplifier interconnect cable installed.

B. Connect the amplifier interconnect cable to the T.M. box and the amplifiers. Connect the canister interconnect cable if applicable.

C. Apply power to the T.M. box and turn it on.

7.0 "Tamarac" B Amplifier Gain & Frequency Response Measurements

7.1 Obtain a copy of TP-84, page 7, Rev 0, Table #1 "Tamarac" B Amplifier Gain & Frequency Measurements.

7.2 A. Connect the output of the X10 attenuator installed on the sine wave generator to the input of the amplifier being tested or the signal input pins of the canister interconnect cable, whichever is appropriate.

B. Connect the true RMS voltmeter and oscilloscope to the signal input monitor of the appropriate channel of the T.M. box, which would be the output of the Tamarac "B" amplifier.

C. Set the oscilloscope to DC input. Set the sweep speed and sensitivity such that a 5V P.P., 30 Hz signal will be clearly displayed. Set the RMS voltmeter to the proper function setting for measuring low frequency voltage "(example AC + DC) refer to manual". "Caution" any DC offset of the amplifier or sine wave generator could cause erroneous readings. Set the RMS voltmeter to the most sensitive range that will read 1.77V RMS.

D. A sine wave should now be visible on the oscilloscope and a voltage indication on the RMS voltmeter.

E. Adjust the amplitude output control of the sine wave generator until a voltage reading of 1.77V +/- 0.05V is obtained. Observe the singal on the oscilloscope to be sure there is no clipping or distortion.

F. Change the sine wave generator frequency to 1.0 Hz +/- 0.2 Hz. Adjust, if necessary, the amplitude output of the sine wave generator to maintain an amplifier output signal of 1.77V +/- 0.5 RMS. Observe the signal on the oscilloscope to be sure there is no clipping or distortion.

G. Record the amplifier output reading of the RMS voltmeter in Table #1 of TP-84 in the "Amplifier Output Volts" column, 1.0 Hz line.

H. Remove the RMS voltmeter from the amplifier output and connect it to the amplifier input. Change the sensitivity of the RMS voltmeter to the appropriate range.

I. Record the amplifier input reading in Table #1 of TP-84 in the "Amplifier Input" column, 1.0 Hz line.

J. Divide the amplifier output voltage by the amplifier input voltage. The result is the gain of the amplifier at 1.0 Hz.

K. Remove the RMS voltmeter from the amplifier input and reconnect it to the amplifier output. Change the sine wave oscillator frequency to the next one listed in Table #1, TP-84 and repeat steps 7.2 F thru 7.2K for the remaining frequencies listed in Table #1, TP-84.

8.0 <u>Safety</u> "The activities and associated equipment covered by this technical procedure have been determined to have no significant or unusual safety hazards. Review and approval by SNL Safety Engineering Department and/or appropriate organizations are not required".

TAMARAC "B"
AMPLIFIER GAIN & FREQUENCY MEASUREMENTS

IDENTIFICATION
STATION #_______________
TELEMETRY BOX #__________
SURFACE______DOWNHOLE____
CANISTER #_______________
MEASUREMENT AXIS_________

DATE______________________
OPERATORS NAME (print)
____
OPERATORS INITIALS_______

TABLE #1
TAMARAC "B" AMPLIFIER GAIN & FREQUENCY MEASUREMENTS

INPUT FREQUENCY +/- 0.2 Hz	AMPLIFIER INPUT VOLTS RMS	AMPLIFIER OUTPUT VOLTS RMS	AMPLIFIER GAIN
1 Hz	.	.	.
2 Hz	.	.	.
5 Hz	.	.	.
10 Hz	.	.	.
20 Hz	.	.	.
30 Hz	.	.	.

PREAMPLIFIER GAIN TEST EQUIPMENT LIST

DESCRIPTION	MFGR	MODEL	SERIAL #	SANDIA PROPERTY #	CALIBRATION EXPIRATION DATE
___________	____	_____	________	__________	___________
___________	____	_____	________	__________	___________
___________	____	_____	________	__________	___________
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COMMENTS: ____

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NNWSI PROJECT

Verification of FFTU Amplifier Gains and Frequency Response

NN.871119.0039

Page	1	2	3	4	5	6	7	8	9	10	11
Rev	0	0	0	0	0	0	0	0	0	0	0

Approved by:

for Robert L Rutter — 9/3/87
Jimmy G. Lee, 7125 — Date
Author

Robert L Rutter — 9/14/87
Robert L. Rutter, 7125 — Date
Independent Technical Review

Douglas C Browne — 9/14/87
D. C. Browne, 7125 — Date
Independent Technical Review

James S Phillips — 8/17/87
J. S. Phillips, 7111 — Date
Task Leader

Subramanian — 10/2/87
C. V. Subramanian, 6311 — Date
Principal Investigator

Al Stevens — 11/7/87
AL. Stevens, 6313 — Date
Supervisor, SNL

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1.0 Purpose

1.1 The purpose of this TP is to measure and verify the frequency response and gain of the amplifiers used in the PFTU telemetry units.

2.0 Scope

2.1 This TP applies to the PFTU amplifiers used in the PFTU telemetry units that are installed in selected waste isolation seismic measurement installations, and applies to gain switch settings 1 thru 7 only.

3.0 Definitions

3.1 Terms:

A.	(PFTU amplifier)	Designation for an amplifier used in the PFTU telemetry units.
B.	PFTU	Programmable Field Telemetry Unit
C.	T.M. Control Unit (PFTU)	A box containing amplifiers and other electronic components necessary to relay the measured signals to the recording facility.

4.0 List and Description of Minimum Needed Equipment

4.1 True RMS Reading Voltmeter

A. Accuracy of +/- 1%

4.2 Sine Wave Generator

A. Variable output level from 0.0 to 1.77 volts RMS

B. Variable frequency from 1 Hz to 30 Hz

4.3 Frequency Counter

A. Accuracy of +/- 0.5 Hz from 1 Hz to 30 Hz

4.4 Oscilloscope

A. DC input

B. Sensitivity of 0.02 to 2V/DIV

C. Sweep speed adjustable such that a frequency from 0.5 Hz to 30 Hz may be clearly displayed.

4.5 PFTU telemetry unit with amplifiers

4.6 Various valves of attenuators, test cables and connectors

5.0 Test Environment

5.1 For comfort and convenience these tests are normally performed in a laboratory environment; however, they are not dependent on this environment. The test may be performed anywhere under any conditions that the tested equipment might be subject to providing the accuracy of the measuring equipment is not affected.

6.0 Test Procedure

6.1 Initial Test Equipment Setup

A. Turn all test equipment on and allow it to stabalize for a minimum of 15 minutes.

B. Connect the RMS voltmeter and frequency counter to the sine wave generator output. Set the sine wave generator output to 30 Hz +/- 1 Hz. Set the output amplitude to 0.2V +/- .05V RMS.

C. Disconnect the RMS voltmeter and counter from the sine wave generator. Connect the oscilloscope to the sine wave generator output. Set the oscilloscope to DC input. Set the oscilloscope sensitivity to .02V/DIV or a sensitivity that will allow the input signal to almost fill the screen top to bottom, but not so sensitive that the peaks of the sine wave cannot be seen. Set the oscilloscope sweep speed so that several cycles of the sine wave are visible and any vertical shift of the signal is easily seen. Switch the oscilloscope input back and forth from DC input to AC input while observing the signal on the oscilloscope. If there is any vertical shift of the signal adjust the DC offset control on the sine wave generator until there is no detectable shift of the signal when switching from DC input to AC input. Disconnect the oscilloscope from the sine wave generator.

D. Connect the RMS voltmeter and frequency counter to the sine wave generator output. Set the sine wave generator output to 1 Hz +/- 0.5 Hz. Set the output amplitude to 0.177V RMS +/- 0.01V RMS. Disconnect the signal generator. Leave the frequency counter connected to the signal generator output.

6.2 Initial PFTU Unit Setup

A. Install PFTU amplifiers in the slots provided in the PFTU unit.

B. Set the PFTU amplifier gain switch to position #2.

C. Connect the oscilloscope to the first stage output of the PFTU amplifier.

D. Connect a resistance of 100 ohms or less to the signal input of the PFTU amplifier to ensure a zero input signal when balancing the DC output offset of the amplifier.

E. Apply power to the PFTU unit and turn it on.

F. Set the oscilloscope sensitivity to 0.1V/DIV or less. Set the sweep speed so a horizontal trace is easily visible. Set the input selector to the GND position and position the trace on the center line. Switch the input selector of the oscilloscope to the DC position.

G. Observe the output of the amplifier on the oscilloscope and adjust the first stage amplifier balance control for zero output. Connect the oscilloscope to the PFTU second stage amplifier output. Observe the output of the second stage and adjust the second stage balance control for zero output. The first and second stage balance controls interact and adjusting one may slightly unbalance the other, so repeat the balance procedure until both first and second stage outputs have zero DC offset. It is important that the DC offset be set as close as possible to zero to prevent erroneous output measurements.

H. Remove the low resistance from the signal input and connect the oscilloscope to the second stage output.

7.0 PFTU Amplifier Frequency Response Measurements

7.1 Obtain a copy of the TP-85, page 10 of 11, Rev 0, Table #1 "Frequency Response Measurements".

7.2 A. Connect the sine wave generator output previously set to 1 Hz and 0.177V +/- .01V to the input of the PFTU amplifier.

B. Connect the RMS voltmeter to the second stage output monitor points. Adjust the output of the sine wave generator to yield an output of 1.77V +/- 0.1V RMS from the second stage amplifier output. This measurement is the output of the second stage of the amplifier and is to be recorded in TP-85 Table #1 "PFTU Amplifier Frequency Response Measurements" on the 1 Hz line, second stage output volts column. Observe the output of the amplifier on the oscilloscope to be sure there is no clipping or distortion of the sine wave.

C. Remove the oscilloscope and RMS voltmeter from the second stage output and connect them to the first stage output. Measure the output of second stage and record this value in TP-85, Table #1 on the 1 Hz line, First Stage Output Volts column. Observe the output of the amplifier on the oscilloscope to be sure there is no clipping or distortion of the sine wave.

D. Remove the RMS voltmeter from the first stage output of the amplifier and connect it to the input of the amplifier. Measure the RMS sine wave input voltage to the amplifier. Record this measurement on the 1 Hz line, Sine Wave Input Volts column of the TP-85, Table #1.

E. Divide the first stage RMS output volts by the RMS input volts. The result is the gain of the first stage of the PFTU amplifier and is to be recorded on the 1 Hz line, First Stage Gain column of TP-85, Table #1.

F. Divide the second stage RMS output volts by the RMS input volts. The result is the total gain of the amplifier, and is to be recorded on the 1 Hz line Amplifier Gain column of TP-85, Table #1.

G. Change the output frequency of the sine wave generator to the next one listed in the Input Frequency column of TP-85, Table #1. Repeat steps 7.2B thru 7.2F for the remaining frequencies listed in TP-85, Table #1.

H. The measured gains should not vary more than +/- 0.05V RMS from the 1 Hz measurement to the 30 Hz measurement.

8.0 PFTU Amplifier Gain Measurements

8.1 Obtain a copy of the TP-85, page 11 of 11, Rev 0, Table #2 "PFTU Amplifier Gain Measurements".

8.2 Preliminary Equipment Setup

A. Set up the test equipment and PFTU unit as specified in TP-85, 6.1A thru 6.1C.

B. Connect the RMS voltmeter and frequency counter to the sine wave generator output. Set the sine wave generator output to 20 Hz +/- 0.5 Hz. Set the amplitude to 0.35V RMS +/- 0.02V. Disconnect the RMS voltmeter from the sine wave generator.

C. Set the gain control switch of the PFTU amplifier to the #1 position.

8.3 Gain Measurements

A. Connect the oscilloscope and RMS voltmeter to the second stage output of the PFTU amplifier. Connect the sine wave generator to the PFTU amplifier input. Adjust the sine wave generator to yield an output from the amplifier of 1.77 +/- 0.1V RMS. This measurement is the output of the amplifier and is recorded on the gain switch position #1 line Second Stage Output Volts column of TP-85, Table #2 "PFTU Amplifier Gain Measurements". Observe the output of the amplifier on the oscilloscope to be sure there is no clipping or distortion of the sine wave.

B. Disconnect the oscilloscope and RMS voltmeter from the second stage output and connect them to the PFTU amplifier first stage output. Measure the RMS voltage output and record this value on the gain switch setting #1 line, First Stage Output Volts column of TP-85, Table #2.

C. Disconnect the RMS voltmeter from the second stage output and connect it to the PFTU amplifier signal input. Measure the RMS input voltage and record this value on the gain switch position #1 line of the Sine Wave Input Volts column of TP-85, Table #2.

D. Divide the RMS output volts of the amplifier first stage by the amplifier input volts. The result is the gain of the first stage of the amplifier and is recorded on the gain switch position line #1 First Stage Gain column of TP-85, Table #2.

E. Divide the RMS output volts of the amplifier second stage by the amplifier input volts. The result is the gain of the amplifier and is recorded on the gain switch position line #1 Second Stage Gain column of TP-85, Table #2.

F. It may be necessary as the gain settings increase during these measurements to install attenuators in series with the sine wave generator to maintain the required amplifier output.

G. Leave the oscillator set at 20 Hz +/- 0.5 Hz and repeat steps 8.3A thru 8.3F for the remaining gain switch positions listed in TP-85, Table #2.

8.4 Compare the measured amplifier gains in TP-85, Table #2 to those listed in TP-85 8.5 (Gain Verification Table). The upper and lower limits listed represent +/- 3% deviation from the ideal gain of the amplifier. If the gains do not fall within these limits then there is a problem in the system to be corrected and the frequency and gain measurements redone.

8.5 GAIN VERIFICATION TABLE
PFTU AMPLIFIER

GAIN SWITCH POSITION	FIRST STAGE GAIN LOWER LIMIT	FIRST STAGE GAIN UPPER LIMIT	FIRST STAGE GAIN NOMINAL	SECOND STAGE GAIN LOWER LIMIT	SECOND STAGE GAIN UPPER LIMIT	SECOND STAGE GAIN NOMINAL
#1	0.97	1.03	1.00	4.89	5.19	5.04
2	1.90	2.02	1.96	9.55	10.15	9.85
3	4.72	5.02	4.87	23.73	25.19	24.46
4	9.70	10.30	10.00	48.67	51.69	50.18
5	19.03	20.21	19.62	95.50	101.4	98.45
6	47.47	50.41	48.94	239.23	252.97	245.6
7	92.50	102.44	99.46	484.03	513.97	499.0

9.0 Safety

The activities and associated equipment covered by this technical procedure have been determined to have no significant or unusual safety hazards. Review and approval by SNL Safety Engineering Department and/or appropriate organizations are not required.

PETU AMPLIFIER
AMPLIFIER FREQUENCY MEASUREMENTS

IDENTIFICATION
AMPLIFIER MEASUREMENT AXIS_____
TELEMETRY BOX #_______________
STATION #____________________
SURFACE______DOWNHOLE__________

DATE______________________
OPERATORS NAME (print)
____
OPERATORS INITIALS______

TABLE #1
FREQUENCY RESPONSE MEASUREMENTS

GAIN SWITCH POSITION	INPUT FREQUENCY	SINE WAVE INPUT VOLTS RMS	FIRST STAGE OUTPUT VOLTS RMS	FIRST STAGE GAIN	SECOND STAGE OUTPUT VOLTS RMS	SECOND STAGE GAIN
	1 Hz	.	.	.	.	.
	2 Hz	.	.	.	.	.
#2	5 Hz	.	.	.	.	.
	10 Hz	.	.	.	.	.
	20 Hz	.	.	.	.	.
	30 Hz	.	.	.	.	.

FREQUENCY RESPONSE TEST EQUIPMENT LIST

DESCRIPTION	MFGR	MODEL	SERIAL #	SANDIA PROPERTY #	CALIBRATION EXPIRATION DATE
__________	____	_____	_______	_________	__________
__________	____	_____	_______	_________	__________
__________	____	_____	_______	_________	__________
__________	____	_____	_______	_________	__________

COMMENTS: ____

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PFTU AMPLIFIER
AMPLIFIER GAIN MEASUREMENTS

IDENTIFICATION
AMPLIFIER AXIS____________
TELEMETRY BOX #___________
STATION #_________________
SURFACE_____DOWNHOLE______

DATE____________________
OPERATORS NAME (print)
____
OPERATORS INITIALS_____

TABLE #2
AMPLIFIER GAIN MEASUREMENTS

GAIN SWITCH POSITION	INPUT FREQ. HZ	SINE WAVE INPUT VOLTS RMS	1ST STAGE OUTPUT VOLTS RMS	FIRST STAGE GAIN	SECOND STAGE OUTPUT VOLTS RMS	SECOND STAGE GAIN
1		.	.	.	.	.
2		.	.	.	.	.
3		.	.	.	.	.
4	20 Hz	.	.	.	.	.
5		.	.	.	.	.
6		.	.	.	.	.
7		.	.	.	.	.

GAIN MEASUREMENT TEST EQUIPMENT LIST

DESCRIPTION	MFGR	MODEL	SERIAL #	SANDIA PROPERTY #	CALIBRATION EXPIRATION DATE
___________	____	_____	________	__________	___________
___________	____	_____	________	__________	___________
___________	____	_____	________	__________	___________
___________	____	_____	________	__________	___________

COMMENTS: ____

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NNA.880317.0007

NNWSI PROJECT

SET-UP AND ADJUSTMENT OF TM CONTROL BOX (PNE SEISMIC)

Page	1	2	3	4	5	6	7	8	9
Rev	0	0	0	0	0	0	0	0	0

Approved by:

Jimmy G. Lee
Jimmy G. Lee, 7125
Author
2-1-88
Date

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SAIC/T&MSS
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SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT

Issued to: M. D. Cotter, SAIC (TEC)

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1.0 Purpose

1.1 The purpose of this TP is to define the procedure for calibration and set up of the electronics in the PNE TM box in preparation for field operation.

2.0 Scope

2.1 This TP applies to the function switch setting, amplifier gain patching and VCO calibration of the PNE TM boxes that are installed at selected waste isolation seismic measurement installations. This document does not cover calibration of the amplifiers in the PNE TM box as those are covered by TP-83.

3.0 Definitions

3.1 Terms:

A.	VCO	Voltage controlled oscillator
B.	PNE	An acronym for a project these TM boxes were originally designed for.
C.	TM Box	A box containing electronic components necessary to relay the measured signals to the recording facility.
D.	Calibration Voltage	A precision known voltage that is applied to the VCO to provide a fixed known data band edge reference.
E.	Data Band Edge	The upper and lower limits of the VCO deviation frequency corresponding to a specified input voltage.

4.0 TM Box Function Description

4.1 The TM box consists of a data transmitter, command receiver, command circuits, voltage controlled oscillators, data amplifiers, calibration power supply and function switches.

4.2 The only adjustments available in the TM box are amplifier gain settings, VCO adjustment and function switch positions. The calibration power supply, the command receiver and data transmitter have no adjustments.

5.0 TM Box Function Switch Settings

5.1 Since the TM boxes can be operated in various configurations such as master-slave, local control and remote control a description of each switch function in each configuration would be difficult, thus only the function of each switch will be covered and should be self explanatory.

5.2 Description of Each Switch Function

A. Manual Power On	Local control of TM box
B. Manual Cal On	Local control of TM box cal applies +2.5V and 0.0V to VCO
C. Command Receiver	Enable TM box to be controlled via command tones from receiver/decoder
D. Remote Command	Enable TM box to be controlled via hardwire from master TM box

E.	Mode Select	(Position 1) Enables TM box to utilize its local transmitter. "single box only" (Position 2) Enables TM box to utilize its local transmitter while bringing in multiplexed data from remote box. "used as master box"
F.	Command Power On	Turns TM box receiver/decoder on and off
G.	Auto Command	Enables TM box to be controlled via command tones
H.	Manual Command	Enables TM box to be locally controlled manually
I.	Remote Command In	Enables the TM box to send commands to any remote station
J.	Remote Command Out	Enables the TM box to receive commands from any remote station

6.0 Data Amplifier Gain Patching

6.1 The data amplifiers consist of two stages of amplification. Each stage has a five position patch board with each position corresponding to a fixed gain. The first amplifier stage is labeled "A1" and the second stage is labeled "A2". The gain of the amplifier is determined by the position of the shorting plug in the respective patch boards. Total gain of the amplifier is the product of A1 x A2.

6.2 PNE Amplifier Gain Selection Table

A2 → A1 ↓	1	2.05	5.11	10	20.5
	Total Gain A1 x A2				
1	1	2.05	5.11	10	20.5
2.05	2.05	4.2	10.47	20.5	42.0
5.11	5.11	10.47	26.1	51.1	104.7
10	10	20.5	51.1	100	205
20.5	20.5	42.0	104.7	205	420.25

7.0 VCO Functional Description

7.1 The voltage controlled oscillators used in the PNE TM boxes are standard +/-7.5% proportional band width VCO's with a sensitivity of +/-2.5V band edge to band edge. The VCO's are standard IRIG frequencies.

7.2 A positive-going input results in an increasing output frequency, while a negative-going input causes the output frequency to decrease.

8.0 VCO Adjustment and Calibration

9.0 List and Description of Minimum Needed Equipment

9.1 PNE TM Box

9.2 Power Supply for TM Box

9.3 Frequency Counter

A. Accuracy of +/-0.25%

9.4 Precision Digital Voltmeter

A. Accuracy of +/-0.25%

10.0 Test Environment

10.1 For convenience these tests are normally performed in a laboratory environment; however, they are not dependent on this environment. The test may be performed anywhere under any conditions that are within the range of acceptable conditions specified by the manufacturers for operating the testing and measuring equipment.

11.0 VCO Test and Adjustment Procedure

11.1 Initial Test Equipment Setup

A. Apply power to the TM box and test equipment and allow it to stabalize for a minimum of 15 minutes.

B. TM Box SW settings

B.1 MAN/CAL SW on
MAN/PWR SW on
VCO Test SW center position

11.2 Obtain a copy of TP-86, page 9 of 9 Rev 0, Table #1 "VCO Frequency Measurements".

11.3 VCO Test Procedure

A. Connect the negative lead of the voltmeter to ground and the plus lead to pin #1 of any VCO mounting connector. The CAL voltage is simultaneously applied to pin #1 "Signal Input" of all the VCO mounting connectors via relays.

B. Place the CAL switch in the UBE position and read the voltage. The UBE CAL voltage should be plus 2.5V +/- 0.025. The measured value is to be recorded on a copy of the TP-86 Table #1 VCO Frequency Measurement in the space under UBE volts. Place the CAL switch in the CB position and measure the voltage at pin #1. The CB CAL voltage should be 0.0 volts +/- 0.025. The measured value is to be recorded on Table #1 in the space under CB volts.

C. Connect the frequency counter to the output monitor jack of the VCO under test.

D. Place the VCO CAL switch in the CB (center band) position. Adjust the frequency of the VCO to the indicated frequency in Table #1.

E. Place the VCO CAL switch in the UBE (upper band edge) position. Adjust the sensitivity control on the VCO to obtain the UBE frequency specified in Table #1.

F. On some models of VCO the frequency adjust and sensitivity adjust interact so it is necessary to repeat steps D and E until the VCO frequency is within tolerance as indicated in Table #1.

G. When the VCO frequencies are properly adjusted, record the CB and UBE frequency in the indicated row and columns of Table #1.

H. Repeat steps 11.3B thru 11.3G for any other VCO to be calibrated.

12.0 The activities and associated equipment covered by this technical procedure have been determined to have no significant or unusual safety hazards. Review and approval by SNL Safety Engineering Department and/or appropriate organizations are not required.

13.0 References

EP-004 "Experiment procedures for acquiring, digitizing, processing, storing and retrieving ground motion data from underground nuclear explosions."

DATE ______________________________

OPERATOR'S NAME (print)

____

OPERATOR'S INITIALS __________

TM BOX # ________________________

TABLE #1

VCO FREQUENCY MEASUREMENT

CALIBRATION VOLTAGE	
CB Volts	UBE Volts
----------	----------

IRIG FREQUENCIES +/- 7.5% Proportional BW			MEASURED FREQUENCY	
Center Band Frequency (Hz)	Upper Band Edge (Hz)	Tolerance (Hz)	Center Frequency (Hz)	Upper Band Edge (Hz)
2,300	2,473	7		
3,000	3,225	9		
3,900	4,193	12		
5,400	5,805	16		
7,350	7,901	22		
10,500	11,288	31		
14,500	15,588	43		
22,000	23,650	66		
30,000	32,250	90		
40,000	43,000	120		
52,500	56,438	157		
70,000	75,250	210		

NNA.880205.0041

NNWSI PROJECT

GROUND MOTION GAGE OPERATION VERIFICATION

Page	1	2	3	4	5	6
Rev	0	0	0	0	0	0

Approved by:

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Jimmy G. Lee, 7125 — Date
Author

Robert L Rutter — 1/29/88

Robert L. Rutter, 7125 — Date
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D. C. Browne, 7125 — Date
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James S Phillips — 1/21/88

J. S. Phillips, 7111 — Date
Task Leader

Subramanian — 2/2/88

C. V. Subramanian, 6311 — Date
Principal Investigator

Al Stevens — 2/2/88

A. L. Stevens, 6311 — Date
Supervisor, SNL

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1.0 Purpose

1.1 The purpose of this TP is to define the procedure for verifying the operation and static 1g sensitivity of instrumentation gages.

2.0 Scope

2.1 This TP applies to gages used to measure acceleration in the seismic instrumentation installations.

3.0 Definitions

3.1 Terms:

A. Accelerometer . A gage used to measure acceleration.

4.0 List and Description of Minimum Needed Equipment

4.1 Precision Voltmeter/Ohm Meter

A. Accuracy of 0.5% or better

4.2 Flat and Level Table or Gage Fixture that is adjustable in such a manner that the sensitive axis of the gage may be aligned coincident with the earth's gravity field.

4.3 Power Source

A. Power supply capable of supplying the proper voltage to the gage.

5.0 Test Environment

5.1 For convenience these tests are normally performed in a laboratory environment; however, they are not dependent on this environment. The test may be performed anywhere under any conditions that are within the range of acceptable conditions specified by the manufacturers for operating the testing and measuring equipment.

6.0 <u>Gage Performance</u>

6.1 An accurate static calibration of +1g and -1g may be accomplished by aligning the sensitive axis of the accelerometer coincident with the earth's gravity vector and measuring the output of the gage in volts.

6.2 The true output sensitivity of the gage in V/G will be obtained when the sensitive axis of the gage is coincident with the earth's gravity field.

7.0 <u>Test Procedure</u>

7.1 Initial Test Setup

A. Turn the power supply on and set the voltage of the power supply to that required by the gage. (Refer to the specifications in the Gage Manual for the proper supply voltage.) Measure and record the power supply voltage on Form #1 TP-88, Rev 0, Gage Sensitivity Measurements.

B. Measure the resistance of any load or range resistors and record these values in the External Gage Components Table of TP-88 Form #1 Gage Sensitivity Measurements, and indicate resistor function (load, range, etc.).

C. Connect the resistors to the appropriate pins on the gage. (Refer to the Gage Manual for pin function and location.)

D. Connect the power supply to the appropriate excitation connections on the gage.

E. Connect the precision voltmeter to the signal output of the gage.

F. Turn the power supply and precision voltmeter on and allow to warm up and stabalize for 10 minutes.

8.0 <u>Gage Sensitivity Measurements</u>

8.1 Obtain a copy of TP-88, page 6 of 6, Rev 0, Form #1 "Gage Sensitivity Measurements".

8.2 A. Place the gage on a flat table or mount it on a suitable gage fixture. The table or fixture should be adjustable in such a manner that the sensitive axis of the gage may be aligned coincident with the earth's gravity field. (A square and bubble levels may be used for alignment.) Adjust the sensitive axis of the gage for maximum voltage output.

B. Read the +1g output in volts of the gage and record this reading on the +1g column of TP-88, Form #1.

C. Invert the accelerometer so the sensitive axis is coincident with the earth's gravitational field and has a -1g output. Repeat Step 8.2A.

D. Read the -1g output in volts of the gage and record this reading on the -1g column of TP-88, Form #1.

E. Numerically add the +1g reading and the -1g reading (disregarding polarity) and divide by two. The result is the sensitivity of the gage in volts per g. This reading is to be recorded in the column Gage Volts per g of TP-88, Form #1.

F. Repeat steps 7.1B thru 8.2E for any other gage being measured.

9.0 The activities and associated equipment covered by this technical procedure have been determined to have no significant or unusual safety hazards. Review and approval by SNL Safety Engineering Department and/or appropriate organizations are not required.

10.0 References

EP-004 - "Experiment procedures for acquiring, digitizing, processing, storing and retrieving ground motion data from underground nuclear explosions."

FORM #1
GAGE SENSITIVITY MEASUREMENTS

INSTALLATION INFORMATION

MEASUREMENT AXIS ________

CANISTER # ______________

SURFACE_____DOWNHOLE____

TELEMETRY BOX # ________

STATION _______________

DATE ____________________________

OPERATOR'S NAME (Print)

____

OPERATOR'S INITIALS__________

GAGE TYPE	SERIAL NO.	EXC. VOLT	+1G VOLTS	-1G VOLTS	GAGE SENS V/G
		+ -			

EXTERNAL GAGE COMPONENTS
RESISTORS, ETC.

COMPONENT TYPE	FUNCTION	VALUE

GAGE SENSITIVITY TEST EQUIPMENT LIST

DESCRIPTION	MFGR	MODEL	SERIAL #	SANDIA PROPERTY #	CALIBRATION EXPIRATION DATE

COMMENTS:

____

____

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NNWSI PROJECT

Procedures for Storing and Retrieving UNE Ground Motion Data used for the NNWSI Project

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Rev	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Approved by:

James S. Phillips — 3/10/88
J. S. Phillips, 7111, Principal Investigator — Date

3/10/88
J. W. Long, 7111, Independent Technical Review — Date

3/14/88
C. V. Subramanian, 6311, Task Leader — Date

John R. Banister — 3/11/88
J. R. Banister, 7111, Division Supervisor — Date

Al Stevens — 3/17/88
A. L. Stevens, 6311, Division Supervisor — Date

SAIC/T & MSS
MAR 25 1988
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1.0 Purpose

1.1 The purpose of this Technical Procedure (TP) is to describe all the steps necessary to insure that the underground nuclear explosion (UNE) ground motion data used to support the NNWSI project are securely stored and easily retrieved for future reference by authorized personnel.

2.0 Scope

2.1 This TP applies only to UNE ground motion data and supporting field records used for NNWSI. All administrative records associated with the gathering of the UNE data will be stored in the NNWSI DRMS. This TP addresses Section 4.3.4 of EP-004 entitled "Experiment Procedures for Acquiring, Digitizing, Processing, Storing and Retrieving Ground Motion Data from Underground Nuclear Explosions". Records covered by this TP are the products of TPs 82 through 88.

3.0 Requirements

3.1 All Personnel directly involved in determining the appropriate file category of the records generated in recording UNE ground motions will be certified in accordance with NNWSI DOP 2-6. Personnel in Sandia National Laboratories Division 3154-1 need not be certified.

3.2 All of these Personnel are required to read and follow the procedures outlined herein. If situations arise in which these procedures cannot be followed, a "Non-Conformance Report" (per the requirements of QAP 15-1) will be filled out and sent to the 7111 PI. Corrective action will be undertaken and documented following the requirements of QAP 16-1.

3.3 All personnel having contact with the original analog tapes, paper playbacks, or digitizing records will take special care to protect these records until they are safely archived.

3.4 Personnel responsible for the generation of a record that will be included in this system are required to check that record for legibility and correctness.

3.5 It is the responsibility of the personnel charged with copying any records to make sure all copies are legible. In addition, personnel sending copies of records are required to notify the recipient of their impending arrival.

3.6 It is the responsibility of the recipient of the copies of records to notify the sender that the records have arrived.

3.7 Access to the records stored in the system described herein is limited to the personnel in SNL Divisions 7111 and 7125. Requests for data in this system must originate with a written request to the 6311 Task Leader, who will transmit the request to the 7111 PI.

3.8 Control of the records included in this system is the responsibility of the 7111 PI. Note that UNE data is considered a national resource and as such, must not be destroyed.

3.9 It is the responsibility of the personnel involved in the work described in this TP, to insure that all records in this system be treated as items for permanent retention.

4.0 Definitions:

4.1 Single Storage Facility A facility where one-of-a-kind records are stored.

4.2 Dual Storage Facility A facility where one of at least two copies of a record are stored.

4.3 Analog Tape The original recording of UNE ground motion. All UNEs used for NNWSI are recorded on analog tape.

4.4 Digital Tape The UNE ground motion is converted from an analog signal to discrete numbers (see TP-82 for a description of the process). These data are transferred to a digital tape.

4.5 Field Records Notebooks containing information concerning how the data was recorded and digitized (records referred to as "Drop Books", "Field Data Sheets" and "paper playbacks" are included in this designation)

4.6 Administrative Files All records not specifically concerned with the recording and processing of UNE ground motions are considered to be administrative records (e.g., annual dump of the WTSI data base and microfiche copies of the tape scans of the digital tapes) and will not be maintained in 7111.

4.7 IRT Inactive Records Transfer - This is a form and the process by which data is inserted into the Sandia National Laboratories Archive Records System.

4.8 Single Storage Record One-of-a kind records.

4.9 Dual Storage Record Records that are stored in duplicate or derived from records stored in duplicate.

4.10 Digitization Records Sheets describing the process by which the data for a particular event were converted from analog to digital form ("Data Digitizing Procedures" and paper playbacks are included).

4.11 Paper Playbacks — Hard copy plots of recorded UNE ground motion taken directly from the analog tape.

4.12 Gage Calibration Log — History of the calibration record of a particular gage.

4.13 Station Log — History of the station containing information about all equipment used in operating that particular seismic station.

4.14 Canister Log — History of the canister containing information about all equipment associated with that canister.

4.15 Event Log — Contains all information about equipment used to record a particular UNE.

5.0 Description of Facilities

5.1 Single Storage Facility - The records entered into the Sandia National Laboratories Archive Records system (SNLARS) are stored in the Manzano facility at Kirtland AFB, NM. This facility has a high level of security which restricts access to only a very few authorized personnel. The storage rooms are underground where the temperature is constant at about 60 degrees Fahrenheit. Drainage is provided, if there is any water infiltration, concrete floors are painted and any rodent populations are controlled with poisons. Records are stored in double-walled cardboard boxes on floor-to-ceiling shelves. Fire protection is provided in the area by military security personnel and fire extinguishers are located in the structure. The nature of these structures and the very limited access to them limits the possibility of fire to a very small probability. This facility meets the requirements specified in NNWSI-SOP-02-01 for a "Single Facility".

5.2 Dual Storage Facilities - There are four locations for the dual facilities. One of these facilities is located in Building 10 of CP 1 in Area 6 of the Nevada Test Site (NTS). This facility consists of office and laboratory space. Large file cabinets house NNWSI records in this facility. A second facility is located at the Fire Station of Area 25 at NTS. This facility houses the recording equipment used to record data at Yucca Mountain. NNWSI records are stored in file cabinets. A third facility is located in the offices of Division 7111 in Building 806 of Area I at Sandia National Laboratories (SNLA) on Kirtland AFB, NM. The storage area in this facility consists of floor-to-ceiling shelves and file cabinets in offices and closed front bookcases in hallways. The final facility is the Tape Library of Department 2600, in Building 880, Area I, SNLA on Kirtland AFB, NM. In addition to the four permanent facilities discussed above, a temporary facility in SNLA Division 7522 is used for analog tapes and paper playbacks during the digitizing process.

6.0 Description of Records

6.1 The records gathered by this project will be placed in two general categories. These are single storage records and dual storage records. The record name, type and location are given in Table 1. The remaining paragraphs in this section describe, in detail, what each record type consists of and where they are located.

Table 1. Records Used in Support of NNWSI

Record Name	Type	Location			
		Manzano	NTS	Div. 7111	Div. 2600
Analog Tape	Single	x			
Field Data Sheets	Dual		x	x	
Digitization Recs.	Dual	x		x	
Paper Playbacks	Single	x			
Final Digital Tapes	Dual			x	x
Hard Copy Ground Motion Data	Dual			x	
Gage Cal. Log	Dual		x	x	
Station Log	Dual		x	x	
Canister Log	Dual		x	x	
Event Log	Dual		x	x	

6.2 <u>Analog Tape</u>

6.2.1 UNE data is recorded such that there are two complete copies on analog tape. These tapes are stored temporarily in SNLA Divisions 7111 and 7522 until the data can be converted to digital form. When the data have been converted and checked, these tapes are entered into the SNLARS.

6.3 <u>Field Records</u>

6.3.1 Field records generated by this project are described in TP-82 through TP-88 and consist of event data sheets and various calibration records. The event data sheets consist of Summary Sheets, Station Track Assignment Sheets, Track Sheets and Station Data Sheets which are generated for each UNE conducted. The calibration records are generated at specified intervals. The original event data sheets are stored in Building 10, Area 6 at NTS. Copies of the event data sheets are sent to SNLA Division 7111 where they are stored in duplicate. Original calibration records of the ground motion gages are also stored in Building 10 at NTS. Copies of these records are sent to SNLA Division 7111 where a single copy is stored. Original calibrations of the equipment used to verify various components of the measurement and recording system are stored at Building 10. Duplicates of these records are stored at the Fire Station in Area 25, NTS.

6.4 <u>Digitizing Records</u>

6.4.1 These records are described in TP-82 and consist of all the information used in the digitizing of the ground motion data. This includes paper playback requests, copies of the input and output to the digitizing macros, plots of the calibrations on the tape, plots of the data (in digitizer counts versus time) and tape scans of the digital tapes produced by SNLA Division 7522. All of these records, with the exception of the plots, are stored in the Manzano facility with the analog tapes. Copies of this information and the plots are stored in Division 7111 at SNLA.

6.5 <u>Paper Playbacks</u>

6.5.1 Paper playbacks are produced immediately after the ground motion data was recorded in the field and in the initial stages of the digitizing process. The field paper playbacks are used as a verification that data were recorded and to provide a qualitative indication of the quality of the data. The paper playbacks produced in the digitizing process are used to verify the contents of the tape and to provide a means to read the time code present on the tape. These records are stored temporarily in SNLA Divisions 7111 and 7255 until the digitizing process has been completed. At that time they are transferred to the SNLARS.

6.6 Final Digital Tapes

6.6.1 These tapes are the end product of the digitizing and processing operations. The data contained on these tapes consist of raw data (as originally recorded), filtered data and rotated data (data placed in UNE specific coordinate system). Three copies of these tapes exist. One copy is stored in SNLA Division 7111 and two copies are kept in the Computer Tape Library of SNLA Department 2600.

6.7 Hard Copy Ground Motion Data

6.7.1 Hard copy ground motion data consist of time history plots of raw data, filtered data and rotated data. In addition, there are plots of power density spectra calculated for the raw data and pseudo relative velocity response (PSRV) spectra calculated at 5% damping from the rotated data. One copy of these data is stored in SNLA Division 7111. These data are derived from other records stored in the system and therefore considered as dual storage records.

6.8 Gage Calibration Log

6.8.1 This log contains all the calibration records of the ground motion gages used in the project. These records are stored in Building 10 at NTS and in Division 7111, SNLA. A summary record of this information is contained in the Weapons Test Seismic Investigations (WTSI) data base.

6.9 Station Data Sheet

6.9.1 This log contains all the information concerning station locations and equipment used in the station. This information is stored in Building 10, NTS and in the WTSI data base in Division 7111, SNLA.

6.10 Canister Log

6.10.1 This log contains information about equipment installed in the various canisters used in the project. This log was discontinued after FY86 because it contained redundant information. The information from this old log is stored in Building 10, NTS and in the WTSI data base in Division 7111, SNLA.

6.11 Event Log

6.11.1 This log contains information about all stations, canisters and gages used to measure ground motion from a specific UNE. This information is stored in Building 10, NTS and the WTSI data base in Division 7111, SNLA.

7.0 Description of Filing System

7.1 Building 10, Area 6 and Fire Station, Area 25, NTS

7.1.1 All files in this system are keyed to the master event file. This file contains all field data sheets used to record the ground motion from a specific UNE by name. In this file all equipment is cross-referenced by their specific identifiers (e.g., gage serial number, station name, etc.). These identifiers can be used to access more specific information concerning any of the measurement system components. This information is filed by component serial number. In addition, calibrations of the bench equipment used to verify the components of the measurement system are cross-referenced and filed by serial number.

7.2 SNLA Division 7111

7.2.1 The WTSI data base is the master file for the records stored in this facility. This data base is set up on the open NOS computer of the SNLA CCF. The data base consists of four files that contain station, canister, gage and event information. The Event file is the primary file (i.e., all other files are cross-referenced in this file). Event information is filed by the event number. All information about the equipment used for a particular event is given in this file as well as the event location. Gage information is filed by gage serial number. The information included in this file consists of a history of calibration and canister of installation. Canister information is filed by canister number. Gage serial numbers and stations numbers are identified in this file. Station information is filed by the station name. This file includes canister numbers, gage numbers and the station location. Using this data base, most of the information concerning the recording of the ground motion from a UNE (e.g., event location, stations operated, gage calibrations, etc.) is easily obtainable. Paper records that back up this data base or that are not included in the WTSI data base, are filed by event name and number (if specifically related to the event) or by equipment serial number (if related to a specific piece of equipment). The DRMS data set ID numbers can be cross-referenced by the date of the record.

7.3 SNLA Department 2600 Computer Tape Library

7.3.1 The SNLA computing facility has a numbering system for all tape contained in the library. This numbering system is cross referenced to event names and numbers in the Division 7111 filing system.

7.4 SNL Archive Records System

7.4.1 This system is used to store many records of Sandia National Laboratories in general and Division 7111, more specifically. In general, records in this system are filed by numbers assigned by Division 3154. Records are transferred to the SNLARS in heavy, double-walled cardboard boxes. An IRT for each box is used to describe the contents. This IRT is cross referenced by the shot name and number. Copies of the IRT are filed in the box, in division 3154 and in division 7111. The IRTs in the 7111 files are subdivided into several categories. The categories of interest to NNWSI are USGS Seismic Records, NE Tests - Paper and Film, NE Tests - Analog Tapes, NE Tests - Digital Tapes and Computer Programs. Records placed in this system are of two types. Any item identified as data from a UNE is designated for permanent retention. All other records have a retention period of five years. At the end of five years, the records are reviewed by the personnel who archived the record to determine if it should be kept or discarded.

8.0 Procedures

8.1 Records Storage

8.1.1 Building 10, Area 6 and Fire Station Area 25, NTS

8.1.1.1 Upon completion of the recording of UNE ground motion data from a specific event, the Supporting Staff (Field Technician) will complete and copy all field data sheets. The original field data sheets will be filed in the Event Master File in Building 10. The copies and analog tapes will be mailed to the 7111 PI as outlined in TP-82. The Supporting Staff (Field Technician) will notify the 7111 PI that the data was shipped.

8.1.1.2 The Supporting Staff (Field Technician) will file all originals of the ground motion gage calibration records for newly calibrated gages as they are received. These will be placed in the Gage File in numerical order by gage serial number. For each gage the calibration records will be filed in chronological order. The Supporting Staff (Field Technician) will make copies of these records, notify the 7111 PI that they are being mailed and transmit them to the 7111 PI.

8.1.1.3 The Supporting Staff (Field Technician) will file all originals of the forms used in the verification and setup of the components of the recording system covered in TP-83 through TP-88 as they are completed. These forms will be placed in the appropriate equipment files in numerical order by serial number. For each piece of equipment the forms will be filed in chronological order. The Supporting Staff (Field Technician) will make copies of these records, notify the 7111 PI that they are being sent and transmit them to the 7111 PI.

8.1.1.4 The Supporting Staff (Field Technician) will copy the originals of the bench equipment calibration forms and file them in the appropriate equipment file. (Note that this equipment is used in the verification of the recording system components.) These forms will be filed in numerical order by serial number and chronologically for each serial number in both Building 10 and the Fire Station.

8.1.2 <u>SNLA Division 7111</u>

8.1.2.1 UNE Data

8.1.2.1.1 Upon receipt of analog tapes, field data sheets and paper playbacks, the 7111 PI will notify the 7125 Supporting Staff (Field Technician) of the arrival of the data. The 7111 PI will then give the data to the 7111 Supporting Staff (Scientific Investigator) to initiate the digitizing process.

8.1.2.1.2 The 7111 Supporting Staff (Scientific Investigator) will make copies of all Field Data Sheets and file them in the Event Files by event name and number in Room 226 of Building 806, SNLA.

8.1.2.1.3 The 7111 Supporting Staff (Scientific Investigator) will transmit the analog tapes, field data sheets and field paper playbacks to the the 7522 Supporting Staff (Data Reduction Clerk).

8.1.2.1.4 The 7522 Supporting Staff (Data Reduction Clerk) will temporarily store these data in a protected environment. All records generated in the digitizing process will be filed in the "Event Data Book" by the Supporting Staff (Data Reduction Clerk).

8.1.2.1.5 At the completion of the digitizing process, the analog tapes, paper playbacks and the "Event Data Book" will be transmitted from Division 7522 Supporting Staff (Data Reduction Clerk) to Division 7111 Supporting Staff (Scientific Investigator).

8.1.2.1.6 The 7111 Supporting Staff (Scientific Investigator) will copy the records describing the digitizing process and file the "Event Data Book" on the shelf in Room 234 of Building 806, SNLA. The 7111 Supporting Staff (Scientific Investigator) will notify the 7111 PI when the digitizing process is complete and the analog tapes, original digitizing records and paper playbacks can be filed in the SNLARS. (See 8.4.)

8.1.2.1.7 The 7111 Supporting Staff (Data Processing Clerk) will input the appropriate event, station canister and gage data from the field data sheets into the WTSI data base.

8.1.2.1.8 During data processing, the 7111 Supporting Staff (Data Processing Clerk) will maintain hard copies of all plots generated. These will be filed in notebooks identified by the type of plot and filed by the shot name and number. These books will be stored in Room 234 and in the closed bookcases in the hallway outside of Room 234, Building 806, SNLA. Plots of PSRVs will be maintained in notebooks located in Room 221, Building 806.

8.1.2.1.9 Upon completion of data processing the 7111 Supporting Staff (Scientific Investigator) will acquire two library tapes from the Department 2600 Tape Library. (See 8.3.) The 7111 Supporting Staff (Data Processing Clerk) will copy the processed data onto these tapes and an additional "personal" tape.

8.1.2.1.10 The 7111 Supporting Staff (Tape Librarian) will be notified of the tape numbers of the library tapes and record the tape numbers and event name and number in the Tape Log stored on the open NOS computer and on hard copy in Room 230 of Building 806, SNLA.

8.1.2.1.11 The 7111 Supporting Staff (Scientific Investigator) will return the two library tapes to the Department 2600 Tape Library. The 7111 Supporting Staff (Tape Librarian) will place a label containing the event name and number on a tape storage box and file the "personal" tape and a listing (tape scan) of the contents on the tape in the tape cabinet in the hallway outside Room 234, Building 806, SNLA. In addition, the 7111 Supporting Staff (Tape Librarian) will file tape scans of the two library tapes in the "Tape Scan" notebook by event name. This notebook is is kept in Room 230 of Building 806.

8.1.2.2 Equipment Records

8.1.2.2.1 Upon receipt of equipment calibration forms the 7111 PI will notify the 7125 Supporting Staff (Field Technician) of the arrival of the records. The 7111 PI will then give the records to the 7111 Supporting Staff (Data Processing Clerk).

8.1.2.3.1 The 7111 Supporting Staff (Data Processing Clerk) will enter the appropriate information from these forms into the WTSI data base and file the forms into the appropriate notebook. These notebooks are stored in Room 234, Building 806.

8.1.3 SNLA Department 2600 Computer Tape Library

8.1.3.1 The 7111 Supporting Staff (Scientific Investigator) will complete the necessary paperwork to place the blank tapes under his user ID in the Tape Library.

8.1.3.2 The 7111 Supporting Staff (Tape Librarian) will obtain and issue tape numbers for the blank library tapes and notify the 7111 Supporting Staff (Scientific Investigator) of these numbers to allow these tapes to be withdrawn from the 2600 Tape Library.

8.1.3.3 The 7111 Supporting Staff (Scientific Investigator) will complete the necessary paperwork to charge out blank library tapes so UNE seismic ground motion data may be written on them.

8.1.3.4 The 7111 Supporting Staff (Scientific Investigator) will obtain the blank "personal" tape.

8.1.3.5 The 7111 Supporting Staff (Scientific Investigator) will return the library tapes to the Tape Library after the data has been written on them.

8.1.4 SNLARS

8.1.4.1 The 7111 PI will file the records in the SNLARS.

8.1.4.2 The 7111 PI will categorize the records by type. The record types of interest to NNWSI are USGS Seismic Records, NE Tests - Paper and Film, NE Tests - Analog Tape, NE Tests - Digital Tapes and Computer Programs.

8.1.4.3 The 7111 PI will determine the box number. The numbers are sequential and designated as follows for the record categories described above.

Record Type	Box Identifier
NE Tests - Paper & Film	NE-XXX
NE Tests - Analog Tape	NE-AT-XXX
NE Tests - Digital Tape	NE-DT-XXX
USGS Seismic Tape	USGS-XXX
Computer Programs	CODES-XXX

8.1.4.4 The 7111 PI will obtain the heavy, double-walled cardboard boxes used for archiving material in the SNLARS and place the records inside.

8.1.4.5 The 7111 PI will obtain the IRT form (SNLA SF 1400-B) and identify the records placed in the box on the form. The records will be identified by a short description and the shot name and number. For example, a box of analog tapes for a group of UNEs would be described as:

<u>Box NE-AT-XXX</u>
Analog Tapes
Shot Number (Shot Name)
Tape 1 of 2, analog, Ground Motion, Recording Sta.
Tape 2 of 2, analog, Ground Motion, Recording Sta.
Shot Number (Shot Name)
Tape 1 of 1, analog, Ground Motion, Recording Sta.

8.1.4.6 Upon completion of the IRT the Division 7111 PI will notify Division 3154 that a box of records is ready for incorporation into the SNLARS.

8.1.4.7 The "Suspense Copy" of the IRT will be filed by the 7111 PI in the "IRT'S FOR ITEMS STILL IN STORAGE" notebook. At such time the records are incorporated in the SNLRS, a completed IRT is returned to 7111 and filed in place of the "Suspense Copy". The "Suspense Copy" is then transferred to the "SUSPENSE COPY" notebook. The notebooks used for the retention of IRTs and other paperwork associated with the SNLARS are stored in a locked spacesaver in the 7111 Division office (Room 218, Building 806, SNLA).

8.2 Records Retrieval

8.2.1 Upon receipt of written requests for data stored in this system, the 7111 PI will determine in which subsystem the requested record exists.

8.2.2 If the record exists in Division 7111 or in the Department 2600 Tape Library, the 7111 PI will request the appropriate 7111 Supporting Staff member to retrieve and copy the record for the requester. The "original" record will be refiled in the system.

8.2.3 If the record exists in the system at NTS, the 7111 PI will prepare a written request for the 7125 Supporting Staff (Field Technician) to retrieve, copy, transmit the copy and refile the original record in the system.

8.2.4 If the record exists only in the SNLARS, the 7111 PI will follow the procedure below.

a. Determine the location and identification of the box containing the requested record.

b. Notify Division 3154 that this box needs to be removed from the Manzano Facility.

c. Remove the IRT for this box from the "IRT'S FOR ITEMS STILL IN STORAGE" notebook and place it in the "IRT'S FOR ITEMS TEMPORARILY REMOVED FROM STORAGE" notebook.

d. Upon receipt of the box, sign the "Records Depository Charge Out" form, return the original and retain a copy for filing in the "RECORDS DEPOSITORY CHARGE OUT FORMS" notebook.

e. Copy the appropriate record and transmit to the requester.

f. Refile the original record in the box and refile it in the SNLARS following the procedures in 8.1.4, above.

9.0 References

9.1 NNWSI-SOP-02-01 "Quality Assurance Program Plan Requirements for NNWSI Project Participating Organizations and NTS Support Contractors and their subtier vendors", Section 17.0 Quality Assurance Records.

9.2 DOP 2-6 "Qualification and Certification of Project Personnel"

9.3 QAP 15-1 "Nonconformance Reporting and Controls"

9.4 QAP 16-1 "Corrective Action Requirements"

9.5 EP-004 "Experiment Procedures for Acquiring, Digitizing, Processing, Storing and Retrieving Ground Motion Data from Underground Nuclear Explosions"

9.6 TP-82 "Procedures for Acquiring, Digitizing, Processing, Storing and Retrieving Ground Motion Data from Underground Nuclear Explosions"

9.7 TP-83 "Verification of PNE Amplifier Gains and Frequency Response"

9.8 TP-84 "Verification of Tamarac-B Amplifier Gains and Frequency Response"

9.9 TP-85 "Verification of PFTU Amplifier Gains and Frequency Response"

9.10 TP-86 "Set-up and Adjustment TM Control Box (PNE Seismic)

9.11 TP-87 "Set-up and Adjustment TM Control Box (PFTU)

9.12 TP-88 "Ground Motion Gage Operation Verification"

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NNWSI Project
Study Plan Requirements

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Author: [signature] 4/28/87
Date

Approved: [signature] 5/11/87
Quality Assurance Date

Approved: T E Blejwas 5/13/87
Division Supervisor Date

Approved: [signature] 5/13/87
SNL - TPO Date

Control of Special Processes

1.0 Purpose

The purpose of this Department Operating Procedure (DOP) is to state the minimum requirements for writing a Study Plan (SP) for the NNWSI Project.

2.0 Scope

This DOP defines the format and sign-off requirements and revision procedures to be used by SNL 6310 staff writing and using SPs for the NNWSI Project.

3.0 Definitions

3.1 Study plan - a document that provides details for studies, experiments, tests, and analyses that are listed in the Site Characterization Plan (SCP). A study may involve single or multiple experiments, tests, or analyses, or combinations of these categories.

3.2 Experiment and Equipment-Test Procedures (EPs)- a document that provides detailed written requirements and provides primary control for implementation of Experiments and Equipment-Tests listed in the SP.

3.3 Technical Procedures (TPs) - a document detailing implementing procedures that define technical requirements, constraints, and the procedural steps in support of EPs.

3.4 Experiment-data gathering conducted to establish characteristics or values not previously known.

3.5 Test - process of exposing an item of hardware to some defined parameter change or operational sequence to determine its acceptability.

3.6 Analyses - calculations or other evaluations needed to assess site characteristics, support design activities, or to support experiment designs and evaluations.

4.0 Procedures

4.1 Format - A SP should be prepared by a Principal Investigator (PI) or Task Leader (TL) in response to SCP needs following a standard outline. Appropriate headings are:

I. Purpose and Objectives of Studies
II. Rationale for Selected Study
III. Description of Experiments, Tests and Analyses
IV. Application of Results
V. Schedule and Milestones

4.1.1 Purpose and Objectives - The following should be considered in preparing the purpose and objectives:

- Describe the information that will be obtained in this study. Briefly discus how this information will be used.

- Provide the rationale and justification for the information to be obtained by the study. It can be justified by: 1) a performance goal and a confidence level in that goal (developed via the performance allocation process and results that will be described elsewhere in the SCP); 2) a design goal and a confidence level in that goal (design goals beyond those related to performance issues); 3) direct Federal, State, and other regulatory requirements for specific studies. Where relevant performance or design goals actually apply at a higher level than the study (e.g. where the goals apply to a group of studies), describe the relationship between this study and that higher level goal.

4.1.2 Study Rationale - The following should be considered in preparing the rationale for the study:

- Provide the rationale and justification for the selected experiments, tests, and analyses (including standard tests). Indicate the alternative measurement concepts and analytical methods from which they were selected, including options for type of measurement, instrumentation, data collection and recording, and alternative analytical approaches. Describe the advantages and limitations of the various options.

- Provide the rationale for the selected number, location, duration, and timing of experiments and tests with consideration to various sources of uncertainty (e.g. test method, location, interference with other tests, and estimated parameter variability). When the achievement of quantitative statistical confidence levels for experiment results necessitates a designed experiment or test, include this experiment design in this rationale. This rationale should also identify reasonable alternatives, summarize reasons for not selecting these alternatives and reference, if available, reports which evaluate alternatives considered.

- Describe the constraints that exist for the study, and explain how these constraints affect selection of experiment and test methods and analytical approaches. Factors to be considered include:

  - Potential impacts on the site from the measurement activities;

  - Whether the study needs to simulate repository conditions;

  - Required accuracy and precision of parameters to be measured with instrumentation;

  - Limits of analytical methods that will use the information from the experiments and tests;

  - Capability of analytical methods to support the study;

  - Time required versus time available to complete the study;

  - Statistical relevance of data and data trends to performance goals and confidence limits. Where appropriate, the experiments or tests will be designed for replications necessary to achieve the quantitative statistical confidence level required (by Performance Allocation) of the parameter under study. Such experiment design will be described in the SP. In cases where experiments or tests are conducted for demonstration purposes or proof-of-concept approaches, then the fact that statistical experimental design may not be appropriate or applicable will be explained in the SP.

- The scale of the phenomena, especially the limitations of the equipment relative to the scale of the phenomena to be measured and the applicability of studies conducted in the laboratory to the scale of the phenomena in the field;

- Interrelationships of experiments and tests involving significant interference with other similar activities and how studies have been designed or sequenced to address such interference; and

- Interrelationships involving significant interference among experiments and tests and exploratory shaft facility design and construction (as appropriate, refer to Section 8.4 of the SCP or its references for specific exploratory shaft facility design information such as design drawings or specifications).

4.1.3 Description - The following should be considered in preparing a description of experiments, tests and analyses:

- Since studies are comprised of experiments, tests, and analyses, provide for each;

  - a description of the general approach that will be used. Describe key parameters that will be measured and the experimental conditions under which the measurements will be conducted. Indicate the number of measurements and their locations (e.g. spatial location relative to the site, exploratory shaft facility elements, repository layout, stratigraphic units depth, and test location);

  - a summary of the Experimental or Equipment Test Procedures. Reference EPs to be used. If EPs are not yet available, indicate when they will be available. Indicate the level of quality assurance and provide a rationale for any experiments or tests which are not judged to be QA-level I. Reference the applicable specific QA requirements that will be applied;

  - specification of the tolerance, accuracy and precision required, where appropriate;

  - indications of the range of expected results and the basis for those expected results;

- lists of the equipment required and describe briefly any such equipment that is special;

- descriptions of techniques to be used for data reduction and analysis of the results;

- discussions of the representativeness of the measurements including why the results are considered representative of future conditions or the spatial variability of existing conditions. Also indicate limitations and uncertainties that will apply to the use of the results;

- illustrations such as maps, cross sections, and facility design drawings to show the locations of tests and schematic layouts of experiments and tests; and

- a discussion of the relationships of the measurements to the set performance goals and confidence levels.

- a discussion of statistical methods used to evaluate data and data trends and an explanation as to the validity of the results.

• For each type of analysis; provide:

- statements as to the purpose of the analysis, indicating the, experiment, testing, or design activity being supported. Indicate what conditions or environments will be evaluated and any sensitivity or uncertainty analyses that will be performed. Discuss the relationship of the analysis to the set of performance goals and confidence levels;

- a description of the methods of analysis, including any analytical expressions and numerical models that will be employed;

- a reference to the Problem Definition Memo (PDM) that will apply to the analysis. If PDMs are not yet available, indicate when they will be available. Indicate the level of quality assurance that will be applied to the analysis and provide a rationale for any analyses which are not judged to be QA level 1. Reference the applicable QA requirements;

- identification of the data input requirements of the analysis;

- a description of the expected output and accuracy of the analysis; and

- a description of the representativeness of the analytical approach (e.g., with respect to spatial variability of existing conditions and future conditions) and indicate limitations and uncertainties that will apply to the results.

4.1.4 Applications - The following should be considered regarding applications of the results:

- Briefly discuss where the results from the study will be used for the support of other studies (performance assessment, design, and characterization studies).

- For performance assessment uses, refer to specific performance assessment analyses (described in Section 8.3.5 of the SCP) which will use the information produced from the studies described above, and refer to any use of the results for model validation.

- For design uses, refer to, or describe, where the information from the study described above will be used in equipment design and development and engineered system design and development (e.g., waste package, repository engineered barriers, and shafts and borehole seals).

- For characterization uses, refer to, or describe, where the information from the study described above will be used in planning other characterization activities.

4.1.5 The schedule and milestones should be established according to the following:

- Provide the durations of and interrelationships among the principal activities associated with conducting the study (e.g., preparation of EPs, TPs, data analyses, preparation of reports), and indicate the key milestones including decision points associated with the study activities;

- Describe the timing of this study relative to other studies and other program activities that will affect, or will be affected by, the schedule for completion of the subject study.

- Dates for activities or milestones, including durations and interrelationships, for the study plans will be provided. These should reference the master schedules provided in Section 8.5 of the SCP.

4.2 Pagination - The cover page and all subsequent pages of the SP will include a Header located in the top right corner that contains the SLTR Number, Revision Number, and Page. The Title of the Sandia Letter Report and Date of Issuance will be included on the cover page only.

4.3 Document Changes - The SP can be revised as needed to:

1) Comply with changes to NNWSI Project Policy.
2) Reflect Changes in SNL Policy.
3) Reflect changes in scope or technical content of the SP that have impacts on EPs.

5.0 <u>Requirements</u>

5.1 General

5.1.1 Quality Assurance Levels - A SP does not require a quality assurance level determination; however, they will be associated with an activity for which a quality level assignment is made.

5.1.2 Initiating Study Plans - The responsible PI shall prepare study plans to comply with NNWSI Project requirements negotiated between SNL and DOE/WMPO. Division Supervisor 6313 or other person designated by the 6310 Department Manager will authorize the preparation of all SP's to assure they are compatible with the agreements between DOE, NRC, and the state of Nevada.

5.1.3 Distribution - The SP shall be produced as a Sandia National Laboratories Letter Report (SLTR) and distribution prepared by the PI or his designee. A master distribution list will be provided to and maintained in the Department 6310 Records Management Center.

5.1.4 Content - PIs shall consider all items in Section 4.1 and apply those that are appropriate.

5.2 Specific

5.2.1 Approval Requirements - The original review and approval of the SP will comply with and be documented in accordance with the review requirements for Sandia Letter Reports outlined in DOP 6-2: Reviewing, Approving, and Issuing Technical Information Documents. In addition, Study Plans will be reviewed and approved by QA. Since there is no place on the Letter Report Review Sheet designated for QA approval, a pen-and-ink entry will be made on the Letter Report Review Sheet form for documentation of QA approval, as follows:

Quality Assurance ________________ Org. ________ Initials _______

Signature (final approval): _________________ Date ___________

5.2.2 Revision of Study Plan - When conditions outlined in Section 4.3 dictate, the PI or appointed designee will prepare a revision of the SP and submit it to the same review and approval process as the original issue. A revised document will be issued and distributed to the same individuals as the original.

6.0 Records - Completed Study Plans, together with the Letter Report Review sheet and other supporting documentation, will be filed in file 34/1291/4.1/NQ. A list of approved Study Plan titles will be maintained at the same records location.

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SANDIA NATIONAL LABORATORIES

NNWSI PROJECT

DEPARTMENT 6310 OPERATING PROCEDURE

ANALYSIS CONTROL AND VERIFICATION

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Felton W. Bingham 11/13/86

Author: Robert Prindle 11/18/86
R. W. Prindle Date

Approved: Felton W. Bingham 11/13/86
Division Supervisor Date

Approved: 11/13/86
Quality Assurance Date

Approved: Thomas O. Hunter 11/13/86
Department Manager Date

SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT

Issued to: M.D. COTTER, SAIC

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RETURN TO 6310 RECORDS CENTER
WHEN NO LONGER NEEDED.

1.0 Purpose

The purposes of this Department Operating Procedure (DOP) are

- to identify the actions required of persons who conduct analyses and calculations in support of facility-design, experiment-design, and performance-assessment activities
- to guide persons involved in the analysis process to other DOPs that control specific analysis activities

2.0 Scope

The applicability of this DOP is determined by

- the type of analysis or calculation that is being performed
- the quality level assigned to the analysis

2.1 Analyses covered by this DOP include those performed by persons within the Nevada Nuclear Waste Storage Investigations (NNWSI) Project Department at Sandia National Laboratories (SNL) and those analyses performed for the SNL NNWSI Project Department by persons in other SNL organizations or by contractors.

2.2 This DOP applies to Quality Level I and II analyses and calculations performed in support of performance assessment, facility design, or experiment design. These analyses and calculations include but are not limited to scientific and engineering analyses, simple mathematical calculations, and standard statistical calculations.

2.2.1 The requirements of this DOP do not apply to analyses and calculations performed at Quality Level III. However, if the Principal Investigator (PI) wishes to have a Quality Level III analysis or calculation documented and entered into the SNL NNWSI Project Department Records Management

System, this DOP and DOP 3-3, Analysis Definition Requirements, will be used to control that analysis.

2.3 <u>Data Base Work Requests</u>--An analysis or calculation to be performed on data contained within the NNWSI technical data bases may be specified in a Work Request for those data bases. Those analyses must be specified by a Problem Definition Memo (PDM), and the Division Supervisor of the PI conducting the analysis or the Division Supervisor responsible for the NNWSI technical data bases may also require that an analysis review be conducted. If either supervisor requires an analysis review, then the requirements of this DOP and of DOP 3-3 will apply. The requirements of DOP 3-7 to define (in a Work Request) and document those analyses or calculations that will be performed on or with data within the technical data bases may be satisfied by clear reference to the PDM in the Data Base Work Request.

2.4 <u>Design Investigations and Routine Design Calculations</u>--This DOP applies to scientific and engineering analyses, simple algebraic calculations, and standard statistical calculations performed in support of a facility-design activity, but it does not apply to the facility-design activity itself. Routine design calculations, which are generally simple calculations done as an incidental part of design, and design investigations that are engineering studies and do not primarily consist of calculations are examples of facility-design activities that are excluded from the scope of this DOP.

2.4.1 The overall design process is controlled by DOP 3-5, Design Control and Verification. Specific design activities are controlled by DOP 3-4, Design Investigation Control. Routine design calculations that are not specifically requested in a Design Information Memo or defined in a PDM are covered under DOP 3-10, Routine Design Calculations.

2.4.2 The relationship between this DOP and the facility-design process is shown in Figure 1.

2.5 Data Analyses--This DOP does not apply to data analyses, which are governed by DOP 11-5, Analysis of Data Gathered in Experiments and Equipment Tests.

3.0 Definitions

Analysis Process: defining, conducting, reviewing, and documenting an analysis.

Analyst: the person responsible for conducting and documenting an analysis.

Data Analysis: the reduction of raw data to meaningful form or the assessment of experiment and equipment-test results.

Principal Investigator (PI): a person from the SNL NNWSI Project Department who is assigned responsibility for conducting a particular scientific or engineering investigation.

Reference Analysis: any analysis or calculation whose results will be baselined in the NNWSI Reference Information Base (RIB) for use throughout the project as input for other analysis or design activities.

Routine Design Calculations: calculations that support preliminary or conceptual design decisions (e.g. sizing of beams or supports; sizing of ventilation shafts or ducts; sizing of electrical substations, loads, or transmission lines; thickness of typical shield walls; static or dynamic analysis calculations). See DOP 3-10, Routine Design Calculations.

<u>Scientific or Engineering Analyses</u>: those analyses that involve a calculational model of a physical processes, phenomenon, or relationships; standard statistical calculations and routine design calculations are specifically excluded from this definition.

<u>Simple Mathematical Calculations</u>: Calculations that are routinely performed by scientists and engineers and do not involve the use of complex computer codes. These calculations are typically performed to define approaches to problems or to provide simple scoping solutions that may be subsequently refined by more complex analyses.

<u>Standard Statistical Calculations</u>: calculations of mean, standard deviation, regression analysis, curve fitting, etc., such as those methods available in statistical library packages.

4.0 Procedures

4.1 This DOP is arranged to guide persons associated with the analysis process through the steps of defining, conducting, reviewing, and documenting an analysis or calculation. It identifies specific actions that must be performed to comply with all of the DOPs that affect the analysis process and it identifies the persons responsible for those actions.

4.1.1 Other DOPs that contribute to the control of the analysis process are

- DOP 2-6 Qualification and Certification of Project Personnel
- DOP 3-2 Software QA Requirements
- DOP 3-3 Analysis Definition Requirements
- DOP 3-7 Technical Data Base Requirements
- DOP 6-2 Procedure for Reviewing, Approving, and Issuing NNWSI Technical Information

4.1.2 The relationship between this and other DOPs that affect the analysis process is shown in Figure 2. The roles, in the analysis process, of the DOPs listed above are also summarized in Figure 2. The general sequence of controlled activities that occur during an analysis is outlined in Figure 3.

4.2 The PI will evaluate the quality level at which the analysis will be performed.

4.2.1 The PI will determine the purpose and intended uses of the proposed analysis and use the current Work Plans for the SNL NNWSI Project Department to identify the WBS element, task, and activity that the analysis supports. Work Plans are located in the SNL NNWSI Project Department Records Management System under the file designation 30/1291/0.6.

4.2.2 The PI will check the Quality Assurance Level Assignment Sheet (QALAS) for the supported activity to determine the quality level assigned to that activity. The QALAS is located in the SNL NNWSI Project Department Records Management System under the file designation 35/1293/5.1.1.

4.2.3 An analysis will be performed at the same quality level as the activity it supports except in the cases identified in paragraph 4.2.3.1. In those cases, the intended use of the analysis may justify conducting the analysis at a quality level either higher or lower than that of the activity it supports. If the quality level of an analysis that will be documented and entered into the SNL NNWSI Project Department Records Management System differs from the quality level of the activity it supports, the PI will state, in the PDM, the reasons for the different quality level of the analysis.

4.2.3.1 Examples of analyses that might be performed at a quality level that differs from that of the supported activity are: (1) scoping calculations used to plan final analyses for a Quality Level I activity; (2) analyses performed under a Quality Level III activity that are expected to be useful in subsequent activities performed at Quality Level I or II.

4.2.4 If the purpose, intended uses, and quality level of the analysis are such that the results of the analysis will not be entered into the SNL NNWSI Project Department Records Management System, the quality level of the analysis need not be declared and the requirements of this DOP will not apply.

4.3 The PI will obtain an analysis number from the SNL NNWSI Project Department records-management staff and will have an Analysis Records File opened for the analysis.

4.3.1 The 70 Series in the SNL NNWSI Project Department Records Management System is allocated for the Analysis Records System. The PI will determine the 70-Series category in which the records of the analysis should be archived (i.e., 71--thermomechanics, 72--hydrologic and thermohydrologic, 73--radionuclide transport and postclosure systems, 74--preclosure radiological safety, 75--design, 76--sealing). If no existing category is appropriate, the PI will request that the records-management staff initiate a new 70-Series category.

4.3.2 The SNL NNWSI Project Department records-management staff will assign to the analysis an analysis number for the 70-Series category determined above. The assignment of the analysis number will open and uniquely identify an Analysis Records File for the analysis.

4.4 The PI will check the NNWSI Reference Information Base (RIB) to determine whether reference values are available for parameters involved in the analysis. The RIB is located in the SNL NNWSI Project Department Records Management System under the file designation 45/12133.

4.4.1 The PI will consult the RIB to determine whether the needed parameter values and design information are available there and whether they are appropriate for the analysis. If the analyst will use parameter values or design information other than that available from the RIB, the PI will document the alternative data and the reasons for using them as required by DOP 3-3.

4.5 The Task Leader will consult with other concerned Task Leaders to determine whether the analysis should be proposed as a candidate reference analysis.

4.5.1 After identifying the analysis as a candidate reference analysis, the Task Leader will submit the results of the analysis to the Systems Engineering Integration Group (SEIG) with a proposal for the SEIG to evaluate the analysis for inclusion in the RIB.

4.6 The PI will ensure that the analysis is defined and documented in accordance with the requirements of DOP 3-3.

4.6.1 The sequence of steps required to define, review, and document an analysis is clearly stated in DOP 3-3.

4.6.2 The quality level evaluated under section 4.2 and the analysis number obtained under section 4.3 will be documented in the PDM as required by DOP 3-3.

4.7 The PI will ensure that the analyst assigned to perform an analysis has been properly certified for that work and will include documentation of the certification in the Analysis Records File opened for that analysis.

4.7.1 An analyst performing Quality Level I analyses or calculations must be certified in accordance with the requirements of DOP 2-6, Qualification and Certification of Project Personnel.

4.7.2 DOP 3-3 states that the signature of the analyst's supervisor on a Task Acceptance Memo will be taken as certification that the supervisor attests to the analyst's qualifications to perform the work defined in the PDM. This certification will be sufficient for Quality Level II and III analyses and calculations.

4.8 The PI will ensure that any computer software used for a Quality Level I or II analysis has been properly certified for use at the intended quality level in accordance with the requirements of DOP 3-2. The version or versions of the software that have been certified under DOP 3-2 must include the version that will be used for the analysis.

4.8.1 The PI will include documentation of the certification in the Analysis Records File of the analysis for which the software will be used.

4.8.2 Software need not be certified for use in a Quality Level III analysis.

4.9 Analyses and calculations to which this DOP applies will be reviewed in accordance with the analysis-review procedures contained in Section 5.0 of this DOP.

5.0 Analysis Verification

5.1 The purpose of the analysis-review procedure defined below is to establish a formal mechanism for verifying Quality Level I and II analyses and calculations. Authority for requiring or requesting an analysis review is established. Procedures for appointing and convening a review committee and for documenting the committee's work are described.

5.1.1 Analysis reviews may be either one-time (final) reviews conducted at the completion of an analysis activity or periodic reviews that occur throughout the time an analysis is in progress.

5.2 The Task Leader will decide at the time an analysis is initiated whether to apply the analysis-review procedure to that particular analysis or calculation. The PI will document the decision in the PDM.

5.2.1 Should it become desirable to change the decision to apply or not apply the analysis-review procedure after the PDM has been issued, that decision will constitute a change to the PDM. The change will be documented as required by DOP 3-3 and will be subject to the same level of review and approval as the original PDM.

5.2.2 The analysis-review procedure does not apply to Quality Level III analyses.

5.3 The Division Supervisor responsible for the analysis will develop an analysis-review plan. The analysis-review plan will specify the scope, purpose, type (periodic or final), and schedule of the analysis review to be conducted. This plan will be documented in the analysis-review notice specified below.

5.4 The responsible Division Supervisor will appoint a chairperson for an analysis-review committee and will designate members of the committee. The committee will include SNL personnel and, when appropriate, contractor personnel or other NNWSI Project staff. Representatives of the DOE and the NRC may be present at the committee meetings.

5.5 The Division Supervisor responsible for the analysis review will ensure that the qualifications of the reviewers and the justification for their selection are documented as follows:

- Quality Level I Analyses
  A person reviewing Quality Level I analyses or calculations must be certified in accordance with the requirements of DOP 2-6, Qualification and Certification of Project Personnel. This requirement applies to all SNL NNWSI Project Department staff, SNL supporting staff, contract staff, and consultants.

- Quality Level II Analyses
  DOP 2-6 does not apply to Quality Level II activities. The responsible Division Supervisor will briefly document reviewer qualifications and justification for selection. The resulting documentation will be submitted to the SNL NNWSI Project Department Records Management System to be entered into the 70-Series Analysis Records Files of the analyses or calculations being reviewed.

5.6 The chairperson of the review committee will distribute to review participants all materials they need to prepare for committee meetings (e.g., PDM, analysis documentation, review checklist). The chairperson will allow sufficient time to ensure that committee members have adequate opportunity to prepare for meetings.

5.7 The chairperson will convene the committee by issuing an analysis-review notice to all committee members. An example analysis-review notice is included in Appendix A.

5.8 The chairperson of the committee will keep minutes of all committee meetings. The chairperson will have the authority to delegate this responsibility to another committee member.

5.9 For final reviews, an analysis-review checklist will be used by the review committee to aid the review process. This checklist will be prepared by the chairperson before the review meeting and will be distributed to committee members as stated above. An example checklist is included in Appendix B.

5.10 During reviews, certain aspects of the analysis may be identified that require further action for correction or clarification. If so, these will constitute action items; the chairperson will assign each action item to one or more persons for future resolution. All action items will be documented in the minutes of the meetings of the analysis-review committee.

5.10.1 The persons assigned responsibility for an action item will submit a follow-up report to the analysis-review committee to document the resolution of that action item. The resolution of each action item identified will be documented in this manner.

5.11 The analysis-review committee will document its findings in a final-review report that will include, as a minimum, the items listed below:

- Purpose of the review
- Identification of the analysis reviewed
- Participants in the review and their qualifications
- Conclusions reached and recommendations made
- Action items identified
- Reports on the resolution of all action items

The analysis-review plan and the review committee may identify additional items to be included in the final-review report and supporting documentation.

5.12 The chairperson of the analysis-review committee will ensure that the review report and minutes of committee meetings are prepared and submitted to the SNL NNWSI Project Department Records Management System to be entered into the 70-Series Analysis Records Files of the analyses or calculations being reviewed. If the review is of an analysis performed by a supporting SNL organization outside of the NNWSI Project Department or by a contractor, the chairperson will also specify that the review documentation be entered into the appropriate file in the 20 Series.

6.0 Records

6.1 All documentation relating to an analysis or calculation will be identified by the analysis number assigned to the analysis and will be submitted to the SNL NNWSI Project Department Records Management System to be included in the Analysis Records File opened for that analysis or calculation.

6.1.1 The chairperson of an analysis-review committee is responsible for preparing and submitting all analysis-review documents. If the chairperson is not from the SNL NNWSI Project Department, these documents will be submitted by the Task Leader.

6.1.2 The PI is responsible for preparing and submitting all other analysis-related documents.

6.1.3 Documents to be submitted to the 70 Series (see paragraph 4.3.1) of the SNL NNWSI Project Department Records Management System include but are not limited to the following:

- Problem Definition Memo (PDM)
- Changes to the PDM
- Task Acceptance Memo
- Authorization to Proceed Memo
- Correspondence - Out
- Correspondence - In
- Code listings
- Input data, mesh data, and computer-control information required to run the analysis
- Documentation of simple algebraic calculations, e.g., detailed handwritten records of computations
- Documentation of code certification
- Documentation of certification of personnel qualifications
- Documentation of independent technical reviews
- Analysis-review documents
  - Analysis-review notice
  - Review checklists
  - Minutes of committee meetings
  - Reports on resolution of action items
  - Department 6310 Manuscript Review Sheets (DOP 6-2)
  - Committee final-review report

- Document deliverables (SAND reports, letter reports, memoranda)
- Closure statement for the Analysis Records File

6.1.4 If computer codes are not used for an analysis or calculation, no code-related documentation will be included in the Analysis Records Files for that analysis.

6.1.5 When an analysis is performed by SNL supporting organizations outside of the SNL NNWSI Project Department or by contractors or consultants, the PI and the chairperson of the analysis-review committee will specify that duplicate copies of all analysis-related documents also be filed in the 20 Series, Contractor Records, in the SNL NNWSI Project Department Records Management System.

6.1.6 When an analysis is performed in support of experiment design, the PI and the chairperson of the analysis-review committee will specify that duplicate copies of all analysis-related documents also be filed in the 50 Series, Data Records Management System (DRMS). The file identifier will correspond to the DRMS Data Set ID of the data that will be produced by the experiment whose design the analysis or calculation supports.

6.2 The PI will ensure that the results of analyses and calculations within the scope of this DOP are documented in Sandia (SAND) reports, letter reports (SLTRs), or memoranda. Sandia and letter reports will be prepared, reviewed, and issued in accordance with the requirements of DOP 6-2, Procedure for Reviewing, Approving, and Issuing NNWSI Technical Information.

6.2.1 When the results of an analysis are expressed in a SAND report or an SLTR, the analysis-review procedures in this DOP will meet the requirements for independent technical review in both this DOP and DOP 6-2. If the analysis review is used for this purpose, each member of the review committee will complete those portions of the Department 6310 Manuscript Review Sheet dealing with the technical merits of the analysis. The analysis review will not meet the requirements of DOP 6-2 that do not deal with independent technical review.

6.3 When an analysis or calculation and any associated analysis reviews have been completed, the PI will review the contents of the Analysis Records File opened for that analysis. If required documents have not been entered into the file, the PI will ensure that they are submitted to the SNL NNWSI Project Department Records Management System. When all of the required documents are included in the Analysis Records File, the PI will place a memorandum in the file to certify that all documents are present and to close that Analysis Records File.

7.0 References

Other DOPs necesary for implementation of this document include

DOP 2-6 Qualification and Certification of Project Personnel
DOP 3-2 Software Quality Assurance Requirements
DOP 3-3 Analysis Definition Requirements
DOP 6-2 Procedure for Reviewing, Approving, and Issuing NNWSI Technical Information
DOP 17-1 Records Management

8.0 Appendices

Appendix A - Analysis-Review Notice (Example)
Appendix B - Analysis-Review Checklist (Example)

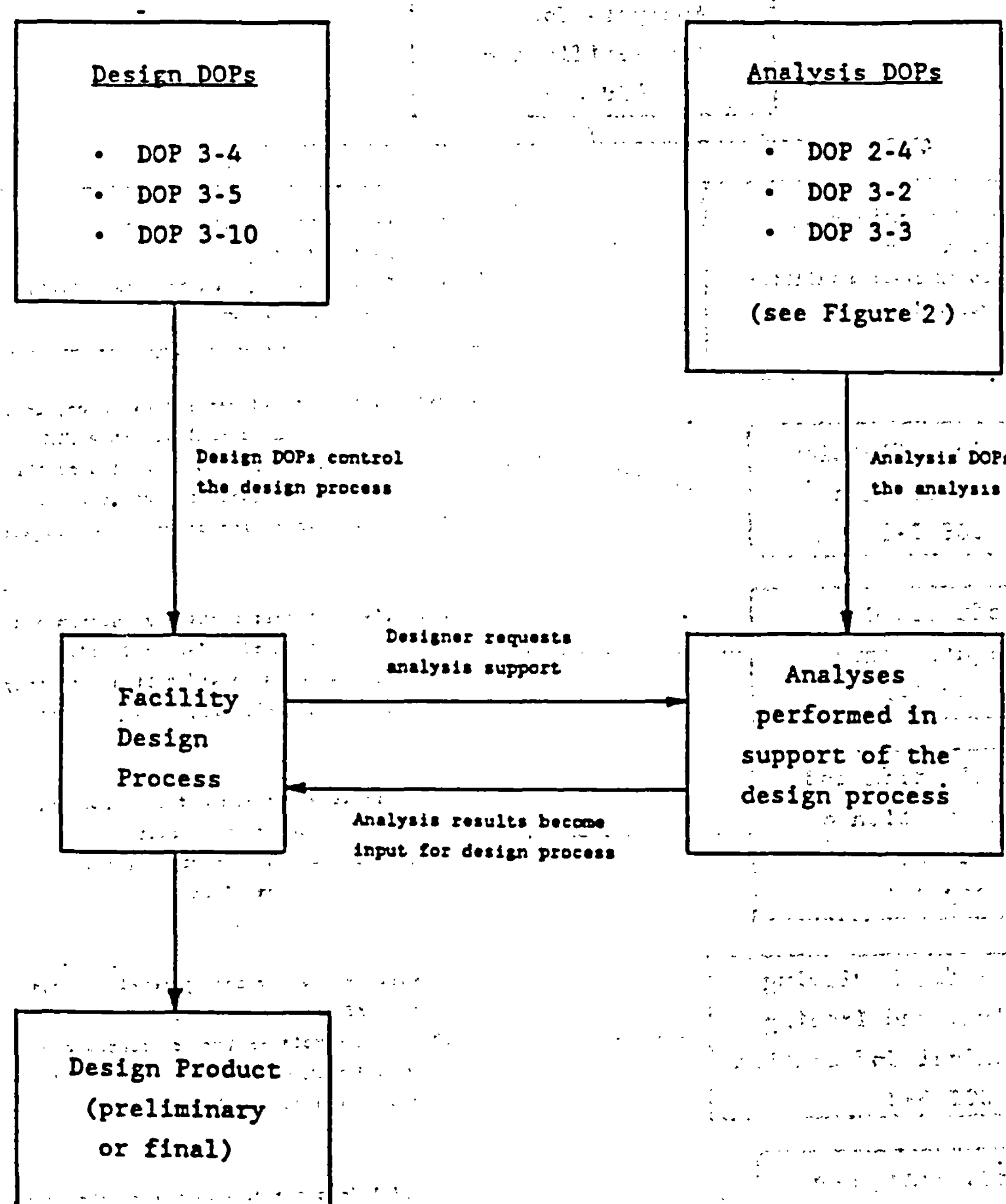

Figure 1. Relationship between DOP 2-4 and the facility-design process.

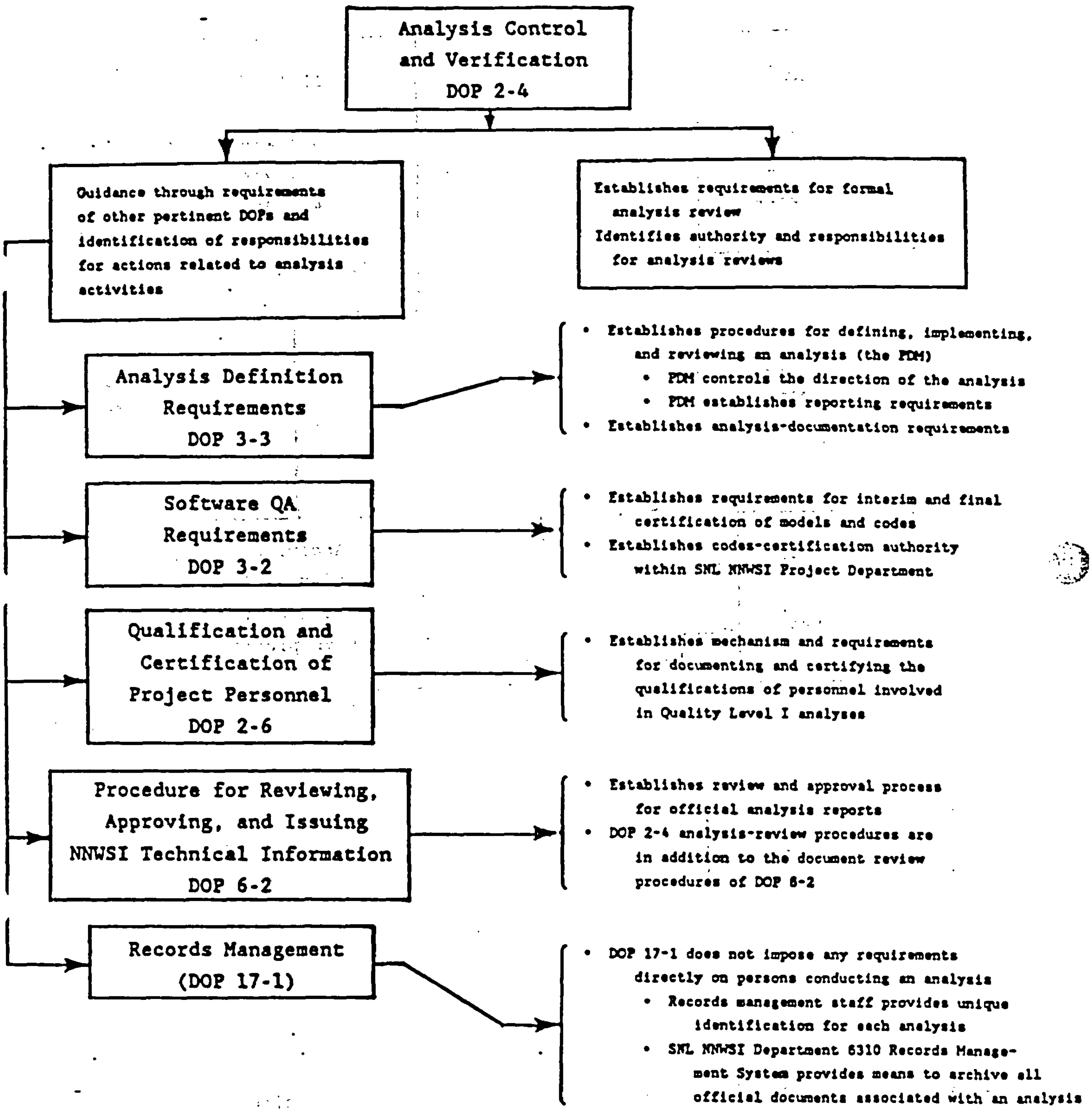

Figure 2. Relationship between DOP 2-4 and other DOPs that contribute to the control of the analysis process.

PI evaluates quality level of analysis
- Determines intended use of analysis
- Identifies supported activity
- Checks QALAS for quality level of supported activity
- Declares quality level of analysis
- Management approves quality level through PDM process described in DOP 3-3

PI obtains analysis number
- Identifies appropriate 70-series category in SNL NNWSI Dept. 6310 Records File
- NNWSI records management staff assigns analysis number and opens Analysis Records File

PI checks RIB
- Identifies available reference parameter values and design configurations
- Selects appropriate information from RIB (or elsewhere if appropriate--justification required)

Task Leader evaluates analysis for RIB
- Decides whether to propose analysis as a reference analysis
- If yes, submits proposal to SEIG to include results in RIB

PI defines analysis
- Details contained in DOP 3-3
  - Prepares Problem Definition Memo (PDM)
  - Ensures analysis methods are appropriate
  - Controls direction of analysis
  - Specifies type and content of documentation to be provided

PI ensures that analyst is certified
- Details contained in DOP 2-6 for Quality Level I analyses
  - Qualifications of analyst must be documented and certified for the analyses being performed
- Includes documentation of certification in Analysis Records File

PI ensures that software is certified
- Details contained in DOP 3-2
  - Version of software being used must be certified as acceptably documented for the quality level of the analysis
- Includes documentation of certification in Analysis Records File

SNL NNWSI Dept. 6310 management decides whether to require an analysis review
- PI documents decision in the original PDM
- If yes, responsible Division Supervisor selects review committee and appoints committee chairperson

Chairperson convenes analysis-review committee
- Details contained in DOP 2-4
- Committee conducts and documents analysis review
- Chairperson prepares review documentation as required in DOP 2-4 and DOP 3-3
- Chairperson submits review documents to SNL NNWSI Project Department Records Management System

PI documents analysis and reviews
- Prepares required documentation as listed in DOP 2-4 and DOP 3-3
- Has reports reviewed and approved in accordance with DOP 6-2
- Submits analysis documents to SNL NNWSI Project Dept. Records Management System
  - Reviews documents in Analysis Records File and closes file when all documents are submitted

Figure 3. General sequence of analysis activities.

APPENDIX A

NNWSI ANALYSIS-REVIEW NOTICE (EXAMPLE)

Date ____________________

Committee Member ____

Analysis to be Reviewed ____

Meeting Date ____________________ Time ____________________

Contract No. ____

WBS No. ____________________ QA Level ____________________

Purpose of Analysis Review

Scope of Analysis Review

Signed ______________________________
(Review-Committee Chairperson)

Attachments:
- Agenda for Analysis-Review Meeting
- List of Reviewers
- Analysis-Review Materials and Documents

APPENDIX B

NNWSI ANALYSIS-REVIEW CHECKLIST (EXAMPLE)

The purpose of this example analysis-review checklist is to identify typical questions that should be asked during an analysis review. It is intended neither to be comprehensive nor to cover all questions for all disciplines. The responsibility for a complete review rests with the analysis-review committee.

Review Date ____________________

Reviewer ____________________

Analysis No. ____________________

WBS No. ____________________

QA Level ____________________

___ Was the analysis performed at a quality level appropriate for the intended use of the results?

___ Were all computer codes used in the analysis properly certified for use at the required QA Level?

___ Were the qualifications of the analyst and reviewers properly certified?

___ Were values for the input parameters properly selected?

___ Was the RIB consulted?

___ Are the assumptions and simplifications in the modeled representation of the physical system appropriate for the intended use of the results?

___ Have the assumptions made to perform the analyses been explicitly identified and documented for future reference?

___ Were the methods used in the analysis appropriate for this application?

___ Were the methods of analysis properly applied?

___ Are there any problems in the way the analysis was conducted?

___ Are the conclusions drawn from this analysis reasonable?

___ Have the limits of applicability of the results of the analysis been identified and documented?

___ Have any new action items been identified and documented?

___ Have all previously identified action items been resolved?

___ Has the required documentation of the analysis been entered into the Analysis Records File and other files as appropriate in the SNL NNWSI Project Department Records Management System? (Note that the final report on the analysis and the closure statement for the Analysis Records File will not be issued and entered into the Analysis Records File until after this analysis-review process has been completed.)

RMS NO. SL * 000476
ACC NO. SL * 100528

SNL NNWSI PROJECTS

Department Operating Procedure

QUALIFICATION AND CERTIFICATION OF PROJECT PERSONNEL

Page	1	2	3	4	5	6	7
Revision	0	0	0	0	0	0	0

Approved: ____________ 7-30-86
Author Date

Approved: ____________ 7/30/86
Quality Assurance Date

Approved: ____________ 7/30/86
SNL - TPO Date

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SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT

Issued to: M.D. Cotter, SAIC

Copy Number: #014

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- Qualification and Certification of Project Personnel

1.0 Purpose

The purpose of this Procedure is to state the actions necessary to determine qualifications of and to certify NNWSI project personnel assigned to perform or verify activities affecting quality.

2.0 Scope

The requirements of this QAP are applicable to the performance and verification of Quality Level I tasks. The assigned tasks are parts of the NNWSI Work Breakdown Structure (WBS). Quality Level I tasks are identified in Quality Level Assignment Sheets recorded for such WBS elements. These requirements apply to all SNL personnel who are assigned to perform and/or verify activities affecting quality, specifically including independent technical reviews, design verification, and surveillance. Additional specific qualification requirements shall cover "special processes," audit personnel, inspection and test personnel, and nondestructive examination personnel.

3.0 Definitions

See Appendix A of SNL NNWSI QA Program Plan.

4.0 Qualification Requirements

4.1 Personnel Performing Technical or QA Functions. Certification will be required for persons performing technical functions affecting quality and performing QA functions. These personnel will have job titles of either task leader, principal investigator, or supporting staff. The following are the minimum qualifications for each of these job titles:

Task-Leader. A Task leader will be designated from the SNL staff by the Technical Division Supervisor for each WBS element. They must have an academic background in a technical area that provides the basic concepts of mathematics, engineering, and the physical sciences to manage the task. The academic degree should be related to the technical content of the task in the judgment of the designating technical supervisor or sufficient related technical experience must be demonstrated. Minimum degree requirements will be commensurate with those of the position classification of the individual. The initial hiring of the staff, the selection of staff for new or vacant positions, and the training of staff will be done by the supervisor in such a way to assure that individuals selected as task leaders have the commensurate academic background.

Task leaders will have appropriate technical experience for the tasks being performed. Actual project management experience or demonstrated potential to perform project management functions will be required in a related technical activity. The supervisor will determine that the technical experience of the task leader is sufficiently related to the technical contents of the task. Similarly, the supervisor will determine that the project management experience is sufficient to assure that quality objectives can be achieved.

Principal Investigator. Principal Investigators will be designated from the SNL staff by the Technical Division Supervisor. PIs will generally be responsible for a major portion or all of an activity or task within a WBS element. The academic and experience requirements will be the same as that of Task Leaders, except that the level of project management experience does not need to be as extensive because the scope of a specific task is not generally as broad as that of an entire WBS element.

Supporting Staff. Various staff will be assigned to support Principal Investigators and Task Leaders. They must have an academic background in a technical area that provides the basic concepts of mathematics, engineering, and the physical sciences. The academic degree should be related to the technical content of the task in the judgment of the designating supervisor or sufficient related technical experience must be demonstrated. Minimum degree requirements will be commensurate with those of the position classification of the individual. The initial hiring of staff, the selection of staff for new or vacant positions, and the training of staff will be done by the supervisor in such a way to assure that individuals designated or supporting staff have the commensurate academic background.

Supporting staff will have appropriate technical experience for the tasks being performed. The supervisor will determine that the technical experience is sufficiently related to technical conduct of the task. Project management experience is not a requirement for supporting staff personnel.

4.2 A special process is one in which the results are intended to meet certain specifications and are highly dependent on either the control of the process or the operator's skill, or both. The procedure for qualification of personnel, equipment, and procedures for special processes, their certification, and the maintenance of records will be addressed in QAP 9-1.

4.3 Personnel certified as auditors or lead auditors shall be qualified in accordance with Appendix D of NNWSI SOP-02-01 (see QAP 2-7).

4.4 The qualifications of personnel who perform inspection, testing, and/or nondestructive examination to verify conformance to specified requirements for the purpose of acceptability is covered in Appendix B and/or Appendix C of NNWSI SOP-02-01. While no such personnel are members of the SNL NNWSI organization, that qualification requirement will be implemented, as necessary, in procurement documents and become a requirement for vendors.

5.0 Personnel Selection

5.1 Supervisor assigned responsibility for the activities to be performed or verified shall select personnel with education and experience commensurate with the minimum requirements specified for the job in the established position description. The capabilities of an individual shall be based upon an evaluation of the candidate's education, experience, and training and compared to those established for the position.

5.2 Prior to assigning personnel to perform or verify activities affecting quality, the Division Supervisor assigned responsibility for the WBS activities to be performed shall familiarize personnel in the principles, techniques, QA Program, technical objectives, and requirements of the WBS activities being performed or verified (see QAP 2-5) and shall so certify by signing the certification document (see Form QAP 2-6(1)). Personnel reassigned within the NNWSI Project shall be certified for their new assignments.

5.3 The job performance of personnel who perform or verify activities important to quality shall be evaluated at least annually. This evaluation shall be performed by supervision assigned responsibility for the activities to be performed or verified and shall determine adequate proficiency has been maintained. The evaluation shall determine the need for retraining or replacement. The evaluation is conducted by the Division Supervisor with the concurrence and participation of the NNWSI Department Manager. This evaluation is used in determining the eligibility for recertification of the individual.

6.0 Documentation of Certification

The certification of personnel shall be documented on form QAP2-6(1) and include the following information: (see Appendix A)

a. Employer's name
b. Name of person being certified
c. Title or job function
d. Tasks certified for
e. Restriction or limitation to the certification
f. Education
g. Experience
h. Record of familiarization, including QA instruction (see QAP 2-5)
i. Date of certification
j. Expiration date (annually)
k. Signature of Division Supervisor-Department Manager

This information shall be recorded on form QAP 2-6(1) with the signature of the responsible Division Supervisor and the signature of the NNWSI Department Manager providing certification for project personnel. This certification document shall be retained as lifetime QA records in file 90/1293/CRT/Q1.

7.0 Recertification

Annually, the immediate Supervisor will evaluate the need for additional training for each individual for which he is responsible, arrange for completion of such training, and initiate recertification of each individual by initiating a new form QAP 2-6(1).

APPENDIX A
FORM QAP 2-6(1)

Certification for NNWSI Project Personnel
Employer: Sandia National Laboratories

Name: ______________________

Job Title	WBS Element	Activity	Task No.	Name of Task

Restrictions: ______________________

Basis for Certification:
Education and Experience Applicable to Job Function

Education: ______________________

____

____

Experience: ______________________

____

____

Training: The subject individual has been familiarized in the purpose, scope, technical objectives, and requirements of the activities to be performed and instructed in the SNL NNWSI QA Program.

______________________ ______________
Division Supervisor Date

Based on the above record and information described in QAP 2-6, ______________________ is certified to perform or to verify activities that affect quality, including conducting independent technical reviews, participating in design verification, and performing surveillances.

______________________ ______________
Department Manager 6310 Date

Date Certification Expires ______________________.

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DOP 2-8
Rev 0
Page 1

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SNL NNWSI PROJECT
DEPARTMENT OPERATING PROCEDURE

Conduct and Reporting of Management Assessments

Page	1	2	3
Rev.	0	0	0

Author: _______________ Mar 31, 1988
R. R. Richards, 6310 — Date

Approved: N/A _______________ ________
Division Supervisor — Date

Approved: Richard M. Baehr _______________ 3/31/88
R. M. Baehr, 6310 — Date
Quality Assurance

Approved: _______________ 4/1/98
T. O. Hunter, 6310 — Date
SNL NNWSI TPO

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1.0 Purpose

The purpose of this procedure is to specify the actions and responsibilities for planning, organizing, performing, and documenting management assessments of the SNL NNWSI QA Program, including analysis and reporting of results and tracking of recommendations.

2.0 Scope

This procedure may be utilized by management personnel of the SNL NNWSI Project Department to perform assessments of the SNL NNWSI QA Program as applied to all activities of the Project.

3.0 Definitions

N/A

4.0 Procedure

	Responsible Individual	Action
4.1	SNL NNWSI Department Manager (TPO)	At his discretion, but at least once during each Fiscal Year, initiate a management assessment of the QA Program. (The objective of this assessment is to determine the effectiveness of the management controls and the system for achieving and assuring quality and to determine the adequacy of resources and personnel provided to the QA Program.) Designate persons who will conduct or participate in the assessment. Specify the objectives of the assessment. Direct how the assessment results will be documented and reported.
4.2	Designated Assessment Team	Plan and conduct the assessment based on guidance and directions provided by the TPO. Generate a report of the activity for analysis.

	Responsible Individual	Action
4.3	TPO	Analyze the management assessment report. Include other management personnel, QA personnel, etc. as desired in this analysis. Finalize the report. For any recommendations or corrective actions to be carried out, utilize the SNL NNWSI Action Item list for status tracking. Send a copy of the completed management assessment report to the WMPO Director and WMPO Project Quality Manager.

5.0 Records Management

A copy of each management assessment report will be placed in SNL NNWSI Records Management System file 90/1293/MGA/Q1 by the TPO or QA Coordinator.

6.0 References

None

7.0 Appendices

None

NNA 211.0029

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SNL NNWSI PROJECT

DEPARTMENT OPERATING PROCEDURE

PREPARING, REVIEWING, APPROVING, AND ISSUING ENGINEERING DRAWINGS

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Rev.	A	0	0	0	0	0	0	0	0	A	A	0	0	0	0	0

Author: Subramanian 2/1/88
C. V. Subramanian, 6311 Date

Approved: Al Stevens 2/2/88
Division Supervisor Date

Approved: R. Richards Feb. 1, 1988
Quality Assurance Date

Approved: R. R. for T.O.H. 2/2/88
Department Manager Date

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DEPARTMENT OPERATING PROCEDURE FOR PREPARING, REVIEWING, APPROVING, AND ISSUING ENGINEERING DRAWINGS

1.0 Purpose

The purpose of this Department Operating Procedure (DOP) is to provide requirements for preparing, reviewing, approving, issuing, and revising engineering drawings.

2.0 Scope

This DOP applies to engineering drawings developed as a result of QA Level I and QA Level II activities for the NNWSI Project by SNL Department 6310. Requirements for drawings prepared by a contractor such as title blocks, drawing classification numbers, checking, and revisions will be specified in the contract by the contract monitor and will be consistent with this DOP, and will be provided as a part of the contract. In addition, it is the responsibility of the principal investigator to ensure that the requirements of Subsections 4.3 and 4.4 and Sections 5.0 and 6.0 are satisfied by the engineering drawings prepared by a contractor.

3.0 Definitions

3.1 Approved Drawing - A controlled or uncontrolled drawing developed to the point where it depicts the basic design of a facility, component, or piece of equipment, which has been reviewed and authorized for release by a Department 6310 Division Supervisor.

3.2 Checker - The person responsible for reviewing and checking an engineering drawing.

3.3 Contract Monitor - Official SNL designee (generally the Task Leader or Principal Investigator) who ensures that the technical terms of the contract are followed by the contractor and who, in conjunction with the purchasing organization, monitors expenditures against the contract.

3.4 Controlled Drawing - A drawing whose distribution is controlled as specified in DOP 6-1, Document Control System Procedures.

3.5 Drawing Filing Code - A number assigned to an engineering drawing to establish identification for the purpose of filing into the SNL/NNWSI Project Records Management Center.

3.6 Engineering Drawing - Engineering drawings are detailed representations of a facility or piece of equipment which depict the design at various stages such as the feasibility study, conceptual design, license application design, and fabrication or construction. These include flow diagrams, conceptual sketches without any calculations, and formal or informal drawings based on specific calculations.

3.7 Principal Investigator - The SNL staff member responsible for completion of a particular study or design. This staff member may or may not also be the Task Leader.

3.8 Task Leader - The SNL staff member responsible for developing the technical guidance, budget, and schedules for a work breakdown structure (WBS) task. This staff member may or may not also be the Principal Investigator.

3.9 Uncontrolled Drawing - A drawing whose distribution is not controlled as specified in DOP 6-1, Document Control System Procedures.

3.10 Verified Design - A design which has been reviewed and evaluated in accordance with DOP 3-5, Design Control and Verification.

3.11 Work Breakdown Structure (WBS) - A system used by NNWSI Project Department 6310 to categorize the tasks to be performed for a particular project.

4.0 <u>Procedure</u>

4.1 General

The PI shall require, by means of contract requirements or internal SNL correspondence, that the organization preparing engineering drawings adhere to the requirements stated below in connection with the preparations, review and approval, issuance, revision, and maintaining of all engineering-drawing records.

4.2 Preparation of Engineering Drawings

4.2.1 Engineering drawings shall be prepared under the direction of the Principal Investigator (PI). The drawings shall conform to standard engineering practices and shall contain the necessary technical information as specified by the PI. The PI shall document inputs (e.g., design calculations, Design Investigation Memos, Problem Definition Memos) and bases used for preparation of the drawing. These shall be filed as specified in DOP 3-3, Analysis Definition Requirements and DOP 3-4, Design Investigation Control.

4.2.1.1 The drawing shall be uniquely identified with a title block which shall contain the following information:

- o Statement that drawing is property of Sandia National Laboratories.
- o Sandia Logo.
- o NNWSI Project identification.
- o Drawing filing code.
- o Drawing number.
- o Title describing the content of the drawing.
- o Design phase (ACD, LAD, etc.).

- o Full signature and date block for the draftsman, Checker, Principal Investigator, Task Leader, and Division Supervisor.

- o Control status (Controlled or Uncontrolled).

- o Quality Assurance Level.

4.2.1.2 The drawing shall contain a revision block with the following information:

- o Revision number.

- o Date of revision.

- o Description of revision.

- o Initial (or full signature) and date blocks for the draftsman, Checker, Principal Investigator, Task Leader, and Division Supervisor.

4.2.2 Drawing numbers shall be assigned by the preparing organization. Drawing filing codes shall be assigned by the PI in accordance with Drawing Filing Code Assignment given in Appendix B. The PI shall maintain a list of drawing numbers, drawing filing codes, and revision numbers. This list shall be filed in the SNL/NNWSI Project Records Management Center (see Section 6.0).

4.2.3 After an engineering drawing has been prepared, it shall be subject to an independent review and check by an individual (Checker) who did not assist or was not associated with the preparation of the engineering drawings. The checker shall use check prints to review and check drawings for technical accuracy and editorial consistency. After the review, the check prints shall be given to the responsible engineer to incorporate all review comments into the drawings. The checker will review the drawings to ensure that the review comments are incorporated into the original drawing and sign off the original. The checker will then give the check prints to the PI for filing. Guidelines for use in the editorial review of engineering drawings are given in Appendix A.

4.3 Review and Approval of Engineering Drawings

4.3.1 Review of drawings shall be done by personnel assigned by the responsible 6310 Division Supervisor. The drawings shall be reviewed using check prints to ensure consistency with the requirements and criteria spelled out in the design investigation memo or contract for which they are being prepared. The PI shall be responsible for ensuring that comments resulting from the review are resolved and documented in check print file or comment file. After the review comments have been resolved, the drawing shall be initialed and dated by the draftsman, Checker, and PI.

4.3.2 The PI shall then forward the engineering drawing to the Task Leader and Division Supervisor for approval, which is indicated by signing and dating the drawing.

4.3.3 After the engineering drawing has been approved, it shall be returned to the PI. The PI shall assign a numeric revision number beginning with "0." The PI shall the forward a reproducible copy of the approved engineering drawing along with the check prints file and review comment file to the SNL/NNWSI Records Management Center. The original of the approved engineering drawing shall be returned to the responsible drafting organization.

4.4 Issuance of Engineering Drawings

4.4.1 This section on the issuance of drawings supplements the provisions of DOP 6-1, Rev. 0, Document Control Systems Procedures, for distribution of engineering drawings.

4.4.2 The PI shall be responsible for providing instructions for the issuance of engineering drawings to the SNL Department 6310 NNWSI Project Records Management staff. These instructions shall include the distribution, how the drawing is to be marked to indicate approval status, and the purpose for issuance and what it supersedes. Only those drawings that have been approved per 4.2.2 shall be used in SAND reports and letter technical reports, and as the basis for any future design modifications.

4.4.3 The responsible Division Supervisor shall determine if a drawing is to be controlled. If so, he shall provide the controlled distribution list to the PI for concurrence. The PI shall forward the controlled distribution list to the SNL/NNWSI Project Records Management Center.

4.4.4 The SNL Department 6310 Records Management staff shall be responsible for issuing engineering drawings. Copies of engineering drawings shall not be issued unless instructions for issuance have been received from the PI.

4.4.5 Engineering drawings shall be marked prior to distribution as either "Controlled Distribution" or "Uncontrolled Distribution."

4.4.6 Controlled and uncontrolled engineering drawings which have been approved shall be marked prior to distribution with either "Design Verified" or "Design Not Verified."

4.4.7 If it is necessary to issue an unapproved engineering drawing, the PI will provide the unapproved drawings along with instructions for their issue to the SNL Department 6310 Records Management staff. The SNL Department 6310 Records Management staff will be responsible for marking copies of unapproved drawings prior to distribution with "Design Not Verified--Drawing Not Approved" and clearly indicating on the drawing, the purpose for issuance.

5.0 Document Revision

5.1 Drawings which are yet to be approved shall be assigned an alpha revision letter beginning with "A." The revision letters will go up B, C, --- etc., each time a drawing is issued as a result of comment incorporation or design evolution. Changes to these drawings shall not be subject to the provisions of DOP 3-6, Design Change Control but shall be made at the direction of the PI. Such changes shall be checked in accordance with Section 4.2.1 of this DOP prior to obtaining approval or being issued.

5.2 At the time of approval, the drawing shall be assigned a numeric revision number beginning with "0."

5.3 Revisions to approved drawings shall be made in accordance with DOP 3-6, Design Change Control, and shall be checked and reviewed in accordance with Sections 4.1 and 4.2 of this DOP. The drawing check shall confirm that the change was made as specified in the Drawing Change Request (see DOP 3-6). Review and approval of revisions to these drawings shall be processed in the same manner as the original drawing.

5.4 If an engineering drawing which has been design-verified requires revision, the responsible Division Supervisor shall determine and indicate in writing if the revision as reflected in the drawing has invalidated the previously verified design. If so, the design as reflected in the revised drawing shall be re-verified in accordance with DOP 3-5, Design Control and Verification, prior to relying on the component, system, or structure to perform its function. The PI will file the written recommendation in the appropriate design investigation memo file.

5.5 Revised engineering drawings shall be issued in accordance with Section 4.3 of this DOP.

6.0 Records

6.1 Engineering drawings which have not been approved shall be maintained by the Principal Investigator.

6.2 Originals of approved engineering drawings shall be maintained by the preparing organization.

6.3 Reproducible copies of approved engineering drawings shall be maintained in the SNL/NNWSI Project Records File - 60 Series - 60/XXXX/1.10.

6.4 Check prints and drawing review comments shall be maintained in the SNL/NNWSI Project Records File - 60 Series - 60/XXXX/1.13.

6.5 A list of drawings (both controlled and uncontrolled), including drawing numbers, titles, filing code, and revision, shall be maintained in the SNL/NNWSI Records File - 30 Series - 35/1293/5.4, Master Document List.

7.0 <u>References</u>

DOP 3-3, Analysis and Calculation Control

DOP 3-4, Design Investigation Control

DOP 3-5, Design Control and Verification

DOP 3-6, Design Change Control

DOP 6-1, Document Control System Procedures

8.0 <u>Appendices</u>

A. Guidelines for Editorial Review of Engineering Drawings

B. Document Filing Code for Drawings

APPENDIX A

GUIDELINES FOR EDITORIAL REVIEW OF ENGINEERING DRAWINGS

A.1.0 Introduction

Guidelines are given below to ensure the professional appearance and readability of the drawings, to make them more consistent with the text of reports prepared to go with the drawings, and to make the style more consistent between drawings.

A.2.0 Legibility and Reproducibility

Drawings must be of sufficient clarity so that they can be microfilmed or reproduced legibly.

A.3.0 Arrangement of Engineering Drawings

In order to provide general consistency between engineering drawings prepared at SNL, arrange drawings as shown in Figure A-1.

A.3.1 Notes and References

Do not locate explanatory material and references on the drawing itself. Indicate any information other than a label or dimension by a note number on the drawing and put a corresponding number and explanation in a box in the upper right-hand corner of the drawing (Figure A-1).

A.3.2 Symbols, Legends, and Keys

If any or all of these items are used in a drawing, locate the information underneath the notes and references (Figure A-1).

A.3.3 Reference Drawings

If a drawing refers to other drawings prepared for the project, list these drawings in the box shown in Figure A-1.

A.3.4 Figure Number

It is particularly useful to be able to find the figure number of a drawing in the same location on each drawing. A space just above the revision block has been left blank so that each time a drawing is used as a figure in a report the appropriate figure number for the particular report can be inserted in that space.

A.3.5 Title Block

The title block is located in the lower right-hand corner. Present information identified in the contract in the space provided.

A.4.0 Spelling, Grammar, Punctuation, and Capitalization

Review spelling, grammar, punctuation, and capitalization for correctness, paying particular attention to verb agreement, parallel construction (in flow diagrams), and hyphenation.

A.5.0 Abbreviations

If abbreviations are necessary, use the commonly accepted abbreviations in the American National Standards Abbreviations for Use on Drawings and in Text, ANSI 1.1. Do not use ampersands (&) in the text of labels, figure titles, references, or block flow diagrams. Use the percent symbol only when it is preceded by a number.

Common units of measurement may be abbreviated (e.g., ft, in., m, km, etc.). Provide a key for less commonly used abbreviations. Use the singular form of the abbreviation (e.g., "9 lb" rather than "9 lbs") and omit the period unless it is needed to distinguish the abbreviation from another word (e.g., 9 in. in diameter).

A.6.0 Alphanumeric Designations

Use current alphanumeric designations for drill holes and stratigraphic units, as furnished by 6310.

A.7.0 Consistency

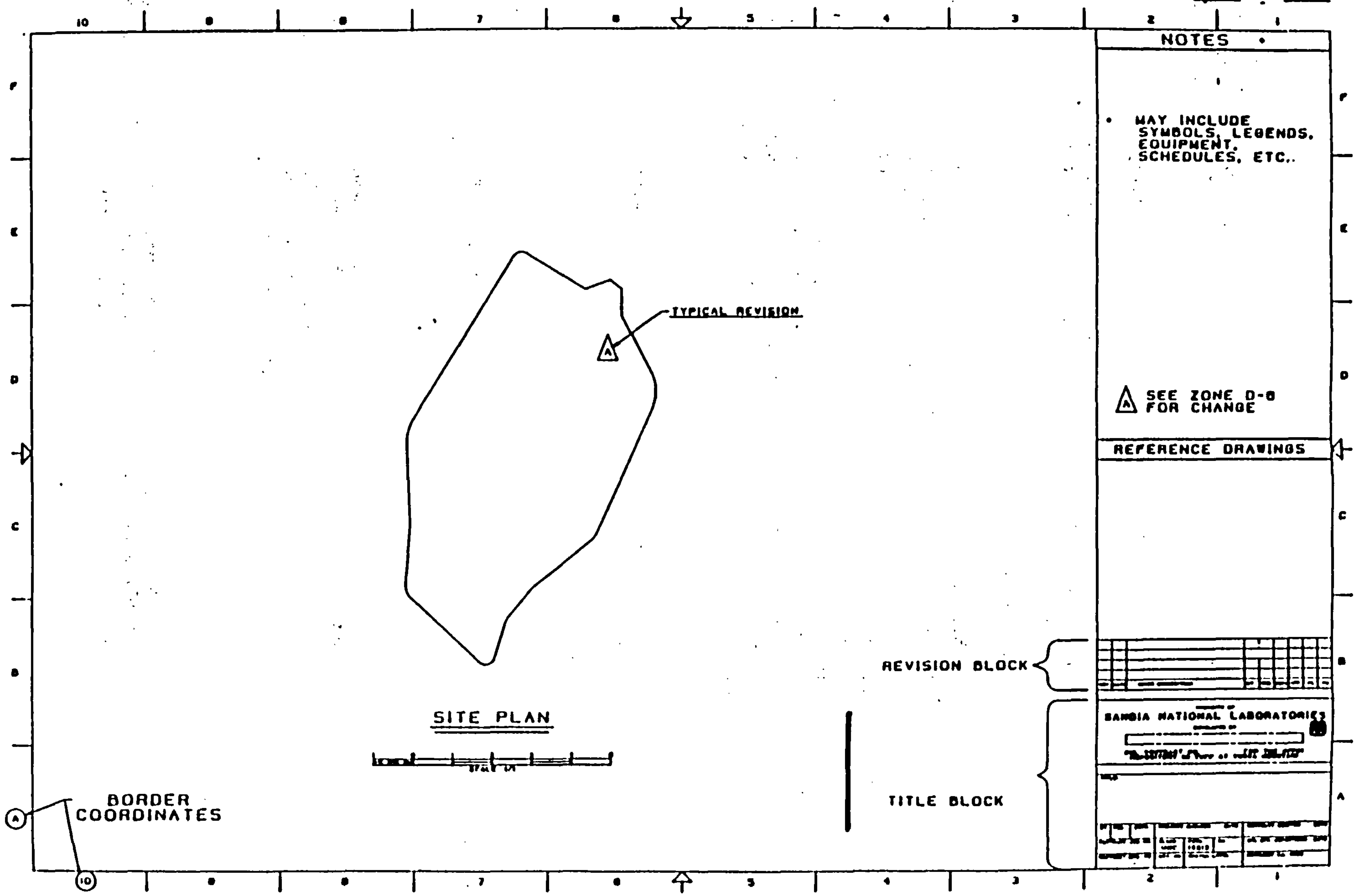
Provide consistency between drawings and between the drawings and the text of reports. Write units of measurement entirely in English units, or metric units, or both (in consistent order), as specified by 6310 for the task. Abbreviations for units of measurement shall be consistent in use and form.

A.8.0 Appearance

Make sure the typeface is consistent within and between drawings. When words are changed, use the same typeface for the changed word as that of the word it replaced. Space letters in series properly (A, B, C, and D, not A,B, C, D). Make the spacing between letters in words, between words, and between lines of words even. Be sure that letters are straight and that lines do not slant.

A.9.0 Review

An editor at 6310 will review drawings used in reports, particularly for the style problems mentioned above. It is expected that all final drawings and illustrations meet the editorial standards described above.



PROPOSED DRAWING ARRANGEMENT

APPENDIX B

DOCUMENT FILING CODE FOR DRAWINGS

The document filing code for drawings consists of a drawing identification code. The drawing identification code consists of the two elements (location and identification) outlined below and a unique number.

Location: Surface

	Identification	Partial Descriptions
1. Site		
	LA	Layout (plot, vicinity)
	UT	Utilities (water, drain, sewage, fire, electrical)
	AC	Access (highway, railroad, aircraft)
	GE	Geological (faults, formations)
	TP	Topographical (grades, elevations)
2. Facilities		
	AR	Architectural (floor plans, elevations)
	CE	Civil (storm, roads, bridges)
	SE	Structural (shielding, foundations)
	ME	Mechanical (plumbing, utilities, HVAC)
	EE	Electrical (power, communication)
	IC	Instrumentation and controls

Identification	Partial Descriptions
NU	Nuclear (staffing, dosage, decontamination)
PK	Process (waste treatment and handling)
ID	Industrial (casks, cranes, containers)
PD	Plant design
DC	Decommissioning

3. Operations Maintenance

EQ	Equipment
PF	Process Flow
TM	Time-Motion
WH	Waste-Handling Sequence
WT	Waste-Treatment (Radwaste) Sequence
HC	Hot Cells
HV	Waste HVAC (filtration, routing)
RO	Robotics

Location: Underground

1. Site

LA	Layout (mine plans, boundaries)
UT	Utilities (water, compressed air, fire, drain)
AC	Access (shafts, ramps)

Identification	Partial Descriptions
GE	Geological (faults, formations)
TP	Topographical (contours, features)

2. Facilities

Identification	Partial Descriptions
AR	Architectural (plans, elevations)
MN	Mining (drifts, panel layouts)
CE	Civil (rock storage, drainage)
SE	Structural (portal, head frame)
ME	Mechanical (plumbing, utilities)
MV	Mine Ventilation (flows, pressures, routing)
EE	Electrical (power, communication, instrumentation/ control
ID	Industrial (conveyors, hoists)
PK	Process (radwaste handling)
TR	Trash (refuse)
TH	Tuff Handling (conveyors, storage pile)
DC	Decommissioning

		Identification	Partial Descriptions
3.	Operations-Maintenance		
		MS	Mining Sequences
		VS	Ventilation Sequence
		WH	Waste-Handling Sequence
4.	Equipment		
		RT	Transporters
		RD	Drilling
		RE	Emplacement
		RO	Robotics
5.	Sealing	SL	

TYPICAL EXAMPLES

1. Railroad Plan - Sheet, 9, Preconceptual Design

Location	S (Surface)
Identification	AC (Access)
Unique Number	To be assigned by PI (001)
Filing Code	SAC001-9

2. DHLW Access Drifts - Sheet 2, Preconceptual Design

Location	U (Underground)
Identification	MN (Mining)
Unique Number	To be assigned by PI (001)
Filing Code	UMN001-2

SNL NNWSI PROJECT

DEPARTMENT OPERATING PROCEDURE

Software
Quality Assurance Requirements
DOP 3-2

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Author: Mary W. Green — 1-27-88
Mary Wilson Green — date

Approved: Stephen J. Bauer — 1-28-88
Technical Reviewer — date

Approved: [illegible] — February 1, 1988
Division Supervisor — date

Approved: [illegible] — Jan 28, 1988
Quality Assurance — date

Approved: Thomas O. Hunter — Feb-1-1988
SNL-TPO — date

SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT
Issued to: S. Klein, SAIC
Copy Number: #072
RETURN TO 6310 RECORDS CENTER
WHEN NO LONGER NEEDED.

Table of Contents

Table of Contents (cont.)

1.0 PURPOSE

The purpose of this Department Operating Procedure (DOP) is to establish the requirements for the planning, development, testing, tracking, and documentation of software used to support the Sandia National Laboratories (SNL) Nevada Nuclear Waste Storage Investigations (NNWSI) project and to assign the responsibilities for implementing these requirements. The requirements are intended to ensure the control of software quality and to provide the Nuclear Regulatory Commission (NRC) staff with part of the basis on which they will evaluate the soundness of the physical and mathematical principles implemented within these codes. An additional benefit of this DOP is that the documentation it requires will allow NNWSI analysts to determine the suitability of particular pieces of software for application to their task.

This DOP uses guidance from NUREG-0856, NUREG-4640, and NNWSI Standard Operating Procedure (SOP) 03-02.

2.0 APPLICABILITY

This DOP, in conjunction with DOP 2-4, applies to software used in support of analyses performed at Quality Assurance Level I and II. Although this DOP does not apply to analyses performed at QA Level III, it may be applied if desired.

The terms "software," "computer code," and "computer program" are used interchangeably throughout this DOP. Appendix D contains definitions of numerous other terms used throughout the DOP.

For the purposes of this DOP, such software is classified in three categories:

1. Scientific and engineering software (SES). This category includes complex scientific, engineering, and mathematical modeling codes and codes that use a numerical method. Trivial calculations and electronic calculations are not included in the SES category.

2. Calculational non-SES software. Some examples of this category are spread-sheet programs, statistical packages, graphics packages, pre- and postprocessors, mesh programs, and mathematical libraries.

3. Noncalculational software. This category includes, but is not limited to, compilers, word processors, operating systems, interfaces, driver routines, and other manifest-product software.

This DOP states specific requirements for computer programs in each of these three categories; within each category, the requirements are different for software developed under Sandia auspices (called "in-house" software) and other software (called "commercial" software). For each of these six classes, Figure 1 lists the sections of this DOP that state the applicable requirements.

Not all of the requirements listed for a category are applicable to all computer programs in the category. Nevertheless, the complete documentation for each program must address each requirement listed for the program's category, either furnishing evidence that the requirement has been met or explaining why the requirement does not apply.

It may not be possible to meet the documentation requirements spelled out in this DOP for commercial codes. Efforts must nevertheless be made to gather the information identified in the DOP to aid in the use of the code and as proof of its credibility. The results of such efforts must be included within the required documentation.

Any modifications made to a commercial code that could affect the integrity of output must be developed, documented, and tested under the same requirements as those for in-house software in the same category.

Figure 1. Requirements for the six classes of software, listed by applicable sections of this DOP.

	IN-HOUSE	COMMERCIAL
SES	6.1 CATEGORY 6.2 LIFE CYCLE 6.3 TEST/DEBUG 6.4 CONFIG MGMT 6.5.1 DOCUMENTATION 6.6 CERTIFICATION 6.7 VERIFICATION 6.8 VALIDATION 6.9 ANALYSIS 6.10 COMPLETE	6.1 CATEGORY 6.3 TEST/DEBUG 6.4 CONFIG MGMT 6.5.1 DOCUMENTATION 6.6 CERTIFICATION 6.7 VERIFICATION 6.8 VALIDATION 6.9 ANALYSIS 6.10 COMPLETE
CALCULATIONAL NON-SES SOFTWARE	6.1 CATEGORY 6.2 LIFE CYCLE 6.3 TEST/DEBUG 6.4 CONFIG MGMT 6.5.2 DOCUMENTATION 6.9 ANALYSIS 6.10 COMPLETE	6.1 CATEGORY 6.4 CONFIG MGMT 6.5.3 DOCUMENTATION 6.9 ANALYSIS 6.10 COMPLETE
NON-CALCULATIONAL SOFTWARE	6.1 CATEGORY	NO REQUIREMENTS

3.0 RESPONSIBILITIES

3.1 Technical Contact

The technical contact (TC) is the person responsible for actions pertaining to the development, correction, or change of a particular version of a code. This "technical expert" will understand the structure, control, and available options of the code (or will be able to find this information). He will maintain a computer-readable copy of the code and make this copy available to any member of the NNWSI project interested in using it. The technical contact, who may be a person external to the NNWSI project, is assigned by the mutual agreement of Department 6310 management and the technical contact's own organization.

The technical contact will implement, where applicable, the software-development life cycle (see Section 6.2). Most of the code-documentation requirements (see Section 6.5) will be written or created under the auspices of the technical contact, and the verification processes (see Sections 6.3 and 6.7) will generally be performed with his help. The technical contact will also decide when a code should receive a new version or release number.

If more than one version of a code is being used, it is possible that each version will have a different TC assigned to it.

3.2 Principal Investigator

The principal investigator (PI) for a particular analysis is responsible for the use of computer codes in that analysis. This person must ensure that all requirements for the codes used in the analysis are met and that all documentation is in place for supporting licensing. It is the direct responsibility of the PI to oversee the writing of Part A of the code documentation required in Section 6.5.1 and to ensure that the certification process has been carried out to the extent appropriate to the analysis (see Section 6.6). The principal investigator and the technical contact may be the same person, and a particular code, with a single TC, may be used in different analyses with different PIs.

3.3 Software Coordinator

The software coordinator for Department 6310 is assigned by management and is responsible for the overseeing of the documentation of software covered by this DOP. The duties that make up this task are described below:

3.3.1 The software coordinator will be familiar with this DOP and will serve as consultant regarding its use when requested.

3.3.2 The software coordinator will be responsible for the collection or receipt of all documentation and written materials submitted to fullfill the requirements outlined in this DOP.

3.3.3 The software coordinator will work with the records-management personnel of Department 6310 to ensure that the storage of all documentation is maintained according to the specifications in Section 4.0, Software Records Management.

3.3.4 The software coordinator will be familiar with the software-development life cycle described in this DOP and will serve as consultant regarding its use where required.

3.3.5 The software coordinator will be responsible for implementing and coordinating the configuration-management system described in Section 5.0.

3.3.6 The software coordinator will aid in preventing duplicate work from being performed by different PIs. For example, if more than one group is attempting validation of a particular code, the software coordinator will make the groups aware of the other efforts.

3.3.7 The software coordinator will work with the principal investigator in deciding whether the documentation collected for each code meets the requirements in this DOP.

3.3.8 The software coordinator will consult with contractors to Department 6310 only with the approval of Sandia's delegated representative to the contractor.

3.4 Technical Reviewer

A technical reviewer is a person with expertise comparable to that of the creator(s) of a product for which a critique is desired. Technical reviewers will, at the request of the TC or PI, review software documentation for such aspects as

- organization, clarity, and conciseness of the material,
- inclusion of the required documentation (see Appendix B),

- adequacy of the discussion of those aspects, and
- validity of assumptions, extrapolations, methods, acceptance criteria, and conclusions drawn.

If the documentation is a SAND Report or Sandia Letter Technical Report (SLTR), the technical review will be conducted in accordance with DOP 6-2.

As is required for all personnel who perform or verify QA Level I or II activities, technical reviewers must be qualified according to the requirements of DOP 2-6 before they complete these reviews.

4.0 SOFTWARE RECORDS MANAGEMENT

The SNL NNWSI Records-Management System will be used to store all software QA material, making it readily available and easy to locate. The software coordinator is responsible for carrying out the requirements of software records management and for making adjustments to procedures as needed. Details of this storage system are as follows:

4.1 All documentation required by this DOP will be stored within the SNL NNWSI Records-Management System (RMS) by the software coordinator. The location will be as follows:
- Code documentation (requirements found in 6.1 through 6.5):
  - 110/WBS/code name/version number.release number/ requirements section/Q?
  - (where requirements section is the number of the section in this DOP that is satisfied by this document)
- Analysis documentation (requirements found in 6.6 thru 6.10):
  - appropriate master code index specified in DOP 2-4

4.2 Every code will be assigned a unique identifier for storage and tracking purposes. This unique identifier will be in the form of "version number.release number." A unique version number is assigned to a code each time its capabilities are modified enough to require that the previous documentation be changed. A new release number is assigned to a code each time errors are corrected in a previous release. Documentation updates are generally not needed for new releases of a code. For example, when a code is initially issued, its version/release number would be 1.0. A subsequent reissue of this code with corrections made to errors found in 1.0 would be assigned the version/release number 1.1, and the original documentation would be unchanged. If the code were enhanced with additional capabilities, the new version/release number would be 2.0 and the documentation would be updated. If corrections were made to 2.0 on three different occasions, the last version/release number would be 2.3 with documentation identical to that for 2.0.

4.3 Each code that is tracked by the configuration-management system (see section 5.0) will have a file for each unique version of that code. This file will contain all the applicable documentation defined in 6.1 thru 6.5, or references to it. Different releases of the same code version will also be stored in that same file.

4.4 Each analysis effort will have its own unique file location, as required by DOP 2-4, cross-referenced to the file containing the documentation for the version of code it used (see 4.3). This file will contain the documentation defined in 6.6 thru 6.10, or references to its location.it.

4.5 Documents that are referred to in more than one location need not be duplicated between the different files. The software coordinator will store one copy of the document and make certain that all other references to it are easily traceable to its location.

5.0 CONFIGURATION-MANAGEMENT SYSTEM

The configuration-management system described here for Department 6310 is designed to identify and describe each version and each release of a code, to cross-reference which version is used for a particular analysis, and to track all requested changes to codes. This system will be divided into two main parts: the master log and the modification-or-discrepancy (MOD) system. The operational requirements of both parts will be performed by the software coordinator.

5.1. Master Log

The master log will consist of a notebook that will establish traceable records regarding new versions and new releases of each code. The details are as follows:

5.1.1 Each unique version and release will be identified on its own page in the log. This page will identify the name of the code, its version and release number, its date of entry into the configuration-management system, and the name of the technical contact. Each use of the code for a Level I or II analysis will be identified on this page by a unique and traceable designator such as product number, PDM number, job number, work-request number, or application number.

5.1.2 Within the log, the most current version of each code will be identified so that the software coordinator can direct new users of the code to the appropriate technical contact.

5.1.3 The information maintained in the log will be provided on Standard Form 185, Software Summary (shown in Appendix C), and by material submitted in support of verification, validation, and analysis efforts.

5.1.4 When not in use by the software coordinator, the master log will be stored in the RMS in a location agreed to by the RMS staff and the software coordinator.

5.2 Modification-Or-Discrepancy (MOD) System

The modification-or-discrepancy (MOD) system will allow anyone working with a code that has been entered into the configuration-management system's master log to suggest a modification to the code's capabilities or to submit a request for the correction to a known error in the code. The details are as follows:

5.2.1 Anyone working with a code that has been entered into the Master Log may submit a MOD request (see Figure 2). This form requests that a change to the program be made or that an error to the code be corrected. A request for code modification must be justified as to its potential benefits or advantages over the current code version.

5.2.2 All MOD requests will be given to the software coordinator for entry into the MOD tracking system he establishes. The request will be assigned initially to the technical contact for that particular code. The technical contact will respond promptly, using that same form, with one of the following answers: 1) a resolution of the request, 2) a reason why the request is not valid, 3) an estimate of how long it will take to perform the correction or modification, 4) a person to whom the request should be more appropriately reassigned to, or 5) a reason why it would be impractical to perform the requested modification. The software coordinator will see that all interested parties, including contract monitors, receive a copy of this reply.

5.2.3 The submitter of a MOD request may suggest whom the request should be assigned to, including himself.

5.2.4 The person to whom a request is assigned for resolution is called the "owner" of the MOD request.

5.2.5 The software coordinator will maintain a list of all open (unresolved) MOD requests and distribute a list of these, along with recently closed (resolved) MOD requests, on at least a quarterly basis. The distribution of this list will include the Department 6310 manager, the Department 6310 QA coordinator, all Sandia divisions with responsibilities under this DOP, and all MOD request owners and submitters with unresolved MOD requests.

5.2.6 It is the software coordinator's responsibility to notify owners of MOD requests when their projected completion dates have passed without resolution. These requests will be flagged on the MOD list.

5.2.7 A MOD request will be prepared for each modification to an existing code so that all interested parties can readily determine what changes are upcoming for the code.

Sandia National Laboratories
Department 6310
NNWSI

MOD # ____________
(assigned by Dept.6310)

MODIFICATION-OR-DISCREPANCY (MOD) REQUEST
(Send to Software Coordinator/6310)

Submitter's name: ______________________ org: ________
phone: ________________ date: ____________

Code: ____
Version.release: ____________________

Check one: [] Modification request
[] Error-correction request

Description of request. (Include supporting documentations or examples, if needed.):

____
____
____
____
____
____

Justification for modification:

____
____
____

Suggested assignment for MOD resolution (optional): ____________

Department 6310 use only

Request assigned to: ________________________ org: ______
Assignment date: ________________

RESPONSE (Return to Software Coordinator/6310)

Check one and fully explain below. (Include any supporting documentation):
- [] Resolution is forthcoming, estimated completion date: ________
- [] Resolution enclosed
- [] Reassign request to another person: ________________
- [] Invalid request
- [] Impractical to resolve

____
____
____
____

Signature: ______________________ Org: ____________
date: ________________

6.0 REQUIREMENTS

Sections 6.1 thru 6.10 describe all steps in the planning, development, testing, and use of software according to this DOP. A flowchart of this software QA process is shown in Figure 3. Some steps in the process are omitted for certain classes of software, as explained by Figure 1. And while Figure 3 depicts a suggested order of events, some software projects may vary from this actual sequence.

Checklists showing the detailed requirements for each class of software (except the noncalculational classes) are included in Appendix A. A copy of the appropriate checklist should accompany each document or review submitted to the software coordinator for permanent storage.

This DOP is provided as a basis for the content of all required documentation. Format, arrangement, and style are left to the discretion of the writer as long as all necessary topics are addressed. If a portion or all of the information called for is already written and located in some other document, that document may be submitted with the necessary topics identified and need not be rewritten. Comment lines within a source-code listing may also be substituted for appropriate portions of documentation called for in this DOP.

Most of the documentation described here must be subjected to a technical review before it becomes part of a code's permanent file. These reviews must be in accordance with the requirements set forth in DOP 2-4. When a required document is in a format that requires its own reviews (e.g., a SAND report), these written technical reviews may be substituted for the technical reviews called for in this DOP. A copy of each review (or a cross-reference to the review) will be stored by the software coordinator in the permanent file.

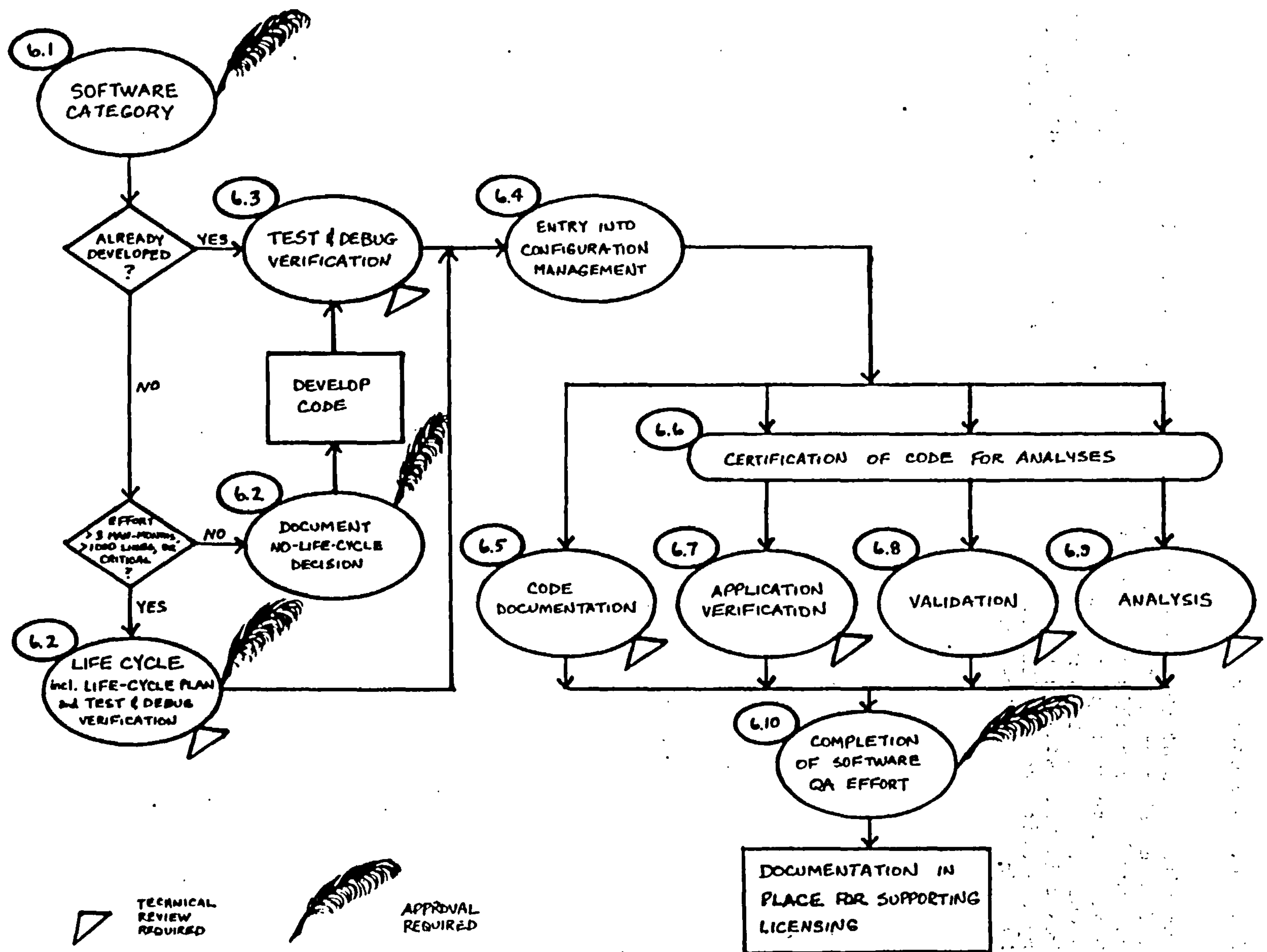

Figure 3. Flowchart for software QA process.

6.1 Software Category

The first step of the Software QA process is to assess what category the software falls under (see Section 2.0, Applicability). After the technical contact has made this decision, he will submit a memo to Department 6310's Quality Assurance group regarding this decision. The form shown in Figure 4 should be used. This memo will be approved by the task leader under whose WBS this work will be funded, and a copy of the approved form will be stored by the software coordinator in the file created for this code within the Records-Management System.

DATE: ____________________

TO: QA Coordinator

FROM: ______________________________

SUBJ: QA SOFTWARE CATEGORY

Please be advised of the software category decision as listed below:

Code name: ____

Version/release: ____________________ or NOT YET ASSIGNED

Approximate time period over which the code was or will be written:
__________ thru __________ or NOT APPLICABLE

Expected entry date of code into configuration-management system: __________ or NOT APPLICABLE

Brief description of purpose of code: ____________________
____
____
____
____

Cateogry (check):

[] SES [] CALCULATIONAL NON-SES [] NON-CALCULATIONAL

and

[] IN-HOUSE [] COMMERCIAL

Approved:

____________________ ____________
Task leader date

PLEASE FORWARD A COPY OF THIS FORM, WHEN APPROVED, TO THE SOFTWARE COORDINATOR FOR INCLUSION IN THE RMS FILE FOR THE SUBJECT CODE.

6.2 Software-Development Life Cycle

Software-development life cycle is a process by which software is developed in distinct phases, with associated documentation required at each phase. The goal of the life-cycle requirements is to establish a good base of documentation for critical software and for programming efforts so extensive that the same personnel may not be working on the effort throughout its life.

6.2.1 When to Use Life Cycle

Software must be considered for development under the guidance of the software-development life cycle if the coding of the program (i.e., the writing of the program as lines in a computer language) has not yet begun as of the date of the initial issue of this DOP. Life cycle is required only for in-house SES or in-house calculational non-SES.

The criteria for deciding whether the life-cycle process will be used are based on the size and the criticality of the programming effort. Life cycle must be used if at least one of the following specifications is met:

1. The coding effort is reasonably expected to require more than 3 man-months.

2. The code will be longer than 1000 lines of a high-level language (excluding comments).

3. The code is expected to be critical in meeting the objectives of the NNWSI project.

If a code meets none of these criteria and the code developer decides not to use the life-cycle process, the code developer must write a memo that documents this decision. Before the coding begins, this memo must be approved by the task leader and the QA coordinator. The software coordinator will store a copy of the approved memo in the code's permanent RMS file.

If a particular programming effort was originally believed to be within the size limits shown above so that life cycle was not used, but becomes appreciably larger upon development, the technical contact can be required by the QA coordinator to meet all life-cycle requirements.

6.2.2 Life-Cycle Plan

The life-cycle process that has been developed for Department 6310 is shown in Section 6.2.3. If a coding effort must use life cycle (see Section 6.2.1), those portions of Section 6.2.3 that are applicable to the effort and make good programming and management sense must be performed. This subset of the full life cycle must be planned out in advance by the technical contact (possibly with the help of the principal investigator in charge of the code-development effort and the task leader). The product of this planning, a Software Life-Cycle Plan, must be approved by the principal investigator and the QA coordinator before coding may begin. This plan will address the complete life cycle, explaining which portions are applicable to the effort and which will not add significantly to the manageability of the effort. A technical review should be specified in the plan after each phase to be performed. The QA coordinator, when reviewing this plan, will consider whether it adequately implements software quality-achievement and quality-assurance practices appropriate to the particular code-development effort. After the plan has been approved, a copy will be stored by the software coordinator in the code's permanent file in the RMS.

6.2.3 Department 6310's Life-Cycle Process

DEFINITION OR REQUIREMENTS PHASE

The purpose of this phase of software-development is to decide on and document why this software project was initiated and what the software must accomplish.

Suggested output: Requirements Specification
This document will explain the purpose, scope, intended users, and terminology for the required software product. The document should include a general description of the functions that the software must perform, along with specifics such as performance requirements, design constraints due to hardware, interface requirements, and special circumstances.

DESIGN PHASE

The programming strategy is decided on, and the major components of the design are described with the aid of flow diagrams, decision tables, or pseudocode.

Suggested output: Preliminary Design
Included in this document should be items such as the overall

description of the input and output data, the flow of information, external files and databases, and design limitations. This document should expand on the requirements specification to describe the approach for how the requirements will be met.

Suggested output: Detailed Design
This document extends the design down to the module level, giving a clear description of the major tasks and processing that occurs within a module. Included should be all data input, data output, and interfaces with other modules.

PROGRAMMING PHASE

The design is translated into a computer language.

Suggested output: Source-code

TEST-AND-DEBUG PHASE

The program is tested to determine whether the code accurately performs the desired mathematics as described in the requirements specification.

Suggested output: Test-and-Debug Verification
This document reports all tests run that verify that the program functions correctly. It reports exercises of all possible paths and the use of valid and invalid data during testing. See Section 6.3, Test-and-Debug Verification, for more information.

6.2.4 Review

The documentation produced in accordance with the life-cycle plan will be reviewed at times specified by the plan. These reviews will be conducted by at least one person who is qualified to judge the progress and direction of the programming effort, usually the principal investigator unless the PI has participated in the work being reviewed. The reviews will consider both the technical adequacy of the documentation and its adherence to the life-cycle plan. A report on the results of each review will be given along with the reviewed documentation to the software coordinator for inclusion in the RMS.

6.3 TEST-AND-DEBUG VERIFICATION

A code will normally be tested and debugged by the programmer as part of its development. The test-and-debug verification attempts to determine whether the code accurately performs the mathematics desired.

The extent to which the code is tested is determined largely by the complexity of the code. A simple code performing algorithms generally accepted as correct can probably be completely and accurately verified by the programmer using ordinary debugging techniques. Examples of these techniques are 1) a line-by-line inspection, 2) testing of individual modules or subroutines of the program, and 3) comparing computed results against hand-calculated numbers. Generally, 3) is considered the final test of program accuracy for simple codes.

The effort that the programmer goes through to test and debug his code will be documented along with the results and will then be submitted as the Test-and-Debug Verification. This document will be reviewed by at least one person familiar with the material, preferably the principal investigator. This review will include a statement regarding the completeness of this verification effort. For codes that embody complex and original modeling approaches, the test-and-debug verification will generally be insufficient for determining the desired accuracy of the code, because calculating more than a few results by hand to compare to the program's output may be too time consuming. For this type of code (which will most likely be SES programs), further verification is called for by Section 6.7, which describes application verification.

If a code has used the life cycle described in Section 6.2, testing has probably already been performed and documented according to a life-cycle plan. This documentation and its technical review may be substituted for the test-and-debug verification.

If a code was developed commercially or before the initial issue of this DOP, the test-and-debug verification that was previously performed must be described. If this information is not available, widespread use of the program may be cited as evidence of its accuracy.

6.4 Entry into Configuration-Management System

For an in-house program or a modification to other types of applicable programs, after coding and test-and-debug verification has been performed, the code must be entered into the configuration-management system's master log (see Section 5.1) by submitting Form 185, Software Summary (see Appendix C), to the software coordinator. For a commercial code, this will be done as soon as a decision to use the software has been made and the software is loaded and working on the computer system. A new form is to be submitted for each new version or release and when the technical contact is changed.

Once a code has been entered into the configuration-management system, changes to the code may only be made to personal working copies until a new release is made of the code with those changes. Multiple adaptations of a particular code that meet the requirements of Sections 6.1, 6.2, and 6.3 (where applicable) may exist within the configuration-management system. New versions may be submitted by anyone working with the code, but the assigned technical contact for the original code will not necessarily be required to provide support for new versions. Authors of a new version may be required to become the technical contact of their modified code. The decision to name a new technical contact will be made by the mutual agreement of Department 6310 management and the technical contact's own organization.

6.5 Code Documentation

6.5.1 SES

There are three categories of documentation that must be produced or identified and collected for SES:

A. Mathematical models and numerical methods

B. User's manual

C. Source-code listings

Appendix B gives a detailed explanation of these categories. Figure 5 is a code documentation checklist for SES codes that lists the major required items detailed in Appendix B. This checklist will be submitted with the documentation, and the column marked "LOCATION" will designate where in the documentation particular information is located. The software coordinator will maintain a single checklist for each permanent file, marking the "LOCATION" column appropriately as material is received for storage in the file. Items called for that are not applicable should be identified with "n/a".

For in-house SES codes, documentation relating to items A and B above must be subjected to a technical review before it becomes part of the permanent file for the codes. The review will be performed by at least two members chosen by Department 6310 management. Optimally, these reviews should be performed by people who will probably use the code in the future or are familiar with the material, but who did not participate in the work that resulted in the documentation. The documentation may also be divided among different reviewers where necessary.

For a commercial code, an effort must be made to obtain documentation in all three categories from the vendor or to have this documentation produced by the technical contact assigned to that code.

Figure 5. SES documentation checklist.

Code name: ______________________

	LOCATION	
A. Mathematical Models		
1. Overall description		
2. Structure		
3. Numerical procedure		
4. Component models		
a. Purpose		
b. Assumptions & limitations		
c. Notation		
d. Derivation		
e. Application		
f. Numerical method type		
g. Derivation of numerical model		
h. Location		
i. Stability & accuracy		
j. Alternatives		
5. Performance experience		
B. User's Manual		
1. Program considerations		
a. Program options		
b. Program paths		
c. Data structures		
d. Initialization		
e. Restart		
f. Error processing		
2. Data files		
a. Content		
b. Use by program		
c. Auxiliary processing		
3. Input data		
a. General considerations		
(1) Techniques		
(2) Consecutive cases		
(3) Defaults		
b. Individual input records		
(1) Record identifier		
(2) Input variables		
(3) Format		
(4) Need		
(5) Repetition		
(6) Units		
(7) Default		
(8) Description		
(9) Range		
4. System interface		
a. System-dependent features		
b. Compiler requirements		
c. Hardware requirements		
d. Control cards, command files		
5. Output		
6. Sample problems		
C. Source-code listings		

6.5.2 In-House Calculational Non-SES

For in-house calculational non-SES, the documentation that must be in place consists of one manual (or the same infomation in several manuals) that includes, at a minimum, the following information:

1. What the program does (i.e., its purpose).

2. How the program performs its purpose (i.e., algorithms, sort routines, etc.).

3. How to use the program (user's manual). Appendix B may be used as a guide.

4. Source-code listings, specifically, a letter-quality copy on 8-1/2" by 11" paper, a copy on microfiche, and a computer-readable copy on magnetic tape or floppy disk.

This information should be written in an amount of detail that would allow a potential user with knowledge of the intended application to use the code effectively.

6.5.3 Commercial Calculational Non-SES

For commercial calculational non-SES codes, the minimum documentation that must be acquired consists of

1. A general user's manual, obtained from the vendor.

2. Source-code listings, on paper and on a computer-readable medium, if obtainable.

6.6 Certification of Code for Analyses

Before a code may be used to perform a Level I or II analysis (which may consist of running the code to perform verification, validation, or a design or performance analysis), the code must be certified. This certification is accomplished according to the specifications found in DOP 2-4, <u>Analysis Control and Verification</u>.

6.7 Application Verification

Application verification is an extension of test-and-debug verification (see Section 6.3) in that it ascertains that the program correctly performs the mathematics intended and accurately corresponds to its documentation. However, application verification is generally applied to codes of greater complexity whose accuracy cannot be determined to the desired level using ordinary testing and debugging techniques. Application verification is performed by the end user and allows him to verify the program for his particular application and its associated range of input.

There are three methods of application verification most commonly used:

1) Comparison of results computed by the program with those calculated by hand or analytically.

2) Use of a "Proof of Correctness". (See Gries, The Science of Programming) This technique employs a form of mathematical induction to prove that every portion of a software product is depicted correctly.

3) Benchmarking the program against other codes.

An application verification effort may use one or more of these techniques in establishing the desired accuracy of a code. The optimal approach may vary from application to application.

Verification efforts will be fully documented. The documentation must include the method, actual steps taken or tests run, and the results. These documents must be subjected to a review according to the analysis-review requirements in DOP 2-4. If the verification effort or its review reveals that additional changes are needed to the code, these changes will be worked out between the technical contact of the code and the principal investigator (using the MOD system where required) to ensure that the altered code is assigned a new version or release number, any needed additional verification efforts are performed, and all documentation is kept up to date. The principal investigator for each application-verification exercise will supply to the software coordinator all the documentation resulting from the exercise or an appropriate cross-reference for inclusion in the RMS. The software coordinator will make certain that any findings brought out through the verification process are distributed among all other users of the code.

6.8 Validation

Validation is the process of judging that a model is a sufficiently accurate representation of a real system for a specified application. The documentation will primarily be published conclusions made from comparisons of model predictions, as embodied in the software, with data from laboratory experiments, field experiments, and natural analogues and with published conclusions made by peer review groups. For software that embodies a model, validation documentation will include available referenceable information that indicates the limitations and capabilities of the model - i.e., the conditions for which the model is considered to be valid for the specified application.

All information regarding the conditions for which the model is valid will be documented. If the validation effort or its review reveals that additional changes are needed to the model, these changes will be worked out between the technical contact of the code and the principal investigator (using the MOD system where required) to ensure that the modified model and associated code is assigned a new version or release number, any additional needed validation efforts are performed, and all documentation is kept up to date. The software coordinator will collect and store all this information in that code's permanent file and make certain that any findings brought out through the validation process are distributed among all other users of the code.

6.9 Analysis

Given that all requirements through section 6.4, Entry into Configuration Management, have been met and that the appropriate certification of the code to perform analyses has been completed (see section 6.6), the user may then use this code for Quality Assurance Level I and II analysis, according to DOP 2-4, Analysis Control and Verification.

6.10 Completion of Software QA Effort

When the requirements in Sections 6.1 through 6.9 have been completed for a particular analysis to the degree necessary for licensing, the principal investigator of that analysis effort will submit a Memo of Completion of Software QA Requirements to the QA coordinator. This memo will list all requirements, their resolution, and the location of all documentation. After the QA coordinator approves this memo, the software coordinator will store a copy of it in the permanent file of that analysis.

All software QA requirement efforts for an analysis must be completed before the results of the analysis are used in an application for a license from the Nuclear Regulatory Commission.

SOFTWARE QA CHECKLIST AND SUBMITTAL FORM -- SES, IN-HOUSE

A copy of this form should accompany each document or review submitted to the software coordinator for permanent storage.

NAME: ______________________ PHONE: ______________
ORG: ________________________ DATE: ____________

PRODUCT: ________________________________
VERSION OR RELEASE: _______________________
ANALYSIS EFFORT (if applicable): _______________

[CHECK THE BOXES THAT DESCRIBE THE MATERIAL SUBMITTED WITH THIS FORM]

1. [] QA Software Category memo, approved

2. [] Software-Development Life-Cycle Plan, approved
   [] Requirements Specification
      [] Review
   [] Preliminary Design
      [] Review
   [] Detailed Design
      [] Review
   [] Test-and-Debug Verification
      [] Review

3. [] Test-and-Debug Verification (not as part of Life Cycle)
      [] Review

4. [] Software Summary, Form 185

5. Code Documentation (include a copy of Figure 5):
   [] Mathematical Models & Numerical Methods
      [] Review
   [] User's Manual
      [] Review
   [] Source-code listing

6. [] Certification

7. [] Application Verification
      [] Review

8. [] Validation
      [] Review

9. [] Analysis
      [] Review

10. [] Memo of Completion of Software QA Requirements, approved

SOFTWARE QA CHECKLIST AND SUBMITTAL FORM -- SES, COMMERCIAL

A copy of this form should accompany each document or review submitted to the software coordinator for permanent storage.

NAME: ______________________________ PHONE: ______________
ORG: ______________________________________ DATE: __________

PRODUCT: ____
VERSION OR RELEASE: ____
ANALYSIS EFFORT (if applicable): _____________________________

[CHECK THE BOXES THAT DESCRIBE THE MATERIAL SUBMITTED WITH THE FORM]

1. [] QA Software Category memo, approved

2. [] Test-and-Debug Verification
   [] Review

3. [] Software Summary, Form 185

4. Code Documentation (include a copy of Figure 5):
   [] Mathematical Models & Numerical Methods
      [] Review
   [] User's Manual
      [] Review
   [] Source-code listing

5. [] Certification

6. [] Application Verification
   [] Review

7. [] Validation
   [] Review

8. [] Analysis
   [] Review

9. [] Memo of Completion of Software QA Requirements, approved

SOFTWARE QA CHECKLIST AND SUBMITTAL FORM -- CALCULATIONAL NON-SES IN-HOUSE

A copy of this form should accompany each document or review submitted to the software coordinator for permanent storage.

NAME: ____________________ PHONE: __________
ORG: ____________________ DATE: __________

PRODUCT: ____________________
VERSION OR RELEASE: ____________________
ANALYSIS EFFORT (if applicable): ____________________

[CHECK THE BOXES THAT DESCRIBE THE MATERIAL SUBMITTED WITH THIS FORM]

1. [] QA Software Category memo, approved

2. [] Software-Development Life-Cycle Plan, approved
   [] Requirements Specification
      [] Review
   [] Preliminary Design
      [] Review
   [] Detailed Design
      [] Review
   [] Test-and-Debug Verification
      [] Review

3. [] Test-and-Debug Verification (not as part of Life Cycle)
      [] Review

4. [] Software Summary, Form 185

5. [] User's Manual
      [] Review
   [] Source-code listing

6. [] Analysis
      [] Review

7. [] Memo of Completion of Software QA Requirements, approved

SOFTWARE QA CHECKLIST AND SUBMITTAL FORM -- CALCULATIONAL NON-SES COMMERCIAL

A copy of this form should accompany each document or review submitted to the software coordinator for permanent storage.

NAME: ______________________ PHONE: ____________
ORG: ___________________________ DATE: ________

PRODUCT: ______________________________________
VERSION OR RELEASE: ____________________________
ANALYSIS EFFORT (if applicable): ______________________

[CHECK THE BOXES THAT DESCRIBE THE MATERIAL SUBMITTED WITH THIS FORM]

1. [] QA Software Category memo, approved

2. [] Software Summary, Form 185

3. [] User's Manual
   - [] Review

   [] Source-code listing

4. [] Analysis
   - [] Review

5. [] Memo of Completion of Software QA Requirements, approved

APPENDIX B -- REQUIREMENTS FOR SOFTWARE QA DOCUMENTATION

A. Mathematical Models and Numerical Methods

The purpose of this documentation is to provide a complete explanation of methods used, including a derivation of and justification for the model along with its capabilities and limitations. Use extensive references to publications and point out new procedures developed for this code.

This documentation should be complete enough to serve as a sole basis for review of the methods used in the code.

1. Overall Description

Describe the general purpose of the model. Indicate in general terms the information that goes into and comes out of the model.

2. Structure

Briefly describe the role of each component model (logically distinct subset of the model). Show the contribution of each to the overall solution of the problem. Use flow charts and block diagrams to describe the mathematical solution strategy.

3. Numerical Procedure

Describe the general numerical solution strategy and computational sequence. Use flowcharts and block diagrams. Give references for the basic numerical procedure. If the method solves a large set of equations, show the structure of the equations and how the coefficients were determined. Show the relationship between the numerical strategy and the mathematical strategy (e.g. how boundary conditions are introduced).

4. Component Models

For each component model, provide the following descriptions:

a. Purpose. Describe the purpose and scope of the component model. State the input to and output from the model in general terms and the way the information is processed. State under what circumstances the component model is executed.

b. Assumptions and limitations. Describe the assumptions and limitations of the component model. Include simplifying assumptions about the geometry and behavior of the system. Include the known ranges of validity of the model for all variables. For models based partially or wholly on observed or experimental data (empirical or semi-empirical models), state the range and type of data. State any known uncertainty about the model's validity.

c. Notation. Identify all algebraic variables that represent essential parameters within the equations being programmed. (This requirement does not apply to temporary storage arrays and temporary variable names. Identify only those variables necessary to allow complete tracing of data through the code.) Give both the mathematical symbols used in the fundamental equations and their equivalents in the numerical formulation and the computer variable name.

d. Derivation. Cite the original publication in which the component model appeared and any subsequent references that present modifications that lead up to the present form. Depict the derivation starting with generally accepted principles. Justify each step in the derivation, noting how assumptions and limitations are introduced and how any experimental data were used. State clearly the final mathematical form of the model. If published material contains an adequate derivation, a copy of this may be included instead of a new derivation.

e. Application. Discuss how the component model applies to a geologic repository. Point out restrictions on extrapolation of the model or use out of range. Describe any restrictions on the use of the model, such as to a particular rock type. Discuss any unusual or extreme conditions that would affect the validity of the model.

f. Numerical method type. Identify any numerical methods used that go beyond simple algebra (e.g., finite-difference method).

g. Derivation of numerical model. Derive the numerical procedure from the mathematical component model, giving references for all numerical methods. State the final form of the numerical model and explain the algorithm. Explain how intermediate results are used.

h. Location. Show where the component model is located within the code.

i. Stability and accuracy. Discuss the stability and accuracy of the numerical model, distinguishing between aspects of stability and accuracy that have been proven mathematically and those that have been observed in practice only.

j. Alternatives. Discuss briefly any alternatives to the component model that were considered and why this one was selected.

5. Performance Experience

Discuss the overall performance of the entire model, noting under which conditions the model gives good or bad results. Point out specific component models known to perform poorly under certain circumstances. Give any recommendations to follow when executing the model.

B. User's Manual

For the purposes of the licensing review, the user's manual allows NRC staff to understand modelling results submitted by the applicant and to install and run the code on its own computer. This manual, along with hard-copy listings, should be sufficient to instruct a user on how to set up and run problems and resolve any difficulties encountered.

Comment cards within the code or self-documenting features may be referred to in place of a detailed description in the user's manual if the information is complete enough to enable a new user (with programming experience) to run the code and resolve errors.

1. Program Considerations

a. Program paths. Describe the purpose of each subroutine. Use flowcharts and block diagrams to explain the paths the program can take. State what conditions cause certain parts of the code to be executed. Show how the computational sequence and solution strategy described in section "A.3 Numerical Procedure" are related to the program flow.

b. Program options. Discuss the function of each major program option, giving special attention to effects of combinations of options. Relate options to the input values that control them.

c. Data structures. Discuss how data are stored during computation. Describe the purpose and content of important common blocks and arrays. State the array dimensions and describe the indexing algorithm if dynamic dimensioning is used. This information, along with the hard-copy listing, should be sufficient to allow the user to follow the flow of data through the computational sequence.

d. Initialization. List any values automatically assigned to important variables, including values of physical significance and parameters that affect program execution. Show where the values are initialized and whether they are default values or fixed.

e. Restart. Describe any restart capabilities of the code and how they are used.

f. Error Processing. Describe the origin and likely causes of all major error messages, error switches, and abnormal stops.

2. Data Files

a. Content. Outline the general content, purpose, and organization of each data file.

b. Use by program. Describe how and when the files are read and written by the program.

c. Auxiliary processing. Describe any available auxiliary programs that create, modify, or use the files.

3. Input Data

a. General considerations.

(1). Techniques. Describe any special input techniques and requirements such as blank fields, order, or field delineation.

(2). Consecutive cases. If the code is able to retain input data from previous cases, give conditions for retention and reinitialization.

(3). Defaults. Give the general conventions governing default values.

b. Individual input records.

(1). Record identifier. Give the line identifier, if any, for this type of record.

(2). Input variables. State the code variables that will contain data given on this record.

(3). Format. Specify the format of this record, if any.

(4). Need. Specify for each variable whether input is necessary or optional for both start and restart runs.

(5). Repetition. State how many of these input records are required.

(6). Units. For each field, state the dimensional units.

(7). Default. State the default value for each field, if any.

(8). Description. Define each variable and discuss its primary use within the code. State how to assign values in setting up a run.

(9). Range. State the acceptable limits for each variable.

4. System Interface

a. System-dependent features. List the external references in the program that must be supplied by the system, and state the purpose of each. Include plot and mathematical libraries, utility programs, and statistical packages, identifying the manufacturer and version used. Omit any intrinsic functions which are standard to the compiler being used.

b. Compiler requirements. Identify all compilers used and any special load or compiler options that are necessary - e.g., large-core-memory addressing.

c. Hardware requirements. Describe all hardware features needed to execute the code and the amount of memory required for a typical case, along with a general rule for determining the necessary memory for varied cases.

d. Control cards or command files. Describe the control cards or command files necessary to control program initiation, manipulation of files, and interaction with other programs. Give detail appropriate to the degree to which control cards or command files contain logic affecting program flow, manipulation of files, and communication among programs. Give examples.

5. Output

Discuss the code output and relate edited output to input options. State the origin and meaning of the output variables. Describe any normalization of results and list associated dimensional units. Describe any graphical capabilities of the code.

6. Sample problems

Include a few problems which demonstrate how the code is used. These problems need not have known solutions or experimental data, but they should exercise a large portion of the available programmed options. These sample problems should use only a reasonable amount of computer time. Input listings and sample output should be given.

C. Source-Code Listings

Listings of the source code should be submitted on each of the following media:

1. Letter-quality print on 8-1/2 by 11" paper
2. Microfiche
3. A computer-readable media, such as magnetic tape or floppy disk

Include these copies for every version and release of the program that is controlled by the configuration-management system.

APPENDIX C -- SOFTWARE SUMMARY FORM 185

FEDERAL INFORMATION PROCESSING STANDARD SOFTWARE SUMMARY

01. Summary date (Yr. | Mo. | Day)
02. Summary prepared by (Name and Phone)
03. Summary action: New ☐ Replacement ☐ Deletion ☐ Previous Internal Software ID
04. Software date (Yr. | Mo. | Day)
05. Software title
06. Short title
07. Internal Software ID
08. Software type: ☐ Automated Data System ☐ Computer Program ☐ Subroutine/Module
09. Processing mode: ☐ Interactive ☐ Batch ☐ Combination
10. Application area — General: ☐ Computer Systems Support/Utility ☐ Scientific/Engineering ☐ Bibliographic/Textual ☐ Management/Business ☐ Process Control ☐ Other — Specific
11. Submitting organization and address
12. Technical contact(s) and phone
13. Narrative
14. Keywords
15. Computer manuf'r and model
16. Computer operating system
17. Programming language(s)
18. Number of source program statements
19. Computer memory requirements
20. Tape drives
21. Disk/Drum units
22. Terminals
23. Other operational requirements
24. Software availability: Available ☐ Limited ☐ In-house only ☐
25. Documentation availability: Available ☐ Inadequate ☐ In-house only ☐
26. FOR SUBMITTING ORGANIZATION USE

185-101

Standard Form 185
1974 July
U.S. Dept. of Commerce—NBS
(FIPS. Pub. 30)

APPENDIX D -- DEFINITIONS

Application verification: an advanced phase of verification for codes that are so complex that the desired level of accuracy cannot be determined by the code developer using ordinary testing and debugging techniques. When using such codes, the end user must verify the code for his particular application.

Benchmarking: the comparison of the results of a particular test case run on a software package with the results of the same test case run on a different software package, where both codes were designed to solve comparable problems.

Calculational non-SES code: a code that can contain complex mathematics, but generally does not involve modeling or the use of numerical techniques. Examples include statistical packages, graphics packages, spread-sheet programs.

Commercial software: software that is developed without Sandia influence. It is generally available to the public on a fee or no-fee basis, and may be used outside of the NNWSI project.

Computer program, computer code, code: synonyms for "software" of any type.

Configuration management: a system of controls that prevents ambiguity as to which version of software is used for a particular computation and to track requested modifications or error corrections to these codes.

Electronic calculation: software developed for very limited use to simplify, augment, support, or verify calculations. Electronic calculations are generally minor software development efforts.

In-house software: software developed under Sandia auspices to fulfill a particular Sandia requirement

Life cycle: see software-development life cycle

Manifest-product software: software that produces a result that can be readily examined for correctness without reference to any software's function or design. Manifest-product software includes, but is not limited to, word processing, editing, electronic mail, accounting software, and trivial calculations.

Mathematical model: a mathematical representation of a system or process.

APPENDIX D -- DEFINITIONS (cont.)

MOD system: Modification-or-discrepancy system.

MOD request: a form submitted by a user to the MOD system that requests a modification or error correction to a particular code that is controlled by the configuration-management system.

Model: a representation of a physical system, based on scientific principles and laws, that serves to transform one set of input information into another set of output information.

Model component: Any logically distinct subset of a model.

Noncalculational code: a code that performs data or symbol manipulation but no mathematical calculations. Examples include compilers, word processors, operating systems, etc.

NNWSI: Nevada Nuclear Waste Storage Investigations.

Peer: a person with expertise comparable to that of the person(s) whose work is being examined.

Proof of correctness: a verification technique that employs a form of mathematical induction to prove that a code accurately depicts what was intended.

Principal Investigator (PI): the person assigned responsiblity for conducting the activities described in the Work Plan, which can include development and use of software.

Release: a unique issue of a code that generally contains corrections to errors that existed in the previous issue of the code. Documentation for a new release of the code generally remains the same as for the preceeding release.

Scientific and engineering software (SES): software that specifies operations according to a physical or mathematical model or that uses a numerical method.

Software: a set of computer operations specified in any compiler language that can be translated unambiguously into machine language. (Operations specified in machine language are also software.)

APPENDIX D -- DEFINITIONS (cont.)

Software coordinator: the person assigned within Department 6310 for the tasks described in Section 3.3 of this DOP.

Software-Development Life Cycle: a method of project planning and documentation for the development of a software product. Life cycle allows optimal traceability regarding the goals, restrictions, decisions made, and current progress of a code for efforts so extensive that the personnel involved may change during the life of the effort.

Technical contact: the technical professional identified on the software summary form, usually the author of or current expert on the software.

Technical review: a documented critical review performed by personnel who have technical expertise at least equivalent to that required for the original work.

Trivial calculation: a computation that could be performed readily on paper or with an unprogrammable scientific calculator.

Validation: the documented confirmation that the software under review is suitable for its intended purpose. Validation includes assurance that a physical model, as embodied in software, is a correct representation of the intended physical system or process.

Verification: the documented confirmation that the software performs exactly the mathematical and logical operations described in documents pertaining to the code.

Version: a unique adaptation of a code that differs in its documented capabilities from other adaptations of the same code.

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SNL NNWSI PROJECT

DEPARTMENT OPERATING PROCEDURE

ANALYSIS DEFINITION REQUIREMENTS

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Page	18	19	20	21	22
Rev.	0	0	0	0	0

Author: Joe Tillerson — 12/1/86
J. R. Tillerson, 6314 — Date

Approved: N/A
Division Supervisor — Date

Approved: [signature] — 12/3/86
Quality Assurance — Date

Approved: [signature] — 12/4/86
Department Manager — Date

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*DOP 3-3 replaces QAP III-3.

ANALYSIS DEFINITION REQUIREMENTS

1.0 Purpose

The purpose of this Department Operating Procedure (DOP) is to detail the methods for preparing documentation for the (1) initiating, (2) documenting, and (3) accepting an analysis or calculation task. Related changes and revisions to the problem definition will also be controlled by this procedure.

2.0 Scope

This procedure (DOP) applied to QA Level I and QA Level II scientific analyses and calculations and engineering calculations performed at Sandia National Laboratories (SNL) within the NNWSI Project Department or by other organizations or contractors for the SNL NNWSI Project Department. This procedure may be used, but is not required, for QA Level III analyses and calculations. Excluded from the scope of this procedure are design investigations which are controlled by DOP 3-4, Design Investigation Control or DOP 3-10, Routine Design Calculations, and simple mathematical calculations, standard statistical calculations, or data reduction calculations.

3.0 Definitions

3.1 Analyst - The person responsible for conducting and documenting a calculation or analysis.

3.2 APM - Authorization to Proceed Memo.

3.3 ATM - Acceptance of Task Memo.

3.4 Data Reduction - Conversion of raw data to meaningful form.

3.5 PDM - Problem Definition Memo.

3.6 Principal Investigator (PI) - The SNL staff member responsible for completion of a particular investigation or design. He may or may not also be the Task Leader.

3.7 Task Leader (TL) - The SNL staff member responsible for developing the technical guidance, budget, and schedules for a Work Breakdown Structure (WBS) task. He may or may not also be the Principal Investigator.

3.8 Scientific Analyses and Calculations and Engineering Calculations - Those calculations or analyses which involve a mathematical or numerical model of a physical process or phenomenon.

3.9 Simple Mathematical Calculations - Calculations that are routinely performed by scientist and engineer that do not involve the use of complex computer codes. These calculations are typically performed to define approaches to problems or to provide simple scoping solutions that may be subsequently refined by more complex analyses.

3.10 Standard Statistical Calculations - Calculations of mean, standard deviation, regression analysis, curve fitting, etc., such as those methods available in statistical library packages.

4.0 <u>Procedure</u>

The sequence of activities described in this section is shown in Figure 1.

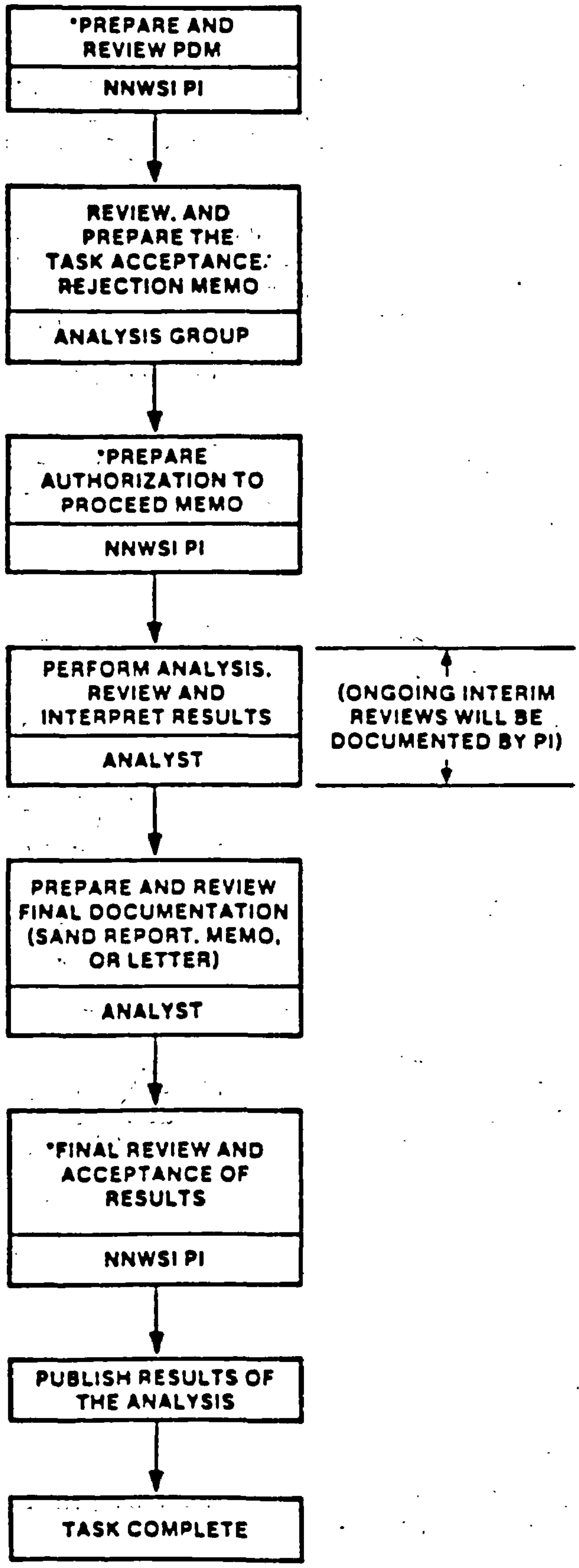
4.1 Initiating Analysis and/or Calculational Tasks

To request or initiate an analysis or set of calculations, the PI and/or the proposed analyst shall prepare a Problem Definition Memo (PDM) which shall include:

A. Date of PDM:____________________
B. Work Breakdown Structure (WBS) No.:____________________
C. PDM No.*:__________. Task/Subtask No.:__________
D. Task Title: ____________________
E. QA Level:____________________
F. Case and Subcase No.:__________.__________
Contractor:________ Contract No.:________ Task No:________
G. Purpose of analysis or calculation to include what decision(s) are dependent on this analysis or calculation.
H. Definition of geometry and loads of the problem.

*The PDM number will be assigned and logged by the SNL NNWSI Records Management Staff.

ANALYSIS AND/OR CALCULATIONAL FLOW CHART



*DENOTES ACTIONS WITHIN NNWSI PROJECT

FIGURE 1

I. Definition of material and physical properties to be used in the analysis. NNWSI reference properties derived from the Reference Information Base will be used unless otherwise specified. If other than NNWSI reference properties are used, then the justification as to why they were not used will be stated as will the reasoning as to why the properties to be used were selected.

J. Definition of what parameters are to be used if a parametric study is to be conducted.

K. Definition of what reports are required and when they are required.

L. Definition of what the results will be compared to, for use as a cross-check.

M. Definition of what type of output required at the end of the analysis, i.e., tabular, plots, slides, movies, viewgraphs, etc.

N. Specification of any special qualifying tests for verification or validation (if necessary), i.e., benchmarks.

O. Statement of whether the analysis will be subjected to analysis review per DOP 2-4.

A sample PDM can be found in Appendix B.

4.2 Review and Approval of PDM

The initial review and approval of the PDM will be as follows:

QA Level I
- Approval of the Task Leader and Division Supervisor, and
- Approval of NNWSI Project Department Manager

QA Level II
- Approval of the Task Leader and Division Supervisor

All SNL NNWSI Division Supervisors will be notified of the proposed analyses/calculations, i.e., receive a copy of the PDM for information purposes.

4.3 Letter of Transmittal of the PDM to Analysis Group

The letter transmitting the PDM to the organization performing the analysis will be prepared by the PI and shall contain instructions to that organization to:

A. - Review the PDM.
B. Accept or reject the task as described in the PDM.
C. If the task is accepted, the analyst assigned to the task will prepare an Acceptance of Task Memo (ATM) and send it to the PI. The ATM shall contain as a minimum the following:

i. Name and signature of the assigned analyst.
ii. Name and signature of the analyst's supervisor, which certifies the analyst's qualifications as well as the qualifications of the method of analysis and of the computer codes used for conducting the task.
iii. Proposed schedule, including required reviews (as shown in the PDM).
iv. Reporting method(s) and schedules of reporting dates.
v. The method of analysis and/or code(s) that will be used as well as the qualifications of the method and/or computer code.

A <u>conditional</u> <u>acceptance</u> by the analysis group may be transmitted by them in the case of discrepancies, such as scheduling or cost estimates, which differ from the original PDM.

D. If the task defined in the PDM is rejected or conditionally accepted by the organization conducting the analysis, a memo stating that the PDM was rejected (or only conditionally accepted) and the reasons will be sent by the assigned analyst to the PI. The PI will then do one of the following:

i. Write a memo to the analyst accepting the conditional (if that is the case) ATM.
ii. Redefine the requirements and return the new PDM to the analysis group (repeat paragraph 4.3).
iii. Transmit the existing PDM to another analysis organization (repeat paragraph 4.3).

A sample transmittal letter is attached as Appendix A.

NOTE: In cases where the PI is conducting his own analysis no letter of transmittal or ATM is necessary; however, a memo from the PI, to file, of the proposed schedule, expenditure approval (signed by the Task Leader responsible for the subcase to be charged) and schedule of peer reviews is required and a copy of this memo will replace the letter of transmittal and ATM.

4.4 Authorization to Proceed

Upon receipt of the ATM from the assigned analyst, the PI will review the memo and will coordinate the proposed expenditure and the proposed schedule with the Task Leader responsible for the subcase to be charged. If the proposed schedule and the proposed expenditure are acceptable, the PI will prepare an Authorization to Proceed Memo (APM) and send it to the analyst assigned in the ATM. The APM shall contain the schedule of interim reviews and the date scheduled for final review prior to publishing and/or releasing the results of the analysis.

NOTE: If the PI is doing the analysis, no APM is necessary and the memo to file indicated in the previous section (4.3) indicates that the schedule and expenditure are acceptable.

5.0 Document Revisions

5.1 Control and Approval of Revision

The PDM shall be revised only under the guidance of the responsible PI. The reason for the change and circumstances requiring the change as well as the changes themselves shall be documented. The approval levels for the changes shall be the same level of management as the original, except that management approvals are not required for correction of typographical errors. Distribution of the change will be the same as the original distribution of the PDM. A copy of the revised PDM signed by the analyst shall be returned to the PI and filed to indicate acceptance of the change by the analyst.

5.1 Temporary Authorization of Revised PDM

To effect a temporary authorization for a change to a PDM, the PI must red-line, initial, and date the PDM. A copy of the red-lined PDM must be filed with the analyst and in the appropriate SNL/NNWSI Project Records File. A permanent authorization for a change consists of revising the PDM and proceeding through the original approval procedure.

6.0 Additional Requirements

6.1 Personnel Qualifications

The personnel assigned to conduct an analysis must have an appropriate educational background and experience in the type of analysis being performed; this is confirmed for the PI by the signature of the supervisor of the analyst assigned in the ATM (or by the signature of the Task Leader's supervisor on the PDM in the case of the PI doing his own analysis).

6.2 Documentation of Analyses and Calculations

In addition to the information required in the PDM, the PI will ensure that the following information is documented where appropriate:

- a listing of applicable references;
- results of literature searches or other background data;
- identification of assumptions;
- identification of computer calculations, including computer type, program name, program version, and the bases of application to the specific problem.
- evidence of computer program verification as specified in DOP 3-2, Software Quality Assurance Requirements.

7.0 <u>Responsibilities</u>

7.1 Quality Assurance Organization

- Verify by means of audits or surveillance, compliance to the provisions of this procedure.

7.2 NNWSI Project Department Manager

- Approve QA Level I PDMs.

7.3 Division Supervisor

- Approve QA Level I and QA Level II PDMs.

7.4 Task Leader

- Approve QA Level I and QA Level II PDMs.
- Approve expenditures.

7.5 Principal Investigator

- o Prepare PDM.
- o Prepare APM.
- o Final review and accept results.
- o Transfer records to the SNL/NNWSI Department 6310 Records Files.

7.6 Analyst

- o Review PDM and prepare Task Acceptance/Rejection Memo.
- o Perform analyses and calculations.
- o Prepare and review final documentation.

8.0 Records

Copies of all correspondence and documentation, such as the PDM, transmittal letter(s), ATM, APM, revisions to the PDM or ATM, data, final results, and the final report will be maintained in an Analysis Records Notebook in the SNL/NNWSI Department 6310 Records File - 70 Series, Analysis Records System.

Copies of the PDM, transmittal letter(s), ATM, APM, revisions to the PDM or ATM, final results, and the final report will also be maintained in the following SNL/NNWSI Department Records File for analyses performed by contractors or SNL matrix support organizations.

- o 21 Series - Multiple WBS Contracts
- o 22 Series - Contracts Applying to a Single WBS
- o 23 Series - SNL Matrix Support

Listings of input data, mesh data (if applicable), and card images to conduct the analysis will be maintained by the organization conducting the analysis. These records will be transferred to the PI upon completion of the analysis, then processed into the Analysis Records Notebook.

A listing of all PDMs will be maintained in the SNL/NNWSI Department 6310 Records File - 30 Series, 35/1292/5.4, Master Document List.

9.0 References

DOP 2-4, Analysis Control and Verification.

DOP 3-2, Software Quality Assurance Requirements.

DOP 3-4, Design Investigation Control.

DOP 3-10, Routine Design Calculations.

DOP 17-1, Records Management.

10.0 Appendices

Appendix A - Sample Letter of Transmittal

Appendix B - Sample Problem Definition Memo and Problem Definition Memo Data Sheets

APPENDIX A

SAMPLE LETTER OF TRANSMITTAL

(NOTE: THIS IS ONLY AN EXAMPLE)

To:

From:

Subject: Request For Analytical Support for (fill in name of analysis) - PDM XXX

Department 6310 at Sandia National Laboratories (SNL) is engaged in the Nevada Nuclear Waste Site Investigations (NNWSI) Project. In accordance with NNWSI DOP 3-3, we request your support in analyzing (Fill in name of analysis requested and reasons for it).

Attached is a Problem Definition Memo (PDM) and data sheets, as required in NNWSI Project DOP 3-3, to aid in documentation of this analysis. In addition to this type of documentation, we request an informal memo, on a monthly basis, describing the activities, accomplishments, and the problem areas encountered during the reporting period. These memos will assist us in our reporting requirements, and also allow us to provide assistance as required.

Please indicate in a Task Acceptance Memo (ATM) your acceptance (or rejection or conditional acceptance) of this task. In this ATM we request you to provide us with the following information:

A. Name and signature of analyst assigned to this task.
B. Name and signature of person supervising analyst, who confirms the qualifications of the analyst and the analytical methods and/or code(s) to be used.
C. Schedule, including required reviews at end of problem definition and input phase, and final review.
D. Reporting method and reporting schedules to include dates.
E. What method of analysis and/or computer codes will be used.

A meeting of the NNWSI Principal Investigator and the analyst assigned in the ATM will be scheduled upon receipt of the ATM. Details of interim reviews and the interim reporting procedures will be determined and documented at this meeting. Documentation of this meeting and of interim reviews will be on a "Conference/ Telecon Note" form or in other appropriate ways.

(NOTE: THIS IS ONLY AN EXAMPLE)

(NOTE: THIS IS ONLY AN EXAMPLE)

In the case of rejection of task or conditional acceptance of task, please respond with a memo detailing the reasons and/or conditions for the rejection or conditional acceptance.

Copy to:
6310 T. O. Hunter
6311 L. W. Scully
6312 F. W. Bingham
6313 R. M. Zimmerman
6314 J. R. Tillerson
6314 S. J. Bauer
6310 10/126923/SNL/Q2
6310 73/126923/27/Q2

(NOTE: THIS IS ONLY AN EXAMPLE)

APPENDIX B

SAMPLE PROBLEM DEFINITION MEMO

AND

PROBLEM DEFINITION MEMO DATA SHEETS

PDM ____________
Rev. ____________
Page ____ of ____

SANDIA NATIONAL LABORATORIES

NNWSI PROJECT

PROBLEM DEFINITION MEMO

APPROVAL SHEET

FOR

PDM ____________

Principal Investigator	Org.	Date
Task Leader	Org.	Date
Division Supervisor	Org.	Date
NNWSI Project Department Manager	Org.	Date

(NOTE: THIS IS ONLY AN EXAMPLE)

NNWSI Problem Definition Memo
Date: ______________

Work Breakdown Structure (WBS) No. 1234
PDM No. 000. QA Level I

Problem Definition: Stability of the Exploratory Shaft may require that a load bearing liner be installed in certain strata due to the thermomechanical loading (See R. M. Zimmerman, 6313, for location(s) and magnitude of heat sources). The diameter of the shaft is 12 feet. It will go to a depth of 500 m which causes it to enter the Calico Hills horizon (see the thermomechanical cross-section of Yucca Mt. (available from D. H. Zeuch, 6315). We need to know what strata will require load- bearing liners and what loads the liner will experience in this situation.

It is anticipated that individual strata will be analyzed separately. Material properties of the various strata and in situ stress fields are available from D. H. Zeuch, 6315.

It is requested that plots of the temperature distribution contours with time, principal stress contours with time and contour plots of deformations with time be provided as well as the loads imposed on a cylindrical liner in the various strata with time.

A final analysis with all strata and a liner is requested. These results will be compared with a simple closed form thermomechanical stress solution. We need the results in final form by June 1 in order to incorporate them into the Exploratory Shaft Preliminary Report.

Attached are data documentation sheets which the analyst assigned should complete with assistance and cooperation from the NNWSI PI.

This analysis will be reviewed by an Analysis Review Committee in accordance with the analysis review procedure specified in DOP 2-4.

PDM NO.: ____________ DATE: ____________

ANALYST: ______________________________ COMPANY/ORG.: ____________

PRINCIPAL INVESTIGATOR: ________________ ORG.: ____________

DESCRIPTION OF PROBLEM (See transmittal letter and PDM - attach sketch if necessary for clarity):

SPECIFIC GOALS OF ANALYSIS:

TYPE OF ANALYSIS:

______FINITE ELEMENT CODE: ______________ VERSION: ________
______FINITE DIFFERENCE CODE: ______________ VERSION: ________
______BOUNDARY ELEMENT CODE: ______________ VERSION: ________
______DISCRETE ELEMENT CODE: ______________ VERSION: ________
______CLOSED FORM SOL. REF: ________________________________
______OTHER REF: ________________________________

Initials: ________ ___/___/___ __________ ___/___/___
PI Date Analyst Date

PDM NO. ____________________ DATE: ______________

ASSUMPTIONS:

LOADING:

______Thermal
______Mechanical
______Thermomechanical
______Thermohydrological
______Static
______Dynamic
____
____

LOAD OR SOURCE TERM DESCRIPTION
(Attach Sketch if Necessary for Clarity):

Initials: ________ (PI) ___/___/___ (Date) ____________ (Analyst) ___/___/___ (Date)

PDM NO. ____________________ DATE: ______________

MATERIAL(S) PROPERTIES DATA (Use NNWSI Reference Properties where possible - otherwise show justification for other properties):

SOURCE OF MATERIAL PROPERTIES DATA: ________________________________

BOUNDARY CONDITIONS (Show on mesh plot if required for clarity):

Initials: ________ PI   __/__/__ Date   ________ Analyst   __/__/__ Date

PDM NO. ____________________ DATE: ______________

MESH CONSTRAINTS, IF ANY (Show mesh plot if required for clarity):

Initials: ________ PI ___/___/___ Date ____________ Analyst ___/___/___ Date

PDM NO. ____________________ DATE: ______________

SKETCH SHEET NO. ______________ OF ______________ SHEETS

Initials: ____________ PI ___/___/___ Date ____________ Analyst ___/___/___ Date

PDM NO. ____________ DATE: ____________

DIMENSION SHEET NO. ____________ FOR SKETCH SHEET NO. ____________

Initials: ________ PI ___/___/___ Date ________ Analyst ___/___/___ Date

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DOP 3-4
Rev. B
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NNA '88 0525 · 0025

SNL NNWSI PROJECT

DEPARTMENT OPERATING PROCEDURE

DESIGN INVESTIGATION CONTROL

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Rev.	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B

The purpose of this revision is to expand the reference information in the DIM to provide more explicit traceability to the latest approved work plan, to add QA review of QA Level I DIMs, and to provide editorial clarifications.

Author: R R Hill — 5/13/88
R. R. Hill, 6311 — Date

Approved: Al Stevens — 5/17/88
Division Supervisor — Date

Approved: Richard M. Baek — 5/17/88
Quality Assurance — Date

Approved: Thomas O. Hunter — 5/17/88
Department Manager — Date

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DESIGN INVESTIGATION CONTROL

1.0 Purpose

The purpose of this Department Operating Procedure (DOP) is to detail the methods for (1) planning, (2) documenting, (3) initiating, (4) accepting, and (5) reviewing a design investigation task. Related changes and revisions to the appropriate Problem Definition will also be controlled by this procedure.

2.0 Scope

This procedure applies to QA Level I and QA Level II design investigations performed at Sandia National Laboratories (SNL) within the NNWSI Project Department or by other organizations or contractors for the SNL NNWSI Project Department. This procedure may be used but is not required for QA Level III design investigations. Excluded from the scope of this procedure are scientific analyses and calculations and engineering calculations which are controlled by DOP 3-3, Analysis and Calculation Control or DOP 3-10, Routine Design Calculations, and simple algebraic calculations, standard statistical calculations, or data reduction calculations. However, these procedures may be required to be used within the scope of a design investigation, itself.

3.0 Definitions

3.1 APM - Authorization to Proceed Memo.

3.2 ATM - Acceptance of Task Memo.

3.3 Data Reduction - Conversion of raw data to meaningful form.

3.4 Design Investigations - Design or design-related tasks to be completed for SNL NNWSI Project Department that include efforts such as trade-off studies, preclosure safety feasibility, optimization, operating, closure, decommissioning, cost and schedule investigations; design development; and other such tasks as SNL NNWSI Project Department shall specify. Design investigations include the actions necessary to develop specific designs.

3.5 DIM - Design Investigation Memo - documents which initiate, guide, and document design-related efforts, as specified in this procedure.

3.6 Investigator - The person responsible for conducting and documenting an investigation.

3.7 Principal Investigator - The SNL staff member responsible for completion of a particular investigation or design. He may or may not also be the Task Leader.

3.8 Task Leader - The SNL staff member responsible for developing the technical guidance, budget, and schedule for a Work Breakdown Structure (WBS) element. He may or may not also be the Principal Investigator.

3.9 Scientific Analyses and Calculations and Engineering Calculations - Those calculations or analyses which involve a mathematical, numerical or analytical model of a physical process or phenomenon.

3.10 Simple Algebraic Calculations - Mathematical expressions or equations which may be evaluated without aid of a computer and which do not involve matrix methods, iteration, finite element or finite difference methods, or numerical integration or differentiation.

3.11 Standard Statistical Calculations - Calculations of mean, standard deviation, regression analysis, curve fitting, etc., such as those methods available in statistical library packages.

4.0 <u>Procedure</u>

The sequence of activities described in this section is shown in Figure 1.

4.1 Initiating Design Investigation Tasks

To request or initiate a Design Investigation Task, the PI and the proposed investigator shall prepare a Design Investigation Memo (DIM) which shall include:

A. Reference information which tabulates titles, work plan authority, QA levels, etc. (see Figure 2). This information is to be provided immediately behind the signature sheet. The work plan referenced must be the latest approved work plan. Other information may be added to this sheet at the discretion of the author.

B. Purpose of Investigation to include what decision(s) are dependent on this investigation.

C. Definition of the scope-of-work for the design investigation.

D. Definition of design requirements (input) to be used as a basis for the investigation including a statement requiring all activities to be done in accordance with the Subsystem Design Requirements or identifying why current requirements are not applicable.

E. Definition of material and physical properties to be used in the investigation for cases in which numerical analyses are necessary. NNWSI reference properties derived from the Reference Information Base will be used unless otherwise specified. If other than NNWSI reference properties are used, then the justification as to why they were not used will be stated as will the reasoning as to why the properties to be used were selected

*The DIM number will be assigned by the SNL NNWSI Records Management staff.

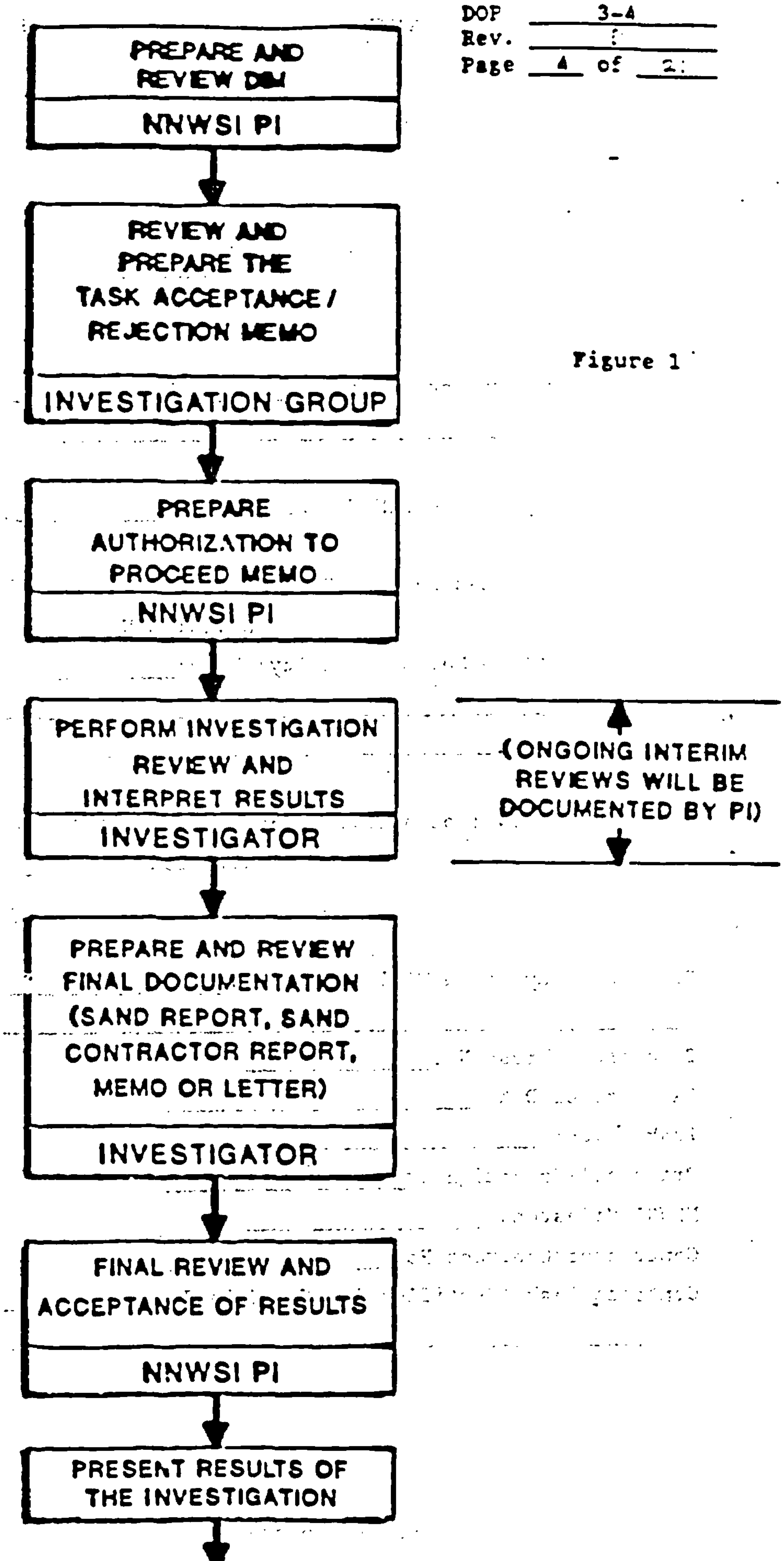
PREPARE AND REVIEW DBM
NNWSI PI
REVIEW AND PREPARE THE TASK ACCEPTANCE / REJECTION MEMO
INVESTIGATION GROUP
PREPARE AUTHORIZATION TO PROCEED MEMO
NNWSI PI
PERFORM INVESTIGATION REVIEW AND INTERPRET RESULTS
INVESTIGATOR
(ONGOING INTERIM REVIEWS WILL BE DOCUMENTED BY PI)
PREPARE AND REVIEW FINAL DOCUMENTATION (SAND REPORT, SAND CONTRACTOR REPORT, MEMO OR LETTER)
INVESTIGATOR
FINAL REVIEW AND ACCEPTANCE OF RESULTS
NNWSI PI
PRESENT RESULTS OF THE INVESTIGATION

Figure 1

Figure 2

Design Investigation Title: ____

____

DIM No: ________ Date DIM No. Assigned ____________ WBS No. ____________

The work performed by this DIM is identified in Work Plan No. ____________

Revision No. ______ Date Approved ______

Title & No. of Activity*/Task: ________________________________

____

____

QA Level of Activity/Task ______ QALAS No. ______________

Revision No. _______ Date Approved _______

Pre-ACD Study No. & Title: ____

____

Case and Subcase No. ____________

QA Level of DIM ________________

Task leader ________________

Principal Investigator ________________

NNWSI Milestone ________________

Contractor/Contract No. ________________

Contract Task Identification No. & Title: ____________________________

____

* or Planning Cost Account (so state)

F. Definition of what parameters are to be used if a parametric study is to be conducted.
G. Definition of what reports, drawings, illustrations, viewgraphs, etc., are required and when they are required.
H. Specification of any special qualifying tests for verification or validation (if necessary), i.e., benchmarks.
I. Definition of the design investigation participant's responsibilities, deliverables, and schedule.

A sample DIM can be found in Appendix B.

4.2 Review and Approval of DIM

The initial review and approval of the DIM will be as follows:

QA Level I
- Approval of the Task Leader and Division Supervisor, and
- Approval of SNL NNWSI QA
- Approval of NNWSI Project Department Manager

QA Level II
- Approval of the Task Leader and Division Supervisor

QA Level III (DIM may be used but is not required)
- Approval of the Task Leader

All SNL NNWSI Division Supervisors will be notified of the proposed investigation, i.e., receive a copy of the DIM for information purposes.

4.3 Letter of Transmittal of the DIM to Group Doing Design Investigation

The letter transmitting the DIM to the organization performing the investigation will be prepared by the PI and shall contain instructions to that organization to:

A. Review the DIM.
B. Accept or reject the task as described in the DIM.
C. If the task is accepted, the investigator assigned to the task will prepare an Acceptance of Task Memo (ATM) and send it to the PI. The ATM shall contain as a minimum the following:

i. Name and signature of the assigned investigator.
ii. Name and signature of the investigator's supervisor, which certifies that the investigator is qualified to perform the design activity (see Sec. 6.0).
iii. Proposed schedule, including required reviews (as shown in the DIM).
iv. Reporting method(s) and schedules of reporting dates.
v. The method of analysis and/or code(s) that will be used as well as the qualifications of the method and/or computer code.

A conditional acceptance by the investigation group may be transmitted by them in the case of discrepancies, such as scheduling or cost estimates, which differ from the original DIM.

D. If the task defined in the DIM is rejected or conditionally accepted by the organization conducting the investigation, a memo stating that the DIM was rejected (or only conditionally accepted) and the reasons will be sent by the assigned investigator to the PI. The PI will then do one of the following:

i. Write a memo to the investigator accepting the conditional (if that is the case) ATM.
ii. Redefine the requirements and return the new DIM to the investigation group (repeat paragraph 4.3).
iii. Transmit the existing DIM to another investigation organization (repeat paragraph 4.3).

A sample transmittal letter is attached as Appendix A.

NOTE: In cases where the PI is conducting his own investigation, no letter of transmittal or ATM is necessary; however, a memo from the PI, to file, of the proposed schedule, expenditure approval (signed by the Task Leader responsible for the subcase to be charged) and schedule of peer reviews is required and a copy of this memo will replace the letter of transmittal and ATM.

4.4 Authorization to Proceed

Upon receipt of the ATM from the assigned investigator, the PI will review the memo and will coordinate the proposed expenditure and the proposed schedule with the Task Leader responsible for the subcase to be charged. If the proposed schedule and the proposed expenditure are acceptable, the PI will prepare an Authorization to Proceed Memo (APM) and send it to the investigator assigned in the ATM. The APM shall contain the schedule of interim reviews and the date scheduled for final review prior to publishing and/or releasing the results of the investigation.

NOTE: If the PI is doing the investigation, no APM is necessary and the memo to file indicated in the previous section (4.3) indicates that the schedule and expenditure are acceptable.

5.0 Document Revision

5.1 Control and Approval of Revision

The DIM will be revised only under the guidance of the responsible PI.

The reason for the change and circumstances requiring the change as well as the changes themselves will be documented. The approval levels for the changes shall be the same level of management as the original except that management approvals are not required for correction of typographical errors. Distribution of the change will be the same as the original distribution of the DIM. A copy of the revised DIM signed by the investigator will be returned to the PI and filed to indicate acceptance of the change by the investigator.

6.0 Additional Requirements

6.1 Personnel Qualifications

The personnel assigned to conduct a design investigation must have an appropriate educational background and experience in the type of investigation being performed and have completed an NNWSI Familiarization Program or equivalent; this is confirmed for the PI by the signature of the supervisor of the investigator assigned in the ATM (or by the signature of the Task Leader's supervisor on the DIM in the case of the PI doing his own investigation).

6.2 Documentation of Design Investigation

In addition to the information required in the DIM, the PI will ensure that the following information is documented where appropriate:

- o a listing of applicable references;
- o results of literature searches or other background data;
- o identification of assumptions;
- o identification of computer calculations, including computer type, program name, program version, and the bases of application to the specific problem;
- o evidence of computer program verification as specified in DOP 3-2, Software Quality Assurance Requirements.

7.0 Responsibilities

7.1 Quality Assurance Organization

- o Verify by means of audits or surveillance, compliance to the provisions of this procedure.

- o Review DIMs for QA Level I activities (as design input) for completeness and adherence to this procedure.

7.2 NNWSI Project Department Manager

- o Approve QA Level I DIMs

7.3 Division Supervisor

- o Review and approve QA Level I and QA Level II DIMs - as a minimum, this review should assure that design inputs selected are appropriate and correct for the design activity.

7.4 Task Leader

- o Approve QA Level I and QA Level II DIMs
- o Approve expenditures

7.5 Principal Investigator

- o Prepare DIM
- o Prepare APM
- o Final review and accept results
- o Enter records in the SNL Department 6310 NNWSI Project Records Management System.

Note - Only Department 6310 personnel are permitted to enter records in the Records Management System (RMS). If the Principal Investigator is other than a person from Department 6310, then the Task Leader will be responsible for entering records in the RMS.

7.6 Investigator

- o Review DIM and prepare Task Acceptance/Rejection Memo
- o Perform design investigation and review and interpret results
- o Prepare and review final documentation

8.0 <u>Records</u>

Copies of all correspondence and documentation, such as the DIM, transmittal letter(s), ATM, APM, revisions to the DIM or ATM, final results, and the final report will be maintained in the SNL/NNWSI Department 6310 Records File. Minimum filing requirements are:

- o All DIMs, when approved, will be filed by the author by a memo to the SNL/NNWSI Department 6310 Records File - 100 Series - Reference Documents - 100/WBS#/DIM#/Q Level. In the event that multiple WBS elements are involved, the WBS# shall be shown as "000."
- o All final results and final reports will be filed in the 60 Series - Design Records System.
- o Correspondence resulting from design investigations performed by contractors will be filed in the 22 Series Contracts. File locations shall be specified as stated in the RMS Master Index.

- Correspondence resulting from design investigations performed by SNL matrix support organizations will be filed in the 23 Series - SNL Matrix Support. File locations shall be specified as stated in the RMS Master Index.
- Correspondence resulting from design investigations performed by SNL Department 6310 will be filed in the 60 Series - Design Records System.
- A listing of all DIMs will be maintained in the SNL/NNWSI Department 6310 Records File - 30 Series - 35/1292/5.4, Master Document List.

9.0 References

DOP 3-2, Software Quality Assurance Requirements
DOP 3-3, Analysis and Calculation Control.
DOP 3-10, Routine Design Calculations.
DOP 17-1, Records Management.

10.0 Appendices

Appendix A - Sample Letter of Transmittal
Appendix B - Sample Design Investigation Memo (DIM)

APPENDIX A

SAMPLE LETTER OF TRANSMITTAL

To:

From:

Subject: Request for Support for (fill in name of Design Investigation) - DIM XXX

Department 6310 at Sandia National Laboratories (SNL) is engaged in the Nevada Nuclear Waste Site Investigations (NNWSI) Project. In accordance with NNWSI Project DOP 3-4, we request your support in analyzing (Fill in name of investigator requested and reasons for it).

Attached is a Design Investigation Memo (DIM) and data sheets, as required in NNWSI Project DOP 3-4 to aid in documentation of this investigation. In addition to this type of documentation, we request an informal memo, on a monthly basis, describing the activities, accomplishments, and the problem areas encountered during the reporting period. These memos will assist us in our reporting requirements, and also allow us to provide assistance as required.

Please indicate in a Task Acceptance Memo (ATM) your acceptance (or rejection or conditional acceptance) of this task. In this ATM we request you to provide us with the following information:

A. Name and signature of investigator assigned to this task.

B. Name and signature of person supervising investigator, who confirms the qualifications of the investigator and the analytical methods and/or code(s) to be used.

C. Schedule, including required reviews at end of problem definition and input phase, and final review.

D. Reporting method and reporting schedules to include dates.

E. What method of analysis and/or computer codes will be used.

A meeting of the NNWSI Principal Investigator and the investigator assigned in the ATM will be scheduled upon receipt of the ATM. Details of interim reviews and the interim reporting procedures will be determined and documented at this meeting. Documentation of this meeting and of interim reviews will be on a "Conference/Telecon Note" form or in other appropriate ways.

In the case of rejection of task or conditional acceptance of task, please respond with a memo detailing the reasons and/or conditions for the rejection or conditional acceptance.

APPENDIX B

SAMPLE DESIGN INVESTIGATION MEMO (DIM)

Note: This DIM is an example only.

SANDIA NATIONAL LABORATORIES

NNWSI PROJECT

DESIGN INVESTIGATION MEMO

APPROVAL SHEET

FOR

DIM ____________

Page	1	2	3	4	5	6
Rev.	A	A	A	A	A	A

The purpose for this revision is to ______________________________

____

Principal Investigator or Author	Org.	Date
Task Leader	Org.	Date
Division Supervisor	Org.	Date
SNL NNWSI QA	Org.	Date
NNWSI Project Department Manager	Org.	Date

Design Investigation Title: Preliminary Repository Operations Plan

DIM No: XXX Date DIM No. Assigned 10/13/86 WBS No. 1.2.4.4

The work performed by this DIM is identified in Work Plan No. 1244-86

Revision No. B Date Approved 7/23/86

Title & No. of Activity/Task: B-Radiologic Systems Analysis (Operations Plans), C - Nonradiologic System Analysis and D-Operations and Maintenance Logistic Support

QA Level of Activity/Task II QALAS No. 093, 094, 095

Revision No. B Date Approved 7/23/86

Pre-ACD Study No. & Title: NA

Case and Subcase No. 1561.460

QA Level of DIM II

Task leader A. W. Dennis

Principal Investigator R. R. Hill

NNWSI Milestone N242

Contractor/Contract No. BNI, 52-9817

Contract Task Identification No. & Title: 2.3 Preliminary Repository Operations Plan

Purpose: The purpose of this Design Investigation is to: (1) describe the principal repository operations involving radioactive materials, underground development, and repository logistical support systems; (2) develop a repository staffing plan and operating schedule (shifts/day and days/year) for major repository systems; (3) identify major equipment items for waste handling, mining, and underground ventilation; and (4) establish time required to prepare a panel in the underground area for waste emplacement, to emplace waste in the panel, and withdraw from the panel following waste emplacement.

The information in this report will be used to: (1) estimate repository operations costs, (2) size repository facilities, (3) provide a basis for the calculation of operator radiological exposures, (4) provide a basis for the identification of credible accidents which involve radiological materials and those which do not involve radiological materials, (5) develop a life-of-repository ventilation plan, and (6) identify logistical support requirements.

Scope-of-Work:

Sandia National Laboratories (SNL will prepare and issue a SAND report describing the repository operations. The plan will address the following systems identified in the draft Yucca Mountain Mined Geologic Disposal System Requirements, SAND84-1882:

1.2.1 Mining
1.2.2 Waste Handling
1.2.4 Decommissioning
1.2.5 Support

The contractor will provide technical support for this activity. Prior to beginning work on items A through G (listed below) the contractor shall prepare a Task Management Plan for this task and assist in the preparation of an Annotated Outline for the Repository Operations Plan. The Task Management Plan will identify each subtask, allocate personnel and other resources to the subtask, and schedule all activities within the subtask. The Annotated Outline will identify the work to be reported and must be correlated with the subtasks identified in the Task Management Plan. The Task Management Plan and the Annotated Outline will be revised monthly to reflect the current status of this task and its subtasks.

A statement of assumptions is listed as Attachment A to this Design Investigation Memo. This list provides special criteria which is specifically applicable to this design investigation. This criteria may not be applicable to other tasks and may not be provided in any other reference document.

A task file system must be maintained throughout the duration of this task. The task file system will include the items listed in attachment B.

Specifically the contractor, in cooperation with SNL, will:

A. Develop an organization chart for the repository.

B. Determine repository staffing requirements.

C. For each system and subsystems identify the expected annual throughput and quantity of materials required for its operation.

D. Identify the principal items of equipment and the number of pieces of equipment required by each system.

E. For each principal item of equipment provide an estimate of its reliability, availability, and maintainability (RAM).

F. For the following subsystems develop time line and material flow diagrams:

1.2.1.2	Drift Construction
1.2.1.3	Borehole Construction
1.2.1.4	Rock Handling
1.2.1.6	Mining Ventilation
1.2.2.1	(Waste) Receiving
1.2.2.2	(Waste) Preparation
1.2.2.3	(Waste) Storage
1.2.2.4	(Waste) Emplacement
1.2.2.7	Waste-Handling Ventilation (Underground)
1.2.5.5	(Construction and Waste Related) Supplies

G. The contractor shall prepare all drawings, figures, tables, and calculations for the operations report. Additionally, the contractor shall prepare and edit report text as directed by SNL.

Responsibilities:

SNL shall be responsible for the coordination of the contractors activities and the preparation of the SAND Report.

For those systems and subsystems contained in the surface facilities, BNI shall be responsible for the work described in Items A through G.

For those systems and subsystems contained in the underground facilities, PBQ&D shall be responsible for the work described in Items A through G.

LATA will be responsible for document preparation, coordination, and editing.

Deliverables and Schedule:

03/31/86	Begin work on the Task Management Plan (TMP) and Repository Operations Plan Annotated Outline (AO) for Task 2.3.
05/06/86	Review Draft TMP and AO.
05/06/86	As supporting documentation becomes available start work on Items A through F.
06/03/86	Review technical activities, TMP, and AO.
07/09/86	Review technical activities, TMP, and AO.
08/13/86	Review technical activities, TMP, and AO.
10/22/86	Review technical activities, TMP, and AO.
11/11/86	Review technical activities, TMP, and AO.
11/28/86	Complete analysis associated with Items A through F - issue for review.
12/05/86	Draft text.
12/12/86	Complete review.
12/31/86	Issue for approval.

References:

The following references will serve as a basis and starting point for the work described in this task statement:

A. W. Dennis, et al., NNWSI Repository Operational Procedures for Receiving, Packaging, Emplacing, and Retrieving High-Level and Transuranic Waste, SAND83-1166, May 1984.

A. W. Dennis, et al., NNWSI Repository Worker Radiation Exposure, Volume 1, Spent Fuel and High-Level Waste Operations in a Geologic Repository in Tuff, SAND83-7436/1, May 1984.

L. W. Scully, et al., Repository Design Plan for a Tuff Repository at the Nevada Test Site, SAND83-1839, to be published.

J. G. Yeager, et al., Yucca Mountain Mined Geologic Disposal System Requirements, SAND84-1882, to be published.

H. R. MacDougall, et al., Repository Conceptual Design in Support of Site Characterization, SAND84-2641, to be published.

R. R. Hill, Subsystems Design Requirements for the Advanced Conceptual Design of the Yucca Mountain Nuclear Waste Repository, SAND85-0260, to be published.

Attachment A

Statement of Assumptions
Preliminary Repository Operations Plan

1. RIB data used in this report will be listed in an appendix. Deviations from the RIB will be listed and explained.

2. The SDR will be used as guidance for this report. Deviations and/or clarifications will be listed in the statement of assumptions. Very important SDR guidance will be repeated in the statement of assumptions if it is fundamental to the Operations Plan.

3. The SCP/CDR (including no at reactor consolidation) shall be used as a basis for the Operations Plan except that the results of the option studies will be incorporated for the repository configuration; i.e., 1 stage, no consolidation. PBQ&D will maintain both vertical and horizontal analysis activities in parallel until one can be eliminated.

4. The Operations Plan will only analyze full capacity "steady state" operations. Checkout and start-up will not be part of this task.

5. Retrieval operations are not part of this task.

6. The Operations Plan will be utilized as basis for the worker exposure calculations.

7. The truck/rail transportation split for spent fuel will be evaluated at the 70% truck 30% rail mix. No alternate transportation splits will be evaluated except that timeline diagrams will also be completed for the 70% rail 30% truck transportation split. Spent fuel is assumed to be 60% PWR and 40% BWR on an MTU basis. DHLW will be received entirely by truck.

   Annual waste receival rates will be based on 3,000 MTU of spent fuel and 400 MTU of DHLW. Characteristics of the waste will be as defined in the SDR.

8. Operations will be based on:

   2 shifts per day for mining
   2 shifts per day for waste-handling
   5 working days per week
   250 working days/year
   and 3 shift/day 365 day/year for maintenance, security, shipment receipts, and other essential operations.

9. Shipping cask capacities are defined as per the SDR; i.e., truck 2 PWR or 5 BWR assemblies; rail 14 PWR or 36 BWR assemblies; DHLW truck, 1 canister.

10. The "hybrid" spent fuel container with a capacity of 3 intact PWR and 4 intact BWR assemblies and also as supplemented with the same size container with ten BWR assemblies shall be used for the Operations Plan analysis.

Attachment B

Preliminary Repository Operations Plan
Task File System

Task Drawing File --	All drawings, flow diagrams, pictorials, or sketches which serve as a basis for the Operations Plan will be checked before they are placed in this file. No work may be performed on this task based on drawings, flow diagrams, pictorials, or sketches not contained in this file.
Task Calculations File --	All calculations will be checked before they are in this file. No work may be performed on this task which is based on calculations not contained in this file.
Task Technical Criteria/Assumptions File --	This file will contain the basis for the analysis, time-line diagrams, flow diagrams, and other materials developed to support findings for Items A through G in the Design Investigation Memo 2. All criteria/assumptions will be approved by the BNI Project Engineer or his delegated representative before they are placed in this file. No work may be performed on this task which is based on criteria/assumptions not contained in this file.

NNA.870930.0042

SNL NNWSI PROJECT

DEPARTMENT OPERATING PROCEDURE

DESIGN CONTROL AND VERIFICATION

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Rev.	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Author: H.R. MacDougall — H. R. MacDougall, 6311 — 14 Nov. 1986 — Date

Approved: [signature] — Quality Assurance — Nov 14, 1986 — Date

Approved: Leo W Scully — Division Supervisor — 14 Nov. 1986 — Date

Approved: Thomas O. Hunter — Department Manager — 14 Nov 1986 — Date

SNL NNWSI DEPARTMENT 6310
ROLLED DOCUMENT
d to: M.D. COTTER, SAIC
y Number: #032
RETURN TO 6310 RECORDS CENTER
WHEN NO LONGER NEEDED.

DESIGN CONTROL AND VERIFICATION

1.0 Purpose

The purpose of this Department Operating Procedure (DOP) is to establish measures that provide for control of design activities by SNL or supporting contractors and verification of the resulting design.

2.0 Scope

This procedure defines the requirements for the control and verification of QA Level I and QA Level II design activities under the direction of the SNL NNWSI Project Department. This DOP also applies to the SNL portion of interfaces with other NNWSI design organizations.

3.0 Definitions

3.1 Design Investigations - Design or design-related tasks to be completed for SNL NNWSI Project Department that include efforts such as trade-off studies, preclosure safety feasibility, optimization, operating, closure, decommissioning, cost and schedule investigations; design development; and other such tasks as SNL NNWSI Project Department shall specify. Design investigations include the actions necessary to develop specific designs.

4.0 Procedure

4.1 Design Control Process

Control of the design process consists of numerous elements. The list of elements include:

- Planning
- Identification of the Design Requirements
- Management of Design Activities
- Records Management

The responsible SNL Division Supervisor and designated task leaders or Principal Investigator will use these elements to control design activities.

4.1.1 Design Planning

A design plan shall be developed to present how the design activities will be accomplished. SAND83-1839, "Repository Design Plan for a Tuff Repository at the Nevada Test Site," provides an overall plan for the NNWSI repository design activities. This plan will be prepared by the supervisor of Division 6311 and will be modified as program guidance or direction requires. The Repository Design Plan will address project management and integration and organization of the work for each element of the work breakdown structure. It will identify design data sources, describe possible design alternatives and specify project staffing and contracting provisions, if applicable. The plan will identify design verification efforts and will, whenever possible, identify testing requirements for the design. The plan will specify all required major design deliverables and shall specify a schedule for reporting design progress. It will describe the files and records to be maintained by the design organization. Specific plans for individual design tasks are developed by Task Leaders. They are manifested in Work Plans and implemented by the Design Investigation Memos that provide instructions to designers.

4.1.2 Identification of Design Requirements

Design requirements will be based on specific project and program documents. Guidance on the legislative, regulatory and programmatic requirements for the site, repository and waste package is provided by the Yucca Mountain Mined Geologic System Requirements document, SAND84-1880. Basic design criteria from which the repository design will be developed is given by the Subsystem Design Requirements for the Advanced Conceptual Design of the Yucca Mountain Nuclear Waste Repository, SAND85-0260. Specific data for site and design parameters will be taken from the Reference Information Base. These references will be utilized by persons performing design tasks to identify requirements of their design.

Requirements for individual design activities as well as task specific design requirements will be documented in the Design Investigation Memos for individual design tasks. Needed data which is not provided as well as assumptions which are required in order to proceed with the design will be identified by persons performing design tasks and reported promptly.

4.1.3 Management of Design Activities

The performance of design activities will require specific functions to be performed by the responsible Division Supervisor and the assigned Task Leader and PI's. These functions are listed below. It is necessary to perform these functions as part of the design process and to assure that all documentation showing that these functions were performed is maintained and transmitted to the SNL 6310 NNWSI Records Management System (see Section 6).

4.1.3.1 Specifying Organization and Responsibilities

The design activities shall be accomplished within an established structure which clearly defines the areas of responsibility and the person assigned to that responsibility. An organization chart showing these assignments will be developed by Division 6311 and kept on file in the SNLA/NNWSI Department 6310 Records File-30/1291/0.5, Design Responsibilities.

4.1.3.2 Selecting and Using Supporting Contractors

Contractors supporting the design activities shall be selected by each assigned 6310 division considering their abilities to perform the required design activities. This selection process is described in DOP 7-1, Control of Purchased Services and Items.

Contractor work will be accomplished according to an agreed upon scope-of-work, resource requirements and input data. These scopes-of-work will be augmented as necessary by use of Design Investigation Memos and Problem Definition Memos as referenced in DOP 3-4, Design Investigation Control and DOP 3-3, Analysis Definition Requirements.

4.1.3.3 Controlling Design Tasks

All design tasks under the direction of SNL NNWSI Project Department will be performed in accordance with DOP 3-4, Design Investigation Control, which specifies the methods for initiating, documenting, accepting and reviewing a design investigation task.

4.1.3.4 Performing Analyses and Calculations

Many design tasks consist of or include calculations. If a significant calculation is to be performed as part of design, the PI shall adhere to the requirements of DOP 3-3, Analysis Definition Requirements. If routine calculations are performed as part of a design task, the investigator or analyst shall adhere to the analysis and calculation requirements for routine design calculations in DOP 3-10, Routine Design Calculations (or their equivalent). Computer codes used for final design analysis must meet the requirements of DOP 3-2, Software QA Requirements.

4.1.3.5 Defining and Controlling Design Interfaces

The physical, functional or operational boundaries between equipment items, or between equipment items and facilities may result in mismatch, omission, interference or duplication. These potential occurrences must be identified and controlled in order that repository designs be efficient and cost effective. DOP 3-9, Interface Control of NNWSI Engineering Design, provides the procedures for identification and control of design interfaces.

4.1.3.6 Controlling Design Changes

The procedure for the introduction, justification, evaluation and approval of changes to NNWSI design documents is given in DOP 3-6, Design Change Control. This procedure requires that all changes be approved at the same level as the original document approval.

4.1.3.7 Issuing Design Documents

Design documents produced by Sandia and contractors personnel may include drawings, reports and specifications. DOP 3-1, Reviewing, Approving, and Issuing Engineering Drawings, contains detailed procedures for drawing review and approval. DOP 6-2, Reviewing, Approving, and Issuing Technical Information Documents, details the method for reviewing, approving and issuing official technical information documents. Such documents include SAND reports, abstracts, conference papers, journal articles and other documents intended to convey technical information. Documentation requirements for specific tasks will be identified in the associated Design Investigation Memos prepared under DOP 3-4.

4.1.4 Records Management

Records from the implementation of the planning, developing of requirements, and management for the design activities will be kept in the SNL 6310 NNWSI records management system as specified in section 6.0 of this procedure.

4.2 Design Verification Procedure

THE NNWSI Project Department individual responsible for the design shall see that design verification is accomplished in a timely manner and is completed prior to the release of the design for uncontrolled use. (Note: As the design progresses through the design phases, the design verification becomes increasingly more formal with increased requirements for documentation). Design verification can be performed by three basic methods or by a combination of the three. They are: (1) intermediate and final design reviews, 2) performing an independent design or analysis, and (3) qualification testing of the final product. Each method has its own purpose and its own requirements for planning, execution and follow up efforts. The following paragraphs provide a description of the review and documentation requirements for each method. The method of design verificaton will be specified in each case by the responsible Division Supervisor.

4.2.1 Verification Accomplishment

4.2.1.1 Design Reviews

4.2.2.1.1 Design Review Conferences

Discussion between individuals participating in design efforts takes place frequently on an unscheduled basis. Advance notice may consist of a memo or telephone call specifying time, place, attendees, the objective of the meeting, and generally the topics to be discussed.

During initiation of a design activity, such topics as the specifics and a' juacy of design criteria, interpretation of the requirements and the cor.;ideration of alternate concepts may be discussed. After the design concept is established, design details, interface requirements and design ver-.fication become increasingly important.

The conferences shall be documented by the issuance of conference notes by the NNWSI Projects Department individual responsible for the meeting. These notes will include key issues that were discussed, any decisions that were arrived at, and a list of action items, if identified. Persons responsible for each action item and the response data, shall be designated. These conference notes become a part of the project record.

Unless specific action items are identified, follow up will normally consist of incorporating results into ongoing design activities.

4.2.1.1.2 Design Review Meeting

Review meetings may be held during the course of the design. When practical, their schedule should be established at the onset of the design activity. There is no requirement that they must be held at regular intervals, but they shall be held as frequently as necessary to ensure a satisfactory design progress.

A plan for individual design reviews shall be developed by the responsible SNL Division Supervisor. The design review plan shall specify the scope, purpose, type and schedule of the design review to be conducted.

The responsible SNL Division Supervisor shall appoint a design review committee chairperson and shall designate members of the committee in the design review notice. Attendance shall include SNL personnel and contractor personnel as appropriate and may include representatives of DOE and NRC.

A review meeting notice, including an agenda, shall be distributed by the design reciew committee chairperson to attendees in advance with all materials which require time for study and review. A sample design review notice is provided in Appendix A of this document.

Where applicable, the following questions shall be addressed by the design review committee as part of the design review:

- o Was the design input correctly selected?
- o Are the assumptions that are necessary for performing the design activity adequately described and reasonable? Where necessary, are the assumptions identified for subsequent reverifications when the detailed design activities are completed?
- o Was rr appropriate design method used?
- o Was the design input correctly incorporated into the design?
- o Does the design meet the requirements?

- o Are the necessary design input and verification requirements for interfacing organizations specified in the design documents, supporting procedures or instructions?
- o Have appropriate QA levels been assigned to all components?

The design review committee chairperson may conclude that a design review checklist should be used to aid the review process. In such cases, the chairperson will direct the committee members to develop portions of the checklist. The checklist will be based on this procedure and the requirements of the specific design being reviewed. A sample checklist is provided in Appendix B with this document.

In the design review, certain components and analyses may be identified which require further verification. If so, these will constitute action items for future resolution, documented in the design review findings report.

The required documentation shall include as a minimum the items listed below. The design review plan and/or the review committee may identify additional items to be included. The design review findings report shall be issued by the design review committee, coordinated by the committee chairperson, and shall include the following items:

- o Purpose of the review
- o Identification of the portion of the design reviewed
- o Design review committee members
- o Conclusions reached and recommendations made
- o Action items identified, and
- o Schedule and responsibilities for the resolution of action items.

A follow up report shall be submitted to the Division Supervisor responsible for the design by the designated action party for each action item identified. The results of any verification activities required will be a part of this report.

4.2.1.1.3 Final Design Review

The final design review shall be scheduled at the completion of each major design phase (e.g., Advanced Conceptual Design or License Application Design) to address the project design in its entirety. This final review shall be planned and conducted in the same manner as the individual design reviews held during the course of the design effort, except the final review will be more extensive and include all aspects of the design. Design material will be distributed to members of the review committee well in advance of the scheduled review. This material shall include information regarding any issues raised during earlier reviews and the resolution of these issues. The agenda for this meeting shall be detailed and shall provide time for a discussion of the points raised by the reviewers.

The conduct of the meeting shall follow the same format as that of the design reviews conducted during the course of the project.

A design review checklist shall be prepared and utilized by the design review committee to ensure coverage of all essential elements. Attendance at the final design review shall include SNL personnel, and may include DOE personnel and NRC representatives.

The required documentation shall include as a minimum the items listed below. The design review plan and/or the review committee may identify additional items to be included. The design review findings report shall be issued by the design review committee, coordinated by the chairperson, and shall include the following items:

- Purpose of the review
- Identification of the design review
- Design review committee members, and
- Conclusions and recommendations, including acceptance or rejection of the design.

The key documentation shall be the completed design itself after all issues raised in the review have been resolved.

After acceptance by the review committee, the design documents will proceed through the approval process as described in DOP 3-1 and DOP 6-2.

4.2.1.2 Independent Design or Analysis

Design verification can be accomplished by an independent design team, working from the same criteria and data, developing an independent design and comparing it with the existing design. The independent design may not necessarily be of the same degree of detail as the original to prove or disprove the validity of the solutions. In addition to independent design, independent engineering analysis and comparison to the original solution of a particular problem can also be used as a verification tool.

Verification of some types of calculations or analyses may be achieved by comparison with alternate methods of calculation or analysis. When alternate calculations are performed to verify the correctness of the original calculation, the appropriateness of assumptions, input data, and the computer program or other calculational methods used shall also be reviewed. Computer codes used for design verification must be documented, verified, and validated in accordance with DOP 3-2.

The alternate method used for comparison may be a more simplified or less rigorous approach, such as using a hand calculation to check computer program results. Although the simplified or less rigorous method may not exactly check the original calculation or analysis, it must provide results consistent with the original calculation or analysis, and it must be documented and appear in the Project records.

The Division Supervisor responsible for the design will specify which of the verification activities described above will be applied to individual designs. The Division Supervisor will assign, or request assignment, of the appropriate qualified personnel to perform these independent, alternate analysis efforts and reviews.

4.2.1.3 Qualification Testing

Design verification for some designs or specific design features can be achieved by suitable qualification testing of a prototype or production unit. The decision to perform design verification by this method will be made by the responsible Division Supervisor.

In those cases where the adequacy of a design is to be verified by a qualification test, the testing procedure shall be prepared as specified in DOP 11-1, Experiment and Equipment-Test Procedure Control. Testing shall demonstrate adequacy of performance under the most adverse design conditions. All pertinent operating modes shall be considered in determining those design conditions where it is intended that the test program confirm the adequacy of the overall design. Where the test is only intended to verify a specific design feature, the other features of the design shall be verified by other means. Qualification testing procedures shall incorporate or reference acceptance criteria or limits contained in applicable design documents. Test results shall be documented by test personnel in accordance with DOP 11-2, Requirements for Experiment/Equipment Test Logbooks, and evaluated by the responsible PI to assure that test requirements have been satisfied.

When testing indicates that design modifications to the item are necessary to obtain acceptable performance, the modification shall be documented and the item modified and retested or otherwise verified to assure satisfactory performance.

5.0 Additional Requirements

5.1 Personnel Performing Verification

The SNL Division Supervisor responsible for the design activity will assure that design verifications are performed by competent individuals or groups other than those who performed the original design. For QA

Level I design activities, those personnel must be certified in accordance with DOP 2-6, Certification of Project Personnel. QA Level I designs will not be verified by the responsible SNL Division Supervisor unless the following requirements are met:

- o the Supervisor is the only individual in the organization competent to perform the verification;
- o the Supervisor did not establish a singular design approach or rule out certain design considerations;
- o the rationale for satisfying the above requirements is documented and approved by the NNWSI Project Department Manager.

5.2 Design and System Engineering Integration

The design will be integrated with the needs of other aspects of the project through active communication by the PI with the Systems Engineering Integration Group (SEIG).

6.0 Records

Design records will include design requirements documents, design plans, Design Investigation Memos, Problem Definition Memos, Engineering Calculations Notebooks, minutes of review meetings, records of design review findings report, completed design reports, drawings, and specifications, and associated documentation. These will be maintained in the SNL/NNWSI Department 6310 Records File as follows:

- o Design requirements documents - 60/12412/1.1 for Subsystem Design Requirements

- o Design Plan - 80 Series - 80/12411/1.0, for Repository Design Plan.

- o Design Investigation Memos shall be filed as specified in DOP 3-4, Design Investigation Control.

- o Problem Definition Memos shall be filed as specified in DOP 3-3, Analysis and Calculation Control.

- o All records associated with intermediate and final design reviews - 60 Series - Design Records System, Design Verification Records, under applicable WBS. Includes: design review checklist, review meeting minutes, conference notes, design review reports, and design review action item reports.

- o Design verification testing records - 50 Series - DRMS.

- o Records of design verification by independent calculations - 60 Series - Design Records System, Design Verification Records, under applicable WBS.

- o Engineering Calculations Notebooks shall be filed as specified in DOP 3-10, Routine Design Calculations.

- Design Drawings - 60 Series - Design Records, under applicable WBS.
- Justification and approval for supervisor as tech. reviewer - 60 Series - Design Records System, Design Verification Records, under applicable WBS.

7.0 References

DOP 2-6, Certification of Project Personnel

DOP 3-1, Reviewing, Approving, and Issuing Engineering Drawings.

DOP 3-2, Software QA Requirements.

DOP 3-3, Analysis Definition Requirements.

DOP 3-4, Design Investigation Control.

DOP 3-6, Design Change Control.

DOP 3-9, Interface Control of NNWSI Engineering Design.

DOP 3-10, Routine Design Calculations.

DOP 7-1, Control of Purchased Services and Items

DOP 6-2, Reviewing, Approving, and Issuing Technical Information Documents.

DOP 11-1, Experiment and Equipment Test Procedure Control.

DOP 11-2, Requirements for Experiment/Equipment Test Logbooks.

DOP 17-1, Records Management.

Subsystem Design Requirements for the Advanced Conceptual Design of the Yucca Mountain Nuclear Waste Repository, R. R. Hill, SAND85-0620, 1986.

Draft Reference Information Base for the Nevada Nuclear Waste Storage Investigations Project, SLTR 86-5005, April 1986.

Repository Design Plan for a Tuff Repository at the Nevada Test Site, L. W. Scully, et al., SAND83-1839, 1986.

Yucca Mountain Mined Geologic Systems Requirements, J. G. Yeager, SAND84-1880, 1986.

8.0 Appendices

Appendix A - Design Review Notice (Example)

Appendix B - Design Review Checklist (Example)

APPENDIX A

DESIGN REVIEW NOTICE (EXAMPLE)

To: ______________________________ Date ____________

Project ____

____

Design to be Reviewed ________________________________

Review Date ______________ Location ______________ Time ________

Contract No. ____

WBS No. ____

You have been selected as a member of the design review committee for the design stated above.

Scope of Design Review

Purpose of Design Review

Signed ______________________________
Design Review Committee
Chairperson

Attachments:

Agenda for Design Review Meeting.

List of Reviewers.

Design Review Materials and Documents.

APPENDIX B

DESIGN REVIEW CHECKLIST (EXAMPLE)

- Were the design inputs correctly selected and incorporated into the design?
- Are assumptions necessary to perform the design activity adequately described and reasonable? Where necessary, are the assumptions identified for subsequent verification as the detailed design activities completed?
- Has the quality level of each item been properly assigned?
- Are appropriate quality and quality assurance requirements specified?
- Are applicable reference documents, such as codes, standards, and regulatory requirements, properly selected and identified, and were their requirements for the design met?

  Has the design been reviewed for constructability?

  Have operational considerations been adequately addressed?
- Have design interface requirements been satisfied? (Design interfaces include, for example, the external design interface between design groups or organization of different contractors, and the internal design interface between divisions or organizations within SNL.)
- Was an appropriate design method used?
- Is the design output reasonable compared to design input?
- Are the specified materials compatible with each other and with the environmental conditions for which they were designed and to which they were exposed?
- Are accessibility and other design provisions adequate for the performance of needed maintenance and repair?
- Has the design properly considered the need to minimize radiation exposure to both the public and operating personnel?
- Have adequate pre-operational and subsequent periodic test requirements been specified?
- Is the design defined in sufficient detail to permit adequate evaluation and checking by competent technical personnel other than those performing the original design?

- Do provisions for access and administrative control for plan security and protection comply with applicable regulations? Does the design comply with OSHA standards and other safety regulations?

- Have construction and operating costs been considered in the design?

- Is the state of the art sufficiently advanced to permit the development of the design as specified?

- Is adequate fire protection provided commensurate with the assigned level of programmatic impact?

- Have natural phenomena (seismic, flood, tornado) requirements, design limits, and loading combinations been established and satisfied?

- Are design drawings accurate, consistent, sufficiently detailed, and of professional quality?

- What supporting analyses have been performed?

- Are computer codes used in the analysis been documented, verified and validated in accordance with DOP 3-2.

- Have any required corrective actions been identified and document?

Since this is an example, this design review checklist is not intended to be comprehensive or to cover all questions for all disciplines. The responsibility for a complete review rests with the reviewers.

UNCONTROLLED

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NNA.880217.0045

SNL NNWSI PROJECT

DEPARTMENT OPERATING PROCEDURE

DESIGN CHANGE CONTROL

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Rev.	A	A	A	A	A	A	A	A

Author: Roger R. Hill — 2/4/88
Roger Hill, 6311 — Date

Approved: Al Stevens — 2/5/88
Division Supervisor — Date

Approved: R R Richards — Feb 5, 1988
Quality Assurance — Date

Approved: Thomas O. Hunter — Feb-5-1988
Department Manager — Date

SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT
Issued to: M. D. Cotter, SAIC
Copy Number: 032
RETURN TO 6310 RECORDS CENTER
WHEN NO LONGER NEEDED.

DESIGN CHANGE CONTROL

1.0 Purpose

The purpose of this procedure is to provide a process for use throughout the design phases to introduce, justify, evaluate, and authorize changes to NNWSI Repository Design documents and drawings produced by Sandia National Laboratories and that have been placed under design change control.

2.0 Scope

This Department Operating Procedure (DOP) defines the process for implementing changes to QA Level I and QA Level II design documents placed under change control for which the SNL NNWSI Project Department has responsibility. This procedure may be used, but is not required, for changes to QA Level III design documents or design changes identified during the fabrication of proof-of-principle equipment.

3.0 Definitions

3.1 DCR - Design Change Request

3.2 Principal Investigator (PI) - The SNL staff member responsible for completion of a particular investigation or design. He may or may not also be the Task leader.

3.3 RDCB - Repository Design Change Board

3.4 SEIG - Systems Engineering Integration Group

3.5 SEMP - Systems Engineering Management Plan

3.6 Task Leader (TL) - The SNL staff member responsible for developing the technical guidance, budget, and schedule for a Work Breakdown Structure (WBS) task. He may or may not be the Principal Investigator.

4.0 Procedure

Whenever any data, requirements, or other information in the design documents are no longer accurate, or are insufficient to adequately define current technical scope, the following procedure shall be used (see Figure 1):

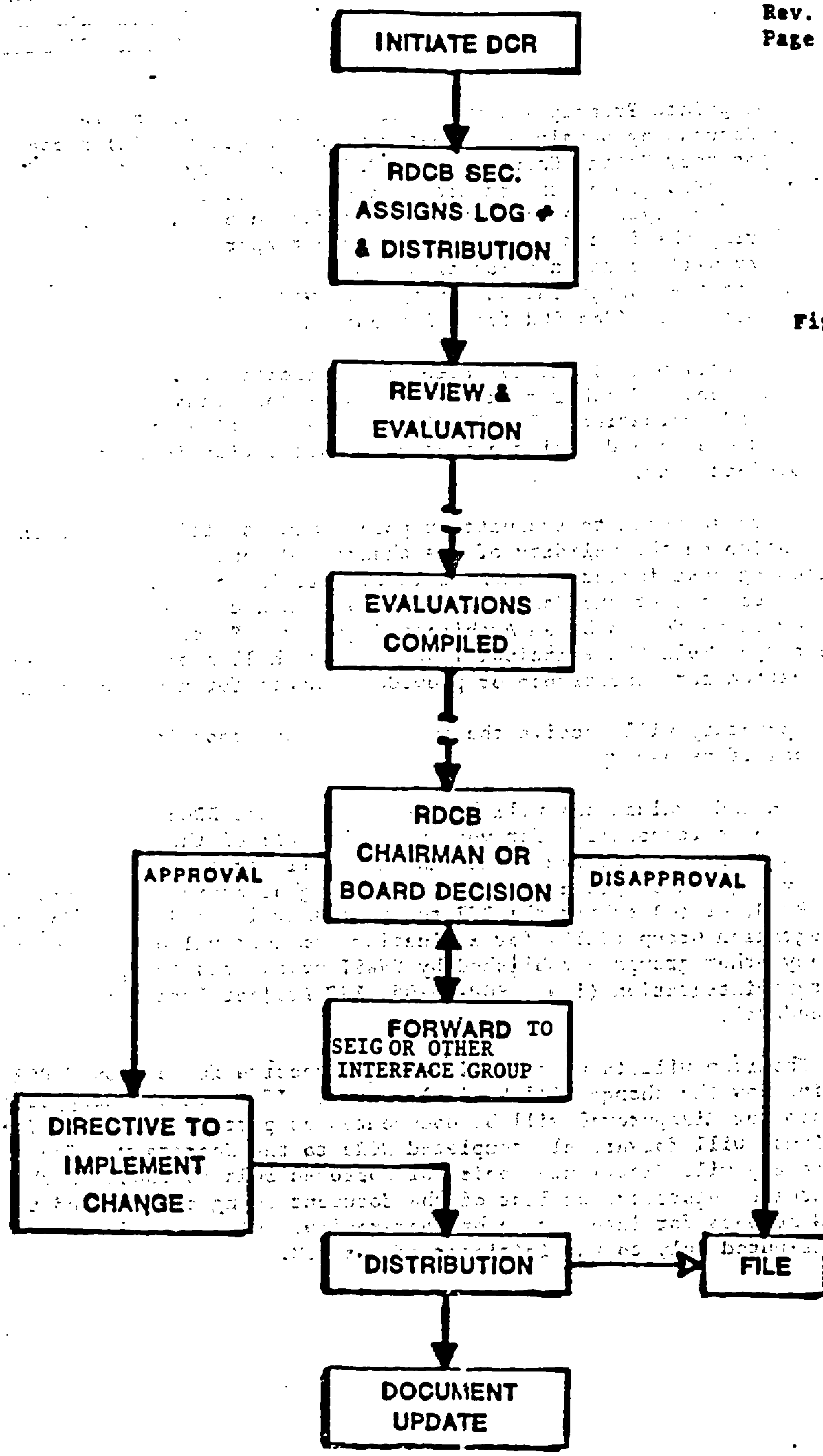
INITIATE DCR
RDCB SEC. ASSIGNS LOG # & DISTRIBUTION
REVIEW & EVALUATION
EVALUATIONS COMPILED
RDCB CHAIRMAN OR BOARD DECISION
APPROVAL
DISAPPROVAL
FORWARD TO SEIG OR OTHER INTERFACE GROUP
DIRECTIVE TO IMPLEMENT CHANGE
DISTRIBUTION
FILE
DOCUMENT UPDATE

Figure 1

4.1 The appropriate Principal Investigator or contractor initiates a Design Change Request by obtaining a Design Change Request (DCR) number from the Repository Design Change Board (RDCB) Secretary, and by providing a title, description of the change, reason and justification for the change, identifying design interfaces affected by the change, and identifying the impact to the design if not approved. The RDCB Secretary will maintain a log of all DCRs. The RDCB Secretary will coordinate the assignment of DCR numbers with the SNL SEIG representative. (See DCR form, Appendix A.)

4.2 The Secretary will identify potentially affected repository design organizations and other required reviewers and transmit the DCR for review and evaluation. The SNL SEIG representative will evaluate the proposed change and assign a change classification in accordance with the project SEMP.

4.3 Reviewers selected to evaluate proposed changes will document their evaluation on the validity of the change and consequent effects including cost impacts. Each reviewer will indicate concurrence or nonconcurrence of the design change and sign and date the DCR. If a review is performed by an Architect Engineer (AE) or other contractor, the responsible SNL Principal Investigator shall approve the contractor evaluation for concurrence or provide comments for non-concurrence.

4.4 The Secretary will receive the evaluations and coordinate further actions if necessary.

4.5 The DCR and evaluations will be presented to the RDCB Chairman. The Chairman is responsible for verifying that all of the necessary reviewers have responded. The Chairman will decide to either (1) approve, (2) disapprove, (3) call a meeting of appropriate members of the RDCB, or (4) submit the DCR to the higher level Systems Engineering Integration Group (SEIG) for evaluation and approval or disapproval, or to any other groups established by NNWSI procedures for purposes of systems integration (i.e., SOP-03-05, ESF Project Interface Control Procedure).

4.6 The Chairman will issue an Engineering Directive for approved DCRs to define how the change will be implemented. If a DCR is disapproved, the reason for disapproval will be documented as part of the DCR. The Chairman will forward all completed DCRs to the Secretary. The Secretary will distribute copies of approved DCRs to those on the controlled distribution list of the document being changed and to the SEIG members for information or post-review. Disapproved DCRs will be distributed only to the initiator of the DCR.

4.7 After the design document has been revised, the RDCB Secretary will check the revised document to ensure that the revision was accomplished as specified in the approved DCR. The revised document will be distributed in accordance with the SEMP.

4.8 It is recognized that many miscellaneous changes may best be incorporated by a general update and revision of a document. In these cases, a document may be revised by initiating a single DCR which identifies all changes included in the general update.

4.9 When a sufficiently large number of approved changes exist to justify the action, the design documents will be updated and a new edition will be distributed in accordance with the SEMP. In any case, documents will be updated at the completion of each major design phase.

5.0 <u>Document Revision</u>

5.1 Revisions to a DCR are made by initiating a new DCR. The description of the change will reference the original DCR by number and title. The revised DCR will be processed in the same manner as the original DCR.

6.0 <u>Additional Requirements</u>

6.1 Repository Design Change Board (RDCB)

Permanent members of the RDCB will include the Chairman and Secretary who will be selected from the SNL Division responsible for the repository design. The RDCB will meet at the discretion of the Chairman and will include other members specified by the Chairman. The RDCB will meet only for the most significant changes. Evaluation of design changes will normally be done by reviewers selected by the Secretary and the Chairman.

6.2 Design Change Control of Proof-of-Principle Equipment

Design changes required during the fabrication of proof-of-principle equipment will be conducted in a controlled manner. The Principal Investigator will be responsible for specifying and documenting the method of design change control if different from this procedure. At the completion of the fabrication and testing of proof-of-principle equipment, the design changes will be subject to evaluation in accordance with DOP 3-5, Design Control and Verification.

7.0 <u>Responsibilities</u>

7.1 RDCB Secretary

- Maintain a log of Design Change Requests.
- Select reviewers to evaluated proposed design changes and forward the Design Change Requests to the reviewers.
- Coordinate design change evaluations and ensure that evaluations are completed in a timely manner.
- Forward Design Change Requests and evaluations to the RDCB Chairman.
- Participate in RDCB meetings.
- Distribute approved/disapproved Design Change Requests.
- Forward revised documents from distribution in accordance with the SEMP.
- Forward records to the SNL/NNWSI Department 6310 Records File.

7.2 RDCB Chairman

- Verify that appropriate reviewers have evaluated and responded to Design Change Requests.
- Determine the need for RDCB meetings and select appropriate members of the RDCB.
- Ensure that proposed design changes which impact on other NNWSI Project participants are submitted to the SEIG for evaluation and approval or disapproval.
- Approve or disapprove Design Change Requests that do not impact on other NNWSI Project participants.
- Issue Engineering Directives to define how approved design changes are implemented.
- Ensure that the reason for disapproval of a Design Change Requests is documented as part of the DCR.

- Forward completed Design Change Requests to the Secretary for distribution.

7.3 Principal Investigator

- Initiate Design Change Requests.
- Approve contractor evaluation for concurrence or provide comments for non-concurrence.
- Specifies and documents the method of design change control during the fabrication of proof-of-principle equipment, if different from this procedure.

7.4 SNL SEIG Representative

- Evaluate proposed changes and assign the change classification.

7.5 Quality Assurance Organization

- Verify, by means of audits and surveillance, that the provisions of this procedure have been followed.

8.0 <u>Records</u>

The RDBC Secretary will ensure that the following records are maintained in the SNL/NNWSI Department 6310 Records File:

- Design Change Requests - 60/12411/1.13, Design Change Control Records.
- Design Change Request Numbers and Titles - 35/1291/5.4, Design Change Request (DCR) List.

9.0 <u>References</u>

DOP 3-1, Reviewing, Approving, and Issuing Engineering Drawings.

DOP 3-5, Design Control and Verification.

DOP 3-9, Interface Control of NNWSI Engineering Design.

NNWSI Project Systems Engineering Management Plans, J. G. Yeager et al., SAND86-1632, 1986.

SOP-03-05 ESF Project Interface Control Procedure, 1/27/87.

10.0 <u>Appendix</u>

Appendix A - Design Change Request (DCR)

Date____________ DESIGN CHANGE REQUEST DCR# __________ Class ________

Originator______________________________ Title____

Description of Change

Interfaces Affected

Impact if not approved

Evaluation

WBS#	Cost

	concur	non concur		concur	non concur
______ date	☐	☐	______ date	☐	☐
______ date	☐	☐	______ date	☐	☐
______ date	☐	☐	SEIG ______ date	☐	☐
______ date	☐	☐	Sec. ______ date	☐	☐
______ date	☐	☐	Chairman Signature date		

☐ Approved
☐ Disapproved
☐ Submit to SEIG

Engineering Directive (by chairman)

RMS NO. SL * 000488
ACC NO. SL * 100540

NNA.880119.0022

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SNL NNWSI PROJECT

DEPARTMENT OPERATING PROCEDURE

Technical Data Base

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Author: Bruce C. Whittet — 3/25/87
Bruce C. Whittet — Date

Approved: 6315 — 3/25/87
Division Supervisor — Date

Approved: 3/27/87
Quality Assurance — Date

Approved: Thomas O. Hunter — 4/2/87
SNL-TPO — Date

SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT
Issued to: M. D. Cotter, SAIC
Copy Number: #021
RETURN TO 6310 RECORDS CENTER
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1.0 Purpose

The purpose of this Department Operating Procedure, hereafter sometimes referred to as "procedure," is to specify requirements for operation of the NNWSI Technical Data Base.

2.0 Scope

This procedure specifies requirements for routine operations of the NNWSI Technical Data Base. The NNWSI Technical Data Base, hereafter referred to as "Technical Data Base," is operated by Sandia National Laboratories on behalf of the Nevada Nuclear Waste Storage Investigation Project. This procedure applies to Technical Data Base activities classified as Quality Assurance Level I in the Quality Assurance Level Assignments for WBS elements 1.2.1.3.1 (QALAS 113, 114) and 1.2.1.3.2 (QALAS 053, 13). Accordingly, this procedure applies to operations of the Site & Engineering Properties Data Base and the Interactive Graphics Information System.

Operations of the Technical Data Base are classified for the purposes of this procedure as data entry, data modification, data retrieval, data base security, and data base audit. Specific procedures are provided for each of these categories in Section 4.1, "Data Base Management." Documentation of operations occurs by maintenance of job logs and product logs. Procedures are also provided for the maintenance of each of these documentation log types in Section 4.2, "Data Base Documentation Logs."

Because all Technical Data Base operations are classified as Quality Level I or Quality Level III, all requests for Quality Level II operations or products of the Technical Data Base will be treated as Quality Level I. This procedure does not apply to operations of the Technical Data Base classified as Quality Assurance Level III, nor to support activities regardless of Quality Level related to software development; hardware procurement, operation, and maintenance; or scientific and engineering calculations that use Technical Data Base products.

3.0 Definitions

Data Base -- a collection of interrelated data stored together with controlled redundancy to serve one or more applications; the data are stored so that they are independent of programs which use the data; a common and controlled approach is used in adding new data and in modifying and retrieving existing data within a data base.

Data Base Product -- a tangible, physical result of a data retrieval, available for distribution as paper, magnetic tape, magnetic disc, or other physical medium.

Certified Data Base Personnel -- individuals assigned by the supervisor of the Technical Data Base to work activities conducted under WBS elements 1.2.1.3.1, 1.2.1.3.2, and 1.2.1.3.4 and certified in accordance with DOP 2-6.

Data Base Security -- a set of operations, controls, and associated documentation that reduces the opportunities for inadvertent or intentional tampering with information in a data base.

Data Entry -- the process by which data are transferred from a source document to locations in a data base schema, (e.g. through use of keyboard, magnetic tape, digitizing table, computer program).

Data Integrity -- the condition of data such that source data is accurately represented in a data base and is not modified other than through intentional, authorized, and documented entries and modifications, including concepts in Section 4.0.

Data Modification -- the process by which alteration to data in a data base is made, (e.g. unit conversions, rounding to set significant digits, conversion from alphabetic to numeric).

Data Retrieval -- the process by which data are retrieved from a data base, usually in a manner compatible with display as a product, such as plots expressing some relationship among similar data or tables of relationships among or between different data types.

Data Traceability -- The state of documentation whereby any item of data in a data base can be traced unambiguously to uniquely identified documents containing and authorizing source data.

Datum (pl. data) -- a measured or inferred, quantitative value of a property or characteristic of a material or process.

Interactive Graphics Information System (IGIS) -- a data base and associated data processing system for storage, manipulation, and display of geometrically organized data, operated for the NNWSI project under WBS element 1.2.1.3.2. The IGIS is primarily used to process information that can be entered, modified, retrieved, and displayed graphically.

Site & Engineering Properties Data Base (SEPDB) -- a data base principally containing data associated with various physical properties of natural (e.g. rock) and engineering (e.g. waste containers) materials associated with the Yucca Mountain Mined Geologic Disposal System and information related to those data such as collecting organizations, quality level, test methods, and others. Activities associated with the SEPDB are performed under WBS element 1.2.1.3.1. The SEPDB is primarily used to process data that can be entered, modified, retrieved, and displayed in tabular form.

Source Data -- Data supplied to and entered into the Technical Data Base. Quality Level I and II source data are limited to those that are authorized for entry in a data base by the TPO responsible for originally collecting the data.

Supervisor - the supervisor of Sandia National Laboratories who manages the WBS elements under which Technical Data Base activities are conducted.

Task Leader -- the person responsible for daily direction of activities associated with a WBS element. Task leaders are listed in the Project Records Center under File item 30/1291/0.2.

TPO -- Technical Project Officer.

4.0 Requirements

The requirements of the Technical Data Base are to assure that all contained information accurately represents its source data (data integrity) and that any item of information in the data base can be traced unambiguously to its source (data traceability).

4.1 Data Base Management

Data base management refers to data handling activities of data entry, data modification, and data retrieval. It also includes data base security control and data base audit activities.

4.1.1 Data Entry

Data contained within the Technical Data Base are entered as source data from documents (including magnetic tape, discs, etc.) generated by other activities within the NNWSI project. QI and QII data entered into a data base must be transmitted by a TPO to the supervisor of the Technical Data Base and authorized by that TPO for entry by a Data Authorization Form (Appendix A). Authorized data shall be accepted for entry by the supervisor of the Technical Data Base or his duly authorized representative. This acceptance for data entry shall be documented on a work request (Appendix B) and filed in a job log. Each work request for data entry shall be accompanied by a Data Authorization Form and shall specify the data entry and verification procedures to be followed, as appropriate. Entry of data into a data base shall be performed by certified data base personnel.

4.1.2 Data Modification

Operations of the Technical Data Base that result in interpolation, extrapolation, unit conversion, or other modification of source data shall be authorized by the supervisor of the Technical Data Base or his authorized representative and filed as a Work Request in a job log. The work request shall specify the data modification and verification procedures to be followed, as appropriate. Modifications of data shall be performed by certified data base personnel.

4.1.3 Data Retrieval

Retrieval of data from a data base shall be initiated by any requestor by submitting a Work Request to the data base task leader. The Work Request shall specify the format and content of any data products based on the retrieval and the verification procedures to be followed, as appropriate. The Work Request shall be signed and dated by the requestor prior to initiation of the work. The correctness or appropriateness of the resulting product shall be verified and certified on the Work Request by initials of a representative of the Technical Data Base after the work is complete. Each product of the Technical Data Base shall be assigned two Quality Levels (which may be the same). The first will indicate the Quality Level of the Data Base Management operations used to produce the product. The second Quality Level will indicate the quality level of the product itself, as determined by the lowest quality level of data used in a significant manner to generate the product. The Quality Levels, a brief description or title of the product, and a unique product number shall be printed directly on the product or shall accompany the product on a separate cover sheet. All products and accompanying Work Request numbers produced by QI or QII Work Requests shall be entered into a product log by certified data base personnel (Appendix C).

4.1.4 Data Base Security

Access to computer systems used for storage of data in a data base shall be approved by the supervisor of the technical data base. Such access control shall be achieved by establishing user-ID's and passwords and associated user-authorization files that limit each user to specified operations (e.g. read only, read-edit, system privileges, etc.). Appropriate file protection shall be instituted for all files containing data such that unauthorized access is prohibited.

4.1.5 Data Base Audit

An audit shall consist of a bit-by-bit comparison of the working copy of each audited Technical Data Base file with an audit copy of that file maintained on a separate storage medium. Documentation of audit results shall be entered on work sheets by persons conducting the audit and filed in a job log by the Task Leader.

An audit of randomly selected files created by QA Level I Work Requests shall be initiated by a Work Request from a Technical Data Base Task Leader and conducted by certified data base personnel on a quarterly basis. The number of files to be audited by a routine audit shall be the nearest whole number to the value representing ten (10) percent of the total number of QA Level I files then residing on the data bases.

An audit of a particular Technical Data Base file shall be conducted upon receipt of an Audit Work Request from any requestor if there are compelling reasons to question the integrity of any file used by a work request requiring Q Level I documentation. The Task Leader shall be responsible for determining if the reasons cited for the audit are compelling.

A comprehensive audit of all Technical Data Base files created under QA Level I work requests that have not been formally abandoned shall be conducted by certified data base personnel if unresolvable discrepancies are encountered during the course of either a routine audit or an audit-upon-request.

Audit files of QA Level I files shall be maintained on a separate, removable disk pack designated for audit purposes.

If the working copy and the audit copy of the file(s) being audited contain discrepancies, this fact shall be entered by a Task Leader in the audit documentation. An attempt shall be made to resolve the discrepancies by (1) running bit-by-bit comparison, (2) verifying that the filenames and file contents correspond, (3) verifying that all system hardware and operating system software are functioning properly and rerunning the comparison, or (4) reloading the working copy of the file from existing backup or system-image tapes and rerunning the comparison. Determination of proper resolution of audit discrepancies shall be the responsibility of the Task Leader. If the discrepancies cannot be resolved, all files that contain discrepancies either shall be abandoned or shall be recreated from the QA Level I product management documentation in the Records Management System at the discretion of the Task Leader.

If a file subject to this procedure is identified as containing unresolved discrepancies, the requestor(s) identified on all QA Level I work requests completed after the performance of the last successful audit of that file shall be notified that such discrepancies exist. Determination of the continued use of any Technical Data Base product already released shall be the sole responsibility of the requestor(s) thus affected.

4.2 Documentation Logs

A job log for all Data Base Management activities and a product log for all Technical Data Base products shall be maintained by Technical Data Base Task Leaders. Separate job logs and product logs may be maintained for the SEPDB and the IGIS.

4.2.1 Job Log

Job logs shall be maintained in a convenient location by the Task Leader(s) of WBS elements 1.2.1.3.1 (SEPDB) and 1.2.1.3.2 (IGIS). Entries in a job log shall be arranged by sequential, unique identification numbers corresponding to work request numbers. For each unique identification number, a job log shall contain, but not necessarily be limited to, the following, as appropriate; work request, data authorization form, and work sheets. All job logs are included in the Project Records Center under file items 41/12131/JGL/QI for SEPDB and 43/12132/JLG/QI for IGIS.

4.2.1.1 Work Requests

All Data Base Management operations of the Technical Data Base will be initiated by a work request and documented by a work request form. Work requests shall be assigned the following items by Technical Data Base Personnel:

(1) an identification number,
(2) Quality Levels of the work initiated by the request,
(3) the date the work request was received, and
(4) the person who will perform the requested work.

A section of the work request form shall be filled in by the requestor including name, telephone, organization affiliation, signature, and date. A separate section shall include a description of the work to be done and may include descriptive information supplied by the requestor, annotations by a Task Leader of the Technical Data Base, and annotations by the person(s) performing the work. Verification procedures required by the requestor or Task Leader shall also be specified in the descriptive section. After the work is complete, a section of the work request form shall be filled in by Technical Data Base personnel and shall include approval of work performed, certification that the required verification procedures were implemented, a listing of product numbers, if any, of products associated with the work, and a listing of accession numbers, if any, associated with newly entered data or modified, previously entered data. Standard work request forms shall be prepared by Technical Data Base personnel and distributed for use to TPO's and other persons. The forms shall conform to the general format of the example in Appendix B.

4.2.1.2 Data Authorization Form

All work requests for entry of Quality Level I or II data shall be accompanied by a Data Authorization Form. This form shall conform to the general format of the example in Appendix A. Information on the form to be provided by the TPO of the organization submitting the data to the Technical Data Base shall include a description of the type of data, their quality level, an indication of whether the data are published, the full citation of the referenceable document or documents where the data are published, if appropriate, an indication of the file number or numbers of any supporting information associated with the data in the submitting organizations Local Records Center, description of the document format of the actual data (e.g. hardcopy tables, hardcopy graphical drawings, magnetic tape, magnetic disc, etc.), a listing of identification numbers or codes on or attached to the documents containing the data, any special instructions for storage or treatment of the data, the full signature of the TPO submitting the data, the date, and the organizational affiliation of the TPO. The TPO who submits the data may propose the target data base (SEPDB or IGIS) where the data should be entered. Each separate physical document containing the data accompanying the authorization form shall be identified and marked with a unique number or code of the submitting TPO's choice. The supervisor of the Technical Data Base, or his authorized representative, shall assign a single unique number to the Data Authorization Form and accompanying work request, note the date the submittal was received, and assign an accession number, if appropriate, to the data.

4.2.1.3 Work Sheet

This section of the job log shall be prepared and/or compiled by certified Technical Data Base personnel, as appropriate, and will contain information that assists in reproduction of work initiated by the work request. Items that may be included are source data, associated QA levels, copies of products, lists of data entered under the work request, correspondence associated with the work request, lists of data base files and associated operational procedures used to complete the work, results of audits, and any other documents relevant to the traceability or the integrity of the data associated specifically with the work request. The level of detail shall be sufficient that the work could be redone, if required, by a person or persons that are certified in the operations of the Technical Data Base. A section of the work sheet shall describe the verification operations used to confirm the quality of resultant product(s), including any data listings, data comparisons, or other checks.

4.2.2 Product Log

A product log of all Technical Data Base products of Quality Levels I and II shall be maintained by the Task Leader. All products of the Technical Data Base shall be assigned a unique product number by the Task Leader. The product log shall contain a listing of product numbers, a brief title of the associated products, the Work Request numbers that initiated work resulting in the products, the QA level of the products, a list of persons to whom the products were delivered or transmitted by Technical Data Base personnel, and the dates of such deliveries or transmittals. Product logs are included in the Project Records Center under file items 41/12131/PLG/QI for SEPDB and 43/12132/PLG/QI for IGIS. Product logs shall be maintained in a convenient location by Task Leaders of WBS elements 1.2.1.3.1 (SEPDB) and 1.2.1.3.2 (IGIS)(Appendix C).

5.0 Responsibilities

The task leader of a Technical Data Base task shall ensure that the activities of that task are conducted according to this Department Operation Procedure.

6.0 Records Management

Because the job logs and product logs specified by this Department Operating Procedure are part of the SNL Records Management System, these logs shall be filed, once completed, in the Records Management System according to the following file numbers:

6310 41/12131/JLG/Q1	SEPDB Job Log
6310 41/12131/PLG/Q1	SEPDB Product Log
6310 43/12132/JLG/Q1	IGIS Job Log
6310 43/12132/PLG/Q1	IGIS Product Log

7.0 References

DOP 2-6 - Qualification and Certification of Project Personnel
DOP 3-3 - NNWSI Analysis and Definition Requirements
DOP 17-1 - Records Management
Computer Data-Base Organization, 2nd Edition.
James Martin, 1977 by Prentice-Hall, Inc.
Englewood Cliffs, NJ.

8.0 A. Data Authorization Form
B. Work Request Form
C. Product Log Sample

DATA AUTHORIZATION FORM

Send to:
NNWSI Technical Data Base Administrator
Geoscience Analysis Division, 6315
Sandia National Laboratories
P.O. Box 5800
Albuquerque, New Mexico 87185
Telephone: (505 or FTS) 846-4922

The accompanying data were collected for the NNWSI Project and I authorize them for inclusion in the NNWSI Technical Data Base.

Type of data (porosity, density, permeability, etc.) ______________________

____

____

____

____

Quality Assurance Level (circle one) I II III

Format of document containing submitted data (e.g., hardcopy, magnetic tape, etc.) ______________________

____

Number of attached documents containing data ______________________

Identification number(s) or code(s) on each submitted document ________

____

____

Is submitted data published? (circle one) YES NO

Published Reference ______________________

____

Local Records File System ______________________

Local Records File Number(s) for supporting information ________

____

____

Proposed Data Base (circle one) SEPDB IGIS

Please attach any remarks regarding special storage format or data organization that might be required.

Signature of TPO ______________________ date ________

Organization ______________________

WORK REQUEST

Send to:
TECHNICAL DATA BASE ADMINISTRATOR
SANDIA NATIONAL LABORATORIES
GEOSCIENCE ANALYSIS DIVISION.6315
P.O.BOX 5800
AL QUERQUE.NM 87185
PH .E:(505 OR FTS)846-4922

REQUEST NUMBER: ______
DATE RECEIVED: ______
PRODUCT QA LEVEL: ______
DATA QA LEVEL: ______

TO BE COMPLETED BY REQUESTOR		
NAME:	SIGNATURE:	DATE:
ORGANIZATION:	DIVISION:	
ADDRESS:	TELEPHONE:	

TO BE COMPLETED BY DATA BASE PERSONEL	
TYPE: ☐ DATA ENTRY (FORM # ______) ☐ PRODUCT REQUEST ☐ AUDIT ☐ OTHER	
ACCEPTED BY:	DATE:
ASSIGNED TO:	DATE:
VERIFIED BY:	DATE:
APPROVED BY:	DATE:

WORK REQUESTED - ATTACH ADDITIONAL EXPLANATIONS, SCHETCHES AND EXAMPLE LISTINGS, IF APPROPIATE:	REQUESTED QA LEVEL:

PRODUCT NUMBERS, OR ACCESSION NUMBERS.

ORIGINAL - JOB LOG
COPY TO - REQUESTOR
FILE - 6310 4 /1213 /JLG/QI

FORM BCWMOD:WORKREQ.M2

NNWSI PRODUCT LOG

Product Number	Description	Job# Number	QA LEVEL	Date	Location	DISTRIBUTION
CAL0001	Section L-L'	J095	III	08OCT85	NTS:	FILE
CAL0002	Section M-M'	J095	III	10OCT85	NTS:	FILE
CAL0003	Section N-N'	J095	III	23OCT85	NTS:	FILE
CAL0004	Section P-P'	J095	III	23OCT85	NTS:	FILE

NNA.880314.0010

SNL NNWSI PROJECT

DEPARTMENT OPERATING PROCEDURE

REFERENCE INFORMATION BASE CHANGE CONTROL

Page	1	2	3	4	5	6	7	8	9	10
Rev.	A	A	A	A	A	A	A	A	A	A

RIBTL: F. Coryl Schelling — F. J. Schelling, 6316 — Date: 3/4/88

Author: F. Coryl Schelling — F. J. Schelling, 6316 — Date: 3/4/88

Approved: [signature] — Division Supervisor, R. B. Pope, 6316 — Date: 3/4/88

Approved: [signature] — Quality Assurance — Date: Mar 4, 1988

Approved: [signature] — Department Manager — Date: 3/4/88

UNCONTROLLED

SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT
Issued to: M. D. CUTTER SAIC
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RETURN TO 6310 RECORDS CENTER
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SAIC/T&MSS
MAR 1 4 1988
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REFERENCE INFORMATION BASE CHANGE CONTROL

1.0 Purpose

The purpose of this procedure is to provide an SNL change control process to introduce, justify, evaluate, authorize, and implement changes to the NNWSI Project Reference Information Base (RIB), which is produced by Sandia National Laboratories, prior to Project approval or baselining.

2.0 Scope

This Department Operating Procedure (DOP) defines the process for implementing changes to the NNWSI Project Reference Information Base by the SNL NNWSI Project Department prior to submitting the changes to the NNWSI Project for approval or baselining.

3.0 Definitions

3.1 RIBCR--RIB Change Request- form used to initiate processing of changes proposed for the RIB (Appendix A).

3.2 RIBDR--RIB Development Request- form used to document the status of proposed RIB changes which have been approved for further development. (Appendix B).

3.3 RIBCE--RIB Change Evaluation- form used to document review evaluations and comment resolution of proposed RIB changes (Appendix C).

3.4 RIBCB--RIB Change Board

3.5 RIBCB Member--A member of the RIBCB. RIBCB members are selected from SNL NNWSI Project staff and certified by the RIBCB Chairperson. The RIBCB Chairperson is designated by the NNWSI Technical Project Officer at SNL.

3.6 RIBTL--RIB Task Leader: The individual responsible for the WBS element 1.2.1.3.3 and for RIB administration at SNL.

3.7 PI--Principal Investigator: A SNL NNWSI Project staff member responsible for completion of a particular investigation or design. He/she may or may not also be a task leader.

3.8 TL--Task Leader: The SNL NNWSI Project staff member responsible for developing the technical guidance, budget, and schedule for a Work Breakdown Structure (WBS) element. He/she may or may not be a Principal Investigator.

3.9 TSAG--The NNWSI Project Technical Systems Advisory Group.

3.10 TSAG Member--A member of the TSAG. TSAG members are from SNL, LANL, LLNL, SAIC, USGS, and DOE/NVO/WMPO. The TSAG Chairperson is from DOE/ NVO/WMPO.

4.0 Responsibilities

4.1 RIBTL

o Maintain a log of RIBCRs and RIBDRs.

o Evaluate and provide RIBCR recommendation summaries to the RIBCB Chairperson.

o Initiate RIBCRs and RIBDRs.

o Coordinate change evaluations and ensure that evaluations are completed in a timely fashion.

o Forward RIB Development Requests with associated documentation to the RIBCB Chairperson following comment resolution.

o Participate in RIBCB and RIB-related portions of TSAG meetings.

o Submit approved RIBDRs to the NNWSI Project for review and approval.

o Maintain records of RIBCRs, RIBDRs, RIBCEs, and supporting documentation.

o Forward records to the SNL/NNWSI Department 6310 Records File per DOP 17-1.

4.2 RIBCB Chairperson

o Staff and certify the RIBCB.

o Convene RIBCB meetings as needed.

o Ensure that proposed RIB changes are submitted to the TSAG for evaluation and concurrence/non-concurrence.

o Approve or disapprove RIBDRs.

o Return completed RIBDRs to the RIBTL for further action.

4.3 RIBCB Member

o Assist in initial evaluation and recommendation of RIBCRs.

o Evaluate proposed changes as requested by RIBCB Chairperson.

o Assist RIBTL in identifying Project staff for development and review of RIB information and in resolving technical review comments.

4.4 Principal Investigator, Task Leader

o Initiate RIBCRs.

o Assist in preparing RIBDRs.

4.5 TSAG Member

o Initiate RIBCRs.

o Evaluate proposed changes as requested by TSAG Chairperson.

o Assist RIBTL and the RIBCB in identifying Project staff for development and review of RIB information.

4.6 Quality Assurance Organization

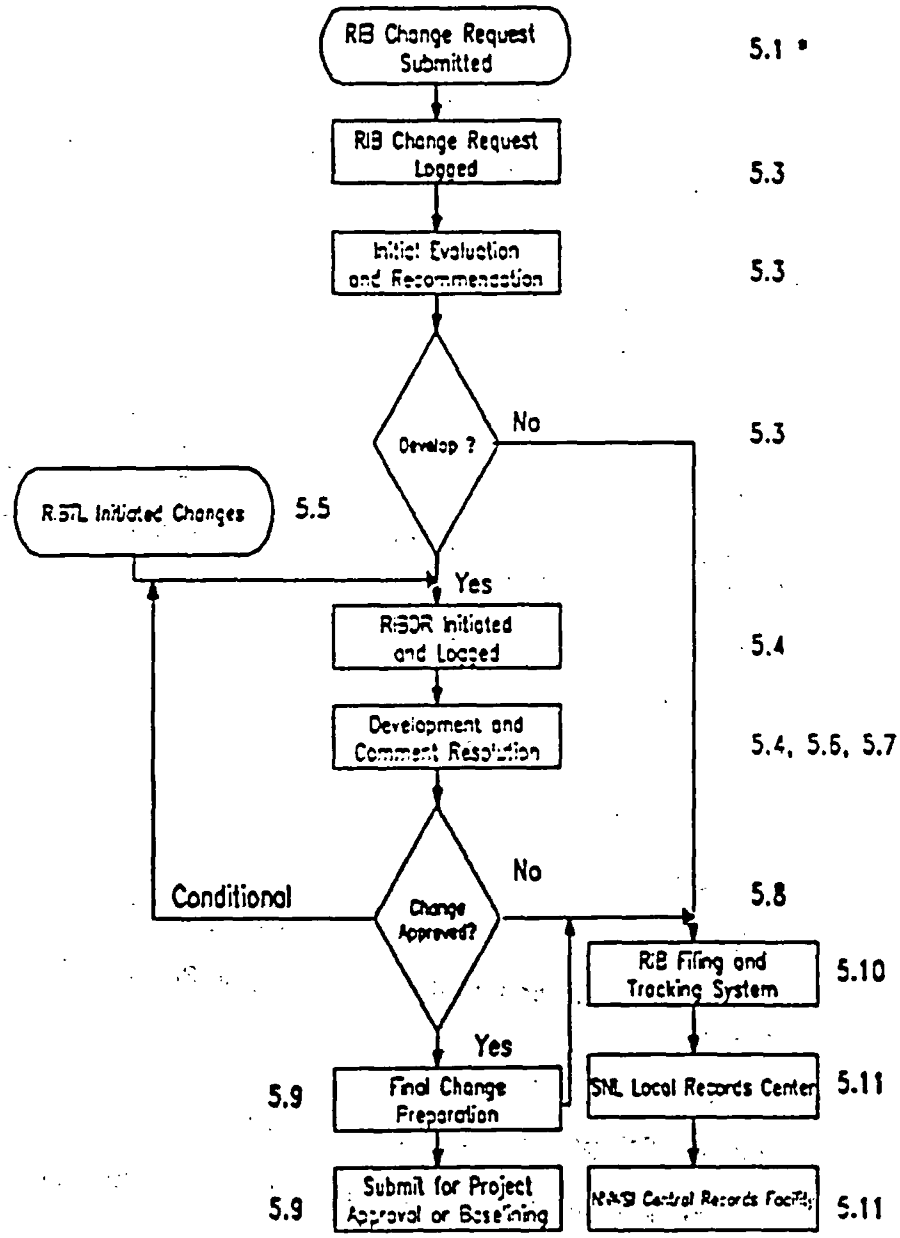
Approve SNL procedures related to the RIB.

Verify, by means of audits and surveillance, that the provisions of this procedure have been followed.

5.0 Procedure

The following procedure shall apply to (1) initially placing information items for the Reference Information Base (RIB) under change control at SNL and (2) for controlling changes to RIB information items thereafter until these items are baselined by the NNWSI Project.

When the RIBTL, or any TL, PI, TSAG member, or other NNWSI personnel through their TSAG member, determines that the development of a RIB information item has progressed sufficiently, a RIBCR shall be introduced by that individual to initiate consideration of that information item for inclusion in the RIB using the following procedure (Figure 1). Also, once the RIB information item has been successfully placed under change control at SNL; thereafter, whenever the RIBTL or any TL, PI, TSAG member, or other NNWSI personnel through their TSAG member, proposes a change for the RIB, the following procedure shall be used (Figure 1):



* Applicable DOP 3-8 Section(s)

Figure 1

5.1 The RIBTL or appropriate TL, PI or TSAG member initiates changes to the RIB by completing a RIB Change Request form (RIBCR, Appendix A). Project personnel can obtain a RIBCR from their TSAG representative or the RIBTL at SNL. Completed RIBCRs shall provide a description of the proposed change, reasons and justification for the change, and a proposed location in the RIB. To minimize the development effort required to add new or modified information, detailed information should be included with the RIBCR for each of the sections comprising a RIB item (marked-up copies of existing RIB items will suffice), including:

- o Description and Methodology
- o Sources
- o Information to be included, modified, or removed

5.2 Since input to the RIB should be primarily user-driven, requests that information be developed for inclusion in the RIB may also be submitted with a RIBCR. This can result in the initiation of a request from the RIBTL to Project technical staff through the TSAG to provide the requisite information. Such requests provide a method for achieving a consensus agreement on controlled reference information for use across Project interfaces.

5.3 Completed RIBCRs are submitted to the RIBTL, who shall maintain a log for tracking the status of all RIBCRs received. The RIBTL shall perform an initial evaluation of the RIBCR (in consultation with the RIBCB and the TSAG as necessary) and shall recommend whether to continue with the change request process. This recommendation will be reviewed by the RIBCB Chairperson, who will indicate concurrence or non-concurrence on the RIBCR. A summary of these evaluations and the status of outstanding RIBCRs shall be provided monthly to the RIBCB Chairperson by the RIBTL. The RIBCB Chairperson shall submit these to the TSAG for their review and an indication of concurrence or non-concurrence of the proposed dispositions and return them to the RIBTL. These reviews will determine if the supplied/requested information is suitable for inclusion in the RIB and assign a development priority. If accepted, processing continues (Sec. 5.4). If not accepted, the documents shall be filed and copies provided to the originating source.

5.4 When a decision to proceed has been made, a RIB Development Request (RIBDR, Appendix B) number is assigned on a RIBDR form by the RIBTL, and the information shall be further developed as required and coordinated by the RIBTL with the RIBCB and the TSAG. RIBDRs shall be tracked and maintained by the RIBTL in a status log separate from that maintained for RIBCRs. Development options include, but are not limited to, solicitation of formal and informal technical input and review comments from the TSAG and other Project personnel through the TSAG, formal requests for development and review assistance from existing Project technical groups, and organization, through the TSAG, of temporary working groups to assist in the identification, development, and review of information. These options will help ensure that the development, technical review, and resolution of comments occurs in an efficient and timely fashion.

5.5 Since it is recognized that many miscellaneous changes may best be incorporated by a general update and revision, a single RIBDR, identifying all changes made in a general update, shall be initiated by the RIBTL and submitted for review and approval to the appropriate RIBCB members, the RIBCB Chairperson, the TSAG, and for Project approval or baselining.

5.6 A list of technical reviewers shall be prepared and maintained by the RIBTL and approved by the RIBCB Chairperson and the TSAG Chairperson. Reviewers selected to evaluate proposed changes shall document their evaluation on the validity, adequacy of the change, and any consequent effects on the Project using the RIB Change Evaluation form (RIBCE, Appendix C). The intent of this evaluation is to verify that the information being processed is technically correct and representative of the best available, and is in the opinion of the reviewer, appropriate for inclusion in the RIB as part of the technical baseline. Each reviewer shall indicate concurrence, or provide comments for non-concurrence, of the change and sign, date, and return the RIBCE form promptly. If a review is performed by an Architect Engineer (AE) or other contractor, the RIBTL, RIBCB or TSAG member, or appropriate designee, shall approve the contractor evaluation for concurrence or non-concurrence. As appropriate, consensus decisions on reference information developed by working groups will be combined and documented on a single RIBCE form.

5.7 Conflicting comments on the RIBCEs shall be resolved by the RIBTL, the RIBCB Chairperson, and the RIBCB and TSAG (as needed). These resolutions shall be documented on the RIBCEs. Only when comments have been resolved shall RIBCEs be signed by the reviewer and the RIBTL.

5.8 Following resolution of technical review comments, the RIBDR, with all appropriate supporting documentation, shall be forwarded by the RIBTL to the RIBCB Chairperson. The RIBCB Chairperson shall recommend either (1) approval, (2) disapproval, or (3) conditional approval of the RIBCR. At the discretion of the RIBCB Chairperson, the RIBCB and/or the TSAG will be consulted for assistance in this determination. The RIBCB Chairperson shall then submit the RIBDR package to the TSAG for final disposition, and then return it to the RIBTL. This final review decision establishes that the proposed changes are sufficiently complete, adequately documented, and appropriate for inclusion in the RIB as part of the technical baseline. Conditionally-approved changes, with written comments provided by the RIBCB Chairperson, are assigned a new RIBDR number and resubmitted to the development process by the RIBTL. These comments shall indicate whether the modifications will require a complete review cycle. Traceability of the new RIBDR to the original RIBDR shall be ensured by recording the original RIBDR number on the new RIBDR and including the original in the supporting documentation.

5.9 Approved changes to the RIB shall be prepared by the RIBTL and submitted for Project approval or baselining.

5.10 The RIB filing and tracking system shall be updated by the RIBTL following submission of approved changes for Project approval or baselining.

5.11 The RIBTL shall ensure that copies of all completed RIBCRs, RIBDRs, RIBCEs, and supporting documentation considered useful for ensuring traceability, are maintained in the RIBTL's resident files, filed in the SNL NNWSI Records Center and submitted for transmittal to the NNWSI Project Central Records Facility (DOP 17-1).

6.0 Document Revision

6.1 Once an information item for the RIB is placed under SNL's NNWSI Department change control according to this procedure, the only revisions thereto shall be by changed pages resulting from the change process defined in Section 5.0.

7.0 Additional Requirements

The RIBCB shall meet at the discretion of the Chairperson and will include other members as specified by the Chairperson.

8.0 Records

The RIBTL shall ensure that the following records are submitted to the SNL/NNWSI Department 6310 Records file, with copies in the RIBTL's resident files and forwarded to the NNWSI Project Central Records Facility:

o Change documentation packages consisting of completed RIBDRs and associated documentation, which shall include any related RIBCRs, RIBCEs, and conditionally-approved RIBDRs. The RIBDR shall be assigned a file number 45/12133/CCD/Q1 for filing at SNL and a file number by the NNWSI Central Records Facility for Project filing.

o Completed RIBCRs for proposed changes which are rejected. These shall be assigned a file number 45/12133/CCD/Q1 for filing at SNL and a file number by the NNWSI Central Records Facility for Project filing.

o Archival copies of the RIB, which will be assigned a file number by NNWSICF.

9.0 References

DOP 17-1, Records Management System.

10.0 Appendix

Appendix A - RIB Change Request (RIBCR)
Appendix B - RIB Development Request (RIBDR)
Appendix C - RIB Change Evaluation (RIBCE)

Appendix A - RIB CHANGE REQUEST

SANDIA NATIONAL LABORATORIES
RIB CHANGE REQUEST

Date____________________ Originator____________________
Organization____________________ Phone____________________

Action Requested:____________________
(editorial, input request, information submission, etc.)

Description of and Justification for Change:
(Include in this section as complete a description of the proposed change as possible, the RIB item(s) affected, information which should be added or removed, and the reasons for introducing the change. Change descriptions should include all sections ["Header", "Description & Methodology", "Sources", and "Reference Information".] If new information is being requested, include possible sources of the information. Additional pages or edited copies of existing RIB pages may be attached.)

Return this form to the RIB Task Leader, Sandia National Laboratories.

Preliminary Evaluation and Recommendation:____________________

TSAG Development Comments:____________________
(Identification of suggested information sources (activities and tasks, quality levels), reviewers, priority, information development process considerations)

[] Further Action [] Reject RIB Task Leader____________________
[] Concur [] Not Concur RIBCB Chairperson____________________
[] Concur [] Not Concur TSAG Chairperson____________________

Status
RIBCR #____________________
RIBCR Log____________________
Disposition____________________
RIBOR #____________________

6310 45/12133/CCO/Q1
NNWSI CF

Appendix B - RIB DEVELOPMENT REQUEST

SANDIA NATIONAL LABORATORIES
RIB DEVELOPMENT REQUEST

RIBDR # ______________________

Date ______________________

Originating RIBCR/DR ______________________

Proposed RIB Location ______________________

General Description and Justification of Change Submitted:

Disposition Comments:

RIBCB Recommendation: [ ] Approve [ ] Disapprove [ ] Conditionally Approve

RIBCB Chairperson ______________________
Signature Date

TSAG Disposition: [ ] Approved [ ] Disapproved [ ]Conditionally Approved

TSAG Chairperson ______________________
Signature Date

Return completed form to the RIB Task Leader, Sandia National Laboratories.

Status
- Evaluations ______________________
- RIBDR Log ______________________
- Disposition ______________________

6010 48/12123/CCD/01
NMWSI CF

Appendix C - RIB CHANGE EVALUATION

SANDIA NATIONAL LABORATORIES

RIB CHANGE EVALUATION

RIBCE # ______________________ Date ______________________

RIBDR # ______________________ Originating RIBCR/DR # __________

Proposed RIB Location ____

Reviewer ____
name, organization, phone

Please return to RIB Task Leader, SNL, within 10 working days.

Review Comments (attach additional sheets if necessary):

____

____ Reviewer Signature

Proposed Resolution:

____

____ RIB Administrator

Final Disposition (to be resolved by RIB Administrator and Reviewer):

____

Verification of Agreement on Disposition:

______________________________ Reviewer
Signature Date

______________________________ RIB Task Leader
Signature Date

Status | Date Returned ______________
Disposition ______________

8310 46/12133/CCD/Q1
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DOP 3-9
Rev. A

880217.0046

SNL NNWSI PROJECT

DEPARTMENT OPERATING PROCEDURE

INTERFACE CONTROL OF NNWSI ENGINEERING DESIGN

Page	1 2 3 4 5
Revision	A A A A A

Author: Roger R. Hill — 2/4/88
Roger R. Hill, 6311 — Date

Approved: Al Stevens — 2/5/88
Division Supervisor — Date

Approved: R. Richards — Feb 5, 1988
Quality Assurance — Date

Approved: Thomas O. Hunter — Feb-5-88
Department Manager — Date

FEB 17 1988

SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT

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Copy Number: 023

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WHEN NO LONGER NEEDED.

1.0 Purpose

The purpose of this Department Operating Procedure (DOP) is to establish measures that provide for the initiation and maintenance of Sandia National Laboratories (SNL) interface control drawings and documents during the design phases.

2.0 Scope

This procedure defines the requirements for the control of interfaces within the design activities under the direction of the SNL NNWSI Project Department. This DOP also applies to the SNL portion of interfaces with other NNWSI design organizations. These requirements will be met primarily through the use of interface control drawings. The scope of the interface control drawings includes the identification and quantification of features required across the interface, and identification of operational limitations or the allocation of performance requirements on both sides of the interface. This scope of this procedure does not include design verification which is discussed in DOP 3-5, Design Control and Verification.

3.0 Definitions

3.1 DCR - Design Change Request.

3.2 Interface Control Drawing (ICD) - A drawing used to establish and control boundaries and interfacing design features. They depict the physical and functional details of interfaces that require coordination to establish and maintain compatibility by co-functioning equipment, items, or facilities.

3.3 RDCB - Repository Design Change Board

3.4 SEMP - Systems Engineering Management Plan

3.5 SDR - Subsystem Design Requirements Document.

3.6 SEIG - Systems Engineering Integration Group.

4.0 Procedure

4.1 Interface Control Drawings (ICDs) will be prepared when it is determined that the physical, functional, or operational boundaries between equipment items or between equipment items and facilities may result in a mismatch, omission, interference or duplication.

4.2 ICDs will be created, maintained, and controlled as an appendix to the Subsystem Design Requirements Document (SDR). During preparation, review, and approval of ICDs and changes to ICDs, care will be exercised to ensure coordination with the existing content of the SDR.

4.3 Any NNWSI Project participant or contractor may request the origination of an ICD. The SNL Division Supervisor responsible for design integration will review and approve the request for the ICD and define the interface design features and boundaries.

4.4 Interface control drawings will delineate design features on both sides of the interface to control physical, functional, and operational compatibility between the affected equipment items and facilities.

4.5. The following type of information should be considered for identification on interface control drawings.

- General configuration and the interface dimensional data specifically applicable to the envelope, mounting and mating of the equipment and the facility (e.g., space dimensions, location and dimensions of support plane with respect to a common datum, forces, weights, moments, and temperatures with tolerances).
- All peculiar interface requirements, such as mechanical, electrical, electronic, hydraulic, pneumatic, optical, etc., which affect the physical or functional characteristics of the co-functioning items (e.g., electrical termination, power requirements, sizes and locations of connection points, mating hardware, including manufacturing name and number, rates of flow, etc.).
- Any other characteristic which cannot be changed without affecting the co-functioning facility or equipment design criteria.

4.6 Interfacing design features which are illustrated on an interface control drawing shall be identified and the interface symbol clearly marked to distinguish the areas of responsibility and the organizations affected.

4.7 When required to provide additional clarification to interfacing design features, information such as design throughputs, operational considerations, etc., will be provided to supplement the ICDs. This information may be tabulated in the SDR as design criteria (with reference to the ICDs) or accompany the ICDs as attachments.

4.8 Review and approval of an ICD will be in accordance with DOP 3-1, Reviewing, Approving, and Issuing Engineering Drawings. An ICD will also be reviewed and approved by the SNL contractors involved in design activities affected by the ICD. If the ICD affects other NNWSI participants, the ICD will be reviewed and approved by the Systems Engineering Integration Group (SEIG) as specified in the Systems Engineering Management Plan (SEMP), or any other procedures established in the NNWSI project for purposes of interface and/or design control (i.e., SOP-03-05, ESF Project Interface Control Procedures).

4.9 The Repository Design Change Board (RDCB) Secretary (see DOP 3-6, Design Change Control) will distribute ICDs as a part of the SDR in accordance with the SEMP.

5.0 Document Revisions

5.1 Changes to an ICD will be made whenever it is discovered that the design features detailed in the ICD are inaccurate, not achievable, or a change is necessary due to some other justifiable reason.

5.2 Changes to an ICD will be made in accordance with DOP 3-6, Design Change Control and as specified in the SEMP. Other NNWSI participants may initiate a change to an ICD by means other than the DCR, in which case the RDCB Secretary will initiate the DCR and attach the original change request documents. Conversely, SNL may request changes to ICD's which are shared with other NNWSI project participants. In these cases the DCR will be attached to the change request documents as established by NNWSI operating procedures.

5.3 The RDCB Secretary will ensure that the design organizations originally approving the ICD are included as reviewers of the ICD change.

5.4 An ICD which has been revised will be reviewed and approved by the design organizations that originally approved the ICD.

6.0 Records

ICDs will be filed and maintained in the SNL/NNWSI Department 6310 Records File - 60 Series - 60/12412/1.1, SAND Reports as an appendix to the SDR.

7.0 References

DOP 3-1, Reviewing, Approving, and Issuing Engineering Drawings.

DOP 3-5, Design Control and Verification.

DOP 3-6, Design Change Control.

NNWSI Project Systems Engineering Management Plan, J. G. Yeager, et al., SAND86-1632, 1986.

Subsystem Design Requirements for the Advanced Conceptual Design of the Yucca Mountain Nuclear Waste Repository, R. R. Hill, SAND85-0260, 1986.

SOP-03-05 ESF Project Interface Control Procedure 1/27/87.

UNCONTROLLED

NNWSI PROJECT

DEPARTMENT OPERATING PROCEDURE

ROUTINE DESIGN CALCULATIONS

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Rev.	0	0	0	0	0	0	0	0	0

Author: Subramanian 10/31/86
C. V. Subramanian, 6311 Date

Approved: Leo W. Scully 10/31/86
Division Supervisor Date

Approved: R. Richards 10/31/86
Quality Assurance Date

Approved: Felton W. Bingham Jr. 10/31/86
Department Manager Date

ROUTINE DESIGN CALCULATIONS

1.0 Purpose

The purpose of this Department Operating Procedure (DOP) is to detail the methods to be used for reviewing and documenting a routine calculation or analysis performed to scope or size a component, subsystem or other design feature.

2.0 Scope

This DOP is applicable for QA Level I and QA Level II routine calculations performed at Sandia National Laboratories (SNL) within the NNWSI Project Department or by other organizations or contractors for the SNL NNWSI Project Department. This procedure may be used, but is not required, for QA Level III routine calculations. The calculations intended to be covered would be typified by 1) sizing of beams or supports, 2) sizing of ventilation fans or ducts, 3) sizing of electrical substations, loads, transmission lines, 4) thickness of typical shield walls, 5) static and dynamic analysis calculations, and other similar calculations which support preliminary or conceptual design decisions. These routine calculations may support a design investigation task but are not specifically requested in a Design Investigation Memo (see DOP 3-4, Design Investigation Control). Excluded from this procedure are special analysis tasks identified and defined by a Problem Definition Memo (see DOP 3-3, Analysis and Calculation Control).

3.0 Definitions

3.1 Analyst - The person responsible for conducting and documenting a calculation or analysis.

3.2 Engineering Calculations Notebook - Files containing all completed calculation sheets, relevant drawings, and computer outputs.

3.3 Checker - The person responsible for reviewing and checking a calculation or analysis.

3.4 Principal Investigator - The SNL staff member responsible for completion of a particular investigation or design. He may or may not be the Task Leader.

3.5 Task Leader - The SNL staff member responsible for developing the technical guidance, budget, and schedules for a Work Breakdown Structure (WBS) task. He may or may not also be the Principal Investigator.

4.0 Procedure

4.1 Requirements for Calculation Sheets

4.1.1 All calculations must be documented on calculation sheets (see Appendix A). The calculation sheets must be discretely identified for referencing in reports. The contents of the calculation sheets must be of a quality that can be readily reproduced.

4.1.2 The following information must be included in the calculation sheets:

- o Title of project
- o Date
- o Analyst's initials
- o A brief description of the calculation and the reason for the calculation effort.
- o Assumptions made in the calculation.
- o Input data with reference to where they were obtained.
- o A clear description of each of the steps in the calculation. If standard methods are used, it may be indicated. Any special method used must be properly and adequately referenced.
- o A clear description of the results obtained and where and how it will be used.

4.1.3 In addition, the calculation sheets must contain the following information where applicable.

- o Task number.
- o Job number.
- o Contract number.
- o Checker's initials (see Section 4.3.1).

4.1.4 All calculation sheets must be dated, numbered in sequence and initialed by the Analyst upon completion of the calculation or analysis and before verification.

4.1.4 All calculation sheets prepared for a given task must be filed in a separate Engineering Calculations Notebook and must be accompanied by a cover sheet (see Appendix A). The cover sheet must contain the following information:

- Title of project.
- Task number.
- Job number.
- Work Breakdown Structure (WBS) number.
- Contract number.
- Quality Assurance Level assigned for the task.
- Analyst's signature and date.
- Checker's signature and date.
- Contractor's signature and date.
- SNL Division Supervisor's signature and date for QA Level I tasks.
- Revision number.
- Description of revision.
- Revision approval of contractor (initials and date).
- Revision approval of SNL Division Supervisor (initials and date).

4.2 Requirements for Computer Generated Calculations

4.2.1 Computer codes used in the calculations or analysis must be verified in accordance with DOP 3-2, Software Quality Assurance Requirements. Reference (e.g., by RMS file code) to the completed verification records must be included in the Engineering Calculation Notebook.

4.2.2 The following information must be included in the calculation sheets for calculations or analyses which utilize computer codes:

- Computer type.
- Computer program name.
- Version of computer program.
- Basis for application of the computer program to the specific calculation or analysis.

4.2.3 All computer outputs which are part of the analytical effort must be included in the Engineering Calculations Notebook.

4.3 Check of Final Calculations

4.3.1 All final calculations supporting Reference Designs (RDD/SC, ACD, LAD, and FP & GD) must be subject to an independent review and check by an individual (Checker) who did not assist or was not associated with the original calculations. The Checker must be at least a technical peer of the Analyst.

4.3.2 The method of independent review must be documented in the Engineering Calculations Notebook and must utilize at least one of the following methods:

- o Separate independent calculations using the same or different analytical methods as the original calculations.
- o A check of each of the calculational steps in the original calculations.
- o A spot or random check of the original calculations depending on the complexity and importance of the calculations.

4.3.3 If separate calculations are done to perform checking, these must be attached to the Engineering Calculations Notebook.

4.3.4 The Checker must initial and date each calculation sheet after the check has been completed and the Checker is satisfied that the calculations are correct and the results are reasonable based on the data and the assumptions used.

4.3.5 Resolution of Errors and Discrepancies

4.3.5.1 If an error or discrepancy is found during the checking, it must be noted in the Engineering Calculations Notebook. The Analyst and Checker may resolve the error or discrepancy by noting the resolution on the calculation sheets. The Analyst and Checker must initial and date changes to the calculation sheets to indicate concurrence with the resolution.

4.3.5.2 If the routine calculation or analysis is being done by an SNL contractor, the contractor will be responsible for resolving errors or discrepancies for which concurrence cannot be reached between the Analyst and Checker.

4.3.5.3 If the routine calculation or analysis is being done by an SNL organization, the responsible Division Supervisor from the NNWSI Project will be responsible for resolving errors or discrepancies for which concurrence cannot be reached between the Analyst and Checker.

4.3.5.4 The resolution of errors and discrepancies shall be documented in the Engineering Calculations Notebook.

5.0 Document Revisions

5.1 Revisions to calculations are made by initiating a new Routine Design Calculation Sheet which makes reference to the calculation sheet which is being revised. Routine Design Calculation Sheets for revisions must be processed in the same manner as the original calculation sheets. A brief description of the revision must also be documented on the cover sheet along with approvals (signature and date) by the contractor and SNL Division Supervisor.

6.0 Records

6.1 The calculation sheets and related documentation will be maintained by the Analyst in the Engineering Calculations Notebook. The Analyst will forward a copy of the Engineering Calculations Notebook to the Principal Investigator upon completion of the task. The Engineering Calculations Notebook will be attached as an appendix to the final report related to the design task which the routine calculation or analysis supports. The final report will be filed in the SNL/NNWSI Department 6310 Records File - 60 Series - Design Records System.

7.0 References

DOP 3-3, Analysis and Calculation Control

DOP 3-4, Design Investigation Control

8.0 Appendix

Appendix A - Sample Cover and Calculation Sheets for Routine Design Calculations

APPENDIX A

SAMPLE COVER AND CALCULATION SHEETS

FOR ROUTINE DESIGN CALCULATIONS

Cover Sheet For Routine Design Calculations

Title ____________________

Task No. ____________________

Job No. ____________________

WBS No. ____________________

Contract No. ____________________

QA Level ____________________

Analyst ____________________
Signature Date

Checker ____________________
Signature Date

Contractor ____________________
Signature Date

SNL
Division
Supervisor ____________________
Signature Date

Rev.	Description of Revision	Contractor	Date	SNL Div. Supervisor	Date

Routine Design Calculation Sheet

<table>
<tr><td colspan="2">Routine Design Calculation Sheet</td></tr>
<tr><td>Title ____________
Task ____________
Job No. ____________
Contract No. ____________</td><td>Page No. ____
Analyst Date
Checker Date</td></tr>
<tr><td>Description of Calculation</td><td>Remarks</td></tr>
<tr><td></td><td></td></tr>
</table>

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Page 1

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SNL NNWSI PROJECT
DEPARTMENT 6310 OPERATING PROCEDURE

Requirements For Submitting Data to the NNWSI Project Site and Engineering Properties Data Base (SEPDB)

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Rev	0	0	0	0	0	0	0	0	0	0

Approved by:

Barry Schwartz — 4/5/88
B. M. Schwartz, 6313 — Date
Author, DRMS Manager

C. Rautman — 4/6/88
C. Rautman, 6315 — Date
Technical Review, SEPDB Manager

4/22/88
S. Sinnock, 6315 Supervisor — Date
Technical Review

April 6, 1988
R. R. Richards, 6310 — Date
QA Coordinator

T E Blejwas — 4/6/88
T. E. Blejwas, 6313 — Date
Division Supervisor of Author

Thomas O. Hunter — 4/25/88
T. O. Hunter, 6310 — Date
SNL NNWSI Project TPO

SAIC/T & MSS
APR 29 1988
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1.0 PURPOSE

1.1 This Department Operating Procedure (DOP) states the requirements and provides associated guidance for Sandia National Laboratories (SNL) Nevada Nuclear Waste Storage Investigations (NNWSI) Project personnel when submitting data to the NNWSI Project Site and Engineering Properties Data Base (SEPDB).

2.0 SCOPE

This DOP applies to SEPDB submittals by the SNL Technical Project Officer where the data originate from either (1) SNL-sponsored data-gathering activities of any Quality Assurance (QA) level in support of the NNWSI Project, or (2) non-NNWSI Project activities. Requirements for submittal of data from other NNWSI Project participants to the SEPDB will be defined in an NNWSI Project Administrative Procedure (AP) and in SNL NNWSI Project DOP 3-7. A chart showing the flow of data from the Principal Investigator to the SEPDB is included as Appendix A.

3.0 DEFINITIONS

3.1 DAF - Data Authorization Form: The form used to document TPO approval for data submittals to the SEPDB. The DAF is included as Appendix B.

3.2 Data Report - A SAND report containing hard-copy DCFs used as the source for data and information submitted to the SEPDB.

3.3 DCF - Data Compilation Form: A hard-copy record in a specified format containing data and associated information to be submitted to the SEPDB. Three examples of completed DCFs are included as Appendix C.

3.4 DRMS Manager - Data Records Management System Manager: The person responsible for interacting with PIs to ensure that the requirements for submittal of SNL data to the DRMS is complete before submittal of associated data to the SEPDB.

3.5 PI - Principal Investigator: An SNL NNWSI Project staff member responsible for a particular data-gathering activity.

3.6 SEPDB Manager - Site and Engineering Properties Data Base Manager: The person responsible for managing SEPDB data entry, operations, and retrieval.

3.7 SNL TPO - SNL NNWSI Technical Project Officer: The SNL NNWSI Project Department Manager.

4.0 RESPONSIBILITIES

4.1 Each PI for a data-gathering activity must ensure that the data and associated information are submitted to the TPO on DCFs contained in a data (SAND) report. The data report shall be submitted to peer review within 60 days from completion of the data-gathering activity.

The PI is also responsible for ensuring that the requirements in this DOP concerning submittal of DCFs and DAFs to the SEPDB Manager are met.

4.2 The SEPDB Manager is responsible for interacting with PIs to develop appropriate DCFs. This is verified by the SEPDB Manager approval on the Manuscript Review Sheet per DOP 6-2. The SEPDB Manager is also responsible for managing the SEPDB in accordance with the SNL NNWSI Project DOP 3-7.

4.3 The DRMS Manager is responsible for ensuring that the requirements for submittal of SNL data to the DRMS have been satisfied before the SEPDB entry. This is verified by the DRMS Manager approval on manuscript review sheets in accordance with SNL NNWSI Project DOP 6-2.

4.4 The TPO is responsible for approving submittals to the SEPDB by signing the DAF. The DAF is included as Appendix B of this DOP.

5.0 REQUIREMENTS

5.1 Data Compilation Forms (DCFs)

5.1.1 Organization and Content

DCFs will be organized using a four-part structure containing the following information:

Sample Location and Identification, as applicable

- o Sample origin such as drill-hole name or location identifier,
- o Sample depth interval,
- o Sample identification, and
- o Test number (if sequential or multiple).

Parameter(s) and Measurement Units, as applicable

- o Data values and
- o Estimated experiment uncertainty (or notation as to why it is not included).

Experiment Conditions, as applicable

- o Type of experiment (e.g., constant-strain-rate compressive, bulk density, etc.) and
- o Conditions such as temperature, pressure, sample size, etc. that could affect interpretation of the data.

Reference and Supporting Information

- o QA Level of the activity that generated the data.
- o DRMS Data-Set ID of the SNL NNWSI Project data-gathering activity, or other identification if source is not an NNWSI Project activity.
- o Project participant name (e.g., SNL), the name and division number of the person submitting the DCF, and the date the DCF was completed.

Three example DCFs are included as Appendix C.

The type of information to be included on the DCF and its format shall be agreed upon by the PI and the SEPDB Manager before submitting data to the TPO for approval. The DCFs shall be hard copy; however, PIs may also submit computer-readable copies of some or all of the data on magnetic media to ease the process of data entry into the data base. If the submittal includes magnetic media containing information from the accompanying hard-copy DCFs, instructions for accessing the magnetic media shall be included with the submittal. The SEPDB Manager may maintain a convenience file of DCFs for reference so that all submittals of similar data will be kept as consistent with previous submittals as possible.

5.1.2 Review of Data and Information

Data From SNL NNWSI-Sponsored Data-Gathering Activities

Before submitting a data report and the associated DAF to the TPO for approval, the Manuscript Review Sheet for SAND reports must be completed and the Division Supervisor of the author(s) must sign it in accordance with the SNL NNWSI Project DOP 6-2.

Data From Sources Not Associated with the NNWSI Project

Before submitting data not generated in support of the NNWSI Project, an SNL NNWSI Project Division Supervisor shall write or approve a memorandum to the TPO explaining the need for the submittal. The memorandum will indicate whether the requirements in NNWSI Project Standard Operating Procedure (SOP) 03-03 (or equivalent NNWSI Project Administrative Procedure) are applicable. The format and content of the submittal must meet the requirements in Section 5.1.1 of this DOP. The Supervisor (or his designee) who writes or approves the submittal is responsible for agreeing with the SEPDB Manager on the content and format of the DCFs and for compiling the non-NNWSI Project information on DCFs.

5.1.3 Changes to Data and Information Previously Submitted to the SEPDB

To change data or information previously submitted to the SEPDB, a PI or SNL NNWSI Project Division Supervisor shall initiate an addendum to the DAF by filling out and submitting a separate DAF to the TPO for approval. If necessary, the DAF shall include attachments that clarify the changes. Such attachments should be edited versions of the DCFs submitted with the previous DCF whenever feasable or other clarifying information as agreed to by the PI and the SEPDB Manager.

5.2 The Data Authorization Form (DAF)

5.2.1 A DAF is required each time a submittal is made to the SEPDB. An example DAF is included as Appendix B of this DOP. The SEPDB Manager will decide if an addendum to a DAF shall retain the previous DAF number or be assigned a new number. The SEPDB Manager will also decide if any changes need to be made to the format of the data and/or information in the SEPDB. DAFs will contain the following information:

- o Work Breakdown Structure (WBS) Number of the data-gathering activity
- o DRMS Data-Set ID and the QA level(s) of data-gathering activity or for acceptance of data not developed under the NNWSI QA Plan, verification that NNWSI Project SOP 03-03 or equivalent NNWSI Project AP requirements have been met (if applicable)
- o Data Report number and title
- o Brief description of the type of data submitted

- For addendum DAFs, the previous DAF number, an indication of which data are to be removed or superceded, the data and information as it should be in the data base, and the reason for such removal (include attachments if necessary)
- If magnetic media are supplied as a supplement to DCFs in the Data Report, include instructions for accessing the computer files, define the number of tapes and/or disks, the number of files, and the size of each file, and describe any special storage format or data organization requirements
- The signature of the SNL TPO, approving the entry into the SEPDB
- The DAF Number assigned by the SEPDB Manager (if applicable)

5.3 Records Management

5.3.1 The Requirements for records transmittal from the SEPDB to the SNL NNWSI Project Local Records Center are defined in the SNL NNWSI Project DOP 3-7.

6.0 REFERENCES

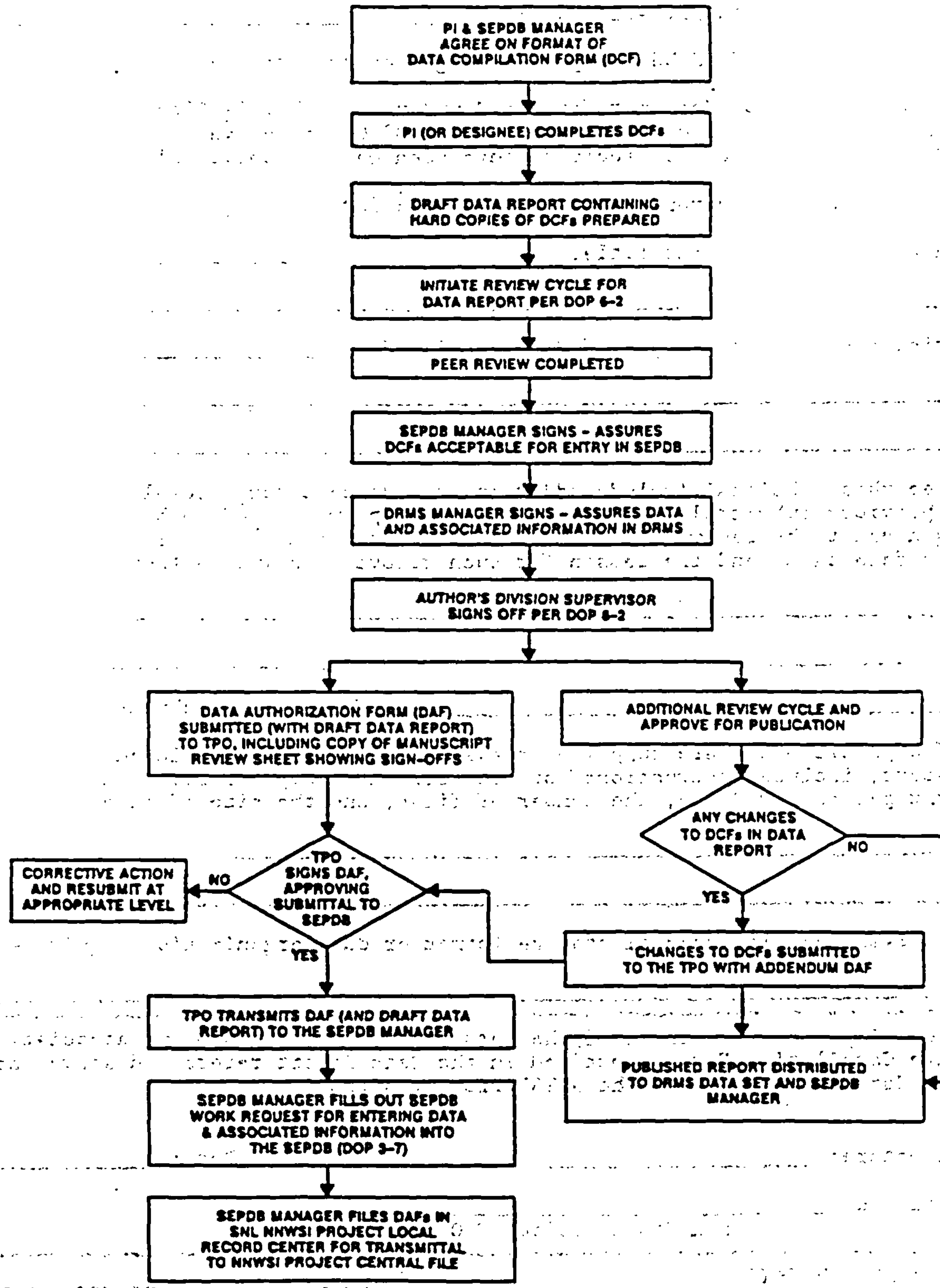
DOP 3-7 Operating Procedures for the Technical Data Base.
DOP 6-2 Reviewing, Approving, and Issuing Technical Information Documents.
DOP 11-3 Data Records Management System Interaction Requirements.

7.0 APPENDICES

A. Data Flow from the PI to the SEPDB
B. Example of Data Authorization Form, NNWSI Project Site and Engineering Properties Data Base (SEPDB)
C. Examples of Data Compilation Forms (DCFs)

APPENDIX A

DATA FLOW FROM SNL DATA-GATHERING ACTIVITIES TO THE NNWSI PROJECT SEPDB



APPENDIX B

DATA AUTHORIZATION FORM
NNWSI SITE & ENGINEERING PROPERTIES DATA BASE (SEPDB)

WBS Number of data-gathering activity. ____________________

QA Level(s) of SNL NNWSI Project data-gathering activity. ____________ or

For acceptance of data not developed under the NNWSI QA Plan, verification that the provisions of NNWSI Project SOP 03-03 or equivalent NNWSI Project Administrative Procedure have been met (if applicable). ____________

Data Records Management System (DRMS) Data-Set ID. ____________________

Data Report number and title. ____________ ____________________

____

Brief description of type of data submitted. ____________________

____

____

Does this submittal include additions to, request for removal, or modification of a previous submittal? If yes, provide the previous DAF number, indicate which data are to be removed or superceded, the data and information as it should be in the data base, and the reason for such removal (include attachments if necessary).

____

____

____________________________ Attachments Included? ____

If magnetic media are supplied as a supplement to DCFs included in the Data Report, include instructions for accessing the computer files, define the number of tapes and/or disks, the number of files, and the size of each file.

____

____

Remarks regarding special storage format or data organization requirements.

____

I certify the correctness of the information on this form and associated data on Data Compilation Forms contained in the Data Report referenced above and approve the data for entry into the NNWSI Project SEPDB.

Signature: ____________________________ Date: ____________

Printed: ____________________________
SNL NNWSI Project TPO

DATA AUTHORIZATION FORM NUMBER: ____________ ____________________ ____________
Signature of SEPDB Manager Date

APPENDIX C

EXAMPLES OF DATA COMPILATION FORMS (DCFs)

PHYSICAL PROPERTIES DATA COMPILATION FORM FOR THE NNWSI PROJECT SEPDB

PART 1. SAMPLE LOCATION AND IDENTIFICATION

SAMPLE ID 2068 SAMPLE ORIGIN UE-25a#1

SAMPLE INTERVAL (ft) 1555 TEST # 1

PART 2. PARAMETERS

SATURATED BULK DENSITY [SBD] (g/cm^3) a	ESTIMATED SBD UNCERTAINTY (g/cm^3) a	NATURAL STATE BULK DENSITY [NSBD] (g/cm^3) a	ESTIMATED NSBD UNCERTAINTY (g/cm^3) a
No Data	N/A	1.94	No Data

DRY BULK DENSITY [DBD] (g/cm^3) a	ESTIMATED DBD UNCERTAINTY (g/cm^3) a	GRAIN DENSITY [GD] (g/cm^3) a	ESTIMATED GD UNCERTAINTY (g/cm^3) a
1.66	No Data	2.46	No Data

POROSITY (%)	ESTIMATED POROSITY UNCERTAINTY (%)
32.6	No Data

PART 3. EXPERIMENT CONDITIONS

GD EXPERIMENT TECHNIQUE	TYPE OF POROSITY	POROSITY CALCULATED USING:
Water Pycnometer	Matrix	$1-\left(\frac{DBD}{GD}\right)$

SBD SAMPLE MASS (g)	NSBD SAMPLE MASS (g)	DBD SAMPLE MASS (g)	GD SAMPLE MASS (g)
N/A	92.71	78.90	31.12

PART 4. REFERENCE AND SUPPORTING INFORMATION

QA LEVEL OF DATA GATHERING ACTIVITY TBD SNL NNWSI PROJECT DATA-SET ID 51/L03-12/1/78 DATA REPORT NUMBER SAND 88-0811

THIS DCF COMPLETED BY: Barry M Schwartz (Name) 6313 (SNL Div.) 12/10/87 (Date)

a. To convert g/cm^3 to kg/m^3, multiply by 1.000 E+03.

COMMENTS:

Unless noted, test conditions for temperature and pressure are ambient.

N/A = NOT Applicable

APPENDIX C
(continued)

EXAMPLES OF DATA COMPILATION FORMS (DCFs)

THERMAL CONDUCTIVITY DATA COMPILATION FORM FOR THE NNWSI PROJECT SEPDB

PART 1. SAMPLE LOCATION AND IDENTIFICATION

SAMPLE ID 08-G1-CH TEST NUMBER 1

SAMPLE ORIGIN USW G-1 SAMPLE INTERVAL (ft) 1794.3-1794.8

PART 2. PARAMETERS

SAMPLE TEMPERATURE (°C)	THERMAL CONDUCTIVITY (W/mK)	UNCERTAINTY IN THERMAL CONDUCTIVITY (W/mK)	PORE PRESSURE (MPa)	SAMPLE SATURATION
30	1.579	No Data	0.3	100% (a)
50	1.580	No Data	0.3	100% (a)
90	1.626	No Data	0.3	100% (a)
200	1.193	No Data	ambient	unknown
230	1.173	No Data	ambient	unknown
260	1.151	No Data	ambient	unknown
30	1.018	No Data	ambient	unknown
30	0.956	No Data	ambient (b)	unknown
200	1.083	No Data	ambient (b)	unknown
260	1.077	No Data	ambient (b)	unknown

ARE THE PARAMETERS CONTINUED ON ANOTHER PAGE? yes |__| no |_x_|

PART 3. EXPERIMENT CONDITIONS

SAMPLE DIAMETER (cm) 5.05 SAMPLE LENGTH (cm) 10.29

EXPERIMENT TECHNIQUE Transient-line-source

PORE FLUID TYPE J-13 water CONFINING PRESSURE (MPa) 10

PART 4. REFERENCE AND SUPPORTING INFORMATION

QA LEVEL OF DATA GATHERING ACTIVITY TBD SNL NNWSI PROJECT DATA-SET ID 51/L01A-5/17/82

DATA REPORT NUMBER SAND88-0624

THIS DCF COMPLETED BY: Fran Nimick (Name) 6313 (SNL Div.) 3/1/88 (Date)

COMMENTS:
(a) Actual saturation not given; value of 100% assumed to be valid.

(b) Confining pressure also ambient.

APPENDIX C
(concluded)

EXAMPLES OF DATA COMPILATION FORMS (DCFs)

CONSTANT-STRAIN-RATE MECHANICAL EXPERIMENTS
DATA COMPILATION FORM FOR THE NNWSI PROJECT SEPDB

PART 1. SAMPLE LOCATION AND IDENTIFICATION

SAMPLE ID G1- 1179.6 SAMPLE ORIGIN USW G-1

SAMPLE INTERVAL (ft) 1179.6 TEST # 1

PART 2. PARAMETERS

	MEASURED VALUE	ESTIMATED EXPERIMENT UNCERTAINTY
BULK MODULUS (GPa)	3.0	N/C (GPa)
YOUNG'S MODULUS (GPa)	23.1	N/C (GPa)
POISSON'S RATIO	0.30	N/C
ULTIMATE STRENGTH (MPa)	109.4	N/C (MPa)
AXIAL STRAIN AT FAILURE (millistrain)	6.8	N/C (millistrain)

PART 3. EXPERIMENT CONDITIONS

EXPERIMENT TYPE Compressive; % SAMPLE SATURATION Vacuum; SAMPLE LENGTH [L] (mm) 51.1156

SAMPLE DIAMETER [D] (mm) 26.1366; SAMPLE L/D RATIO 2/1; DRAINED OR UNDRAINED Drained

DRY SAMPLE MASS (kg) N/D; SATURATED SAMPLE MASS (kg) N/D; TEMPERATURE (DEGREES C) Ambient

CONFINING PRESSURE (MPa) 5; PORE PRESSURE (MPa) 0.1; STRAIN RATE (1/s) 10^{-5}

ORIENTATION OF SAMPLE AXIS TO ROCK FABRIC (DEGREES) About 90°

PART 4. REFERENCE AND SUPPORTING INFORMATION

QA LEVEL TBD SNL NNWSI PROJECT DATA-SET ID 51/102- 3/1/82

DATA REPORT NUMBER SAND 88-9999

THIS DCF COMPLETED BY: R.H. Price (Name) 6313 (SNL Div.) 4/1/88 (Date)

COMMENTS N/C = not compiled. Elastic Parameters recalculated by F.B. Nimick (6313) to the (10-50% of $\sigma_{ult.}$) - Criterion of RH Price to achieve consistency with later procedures.

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Page 1

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SNL NNWSI PROJECT

DEPARTMENT OPERATING PROCEDURE

PROCUREMENT DOCUMENT REQUIREMENTS

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Rev.	A	A	A	A	A	A	A	A	A	A	A	A

Author: Dorothy Brockman — Date: 8·13·87

Approved: NA
Division Supervisor — Date:

Approved: Quality Assurance
Robert R. Richards — Date: 8/13/87

Approved: Department Manager
Thomas O. Hunter — Date: 8/17/87

SNL NNWSI DEPARTMENT 6310
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PROCUREMENT DOCUMENT REQUIREMENTS

1.0 Purpose

The purpose of this Department Operating Procedure (DOP) is to specify the content of and to state the requirements applicable to initiating and processing procurement documents and changes to procurement documents.

2.0 Scope

This DOP applies to all procurements requiring a written Purchase Requisition or a written Change Requisition, as well as to negotiated changes. This DOP does not cover Just In Time Procurement activities.

This procedure defines the content, review, and approval requirements to be followed by the SNL staff when initiating new Purchase Requisitions or Change Requisitions. It also describes documentation requirements for negotiated changes.

3.0 Definitions

Purchase Requisition (PR) - The document originated by the project organization to define and authorize a procurement action to be accomplished by the Purchasing organization.

Request for Quotation (RFQ) - The document which is sent to the supplier(s) requesting quotation on the work defined in the PR. The RFQ is normally sent to the suggested sources on the PR and to any other sources that the Sandia Contracting Representative (SCR) deems appropriate.

Contract or Purchase Order (PO) - Any of the several forms of the document prepared by the Purchasing organization to implement the requirements of the PR and define all conditions agreed upon by the Purchasing organization and the contractor (i.e., the seller).

Change Requisitions (CR) - The document originated by the project organization to define and authorize a change to procurement. This document is sent to Purchasing authorizing them to initiate a Change Amendment.

Change Amendment - The document issued by Purchasing as a result of the project organization issuing a change requisition. This document is sent to the supplier and is considered part of the contract.

Supplier (seller) - The entity which is legally responsible to provide the product and/or service specified in the PO and/or Change Amendment. Synonymous with "contractor."

Negotiated Contract Changes - The contract changes negotiated by the supplier, the buyer, and/or requester. Usually, these changes are identified after the PR has been completed by the NNWSI project organization and after the supplier has been chosen as the successful bidder but before the contract is placed with the supplier. This type of change is very important (see 4.3.2 for more information).

4.0 Procedures

4.1 Preliminary Requirements

4.1.1 PRIOR TO CARRYING OUT THE ACTIONS SPECIFIED HEREIN, THE REQUESTER IS RESPONSIBLE TO HAVE COMPLETED ALL PROCUREMENT PLANNING ACTIONS STATED IN DOP 7-1, "PROCUREMENT PLANNING." Procurements estimated at over $500,000 require a written Acquisition Plan, per SLI 6600-1.

FOR PREPARATION OF NEW PURCHASE REQUISITIONS, START WITH PARA. 4.2.1 FOR PREPARATION OF CHANGE REQUISITIONS, START WITH PARA. 4.3.1. FOR NEGOTIATED CHANGES, START WITH 4.3.2.

4.2 Preparation of the Purchase Requisition for New Contracts

4.2.1 The requester completes the PR as instructed on Appendix A. See Appendix A, "Instructions for preparing PR." The requester is required to complete the PR only through "Total Estimate."

4.2.1.1 Exceptions, additions, and/or special instructions in addition to the "Instructions for Preparing PR."

a. PR number: Obtain PR number from Dept. 6310 Administrative Assistant.

b. Government Priority is always "None" for all NNWSI procurements.

c. Material or Service Description/Specification - Clearly state the services to be performed by the supplier or the item(s) or material(s) to be provided. Include or refer to applicable and appropriate technical requirements, specifications, drawings, spare and replacement part requirements, regulatory requirements, design or site investigation bases, data criteria, etc., that describe or specify the items or services to be provided.

d. Documentation Requirements - Specify reports, documentation, and submittal dates required by SNL. When specific QA records are required, their retention time and disposition requirements will be specified.

e. Quality Assurance Requirements: Disregard instructions under "Quality Program" in the "Instructions for Preparing PR." Specify the QA requirements applicable to the supplier as developed previously using DOP 7-1. Depending on the type of item or service being procured and its QA Level, these QA requirements may include:

- For QA Level I or II "non-catalog" items or services, a documented QA Program.
- Review and approval of that QA Program by an SNL NNWSI QA representative.
- Extension of QA Program requirements to sub-tier contractors.
- Contractor responsibilities for recording and reporting nonconforming items or activities and for obtaining SNL approval of their resolution.
- Providing a Certificate of Conformance.

f. Acceptance and Inspection Criteria: Specify the acceptability criteria applicable to purchased end-product hardware and equipment, or the performance criteria applicable to purchased services.

g. Right to Access: Include a statement that specifies that SNL and DOE representatives shall have access to facilities and quality records for audit purposes at each tier of procurement, all such access to be coordinated through SNL.

h. Inspection Code: Designate the code for the type of acceptability verification determined by use of DOP 7-1:

- For services: use "X".
- For source verification: use "X," and include requirements for Mandatory Hold Points in "Material or Service Description."

  For receiving inspection: use "C," "D," "E," "X," or "Z" as appropriate to the item. For QA Level I or II items, Code Z must be specified, unless otherwise designated by the QA Coordinator.

i. Sole Source Justification: Follow instructions in SLI 6600-2. Basically, for PRs up to $5,000, state reason for Sole Source on PR form. For PRs from $5,001 to $25,000, complete SF 6430 JJ. For all newly originated PRs over $25,000, a justification memo must be prepared. This memo should be from the NNWSI Department Manager to the Department Manager of the appropriate Purchasing organization. This memo will be approved as defined in SLI 6600-2.

4.2.2 The requester prepares other supporting procurement documents, as appropriate to the procurement action:

a. Include the "QA Requirements for Purchase Requisitions" for (see DOP 7-1) with the PR. See a QA representative for assistance in completing the form.

b. Consultant Contracts - Require PR approval by VP. A letter of justification must accompany PR stating why this consultant is qualified. The memo should be from 6300 Director to 6000 VP.

c. Procurements over $500,000 - Requires a <u>written</u> Acquisition Plan. See SLI 6600-1 Acquisition Planning.

d. Complete NNWSI form "SNL and Contractor Documents - Expected Documents," Appendix B, when SAND or SLTR documents are deliverables in the PR.

e. Non-Sole Source Contracts over $50,000 require a letter of explanation/justification. The letter should be addressed to the highest authorization level required from the next lower authorization level, e.g., to 6000 from 6300.

FOR FURTHER PROCESSING OF NEW PURCHASE REQUISITIONS, GO TO PARA. 4.4.

4.3 Contract Changes

4.3.1 Preparation of Change Requisitions for existing contracts.

4.3.1.1 The requester completes the CR using the instructions for completing PR - see Appendix A. The requester is required to complete the CR only through the "Total Estimate."

4.3.1.2 Exceptions, additions, and/or special instructions in addition to the "Instructions for Preparing a PR."

The exceptions listed under 4.2.1.1 also apply to Change Requisitions - see a through i in 4.2.1.1.

4.3.1.3 The requester prepares other supporting procurement documents, as appropriate to change in procurement action:

a. Include a "QA Requirements for Purchase Requisitions" form (see DOP 7-1) with the CR for all changes except those listed in 4.4.1.2.

b. Changes to consultant contracts - Requires approval by the VP. A letter of justification must accompany CR stating why this consultant is qualified. The memo should be from 6300 Director to 6000 VP.

c. Nearly all change requisitions are considered sole source. A sole source memo must accompany all CRs which require approval by Director or above. The memo should be from 6310 Department Manager to the appropriate Purchasing Department Manager with signature line(s) for higher level approvals.

d. Complete NNWSI form "SNL and Contractor Documents - Expected Documents," Appendix B, when SAND or SLTR documents are added as deliverables on CRs.

4.3.1.4 Additional Information

a. Changes to contracts with cumulative dollar changes which are 10% or less of original contract amount must be approved by the level of supervision which has commitment authorization for the dollar value of the change. See SLI 1053 for commitment authority levels.

b. Changes to contracts with cumulative dollar changes over 10% of original contract amount must be approved by the level of supervision with approval authority for the new total amount of the contract. Per SLI 1053.

c. For contract changes which substantially change the scope of work, the approvals required on the CR are determined by the total cumulative amount of the contract (i.e., a CR for zero dollars which redefines the SOW on a $1,000,000 contract must go to the VP for signature).

d. All change requisitions with a dollar increase must provide justification for the dollar increase.

e. Change Requisitions which do nothing but increase the amount of limited funds may be approved by the Division Supervisor.

4.3.2 Precontract award negotiated changes dealing with technical or QA requirements

Preaward contract negotiations take place when there are areas in the contract which require additional clarification for the supplier. These negotiations can be administrative or technical. This procedure deals only with the technical negotiations. Negotiated technical changes are done via discussions between the requester, buyer, and supplier.

4.3.2.1 The requester <u>will not</u> agree with supplier- or buyer-requested changes that affect or could be construed to affect the QA requirements specified in the PR/CR until the requester has obtained the approval of an SNL NNWSI QA representative. The requester or QA representative will document the details of the change and approval via memo, telecon, or conference note to the contract file.

4.3.2.2 Technical Changes. For supplier-requested changes to technical requirements, the requester will analyze the effects of such changes on the intent of the procurement and quality of the product prior to agreeing to the changes. This analysis will be documented by the requester, via memo, telecon, or conference note to the contract file.

4.3.2.3 The requester must also review the final version of the placed contract (and all change amendments) to assure that no additional changes were negotiated that will impact the technical requirements or quality of the product. The requester is responsible to verify that the contract was written as intended, even if no negotiated changes were anticipated. To document that the requester has verified the accuracy of the placed contract, the requester must make a notation on the contract prior to sending the contract to the records center. The notation should be "Verified by (requester's name)" "date."

4.3.3 Other Negotiated Changes

When specific information in a PLACED contract is changed as a result of negotiations between the requester and the supplier, a change requisition must be issued. No other vehicle is available to change the contract.

However, in this case, the requester will analyze the effects of such changes on the intent of the procurement and the quality of the item or service to be furnished. This analysis shall be completed and documented, via a memo to the contract file, prior to placing the CR in the review process.

4.4 Further processing and review responsibilities for PR/CR and negotiated changes.

4.4.1 QA Review and Responsibilities:

4.4.1.1 The QA Coordinator or other SNL NNWSI QA representative reviews the PR and/or CR for adequate coverage of topics 4.2.1.1.c through h above and for completion of "QA Requirements for Purchase Requisition" form. Approval is indicated by initialing the "Special Approvals" block. For negotiated changes, the QA Coordinator or other SNL NNWSI QA representative will send a memo to contract file documenting resolution of QA areas in question.

4.4.1.1.1 QA approval is required on all PRs, CRs, and negotiated changes to contracts except when:

a. Negotiated changes are administrative changes only
b. CR releases Limited Funds only
c. CR is extending the Period of Performance only
d. CR does not change the SOW or QA requirements

4.4.1.2 The QA Coordinator ensures that a copy of QA Level I PRs (and Statements of Work) are forwarded to the WMPO QA Support Contractor (Audit and Surveillance Branch).

4.4.2 Division Supervisor Review and Responsibilities:

- The PR/CR is reasonable, necessary, and technically accurate for the mission of the NNWSI Project.

- The proper security classification is designated.

- That no acceptable equipment is available within SNL.

- Approval of the items listed below is indicated by initialing in the "Preliminary or Requesting Supervisor Approval" block or by signing in the "Commitment Approval Supervisor" block.

4.4.3 Finaicial Assistant Review and Responsibilities

4.4.3.1 The Financial Assistant reviews the PR/CR in order to:

- Ensure that all appropriate signatures are obtained per SLI 1050 and SLI 1053-2.

- Verify that the PR and associated paperwork are in the correct format.

- Ensure that the Quality Coordinator or his designee has initialed the PR or CR as defined in 4.4.1.

4.4.3.2 The Financial Assistant is responsible for:

- Completing the balance of the "Instructions for Preparing PR" for both PRs and CRs (starting with Preliminary or Requesting Supervisor Approval).

- Ensures that a copy of the PR/CR and all associated paper work are forwarded to the SNL NNWSI Records Center. (NOTE: THE REQUESTER IS RESPONSIBLE TO ENSURE THAT ALL OTHER CONTRACT RELATED PAPERWORK IS FORWARDED TO THE RECORDS CENTER, INCLUDING THE PLACED CONTRACT AND ALL CONTRACT AMENDMENTS.)

- Ensures that the PR/CR is processed by the SNL accounting classifier and the SNL Purchasing Log Desk and ultimately to the designated buyer.

4.4.4 The Requester is responsible to ensure that, after the PR is processed by Purchasing:

- The PO/Change Amendment, as compared to the PR/CR, correctly incorporates the technical and quality requirements and that the negotiated changes which impact QA (see 4.3.2) are documented. The contract document must be marked "Verified By (requester's name)" and "date" before the PO/Change Amendment is sent to the Records Center.

- The contract/PO and all associated paperwork is properly coded to the 20 series of the Records Management system and forwarded to the Records Center for filing.

- The QA coordinator or his designee is given a copy of the suppliers QA Plan, when applicable, for QA approval.

5.0 Records Management

All procurement (contractor) records are to be entered into the 20-Series in the SNL NNWSI Records Management System. For the following records the indicated personnel are responsible for providing them to the SNL NNWSI Records Management System:

- Purchase Requisitions and Change Requisitions and all accompanying documents (including "QA Requirements for PRs" form) - the Financial Assistant.

- The contract/PO and Change Amendments - the Requester.

- Other contract documents - the Requester.

6.0 References

- DOP 7-1, Procurement Planning
- SLI 1050, Commitment Approvals
- SLI 1053, Special Approval
- SLI 6600-1, Acquisition Planning

- SLI 6600-2, Sole Source/Sole Make Justification

7.0 Appendices

A. Form: Instructions for Preparing PR
B. Form: SNL and Contractor Documents

INSTRUCTIONS FOR PREPARING PR
(detach t' heet from PR)

Use this form to request
- the purchase, lease, or borrowing of property, materials, or services (SLI 6600)
- changing, cancelling, or terminating a requisition or contract (SLIs 6600, 6632).

NOTE: Pinfeed forms are available: SF 6430-RDS (8-1/2 X 11) and SF 6430-RDF (11 X 8-1/2).

Procedure:

1. Complete all the unshaded fields of the PR as instructed on this form. Do not fill in the shaded areas.
2. Remove Requester PR copy and retain.
3. Forward remaining copies to the Purchase Requisition Service Center in Bldg 887 (Budget and Financial Div. 8023 in Livermore).

Note: The requester will receive a copy of the contract or purchase order after it is placed.

Multipage PRs: When the PR has more than one page, complete all fields on the first page (including approvals), and include additional information on succeeding pages. Note: Form SF 6430-RDD, "Purchase Requisition Continuation Page," is available for follow-on pages. (Pinfeed forms: SF 6430-RDH, -RDE)

SPECIAL CONSIDERATIONS

Emergency Requisitions: Procedure:

1. Call the Sandia Contracting Representative (SCR) and explain the emergency. If the item is not acquired through the SCR assigned to your organization, call the appropriate division supervisor in Purchasing Organization 3700 for an SCR assignment, or Purchasing Hotline Ext. 4-2253 (in Livermore Divs. 8264, 8022, 8161-1). (SLI 6600)
2. Complete the PR as specified in these instructions under "HOW TO COMPLETE THE FIELDS," and include the word "Emergency" in the "Material or Service Description/Specification" field.
3. Obtain commitment and special approvals.
4. Handcarry the PR to Purchase Requisition Service Center (Classifier, 8023) and then to assigned SCR.

Advance Action: (SLI 6600) Procedure:

1. Complete PR fields as specified in these instructions under "HOW TO COMPLETE THE FIELDS" except for obtaining approvals.
   Note: Also complete the "Sole Source/Make Justification" when required and treat the attachment as indicated for PR in steps 2 through 5. (SLI 6600-2)
2. Make a copy of PR and mark it "Advance Copy."
3. Obtain division supervisor approval on "Advance Copy" and forward it to the Purchasing Log Desk in Contract Typing and Administrative Services Div. 3735 (Purchasing Section 8264-1).
   Note: If classified material or information is involved, obtain special approval (SLI 1053-2).
4. Mark the original PR with the words "Advance Action previously requested."
5. Obtain funding, if needed, and all required approvals on original PR. Make a photocopy of the PR for your files and forward remaining copies to the Purchase Requisition Service Center (Div. 8023).

HOW TO COMPLETE THE FIELDS

Date: Month, day, and year of request. (Example: 071586)

PR Number: To obtain PR number contact Requisition Service Clerk, 3735 (Procurement Coordinator, 8161-1) or obtain number from organization's block of numbers.

Ch. Req. No.: 00 for original; consecutive succeeding numbers for Change Requisitions (Example: 01, 02, etc.).

Page/Pages: Current page number of total number of pages (Example: 1 of 3).

Suggested Source: Include as much information as possible. If more space is needed attach a separate sheet with the information.

Government Priority: DO, DX, None or Other. Contact your case manager or Defense Budget Div. 142 (Div. 8023) for assistance. (SLI 6600-3) Important: Do not combine rated (DO or DX) and orders with "none" or "other" ratings.

Security Classification: This document must itself remain unclassified. In the first space, use U if Unclassified, C if Confidential, S if Secret or T if Top Secret material or information is associated with this order. If the security level is C, S, or T, also enter the security category in the second space: R if Restricted data (RD), F if Formerly Restricted data (FRD), or N if National Security Information (NSI). See instructions for "Material or Services Description/Specification" field. On Change Requisitions use same classification as that used on original PR.

Item: Number the items sequentially. On Change Requisitions use the next sequential number for additions or the line item number from the previous PR that is to be changed or deleted.

Quantity: On Change Requisitions use the new total quantity. For deletions enter zero.

Unit of issue for each item requested: Use standard two-character abbreviations. (Examples: EA for each, DZ for dozen, RL for roll, GL for gallon, LB for pound, CN for can.) A list of standard abbreviations can be obtained from Stores Management Div. 3742.

Material or Service Description/Specification: Provide a complete description/statement of work which begins with the most descriptive word and includes terms that will be clearly understood by all potential contractors and the SCR administering the contract. (Note: Only the first 48 characters will be keypunched.) If the description is complex or includes drawings, specifications, or engineering procedures, attach to the PR a separate titled and dated document with the information. The public may gain access to PR information—do not include extraneous or superfluous comments.

Material or Service Description/Specification, *Continued*

On Change Requisitions write the description as it should read for each item being changed or added. For deletions write description as it is currently stated in contract (or previous PR if contract or amendment hasn't been placed).

Classified information: Put classified information in a separate document and reference it on the PR. Send the classified document marked for the SCR to Access Control and Administrative Div. 3437 (Administrative Services Dept. 8260). If a contractor requires access to or will originate classified information, describe the circumstances. (SLI 1008)

Classified material: Reference Sandia Packaging Specifications (SPS 230). Include specifications and send required strapping seals to the packaging point. Strapping seals are available from Shipping and Receiving Div. 3428 (Property Management Div. 8262).

Sandia Property or Material furnished to commercial contractor or institution to be used in conjunction with performance of contract: Include quantity, description, property number, and value of item(s) and a reason or justification for furnishing the item(s). Also mark the appropriate box in "Special Info." field.

Property or material acquired or fabricated by a contractor for Sandia: Include description of property or material. Also mark the appropriate box in "Special Info." field. Important: Rules regarding type of funds used and approvals required are the same whether property is acquired directly or through the contractor. (SLIs 6600 & 6931)

Limited Funds: (SLI 6600) Include this paragraph:

"Limited Funds — This PR is approved for (full $ amount) and limited to (limited $ amount). Costs for which Sandia may be liable may not be incurred by the contractor in excess of the limited amount (enter date if appropriate)."

Obligation of Funds: Enter the words: "Obligation of Funds" when 1) requesting a Cost-type, Labor Hour, or Time and Materials contract, 2) costing $500,000 or more, and 3) using operating (expense) money. Do not enter if using "Limited-Funds."

Advance Action: (SLI 6600) Include SCR identification number. See instructions under "SPECIAL CONSIDERATIONS."

Material or Service Description/Specification, *Continued*

Hazardous material: Include clear description. See SLI 6950 for definition of hazardous material. Also mark appropriate box in "Special Info." field.

Quality program: Usage Index of Active EP's for Commercial Procurement (9/24/85) in Engineering Procedures manual (p. 21) states available quality programs. Attach appropriate EPs to PR.

Engineering cost estimates: Send original draft to SCR. Reference the estimate by date and addressee in this section.

GSA and FSS materials: For items available from the General Services Administration (GSA) or Federal Supply Schedules (FSS), include GSA and FSS stock numbers and FSS expiration dates, if known.

Borrowing Property: Include the words "Borrowed Property" and the property's description, intended use, proposed location, estimated purchase value, loan period, and return date.

Trade-In or Exchange: See PI 8.06-26 for restrictions. A copy of the PI can be otained from Purchasing Planning Div. 3732.

Drawing No.: Insert applicable drawing number.

Inspection code: Enter one of the following codes for each line item. (SLI 6640-1):

- C Calibration (Use for all commercial equipment)
- D Development Inspection, Mechanical
- E Development Inspection, Electrical
- F Field Inspection
- G Gage Inspection
- M Ladder and Rigging Equipment
- N Nuclear and Radioactive
- S Inspection by General Stores
- X Immediate Inspection by Using Organization.
- Z Receiving Inspection and Assessment (SNLA only)

Est. Unit Price: Your best estimate of the cost of each item. If more than $100 do not include cents. If more than $100,000 and more space is needed expand number into "Unit PR/Tax" field. Do not write in shaded area if under $100,000. On Change Requisitions: If changing Est. Unit Price, enter new amount. If deleting an item, enter zero (-0-). If borrowing property, enter associated costs such as shipping, installation and maintenance.

Special Information is used to identify and monitor contracts for special reporting. Mark the applicable blocks.

Radioactive (SLIs 1053-2, 6476, Safety Manual)
Explosive (SLIs 1053-2, 6620-2, Safety Manual)—Include classification.
Nuclear (SLI 1053-2)
Other Hazard See instructions for "Material or Service Description/Specification" field.
Computing Equipment (SLIs 1053-2, 6315, 6316, 6318)
Sole Source/Make (SLI 6600-2)

Special Info. *Continued*

Precious Materials (SLIs 6475, 6610)
Continuing Requirement (SLI 6600)
SNL Property/Material Furnished See instructions for "Material or Service Description/Specification" field.
SNL Property Acquisition Authorized See instructions for "Material or Service Description/Specification" field.
SAND Report # - Include report number. (SLI 1053-1)
Weapon/Weapon Related See Quality Control Policy (QC-1), Revision 4, issued 4-30-85. See Engineering Manual for Quality Program requirements.
Non-Weapon Related Either "Weapon/Weapon-Related" or "Non Weapon Related" must be marked.

▶**Accounting Classification Line:** Forecast all costs in the month they are expected to be incurred. For Cost Type, Time and Material, and Labor hours orders costing $500,000 or more and using operating (expense) funds, include forecasts by fiscal quarter for the first year of the intended contract life and at least yearly forecasts by fiscal year thereafter. State "Obligation of Funds" in "Material or Services Description/Specification" field. Use a separate line for each Case/CCO when you split costs between cases/CCO and for each forecast when you have multiple forecast dates. If you need more than three lines, prepare Form SF 6430 RDB, "Purchase Requisition Accounting Data Supplement."

Case/CCO, work order. Important: Be sure the funds are available.

Subclass: If unknown, leave blank.

Organization: Charging organization number (usually the requester's).

Note: When borrowing property, include a valid case, subclass, and organization for charging incidental costs such as shipping, installation, and maintenance.

Esc: Equipment subcase for capital items. Contact your administrative assistant for information.

$ Amount: (amount) to be committed from each case. Total of all commitments should equal the full amount (Total Est. $) of the order. On Change Requisitions list the increase (decrease) in commitment.

Payguide Amount: Should only be used if it is necessary to direct the charging of costs for a particular $ amt to one Case/CCO before costs apply to another Case/CCO. This field can also be used to allocate a limitation amt to a particular Case/CCO(s) by putting an amt = to the limit amt in the payguide field for the case desired.

Fcst Dates: Your best estimate of the month and year the items will be delivered or the work will be performed.

Brief Description of material or service. This field will appear on management reports and should be as descriptive as possible within the 23 character limitation.

Date Del./Perf. Req'd.: REALISTIC date for delivery/performance.

Requester: Initials, last name, organization & phone number.

Deliver To: Employee and location.

**Total Est. $** Amount for all materials/services requested on the PR. On Change Requisitions list the increase (decrease) in commitment. Must equal sum of "$ Amount" field.

Preliminary or Requesting Supervisor Approval: If a shop order, signature of appropriate individual in requesting organization (1050 series of SLIs).

Special Approvals: Initials and organization number. (SLI 1053-2)

Commitment Approval Signature and Org. for amount shown in Total Est. $ field. (SLI 1053) Be sure funds are available. When borrowing property include commitment approvals based on the estimated purchase value. On multipage PRs obtain signature on first page (i.e., Page 1 of 3). For Change Requisitions see SLI 1053-1.

Notification Copies Sent: Signature certifies that notification copies were sent when required by SLI 1053-2.

No Acceptable Equipment Available: Signature certifies that there is no acceptable equipment within Sandia. (SLI 6610)

Classified Information or Material: Signature certifies proper security classification level and category (including unclassified).

Orders for services: The commitment approver and the "Deliver to" should not be the same person, since the person signing for commitment may not also sign for receipt.

Limited Funds PRs must have approvals for the full PR amount, not just the limited amount.

Notification Copies Sent: Check box after sending copies per SLI 1053-2.

No-Acceptable Equipment Found within Sandia. Check box after search of Sandia sources. (SLIs 6600, 6610)

REQUIRED ATTACHMENTS

When ordering Capital or Capital-Like Property that falls into one of the categories exempt from numbering (SLI 6900), prepare and attach Form SF 6920-B, "Capital-Like Property Purchase Justification."

Sole-Source/Sole-Make: Avoid specifications for materials and services available from only one source or produced by only one manufacturer if possible. See SLI 6600-2 for policy and requirements regarding justification and documentation that must accompany the PR.

For Additional Help contact the following:

At Albuquerque

- The Administrative Assistant for your organization
- a SCR, 3700
- a Budget Analyst, 140

At Livermore

- a Procurement Coordinator, 8161-1
- a Shop Liaison employee, 8184—for shop services
- a SCR, 8264, 8161-1, 8022
- Division 8023

APPENDIX B

SNL and Contractor Documents-Expected Documents

Contractor	Contract Number	Responsible Staff	Div.	WBS Number	Mile-stone	Title	Type (SAND, SLTR, KEYS)	Author	Status (Expected Date)

UNCONTROLLED

DOP 5-1
Rev A

NNA.880519.0015

SNL NNWSI PROJECT
Procedure Format and Content Requirements

Page	1	2	3	4	5	6
Rev	A	A	A	A	A	A

Author: R. R. Richards, 6310 — May 6 1988 Date

Approved: Division Supervisor — May 11, 1988 Date

Approved: Quality Assurance — May 9 1988 Date

Approved: SNL-TPO — May 11, 1988 Date

SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT
Issued to: [illegible], SAIC
Copy Number: 013
RETURN TO 6310 RECORDS CENTER WHEN NO LONGER NEEDED.

SAIC/T & MSS
MAY 19 1988
OCF RECEIVED

1.0 Purpose

The purpose of this Department Operating Procedure is to state the minimum requirements for the writing of procedures and instructions for the SNL NNWSI Project, including QA Procedures and Department Operating Procedures.

2.0 Scope

This procedure defines the format, preparation, review and approval requirements, and revision procedures to be used by SNL staff when writing procedures or instructions other than Experiment Procedures, Equipment Test Procedures, or Technical Procedures for the NNWSI Project.

3.0 Definitions

3.1 Procedure - a document that contains definitions, procedures and other relevant instructions that will be followed in performing specific Project functions.

3.1.1 Quality Assurance Procedures (QAPs) and Department Operating Procedures (DOPs) implement, in specific terms, the policies and plans stated in the SNL NNWSI QA Program Plan. QAPs and DOPs differ in that, generally, the actions in QAPs are performed or guided primarily by personnel in the QA organization and DOPs are performed primarily by personnel who are not in the QA organization.

4.0 Procedure

4.1 QAPs and DOPs:

Responsible Individual(s)	Action
Management of 6310 organization	Designate procedure authors.
QA Coordinator	Assign the procedure identifier. QAPs or DOPs shall have a designation consisting of letters and Arabic numerals, e.g., QAP 2-3 or DOP 8-1. The first numeral corresponds to the QA Program criteria designators in 10CFR50 and NQA-1. The second numeral identifies the specific procedure.

Responsible Individual(s)	Action
Author	Write the procedure according to the requirements below, ensuring that all necessary technical and QA content is included:

Format - QAPs and DOPs shall be written according to a standard, but flexible format. Procedures shall be written in an outline fashion with the major paragraphs identified as in this procedure. Typical titles and content for major paragraphs are:

Purpose -what the QAP is intended to do.

Scope - a description of the extent of the application of the procedure. The specific activities, tasks, or organizations affected by the procedure can be stated. If useful for clarity, aspects specifically excluded from the scope of the procedure can also be stated.

Definitions - terms used in a QAP or DOP are to be consistent with those in the QAPP; definitions of such terms need not be included in those procedures, but reference may be made to the QAPP. Special definitions (those items needing a specific description to avoid ambiguity) and those definitions not included in the QAPP should be included where appropriate.

The body of a procedure, conveying what is to be done and who is to do it, shall be written in either of two alternative styles by specifying "Responsibilities" and "Requirements" or by specifying the "Procedure."

1a) Responsibilities - a statement as to who is answerable or accountable for generalized functions or sets of specific actions (e.g., "The Division Supervisor reviews all documents generated as a result of this procedure.").

1b) Requirements - a statement of those actions or steps that are necessary to accomplish the subject activity or to meet appropriate requirements (e.g., "Complete form SF1926RF.").

2) Procedure - a series of statements which define a particular course or mode of action, i.e., specify the actions necessary to accomplish the subject activity or to meet appropriate requirements, with the party who is to take the action designated for each step. Procedures should be written in "playscript" format, as shown in this procedure.

Specifying the "Procedure" is most effective when the specified actions are carried out by a number of different responsible parties. In cases where all or most of the specified actions are to be carried out by only one or a few responsible parties, stating "Responsibilities" and "Requirements" is more efficient.

Records Management - a statement of which documents resulting from the procedure are records, where in the Records Management System (RMS) they will be filed (i.e., specify coding index for RMS filing, including "NNWSICF") and who must take the action to do so.

References - a list of documents referred to in the text of the procedure.

Appendices - supplementary material which gives useful additional information or necessary tables, charts, or forms.

Pagination - the dated signature page and subsequent pages should be identified as shown in this procedure. The individual procedure pages show the procedure identifier, revision number, and page number. Alternately, the page number may be co-located with the Procedure/Rev. identifier.

QA Level differentiation - the author may provide differentiation (which must be consistent with the QAPP) within the procedure concerning how requirements shall be applied to QA Level I and II activities, as well as how (or whether) any requirements are to be applied for QA Level III or "None" activities. In cases where no such differentiation is necessary or useful, procedures will be written based on QA Level I requirements.

Responsible Individual(s)	Action
Author	Once it is prepared, sign the procedure and obtain reviews by a Division Supervisor, a QA reviewer, and the Department Manager.
Author	May obtain reviews in addition to those specified, if deemed appropriate.
Author	Incorporate comments provided by the reviewers and obtain approval signatures.

Responsible Individual(s)	Action
Division Supervisor	Review the procedure for technical and administrative accuracy and completeness, provide comments if necessary, and approve the document by signature, once comments are resolved.
QA Reviewer	Review the procedure to verify incorporation of all necessary QA requirements and for adherence to this procedure. Provide comments, if necessary, and approve the document by signature, once comments are resolved.
Department Manager	Review the procedure, provide comments, and approve the procedure by signature, once comments are resolved.
Author	Once all approvals are obtained, request that the RMS staff issue the procedure in accordance with DOP 6.1, "Document Control."

4.2 Other Procedures:

Other procedures will be written according to the requirements in paragraph 4.1 with the following exceptions:

- RMS staff will assign procedure identifiers.
- The only required review is by Division Supervisor.

5.0 Document Revisions

5.1 Procedures will be revised as necessary to:

1) Implement changes in NNWSI Project policy.
2) Reflect changes in SNL policy.
3) Correct recognized deficiencies.
4) Establish policy and procedures for activities not presently covered.

5.2 No changes to procedures can be made without following a review and approval process as specified in paragraphs 4.1 and 4.2, above, except for minor (generally editorial) changes. DOP 6-1 contains instructions for minor changes.

5.3 Issuance and control of QAPs and DOPs and their revisions will occur in accordance with DOP 6-1.

6.0 Records - all issued DOPs and QAPs shall be filed in file 35/1293/5.2.4 or 5.2.5 of the SNL NNWSI Project Records Management System. Other procedures shall be filed as indicated in the Records Management System "Master Listing of Coding Indexes." In all cases, a copy will be provided for the Project Record Center (NNWSICF).

7.0 References - Other procedures necessary for implementation of this document include:

DOP 6-1, Document Control System

8.0 Appendices

None

UNCONTROLLED

DOP 5-2
Rev B
Page 1

NNA.880119.0027

SNL NNWSI PROJECT
Department Operating Procedure

Technical Procedure Requirements

Page	1	2	3	4	5	6
Rev	B	B	B	B	B	B

Approved by:

Barry M. Schwartz (signature) — 8/28/87
Barry M. Schwartz, 6313 — Date
Author

R. R. Richards (signature) — Aug 31, 1987
R. R. Richards, ~~6310~~ — Date
QA Coordinator

T E Blejwas (signature) — 9/3/87
T. E. Blejwas, 6313 — Date
Division Supervisor

Thomas O. Hunter (signature) — 9/4/87
T. O. Hunter, 6310 — Date
Department Manager

SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT

Issued to: M. D. Cotter

Copy Number: #034

RETURN TO 6310 RECORDS CENTER
WHEN NO LONGER NEEDED.

1.0 Purpose

1.1 The purpose of this DOP is to state the procedures for writing, approving, revising, and using Technical Procedures (TPs).

2.0 Scope

This DOP applies to the writing of TPs in support of Experiments and Equipment Tests, including major changes to nationally recognized procedures. TPs are a vehicle for documenting approved instructions, checklists, and operations and define specific steps to be followed in a required order.

3.0 Definitions

Technical Procedure - Detailed implementing procedures that define technical requirements, constraints, and procedural steps in support of Experiments and Equipment Tests. They may include requirements for using and/or calibrating measuring devices and other equipment, and for defining criteria for sample/site preparation.

4.0 Requirements

4.1 Personnel

4.1.1 It is the responsibility of the SNL NNWSI Project Principal Investigator (PI) to ensure that:

- TPs are defined for all appropriate Experiments and Equipment Tests and that they are written in conformance with this DOP.
- SNL NNWSI Project Records Management System (RMS) staff are provided a distribution list for controlled issuance.
- Users of the TPs are familiarized, trained and certified in the use of the TP prior to the conduct of work, consistent with requirements in SNL NNWSI Project QAP 2-5 and DOP 2-6, with documentation provided to the SNL NNWSI Project QA Coordinator and the following SNL NNWSI Project file:

  90/1293/TNG/QA Level, where QA Level is either Q1, Q2, or Q3.

4.1.2 It is the responsibility of SNL NNWSI Project RMS staff to maintain unique identifying codes for TPs, including revisions, and as necessary, to distribute TPs as controlled documents.

4.1.3 It is the responsibility of the users of TPs to adhere to the content of them.

4.2 Control

TPs may be prepared by contractors or SNL employees outside of the NNWSI Project Department, subject to review and approval per section 4.5 of this DOP.

4.3 Format of TPs

4.3.1 The format of the cover sheet of the TP will follow that of page one of this DOP with the addition of a header which states that the document is an SNL NNWSI Project Technical Procedure.

4.3.2 Each page of a TP will bear the following header, located in the upper right hand side of the page:

TP - B
Rev - C
Page - #

where TP stands for Technical Procedure

where B is:

An arabic numeral, e.g. 1, which is a unique identifying code assigned by the SNL NNWSI Project Records Management Staff.

where C is:

The latest revision, starting with 0 (for "original") and then proceeding alphabetically (A, B, C...). Revisions will be consistent for each page of the TP, i.e., changes to the TP will result in each page having the latest revision identifier.

4.3.3 If Appendices are included in TPs, the page number on the cover sheet will have App. followed by the Appendix designator. Each page of appendices will have a page count with the header, in the form of "page # of #", in addition to the TP identifier and revision.

4.4 Quality Assurance (QA) Levels of TPs

TPs are to be used as supplements to Experiment Procedure (EPs) and Equipment-Test Procedures (ETPs). Because it is a requirement that the QA level for each activity be defined in the EP or ETP which the TP supports, it is not necessary for the QA level to be specified in the TP.

4.5 Review and Approval Requirements

The persons listed below shall review and approve original and subsequent versions of TPs and provide a dated signature on their cover sheet.

- o The author of the TP, if different from the PI.
- o The SNL NNWSI Project PI
- o An independent technical reviewer.
- o Other independent technical reviewers (as determined necessary by the PI or Division Supervisor of the PI).
- o Division Supervisor of the PI. (In addition to reviewing the TP for technical content, the Division Supervisor will ensure that the provisions of this DOP are satisfied).

To ensure that changes to TPs are consistent with the current needs of the author (user) of the previous revision, TPs will not be revised without the written approval of the author, the SNL NNWSI Project PI responsible for the version which is being revised, or the Division Supervisor of that PI.

5.0 Content of a TP

5.1 TPs written in support of Experiments and Equipment Tests will include but are not limited to:

5.1.1 Scope - A description of the extent of the application of the TP.

5.1.2 Definitions - Special definitions, (those items needing a specific description to avoid ambiguity) should be included where appropriate to describe terms.

5.1.3 Activity Objective - The activity objective, stated concisely.

5.1.4 Description of activity - A brief representation of the work to be performed.

5.1.5 Procedure Content - TPs will be written as a series of steps to be followed in a regular, definite, sequential order. These steps will state what actions will be taken in a logical sequence for each phase of the process from preparation, through verification of prerequisites and post-requisites. Portions of users manuals should be extracted and/or the users manuals referenced as appropriate. A TP should be complete enough so that when followed, the activity is repeatable. When it is necessary to develop procedures while a process is being performed, the criteria in SNL NNWSI Project DOP 11-1 concerning interactive procedures should be followed.

A TP will, as applicable, address the following items in their appropriate sequence:

a. Description of set up, including detail of all tools, gauges, instruments, and measurement standards. Manufacturer/make, model and serial/lot number (including property or inventory control number, if available) should be included when the quality of the product is contingent on the information being known. If make and model information are unavailable, an identifier will be assigned to the equipment consistent with SNL NNWSI Project DOP 13-1.

b. Definition, establishment, and verification of suitable environmental conditions (including any requirements for warm-up of instruments).

c. Prerequisites and Initial Conditions - In order to verify that critical aspects of set-up are in readiness prior to starting anactivity, TPs will include instructions to check that critical requirements have been completed for each replication of a process.

d. Definition of control settings of items specified in section 5.1.5.a.

e. Definition of the parameters to be recorded (including units) and the method of documentation of data, consistent with logbook requirements stated in SNL NNWSI Project DOP 11-2.

f. Instructions for sample identification, handling, shipping, and temporary storage per SNL NNWSI Project DOP 8-1.

g. Data acquisition and reduction. Computer hardware will be utilized consistent with the requirements in DOP 11-1 and DOP 13-1. In addition, application software will be utilized consistent with requirements in DOP 11-1.

h. Written instructions for inspection to predetermined specification, or reference to existing inspection instructions.

i. Equations (including all units)

j. Applicable reference documents such as instrumentation diagrams and manufacturers operation (owners) manuals.

k. Postrequisites and Final Conditions - In order to ensure that critical requirements of the TP have been implemented, TPs will include instructions to check that key actions associated with those requirements have been completed as part of the closing down phase for each replication of a process.

5.1.6 Safety - Safety should be of primary concern in all aspects of the TP. That is, safety should be integrated into all activities. The author and reviewers of the TP will determine whether hazardous conditions might exist during the conduct of the activities, including operation of equipment, other than those normally encountered in the facility. If hazardous conditions exist, the following safety aspects will be addressed:

- A description of potential hazards and the means by which the hazards will be eliminated or mitigated.

- Definition of procedure(s) to handle or mitigate each potentially hazardous situation.

As required by the SNL Safety Department, Safe Operating Procedures (SOPs) will be written, either as as appendices to TPs or as a TP, with review and approval of the SOP by the SNL Safety Engineering Department and other appropriate organizations.

If hazardous conditions do not exist, a statement to that effect will be included in the TP as follows, "The activities and associated equipment covered by this TP have been determined to have nc significant or unusual safety hazards. Review and approval by the SNL Safety Engineering Department and/or appropriate organizations are not required".

6.0 References

- DOP 2-6, "Qualification and Certification of Project Personnel"
- DOP 8-1, "Sample Identification and Handling Requirements"
- DOP 11-1, "Experiment and Equipment-Test Procedure Requirements"
- DOP 11-2, "Requirements for Experiment and Equipment Test Logbooks"
- DOP 13-1, "Identification, Handling, Shipping, and Storage Procedures for Items"
- QAP 2-5, "NNWSI Project Training and Familiarization Procedures"

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NNA.880119.0014

SNL NNWSI PROJECTS

DEPARTMENT OPERATING PROCEDURE
QA REVIEW OF DEPARTMENT OPERATING PROCEDURES

Page	1	2	3	4	5	6
Rev.	0	0	0	0	0	0

Author: R. R. Richards — Date: Sep 29, 1986

Approved: Q. A. Coordinator — Date: Sep 29, 1986

Approved: Department Manager — Date: 9/29/86

SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT
Issued to: M. D. COHER, SAIC
Copy Number: #013
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DEPARTMENT OPERATING PROCEDURE
QA REVIEW OF DEPARTMENT OPERATING PROCEDURES

1.0 PURPOSE:

The purpose of this procedure is to specify the procedure to be followed when Department Operating Procedures are to be reviewed for quality assurance considerations by personnel who are not a part of the QA organization.

2.0 SCOPE:

This procedure applies only to the review of Department Operating Procedures (DOPs) and only to review by personnel not in the QA organization.

3.0 PROCEDURE:

3.1 Procedures, such as QA Procedures or Department Operating Procedures which implement the policies of the SNL NNWSI QA Program Plan are normally reviewed with respect to QA considerations by personnel in the QA organization. However, management in the NNWSI Projects Department may determine that it is appropriate for such QA review of DOPs to be performed by other personnel in the organization. (Approval authority of procedures with respect to QA concerns is always retained by the QA organization.)

3.2 The person designated to review a DOP will be selected by department management, in consultation with the QA Coordinator.

3.3 The QA Coordinator will train the person designated to perform QA review of a DOP. This training will address:

1. The use of this procedure.
2. The contents of DOP 5-1, "Requirements for QA and Department Operating Procedures."
3. The use of the review checklist, Form DOP 5-3(2), including particular areas of QA concern. This training will be documented on Form DOP 5-3(1) by the QA Coordinator.

3.4 After completion of the above training, and its documentation, the supervisor of the designated reviewer will certify the individual's qualification to perform QA review of DOPs on Form DOP 5-3(1) (Appendix A). A copy of the certification will be forwarded to the SNL NNWSI Records center.

3.5 The person designated to perform the review of a DOP will do so.

3.5.1 The review will be documented on Form DOP 5-3(2), "Checklist for QA Review of Department Operating Procedures," (Appendix B). The following guidance will be considered by the reviewer:

(1) The format provided in DOP 5-1 is not absolutely mandatory. Sections that are not necessary need not be included. For example, if there are no references in the DOP and no appendices included, the sections "References" and "Appendices" need not appear in a DOP. Similarly, if sections other than those named in DOP 5-1 are either necessary or constructive in a DOP, they should be included.

(2) The most important aspect of a DOP is that it fully and adequately implement the aspects of this organization's QA Program that it is intended to address. Reference should be made to the approved section of the QA Program Plan that the procedure is intended to implement. If the DOP implements aspects of the QA Program for which the QAPP section is not yet approved, reference should then be made to the corresponding section of NNWSI-SOP-02-01. Consult the QA Coordinator in such cases.

(3) Concerning item 5 of the checklist, it is of special concern that specific responsibility for the steps of a procedure are made clear in the procedure. Generally, subject-action verb sentences should be used for the steps of the procedure. Phraseology such as, "The documents will be forwarded to the DRMS," should be avoided as it does not specify who is responsible for the action. In cases where it does not matter who takes the action, the individual who is generally responsible can be specified, e.g., "The PI will ensure that the "Sample Custody Form" is properly filled out."

3.5.2 The reviewer will attach any comments generated during the review to the checklist form. The reviewer will then provide the checklist and the comments to the DOP author.

3.6 The author of the DOP will address the reviewer's comments, incorporating changes in the DOP as necessary. Any comments not addressed will be resolved with the reviewer. The author will then provide the updated DOP, the checklist, and the comments to the QA Coordinator.

3.7 The QA Coordinator, or other person in the QA organization, will use the documents provided to verify that an adequate QA review was conducted and that any resulting comments were adequately addressed in the updated DOP. The QA Coordinator may generate additional comments, which will be resolved by the author prior to approval. Once satisfied, the QA Coordinator, or other person in the QA organization, will indicate approval of the DOP by signature on the cover sheet. The person providing QA approval will forward the completed checklist [Form DOP 5-3(2)] to the SNL NNWSI Records Center.

4.0 REFERENCES:

DOP 5-1, "Requirements for Quality Assurance and Department Operating Procedures"

5.0 APPENDICES

Appendix A - Form DOP 5-3(1), "Certification of Personnel to Perform QA Review of Department Operating Procedures."

Appendix B - Form DOP 5-3(2), "Checklist for QA Review of Department Operating Procedures."

CERTIFICATION OF PERSONNEL TO PERFORM QA REVIEW OF DEPARTMENT OPERATING PROCEDURES

______________________________ has been instructed in the use of DOP 5-3 and
(Name)
its associated checklist in performing reviews of Department Operating Procedures for incorporating Quality Assurance practices and requirements.

______________________________ ______________
QA Coordinator Date

______________________________ is hereby certified as being qualified to
(Name)
perform QA reviews of SNL NNWSI Projects Department Operating Procedures.

______________________________ ______________
Supervisor Date

CHECKLIST FOR QA REVIEW OF DEPARTMENT OPERATING PROCEDURES

DOP No. ______________ Title ______________________________

Revision _____

QA Aspect	OK	Not OK	Comment Attached
1. Does the DOP adhere to DOP 5-1 regarding format and content?	___	___	___
2. Does the DOP completely fulfill the stated purpose of the procedure?	___	___	___
3. Does the DOP fully implement the policies and requirements stated in the SNL-NNWSI-QAPP (or in NNWSI-SOPs)?	___	___	___
4. Is the procedure written clearly and unambiguously?	___	___	___
5. Does the DOP specify the actions or steps necessary to accomplish the function and specify <u>who</u> is to perform them?	___	___	___
6. If appropriate, does the DOP adequately address exceptions and non-standard situations?	___	___	___
7. Does the procedure incorporate good QA practices and avoid ineffective or inefficient practices?	___	___	___
8. Other aspects			

I have reviewed the procedure identified above and, if indicated, have provided comments to the author.

_____________________________ __________
Signature Date

____
Name, printed

Form DOP 5-3(2)
File 90/1293/DRW/Q1

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APPENDIX A
SANDIA NATIONAL LABORATORIES
NNWSI PROJECT

MASTER DOCUMENT CONTROLLED DISTRIBUTION LOG

Document Title (No. of Text Pages)____

Revision No.____________________

Copy No.	Date Assigned	Name of Holder	Date of Distribution	Date of Return

Comments Regarding Action to be Taken on Document:

APPENDIX B

SANDIA NATIONAL LABORATORIES
CONTROLLED DOCUMENT
TRANSMITTAL AND ACKNOWLEDGMENT FORM

DATE:

TO: Name____________________, W/___COPIES, Organization__________________

FROM: Name____________________, Organization____________________

CONTROLLED DOCUMENT TITLE (with number of text pages):____________________

____

____

Copy(ies) No. ________________ Revision ________________

Summary:

Please add or replace as directed:

I have performed the above action(s) and superseded portions have been discarded or marked superseded and placed in a separate location.

Signature:____________________________ Date:____________________________

Comments:

Please return this form by_______ to: SNL NNWSI Records Management Staff
Records Center, Bldg. 823, Rm. 4025A
Sandia National Laboratories
Albuquerque, NM 87185

NNA.880127.0036

SANDIA NATIONAL LABORATORIES
NNWSI PROJECT
DOCUMENT CONTROL SYSTEM PROCEDURES

Page	1	2	3	4	5	6	App. A	App. B
Revision	A	A	A	A	A	A	A	A

Mary A. Tang — 10/7/87
Author — Date

Approved: Donald R. Pope — 10/13/87
Division Supervisor — Date

Approved: R. Richards — Oct 7, 1987
QA Coordinator — Date

Approved: Thomas O. Hunter — 10/14/87
SNL TPO — Date

SNL NNWSI DEPARTMENT 6310
CONTROLLED DOCUMENT

Issued to: M. D. COHER, SAIC

Copy Number: #066

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DOCUMENT CONTROL SYSTEM PROCEDURES

1.0 PURPOSE

The purpose of this Department 6310 Operating Procedure (DOP) is to define measures to control the distribution of documents (and their revisions) identified in the Master Document List. This distribution process ensures that the latest approved version is in use by personnel of organizations performing work on the Nevada Nuclear Waste Storage Investigations (NNWSI) Project. This procedure also specifies the control measures applicable to controlled documents from other organizations that are sent to SNL Department 6310.

2.0 SCOPE

This DOP applies to controlled documents identified in the Master Document List, including those pertaining to design bases, design criteria, drawings, specifications, and contractor documents. Thus, this DOP does not apply to Nonconformance Reports nor to procurement documents such as Purchase Requisitions, Requests for Quotes, Contracts, and Purchase Orders. (The control measures for those documents are specified in the Quality Assurance Procedures (QAPs), Department Operating Procedures (DOPs), and other procedures that pertain to those documents.)

3.0 DEFINITIONS

3.1 Document

A report, letter, memorandum, procedure, drawing or other written or pictorial information describing, defining, reporting or certifying activities, requirements, procedures or results pertaining to the NNWSI Project.

3.2 Controlled Document

A document which prescribes activities affecting quality or specifies quality requirements and which is distributed through a system that provides for 1) assignment of control numbers to documents issued, 2) use of transmittal forms with provisions for receipt acknowledgment, and 3) maintenance of a controlled documents list and log.

4.0 PROCEDURES

4.1 Identification, Assignment of Author, Preparation, Review and Approval of Controlled Documents

4.1.1 Documents designated as controlled documents will be placed on the Master Document List, which will be maintained by the SNL

Department 6310 NNWSI Records Management staff. Assignment of responsibility for document preparation, review for adequacy, completeness, and correctness prior to issuance and routing for approvals will be specified in the QAPs and DOPs that pertain to those documents. See Section 5.1.3 for further details on responsibilities.

4.2 Initial Assignment of Controlled Documents and Additions to Distribution List of a Controlled Document

4.2.1 For the initial assignment of each controlled document, Records Management staff will:

(1) Assign a unique control number to each document copy.

(2) Label each document copy as a controlled distribution document, with holder's name, copy number, and instruction to return document when no longer needed.

(3) Record the following information for each document copy in the Master Document Controlled Distribution Log (Equivalent to Appendix A):

--Title of document and number of text pages
--Revision
--Copy number
--Date number assigned
--Name of copy holder
--Date of distribution to copy holder
--Date receipt acknowledgment is returned by copy holder

4.3 Distribution Control

4.3.1 Distribution control activities will consist of assigning individual copy numbers, sending transmittal and acknowledgment forms with the controlled document, maintaining a Master Document List along with a controlled distribution log, and following up unreturned receipt acknowledgment forms.

4.3.2 The responsible SNL NNWSI Project staff member for the activity which generates the document or the SNL NNWSI QA Coordinator will:

(1) Identify a document as a controlled document.

(2) Determine the distribution for that document.

(3) Provide Records Management staff with the approved document and with the distribution list for that document.

4.3.3 Requests for additions to or deletions from the distribution list shall be addressed to the responsible SNL NNWSI Project staff member, to the SNL NNWSI QA Coordinator, or to the Records Management staff.

4.3.4 When a document requiring controlled distribution is received from the responsible SNL NNWSI Project staff member, the Records Management staff will:

(1) Review the document for completeness and legibility and for approvals as required by appropriate QAPs and DOPs.

(2) Enter document information on the Master Document List. Periodically issue updated copies of the Master Document List and ensure that copies are distributed to the Waste Management Project Office (WMPO) and to the WMPO QA Support Contractor.

(3) Enter into the Document Controlled Distribution Log the document information and the corresponding distribution list for each controlled document issued.

(4) Complete Transmittal and Acknowledgment Forms (Equivalent to Appendix B), accurately identifying the document being transmitted.

(5) Assign a unique number to each copy of the document and indicate that number on each Transmittal and Acknowledgment Form as listed in the Document Controlled Distribution Log.

(6) Reproduce or make provision to reproduce required copies of the document and completed transmittal forms.

(7) Assemble and issue Transmittal and Acknowledgment Forms with document copies according to distribution requirements, and file a suspense copy of the Form.

(8) Issue a Transmittal and Acknowledgment Form for each individual on the controlled document distribution.

(9) Monitor receipt of Transmittal and Acknowledgment Forms, send additional reminders when necessary, and prepare and file reports as requested on the status of returned and outstanding Forms.

(10) File returned Transmittal and Acknowledgment Forms, remove and destroy the suspense copy of each Form as acknowledgment of the transmittal is received.

4.3.5 Recipients of distributions of controlled documents and partial revisions will update their documents as stated on the Transmittal and Acknowledgment Form, complete the form, and return it to the Records Management staff within the stated period of time.

4.4 <u>Revisions of Controlled Documents</u>

4.4.1 Review and Approval. Revisions to controlled documents must be performed according to specifications of QAPs or DOPs pertaining to those documents. When not specified, all revisions to controlled documents will be issued in a manner identical to the process utilized for the issuance of original documents.

4.4.2 Minor Revisions.

4.4.2.1 The authority to determine whether or not a proposed change to a controlled document is minor is delegated to the SNL NNWSI QA Coordinator. These will generally be editorial, clarifying, non-technical changes.

4.4.2.2 Minor changes to controlled documents do not require the technical, QA, and management review and approvals necessary for other revisions prior to their incorporation in the subject document.

4.4.2.3 Minor revisions may be issued with a cover (approval) page containing no other signatures than that of the QA Coordinator (indicating concurrence that the change is minor) and containing a footnote reference to other approvals appearing on the cover sheet of the last non-minor revision.

4.4.3 In addition to the steps outlined under 4.3.2, the Records Management staff will ensure that the responsible SNL NNWSI Project staff member or the SNL NNWSI QA Coordinator certify that the distribution list is current for each revision by initialing and dating the existing list or by written instruction for addition to or deletion from that list.

4.4.4 Records Management staff will maintain a historical file of originals of all controlled documents and revisions and superseded issues, and will mark copies superseded, deleted, etc., as appropriate.

4.5 <u>Controlled Document Distribution List Maintenance</u>

4.5.1 To ensure that distribution for each controlled document remains current and minimal, Records Management staff will:

(1) Revise distribution list as instructed by the responsible SNL NNWSI Project staff member or by the SNL NNWSI QA Coordinator.

(2) Recall copies in accordance with revised distribution lists.

(3) Log the return of controlled copies in the Controlled Document Distribution Log, stamp them discarded, then dispose of those copies.

4.6 <u>Controlled Documents from Other Organizations</u>

Upon receipt of a controlled document, or a revision to a controlled document generated by another organization, the document recipient will:

- Verify that the document received is that described on the transmittal form or letter, in terms of content and number identity. Directly notify the sender of discrepancies.

- Complete the receipt acknowledgment form as requested by the sender (as a minimum by signing and dating the form) and return it to the sender. Keep a copy of the form and file it under 90/1293/DOC/Q Level designator.

- Ensure the document listing is in the Records Management System Master Coding Index (if it is not correctly listed, initiate a change to the Master Coding Index).

5.0 RESPONSIBILITIES

5.1 The SNL Department 6310 NNWSI Project Records Management staff will be responsible for implementing this procedure.

5.1.2 The SNL QA Coordinator will establish the initial listing of controlled documents in the Master Document List and review the updated listings and all monitoring reports issued by the Records Management staff.

5.1.3 The responsible SNL NNWSI Project staff member who generates controlled documents and revisions or updates of these documents will provide Records Management staff with documents which have been appropriately prepared, reviewed and approved, and will provide an accurate listing of recipients for the controlled distribution lists.

5.1.4 Holders of controlled documents are responsible for acknowledging receipt of documents, for updating their copies and discarding or marking copies superseded, deleted, etc., as instructed, and for returning their copies to Records Management staff when no longer needed.

5.1.5 Users of controlled documents are responsible for determining, by reference to the Master Document List, that they are utilizing the current version of the document.

6.0 REFERENCES

6.1 References to this procedure are those Quality Assurance Procedures and Department Operating Procedures which pertain to each document listed on the Master Document List

7.0 RECORDS MANAGEMENT

7.1 The documents generated during the implementation of this procedure will be transmitted to the SNL Department 6310 NNWSI Records Center with the file code 90/1293/DOC/Q1, in addition to other file codes specified in procedures. The Master Document List will be filed under 35/1293/5.4/Q1.

APPENDIX B

.:DIA NATIONAL LABORATORIES
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::ITTAL AND ACKNOWLEDGMENT FORM

________, W/___COPIES, Organization________________

________, Organization________________

_____ (with number of text pages):________________

____

____

________ Revision ____________

___ :irected:

____e action(s) and superseded portions have been
____seded and placed in a separate location.

______________ Date:________________________

____:_______ to: SNL NNWSI Records Management Staff
Records Center, Bldg. 823, Rm. 4025A
Sandia National Laboratories
Albuquerque, NM 87185