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A PROPOSAL FOR
MCLAMS MODIFICATION

VOLUME I - TECHNICAL PROPOSAL

Prepared For
The
U.S. Nuclear Regulatory Commission
In Response to
RFP No. RS-NMS-82-034 dated
October 5, 1981

Proprietary Statement on Next Page

McLean, Virginia

November 4, 1981

P1-76.1

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NUSAC PROPOSAL RESPONSIVENESS TO RFP EVALUATION CRITERIA

Evaluation Criteria:	Weight: Based on 100 points	Responsive Sections of NUSAC Proposal:
1. Related Past Experience	Total Weight 45%	
a) Extent that the key personnel have demonstrated past experience in developing user oriented computer simulation methodology	10%	Chapter III, E; Appendix A; Appendix B
b) Extent of the general experience, education, background and prior accomplishments of key personnel which can be related to this effort	5%	Chapter III, A, E; Appendix A; Appendix B
c) Extent that key study personnel have demonstrated in-depth knowledge of statistical procedures and experience with application to nuclear material accounting	10%	Chapter I, C; Chapter II; Chapter III, E; Appendix A; Appendix B
d) Extent that key study personnel have demonstrated general knowledge of NRC regulations pertaining to licensee nuclear material accounting requirements	5%	Appendix A; Appendix B
e) Extent that key study personnel have demonstrated in-depth knowledge of the AMASS, MCLAMS and other material accounting simulation techniques	15%	Chapter II; Appendix A; Appendix B
2. Technical Approach	Total Weight 40%	
a) Soundness of the offeror's technical approach to each task and the likelihood of success for the overall effort	20%	Chapter I, A, B, C; Chapter II; Chapter III, A, I, L; Appendix B
b) Extent the proposal reflects the offeror's understanding of the Statement of Work	15%	Chapter I, A, B, C; Chapter II, A, B, C, D, E; Chapter III, F, G, Figure III-2; Figure III-3
c) Offeror's identification of any difficulties and the rationale provided to support the soundness and adequacy of proposed solutions	5%	Chapter II, E.1.b, 2.b, 3.b, 4.b, 5.b, 6.b, 7.b; Chapter III, K, L; Appendix B
3. Management	Total Weight 15%	
a) Clear definition and reasonableness of the roles and authority of the program manager and other key personnel to control cost, schedules, and technical quality	10%	Chapter I, D; Chapter III, A, B, C, D, E, F, G, I; Figure III-2; Figure III-3
b) Dedication (percentage of time per week) of all project personnel assigned to this task	5%	Chapter III, E

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CHAPTER I

Introduction and Executive Summary

NUSAC, Incorporated (NUSAC) and TS Infosystems (TSI)*, an "8(a)" firm acting as NUSAC's subcontractor, are pleased to submit this proposal for the MCLAMS Modification. This proposal is submitted to the U.S. Nuclear Regulatory Commission (NRC) in response to RFP No. RS-NMS-82-034, dated October 5, 1981.

NUSAC/TSI believes that this intercorporate team offers the advantage of bringing together the resources of two firms, each recognized for technical excellence within their own fields. NUSAC is an industry leader in the field of nuclear material control and accounting, safeguards, and quality assurance. TSI has widely recognized expertise in the design, development, and implementation of computer models, systems simulations, and computer software for a variety of technical applications.

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* TS Infosystems is a handicapped-owned minority business under the provisions of Section 8(a) of Public Law 85-536, the Small Business Act as ammended by Public Law 95-507.

The NUSAC/TSI project team integrates the best resources of both companies into a responsive, efficient organization which offers both an in-depth understanding of the requirements for the system capabilities called for and the expertise to develop and integrate such capabilities into the AMASS program.

A. Objective of the Proposed Effort

The objective of the study as stated in the RFP Statement of Work is the modification of the presently existing AMASS* software to incorporate certain capabilities now available in the MCLAMS simulation model but not in AMASS. Specifically, the AMASS software will be modified to incorporate the capability to determine an estimate for the variance of the variance of the ID, as computed by AMASS, and the capability to include known process probability distributions to model identifiable process errors.

As a secondary objective, the effort will include a determination of the conditions under which the prospective approach, using the AMASS data base including historical ID data, can be considered valid in the estimation of the parameters of the model and the inferences to be made as a result of the anlaysis.

*AMASS, the Automated Material Accounting Statistics System, was developed by NUSAC under contract to the NRC, Contract Number NRC-02-80-024 and is currently being used by NUSAC in the evaluation of Material Control and Accounting Data at selected fuel cycle facilities under Contract Number NRC-02-81-028.

B. Scope of Effort

NUSAC/TSI has concluded on the basis of the RFP Work Required statement that the scope of the project should be limited to the modification of the AMASS program and should not include modification of the MCLAMS software or merging of it with AMASS software. The AMASS modification will be to include certain capabilities now included in MCLAMS but not to include or merge MCLAMS-AMASS software.

It also should be noted that the modified AMASS computer code will be in FORTRAN G-1 which is available at the NIH Computer Center rather than the ANSI Standard X3.9-1978 FORTRAN (also known as FORTRAN 77) which is not available at NIH. The NIH staff indicated that there were no current plans to obtain the Fortran 77 capability at NIH.

NUSAC/TSI believe that the AMASS modification can be accomplished within the nine (9) person-months level of effort expended over a twelve (12) calendar month period, as specified in the RFP.

C. Summary of NUSAC's Technical Approach

The AMASS and MCLAMS methodologies represent two different approaches to the analysis of ID data. AMASS is an analytical model using general algorithms for calculating ID variances and covariances based on a comprehensive measurement error structure and using historical ID data to obtain estimates of nonmeasurement contributions to the variance of ID. AMASS also has the capability of determining the variance for sums of IDs either sequential or otherwise. On the other hand, MCLAMS is a simulation model which uses measurement control data and postulated loss mechanisms and system biases to simulate ID distributions. MCLAMS does not have the capability to address cumulative IDs but does have the capability to generate simulated distributions for ID and LEID which permit analysis of the effect of measurement system changes and of particular loss mechanisms. The AMASS program does not presently include this capability.

The NUSAC/TSI approach will be to provide this capability through an analytical methodology as recommended in the RFP rather than the simulation methodology of MCLAMS. This approach has the advantage of permitting the use of real data in real situations rather than simulation. A further advantage is that the AMASS program already is structured to contain the required data so that major software changes would not be required as would be the case if simulation methodology were to be used. During the original AMASS development, Drs. Tingey and Lumb of NUSAC suggested to NRC personnel that AMASS could be modified to provide the analytical capabilities addressed in the RFP statement of work and discussed the means to do so.

The NUSAC/TSI approach will address two specific areas of the AMASS program. One is the estimation of the variance of the ID variance and the other is the resolution of the AMASS process variance into identifiable components. AMASS provides algorithms by which estimated errors associated with basic measurement systems can be propagated to obtain the estimated variance of the Inventory Difference. The usual application of the estimated variance to the computation of "confidence limits," or "limits of uncertainty" is to simply choose an appropriate multiplier for the standard deviation from the table of the normal distribution. This ignores the fact that the basic error variances were estimates based on various degrees c freedom and results in an understatement of the confidence limit. One way to quantify the extent of the understatement is to estimate the variance of the estimated variances of the Inventory Difference. To do this it must be presumed that the degrees of freedom for each of the basic measurement variances is known. As a practical matter this may not be the case, however, approximation can usually be made in these instances. The AMASS program currently includes as output, data relevant to the computation of the variance of the variance calculation. Mathematical formula will be derived and AMASS algorithms developed using data currently in or generated by the program along with supplemental information as needed to provide the capability of generating the variances of the estimated ID variances now computed by AMASS.

With regard to an increased capability in the modeling and resulting analysis of process error, AMASS currently uses the analysis of variance and covariance of historic ID along with measurement data to arrive at these estimates. AMASS composites all process variables into a single term in the measurement model expressed as:

$$X_i = Y_i + \epsilon_i$$

where

X_i is the ID for period i

Y_i is the unmeasured inventory or process variable for the period and

ϵ_i is the measurement error as modeled by AMASS.

It is implicit to the analysis that the X_is be culled to correct for known or postulated aberrations from a stationary condition. It is desirable that the informal culling now being done with AMASS be modeled and that provisions be made for postulating probability distributions for process variable source terms and determining their effect on the estimation process and the statistics resulting therefrom.

It is proposed then to expand the basic AMASS process variables/measurement error model as given above to effect resolution of the process variable term (Y_i) into identified components, to postulate distribution parameters for the components, and to provide a formal method of adjusting the ID data for known causes and determining the error consequences of such adjustments. Thus an approach may be as follows: Assume as in AMASS

$$X_i = Y_i + \epsilon_i$$

Note in reality that

$$Y_i = \sum_{j=1}^{n} Z_{ij} ,$$

where the Z_{ij}'s are identifiable components of the total process error Y_i. These components might include unmeasured plant losses for the given inventory period, unknown systematic effects, and a residual error term. From distribution assumptions and the translation of variables, the AMASS model would be transformed to

$$X_i^* = Y_i^* + \epsilon_i^*$$

where

X_i^* represents the adjusted inventory difference for known or postulated process errors.

Y_i^* is the stationary series of residual process errors.

ϵ_i^* is the error resulting from measurement plus the error in the adjustments used to arrive at X_i^* from X_i.

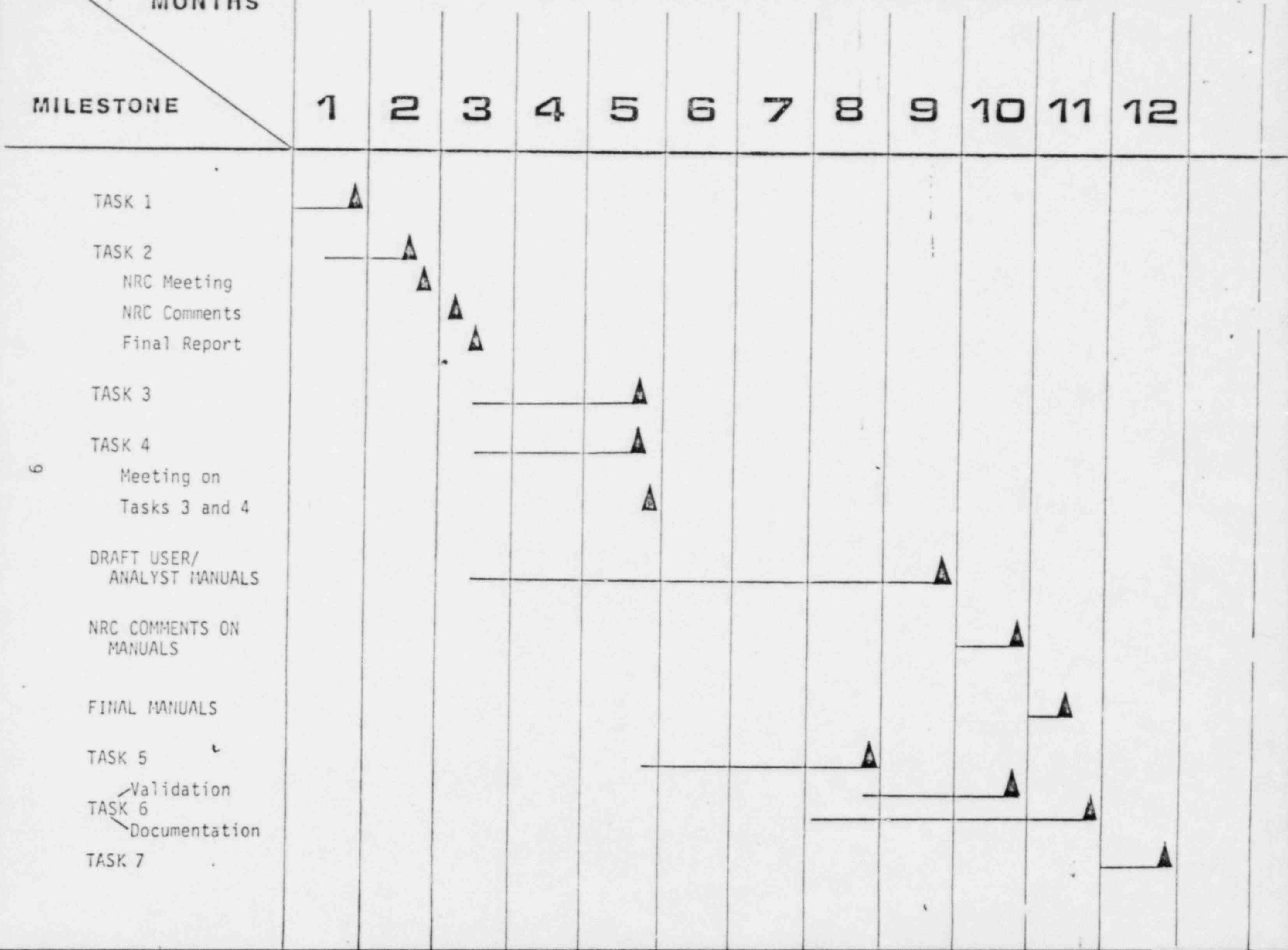
From this model and assumed distribution functions on the variables involved, using the AMASS data base and supplemental engineering estimate type data, procedures will be developed for the estimation of distribution parameters and the application, including constraints on the procedures, to the general material balance problem. Particular emphasis will be placed on utilizing the technology developed in AMASS and its computational structure supplemented by statistical techniques such as multiple regression analysis as appropriate.

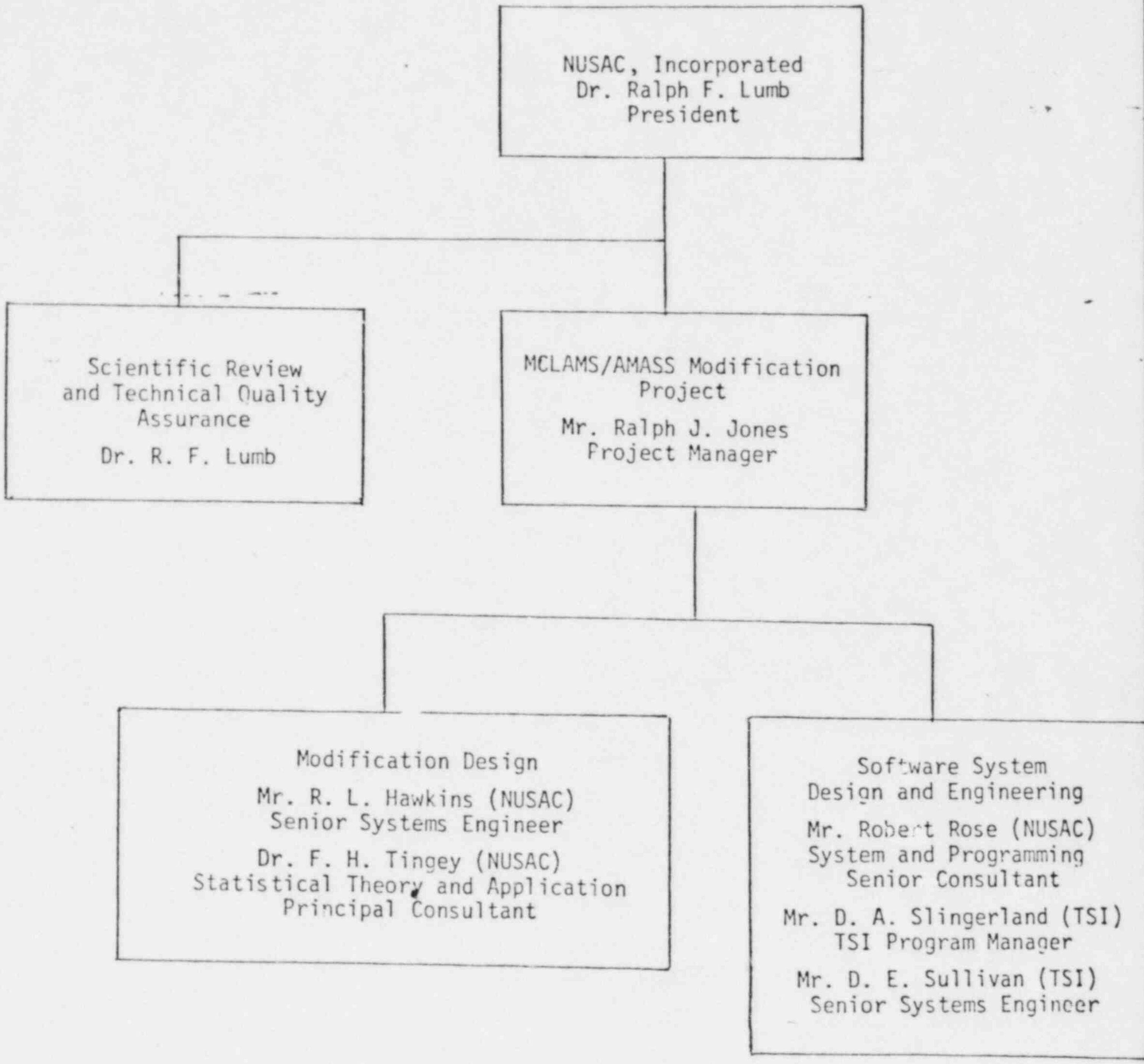
The result of this effort will be an AMASS subroutine which will be based on a resolution of the total process error into components along with the associated probability distribution; an analysis of data relevant to the model and the effect on the ID and LEID computation of various distribution assumptions for the source term; the basic assumptions and constraints associated with the analysis; and the application of the results to the world at large.

D. Summarizing NUSAC's Project Management and Staffing

Project management and scheduling will be on a task by task basis because the output of Task 2, 3, and 4 is required to be reviewed and approved by the NRC before proceeding. Figure I-1 shows the proposed project schedule and deliverable deadlines. Figure I-2 presents NUSAC's project organization and staffing for the proposed effort.

FIGURE I-1. PROJECT SCHEDULING AND DELIVERABLE MILESTONES





NUSAC/TSI MCLAMS/AMASS Modification Project

Project Organization and Staffing

Figure I-2

E. Proposal Organization

The remainder of this proposal is organized as follows:

- o Volume I - Technical Proposal
  - Chapter II: Technical Approach Task Statement of Work
  - Chapter III: Project Management Plan and Staffing
  - Appendix A: Staff Resumes
  - Appendix B: Relevant Corporate Experience
    - o NUSAC Incorporated
    - o TS Infosystems, Incorporated

CHAPTER II

Technical Approach

Task Statement of Work

A. Introduction

The AMASS and MCLAMS methodologies represent two different approaches to the analysis of ID data. Whereas AMASS is an analytical approach to the modeling and analysis of material accountability data, MCLAMS is based on simulating various loss mechanisms and determining the consequences in the ID calculation and its associated limits of uncertainty. Also, there are other basic differences. AMASS as a multi-period material accounting model facilitates the computation through error propagation of variances of inventory differences and covariances between different inventory components within an inventory period and across inventories. Thus variances of cumulative sums of inventory differences are simply a special application. It also has a capability to treat under a single model both measurement and the composited process errors and to estimate their effects on the variance calculation for individual inventory differences or sums of inventory differences. MCLAMS, on the other hand, does not model all covariances and is limited to the analysis of single material accounting periods. MCLAMS is capable, however, of simulating through Monte Carlo techniques certain process loss mechanisms and from postulated distributions determine their effect on the variance of the inventory difference. MCLAMS thus has the desirable capability of generating distributions of ID and LEID as well as facilitating the analysis of the effects of particular loss mechanisms and biases on the ID and LEID.

It was apparent during the original development of the AMASS methodology that these capabilities could be included in AMASS. Drs. Tingey and Lumb of NUSAC suggested this and outlined the preliminary mathematics and statistics that would be involved. It was, however, outside the scope of the original development work.

B. Variance of the Estimated Variance

The present AMASS program results in reports of the variance components for each inventory for each measurement type, i.e., bulk, analytical, and sampling; and a summary of variance components for all measurements, i.e, the variance of the measurement system for each inventory. From these data the limit of error of the measurement system (LEM) can be estimated. This normally is taken to be two times the square root of the variance for the 95% confidence level.

The basic error variances that have gone into these estimations are themselves estimates with various degrees of freedom. Not to take this fact into account will understate the confidence limit. One way to quantify the extent of such understatement is to estimate the variance of the estimated error variances from which the LEM was determined. To do this analytically, the degrees of freedom for each of the basic measurement variances need to be know. While these may not be known exactly, usually data exist from which reasonable estimates can be obtained.

The following discussion consists of some preliminary mathematical derivations to accomplish the estimation of the variance of the inventory difference measurement variance.

Let V_i be a variance estimate based on f_i degrees of freedom. Let σ_i^2 be its true value. Then the variance of V_i denoted by $\sigma^2(V_i)$ is

$$\sigma^2(V_i) = \frac{2\sigma_i^4}{f_i} \cong \frac{2\ V_i^2}{f_i+2} \qquad (1)$$

(Reference: Anderson and Bancroft, "Statistical Theory in Research," McGraw-Hill, 1952.

It is to be noted that equation (1) holds also for relative variance since if $\widehat{\delta}^2$ denotes the relative variance estimate and $\widehat{\sigma}^2$ the corresponding random variance estimate, then the relationship between $\widehat{\delta}^2$ and $\widehat{\sigma}^2$ is

$$\widehat{\delta}^2 = \frac{\widehat{\sigma}^2}{C} \qquad (2)$$

so that the variance of $\widehat{\delta}^2$ denoted by $V(\widehat{\delta}^2)$ is

$$V(\widehat{\delta}^2) = \frac{1}{C^2} V(\widehat{\sigma}^2)$$ which by equation 1 is

$$V(\widehat{\delta}^2) = \frac{1}{C^2} \left(\frac{2\widehat{\sigma}_i^4}{f+2}\right) \qquad (3)$$

which from (2) becomes

$$V(\widehat{\delta}^2) = \frac{1}{C^2} \left(\frac{2C^2\widehat{\delta}^4}{f+2}\right) = \frac{2\widehat{\delta}^4}{f+2} = \frac{2(\widehat{\delta}^2)^2}{f+2} \qquad (4)$$

It is also to be noted from AMASS that the variance of the Inventory Difference is of the form

$$\widehat{Var}(ID) = \sum_b a_b \widehat{\delta}^2_{rb} + \sum_s b_s \widehat{\delta}^2_{rs} + \sum_a c_a \widehat{\delta}^2_{ra} + \sum_b \sum_i S_{bi} \widehat{\delta}^2_{vbi}$$

$$+ \sum_s \sum_j S^2_{sj} \widehat{\delta}^2_{vsj} + \sum_a \sum_t S^2_{at} \widehat{\delta}^2_{vat} + \sum_b \sum_i A_{bi} \widehat{\delta}^2_{wbi} +$$

$$\sum_s \sum_j B_{sj} \widehat{\delta}^2_{wsj} + \sum_a \sum_t D_{at} \widehat{\delta}^2_{wat} \qquad (5)$$

where

$$a_b = \sum_k S_k^2 / m_{bk} \; m_k \; m_k$$

$$b_s = \sum_k S_k^2 / m_{sk} \; m_k$$

$$c_a = \sum_k S_k^2 / m_{ak} \; m_{ak} \; m_{ak}$$

$$A_{bi} = \sum_g S^2_{bi(g)} \qquad B_{sj} = \sum_{h_j} S^2_{sj(h_j)}$$

$$D_{at} = \sum_{p_t} S^2_{at(p_t)}$$

It follows then that the variance of the estimate of the variance of the Inventory Difference is

$$\hat{\sigma}^2(\widehat{Var}.ID) = 2\left[\sum_b \frac{(a_b \hat{\delta}^2_{rb})^2}{f_{rb}+2} + \sum_s \frac{(b_s \hat{\delta}^2_{rs})^2}{f_{rs}+2} + \sum_a \frac{(c_a \hat{\delta}^2_{ra})^2}{f_{ra}+2}\right.$$

$$+ \sum_b \sum_i \frac{(S^2_{bi} \hat{\delta}^2_{vbi})^2}{f_{vbi}+2} + \sum_s \sum_j \frac{(S^2_{sj} \hat{\delta}^2_{vsj})^2}{f_{vsj}+2} + \sum_a \sum_t \frac{(S^2_{ac} \hat{\delta}^2_{vat})^2}{f_{vat}+2}$$

$$\left. + \sum_b \sum_i \frac{(A_{bi} \hat{\delta}^2_{wbi})^2}{f_{wbi}+2} + \sum_s \sum_j \frac{(B_{sj} \hat{\delta}^2_{waj})^2}{f_{wsj}+2} + \sum_a \sum_t \frac{(D_{at} \hat{\delta}^2_{wat})^2}{f_{wat}+2}\right] \qquad (6)$$

It is to be noted that the quantities in parenthesis, after the summation signs in (6), are simply the AMASS components of variance in the variance of the Inventory Difference attributable to the individual basic measurement errors. Thus, if we identify the components by the letter C and use subscripts corresponding to the measurement error propagated for that component, (6) becomes

$$\hat{\sigma}^2 (\widehat{Var}.ID) =$$

$$2 \left[\sum_b \frac{C^2_{rb}}{f_{rb} + 2} + \sum_s \frac{C^2_{rs}}{f_{rs} + 2} + \sum_a \frac{C^2_{ra}}{f_{ra} + 2} \right.$$

$$+ \sum_b \sum_i \frac{C^2_{vbi}}{f_{vbi} + 2} + \sum_s \sum_j \frac{C^2_{vsj}}{f_{vsj} + 2} + \sum_a \sum_t \frac{C_{vat}{}^2}{f_{vat} + 2}$$

$$\left. + \sum_b \sum_i \frac{C^2_{wbi}}{f_{wbi} + 2} + \sum_s \sum_j \frac{C^2_{wsj}}{f_{wsj} + 2} + \sum_a \sum_t \frac{C^2_{wat}}{f_{wat} + 2} \right] \qquad (7)$$

The consequence of (7) is that the variance of the estimated measurement variance of the inventory difference is twice the weighted sum of squares of the variance components making up the variance of the inventory difference, where the weights are the reciprocals of the degrees of freedom corresponding to the measurement error propagated in that component. A similar analysis could be applied to the other error components contributing to the variance of the inventory difference.

Using these formulae with appropriate refinements to accept AMASS data and appropriate additions to process AMASS data to fit the formulae and associated assumptions, subroutines would be developed for AMASS to determine the variance of LEM. The details of the AMASS modifications are discussed later in this proposal.

C. Process Variable Analyses

In the resolution of the total process error into identifiable components, the model of Section I-C will be used as an initial approach. This model is of the form

$$X_i = Y_i + \epsilon_i$$

where X_i is the unadjusted inventory difference

Y_i is the process error and

ϵ_i is the measurement error distributed as $N(0, \sigma_{\epsilon i}^2)$.

It will be further presumed that

$$Y_i = \sum_{j=1}^{n} Z_{ij}$$

where the Z_{ij}'s are identifable components of the total process error Y_i . These components would include as separate terms unmeasured plant losses, unknown systematic effects, and a catchall residual error term which represents the stationary component (apart from random variation) of the process error.

It will be presumed that

$$Z_{ij} \longrightarrow D_j\ (\mu_{ij}, \sigma_{ij})$$

where D_j is a postulated distribution, with mean μ_{ij} and standard deviation σ_{ij}.

Thus by the transformation

$$Z_{ij} = \mu_{ij} + \eta_{ij}$$

where η_{ij} is an error term whose variance is σ_{ij}, equation (1) is equivalent to

$$X_i - \sum_{j=1}^{n-1} \mu_{ij} = \sum_{j=1}^{n-1} Z_{in} + \epsilon_i + \sum_{j=1}^{n-1} \eta_{ij} \qquad (2)$$

where Z_{in} is the residual process error component. Equation (2) is the form:

$$X_i^{\star} = Z_{ij} + \epsilon_i^{\star} \qquad (3)$$

where

$$X_i^{\star} = X_i - \sum_{j=1}^{n-1} \mu_{ij}$$

$$\epsilon_i^{\star} = \epsilon_i + \sum_{j=1}^{n-1} \eta_{ij}$$

It is to be noted that the Central Limit Theorem suggests ϵ_i^* will be distributed approximately as $N(0, \sigma_{\epsilon i}^2 + \sum \sigma_{ij}^2)$ regardless of the basic distributions D_j.

From equation (3) several approaches can be exmined. If the parameter of the base distributions, D_j, are known, then the X_i* can be determined and the AMASS process error analysis can be made on the X_i* to yield residual (Z_{ij}) process variance and covariance. These along with the measurement variances, can then be used to determine the overall ID variance or the effect on the ID variance resulting from presumed distribution parameters in the process error components. It is to be noted that the distribution parameter would be unique to an inventory period and would be treated as such in the AMASS modification.

A more complex problem is presented if some or all of the parameters of the base distributions assumed for the Z_{ij}'s $j = 1, 2...n-1$ are to be estimated. A comprehensive review of the AMASS data base and relevant supplemental information will be required in addressing this problem as well as an examination of statistical techniques such as regression analysis that might be applicable. In particular, the estimation of the distribution parameters for unknown systematic effects might yield to a step-wise multiple regression approach. [In concept, one could use for a given set of inventory difference the adjusted (for "known" losses) observed inventory differences as the independent variable and the set of quantities by measurement method, specific to the inventory period, as the dependent set.] An alternate dependent set might be the signed strata quantities as inputted to AMASS. The procedure would be then to select an "optimum" set, fit the regression equation and then use that equation with its associated error in estimating the parameters of the unknown systematic effects distribution.

These estimates, along with estimates obtained by engineering calculations for the plant losses, plus the residual process error distribution parameters and measurement error variances obtained by AMASS would give a complete set under the model of equation (2). Such would facilitate the construction of decision rules or simulations relative to inferring the statistical significance of observed inventory differences.

The result of this effort will be an AMASS subroutine which will permit the introduction and analysis of process errors in a component form and will facilitate the calculation of the effect of changes in component distribution assumptions and parameters on the ID and LEID.

D. AMASS Program Modification

AMASS has been developed in a very structured manner. Each function of the program is easily identified. This technique provides flexibility and allows easy program alterations.

Minimal changes to the existing AMASS software are anticipated. The additional capabilities will be acquired through additional programming in the form of new modules. These modules will be duly integrated with the existing AMASS as indicated in subsequent paragraphs. Whenever standard statistical subroutines such as regression analysis are required, "canned" programs will be used.

The capacity of AMASS core memory is a major factor to be considered. Any simplistic addition of programming to AMASS that would cause core overrun is not acceptable.

The additional program will be divided into several logical tasks or functions and distributed into one or more modules. The modules are independent overlays and will be loaded one at a time only when they are needed.

The modules are linked to the existing AMASS with the link facilities of the system. Each module may also include all or part of the data base the logic of the program needs to access. Modules may access the data base directly from the hard disk depending upon the core space available to each module.

System space is divided into two parts: one for the resident processes and the other for overlays. Resident processes are the programs and the data areas which are loaded at the power-up time and which are always available during run time. The resident part also includes the loader which inserts different overlays as needed. Overlays are program and data files which reside on the hard disk but which are loaded into the overlay area of core when that task is required. Loading occurs over the previous overlay which is no longer needed.

This approach has distinct advantages. Most importantly, limited memory core space can be used to write larger programs. Essentially trade-off is made between time and memory core.

Moreover, programs must be developed in a structured fashion by reducing larger tasks to smaller ones which can be readily analyzed and, thus, easily debugged. Also, future expansion is simplified through the addition of separate overlays to the system.

The formula devised for estimating the variance of the estimated variance of the inventory differences will be used to enhance the present AMASS program. This formula includes the AMASS component, namely, individual basic measurement errors. The component will be computed by the existing AMASS program. The enhancements will be computed by the additional program.

The programming associated with the resolution of the process error into identifiable components and the resulting inferences to be made will depend on the complexity of the statistical analysis. "Canned" statistical routine programs will be used where applicable in parameter estimation. Preliminary analysis indicates that the modeling can be put in the AMASS format after the resolution of process error into components. Input data adjustments coupled with corresponding changes in the decision equations will be considered in the development of the program responding to this phase of the work scope.

All of the application programs will be developed in FORTRAN G and will be compatible with IBM computer systems at NIH and Oak Ridge.

Figure II-1 is a block diagram depicting the components of the AMASS enhancement and their functional relationships.

The program will be input to the computer at NIH and tested with a known example to establish its validity. The program also will be input to the computer at Oak Ridge. Necessary debugging will be accomplished. After the programs validity and accuracy has been demonstrated, a detailed users manual will be prepared in a form which can be readily used by unsophisticated analysts. In addition, a detailed systems manual will be prepared suitable for someone familiar with AMASS and with FORTRAN who must maintain and/or make modifications to the code. While draft manuals can be submitted to the NRC upon completion of Task 2 as called for in the Statement of Work in the RFP, it would not be appropriate to submit final manuals until after validation and debugging.

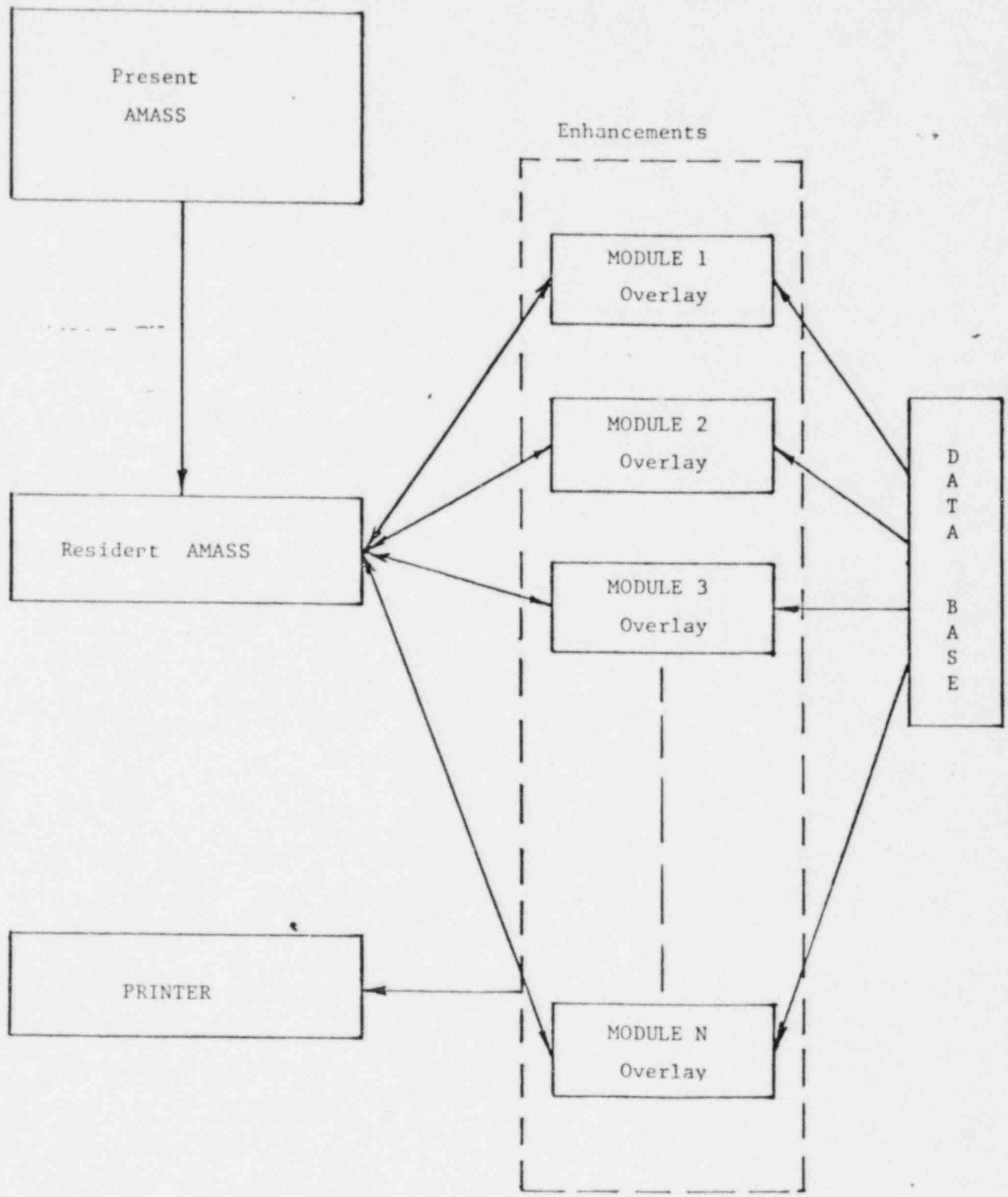


FIGURE II-1: OVERLAY TECHNIQUE

A short briefing and training course will be developed such that the initial portion will be an overview suitable for management orientation followed by detailed training to familiarize NRC personnel with the methodology and operation of the program.

E. Task Plans

The task plans which follow have been ordered to correspond with the tasks specified in the Request for Proposal for MCLAMS Modification (RFP No. RS-NMS-82-034).

1. Task 1 - Review of Literature.

   a. Task Approach

      Task 1 will involve review of MCLAMS and AMASS and pertinent literature and correspondence applicable to the project. The basic documents are those listed in the RFP. A most significant document, the memo from M. Messinger to Ted Sherr of July 29, 1981, on "Intergration of AMASS and MCLAMS" will be discussed in depth with the NRC Project Officer. This document provides the basic ideas for this project and will be used as such with expansion and elaboration as needed, based on interaction with the NRC Project Officer and others. The other documents will be used to provide a technical, mathematical and system methodology base on which to build the system enhancements called for in the RFP.

b. Anticipated Problem Areas

NUSAC anticipates no problems with this task. NUSAC personnel are fully knowledgeable of the AMASS methodology documentation because it was a NUSAC development. They also are knowledgeable of MCLAMS as a result of the AMASS project. Further, NUSAC personnel and consultants contributed to many of the other referenced documents.

2. Task 2 - Methodology Development.

a. Task Approach

The development of the AMASS modification will be based primarily on the concepts postulated in the Messinger to Sherr memo of July 29, 1981. These concepts will be amplified along the lines discussed in the preceding Sections B and C of this Chapter on the basis of discussions during and experience gained in the development of the original AMASS principles.

Finite mathematical formula will be derived from the postulated concepts to address the two additionalcapabilities, i.e. variances of estimated variances and analysis of process variables. Data requirements for these formulae will be identified in relation to the current AMASS data bases and out it reports and in relation to additional data t t will need to be input. The source, structure, and treatment of these additional data will be addressed.

b. Anticipated Problem Areas

Given timely review and approval of the results by the NRC, NUSAC anticipates no problems with this task. NUSAC personnel are fully knowledgeable of the basic objectives desired because both Drs. Tingey and Lumb as well as others at NUSAC contributed to the development of the approach and to some of the basic mathematical statements.

c. Task Products and Results

The primary product of this task will be a report detailing the mathematical theory and detailed model for the modifications to the AMASS program. The report will be submitted in draft to the NRC Project Officer for review and comment before proceeding with subsequent tasks.

3. Task 3 - Information Flow Development.

a. Task Approach

Based on the indentification of data needs resulting from Task 2, information flows will be developed to

b. Anticipated Problem Areas

A primary problem with such a task is developing the design in sufficient detail to permit accurate and logical coding of the program. This problem should be avoided by continuing liaison between NUSAC personnel and TSI personnel as the model is developed. The NUSAC experience in the development of the original AMASS program should preclude significant problems in thjs area. Given timely review and approval by NRC, NUSAC/TSI anticipates no major problems for this task effort.

c. Task Project and Results

The product of this task will be information flow charts defining the program modules for the enhanced AMASS capabilities. These information flows will be documented for internal use and serve as design specifications for the computer code modification. They also will be included in the systems manual. They will be submitted to the NRC Project Officer for review and approval. All documentation shall be in conformance with NRC Manual Chapter Bulletin 0851-1, i.e., ANSI Standard N-413.

4. Task 4 - Data Coding.

a. Tasks Approach

The effort for this task will be the development of coding sheets for the additional data inputs integrate data currently in or produced by AMASS with additional data required for the enhanced AMASS capabilities. There will be a need to integrate degrees of freedom data not now included in AMASS with variance data presently in the AMASS data base and reports to permit calculation of the variance of the estimated variances. In addition, there will be a need to identify and detail different information flows in the present AMASS subroutine UNMEAS to include known process variables and/or to include the results of regression analyses or other analyses which may be used to estimate process variable components. Flow charts and descriptive narrative will be developed to permit technical review to assure that subsequent computer program changes are appropriate and correct. Close liaison will be maintained between NUSAC personnel developing the mathematical principles and TSI personnel who will assist in developing information flows and who will subsequently modify the computer programs. The resulting documentation will be submitted to the NRC Project Officer for review and approval prior to proceeding with the computer code revisions of Task 5.

required for calculating the variance of the estimated variances and for inputs for the enhanced process variable calculations. The information flow charts developed in the prior task will have identified the data inputs and their interface with present AMASS data files. The coding sheets will be designed to fit the information flows required. These may be separate code sheets as well as possibly revisions of code sheets currently used for AMASS input.

Additional, as well as revised, output reports will be designed to display the results of the enhanced AMASS capabilities to facilitate evaluations and interpretation of the enhanced program outputs. Outputs could include, reports such as the variance of the estimated variances, a decomposition of the process variability into known and residual components and a report of total variance similar to the current AMASS Report 18. The code sheets and report contents and formats will be submitted to the NRC Project Officer for review and approval.

b. Anticipated Problem Areas

Given timely review and approval of the results of this task effort by NRC, NUSAC anticipates no problems in this area. The NUSAC experience in developing and revising code sheets and output formats in the original development program should preclude significant problems.

c. Task Products and Results

The results of this task effort will be additional and/or revised coding sheets and output report formats to accommodate the enhanced AMASS capabilities. These will be approved by the NRC Project Officer and will be included in both the systems manual and the user/analyst manual. All documentation will be in conformance with NRC Manual Chapter Bulletin 0851-1, i.e. ANSI Standard N-413.

5. Task 5 - Code Modification.

a. Task Approach

The effort for this task will be modification of the AMASS computer software to include the enhanced capabilities. With the use of detailed information flow charts from Task 3 and the data input sheets and report formats of Task 4, this task should be a straightforward programming effort. The critical consideration will be to make changes to assure the conservation of core space so that the program can be run at NIH. There are several alternatives that will be considered to accomplish this conservation, including modular overlays, and job step operation. Before this task milestone is reached it is anticipated that some maintenance effort under the original contract will have been accomplished which is expected to reduce core usages and simplify the present task. If this has not been done there are alternatives still available. It should be noted that the program will be written in Fortran G-1 as is the original AMASS program. The ANSI Standard X3.9-1978 Fortran (also known as Fortran 77) specified in this RFP is not currently available at NIH. The NIH staff indicated that there were no current plans to obtain that capability.

b. Anticipated Problem Areas

NUSAC/TSI anticipate no major problems in this area. The most critical aspect is core conservation. There are several alternatives to consider in this area all of which will be evaluated. Program maintenance work during the interim before the programming task is reached may simplify the effort in this area.

c. Task Products and Results

The result of this task effort will be a revised AMASS code to permit calculations of variances of estimated variances and treatment of known or estimated parameters of process variability. The revised code will be ready for the test and validation of Task 6.

6. Task 6 - Establishment Testing and Validation of Operation Programs.

a. Task Approach

The effort for this task will be testing and validation of the revised code and installations of operational copies on the NIH IBM 370 and on the Oak Ridge IBM 360 computer systems. Validation and testing will be accomplished through the use of a multi-period example. This example will be developed by extension of the examples used to validate the original AMASS program. The revised examples will be submitted for review by the NRC Project Officer prior to use. The criteria against which the revised program will be tested and validated follow:

The program shall:

(1) duplicate computational results produced by the manual exercise of the revised AMASS model using the extended three-period test example and

(2) compile successfully on both the NIH IBM 370 and the Oak Ridge IBM 360 computer systems and be compatible with the security requirements of the Oak Ridge facility.

b. Anticipated Problem Access

The only significant problem that NUSAC/TSI anticipates in this area is possible difficulty in reading the program onto the Oak Ridge Computer system using the NRC remote facilities in Silver Spring. Some difficulty was experienced in this area with the original AMASS program such that card decks were taken to Oak Ridge and loaded directly. No plans have been made for travel to Oak Ridge but card decks can be sent to Oak Ridge if the remote facility use is not successful. Given timely review and approval of the test examples by the NRC Project Officer and based on the NUSAC experience in validating the original AMASS program a smooth and expeditious test and validation is expected.

c. Task Products and Results

The result of this task will be tested and validated modifications of the AMASS program to include the enhanced capabilities to treat variances of estimated variances and to treat known and estimated components of process variability. As a means of transferring use of the revised program to the NRC the following documentation will be provided:

(1) Coding Sheets

(2) Source code listings for the NIH and Oak Ridge computer facilities

(3) A verified card listing of all source cards.

(4) Computer tapes of source codes for the NIH and Oak Ridge computer facilities. (These tapes may remain in the respective computer facilities tape libraries).

(5) Compiled object codes resident on disks of both computer facilities.

(6) Documentation of the sample test cases and results used in the validation of the computer software.

(7) Suitable card decks to permit access to and modification of the code.

In addtion to the above, final systems manuals and users/analyst manuals will be provided. Although these manuals will be provided in draft, based on the efforts of Tasks 2 through 5, the final manuals cannot be prepared until this program validation is completed. Documentation shall be in accordance with NRC Manual Chapter Bulletin 085-1, i.e. ANSI Standard N-413.

7. Task 7 - Training.

a. Task Approach

Based on the NUSAC experience in the training and briefing efforts of the original AMASS development, NUSAC will prepare briefing material for NRC management overview of the enhancements to AMASS and more detailed training for NRC personnel who may need to use the program in actual evaluations. All course and briefing materials will be submitted to the NRC Project Officer for review and approval before use. Schedules for the briefing and training will be developed on a mutually agreeable basis between NUSAC and the NRC Project Officer.

b. Anticipated Problem Areas

Based on the NUSAC experience in training and briefing courses for the original AMASS development no problems are anticipated in this area.

c. Task Products and Results

The product of this task effort will be an NRC management briefing on the AMASS enhancements, and their use and a training course for NRC personnel who need to use the AMASS program in facility evaluations or in other ways.

CHAPTER III

Project Management Plan and Staffing

This Chapter presents the following information and data pertinent to the evaluation of the proposed effort.

- Project Management Concept
- Cost Control and Management Project Resources
- Documentation of Project Contingencies
- Project Organization and Staffing
- Key Personnel and Other Staff
- Project Schedule and Deliverable Milestones
- Estimated Distribution of Level of Effort by Project Staff and Task
- Government Furnished Equipment
- Technical Quality Assurance
- Limitation of Liability
- Statement of Concurrence
- Contingencies and Special Situations
- Potential for Conflict of Interest

A. Project Management Concept

Over the past two years during the AMASS Development (Contract NRC-02-80-024) and the subsequent AMASS field testing in the

Evaluation of Fuel Cycle Facilities (Contract NRC 02-81-028) NUSAC has evolved a highly responsive and efficient project management organization, specifically tailored to support all present and future AMASS work.

This organization and its management and technical personnel have worked closely with their counterparts in the NRC Office of Nuclear Safety and Safeguards (NRC/ONMSS) and the NRC Division of Contracts to resolve both technical and contractual contingencies and to deliver a product (the AMASS Software and its Documentation) of the very highest technical quality and utility. The high degree of responsiveness of this management organization has been due in large measure to the close involvement of the project manager (PM) with the technical as well as the administrative functions of the contract effort. The NUSAC PM has also been the Principal Investigator (PI) for all AMASS-related work. Previous AMASS projects have also benefited significantly from the very short chain of management from the AMASS PM/PI to NUSAC's President, Dr. Ralph F. Lumb. Dr. Lumb also serves as the Technical Quality Assurrance (TQA) Officer for the AMASS effort. In his dual role as TQA Officer and Chief Executive Officer of the Corporation, Dr. Lumb has demonstrated his unique ability to resolve seemingly difficult technically related contractual problems to the mutual satisfaction of the NRC and NUSAC in a remarkably short period of time. Such responsiveness is normally rare in larger companies.

NUSAC intends, for the proposed MCLAMS Modification effort, to continue this project management concept which has been evolved over the past two years through the above referenced AMASS-related contracts. Accordingly, Mr. Ralph J. Jones, currently the PM/PI for NRC-02-80-024 and NRC-02-81- 028, will serve as the PM/PI for the proposed MCLAMS Modification effort. Mr. Jones will also remain the active PM/PI for the two currently on-going AMASS-related efforts, '80-024 and '81-028. In this way, NUSAC will preserve both the project management and principal technical continuity of all AMASS-related activities for the NRC. Assuming NRC acceptance of NUSAC's proposal and award of the proposed effort to NUSAC, Mr. Jones will be dedicated almost entirely full time to the direction of technical activities which support the further refinement, validation, and implementation of AMASS within the nuclear community.

Mr. Jones will continue to report directly to Dr. Ralph F. Lumb, NUSAC President, who will continue to serve as the Technical Quality Assurrance Officer for all AMASS-related work.

As with the current AMASS projects, Mr. Jones' authority and responsibility as PM/PI will include but may not be limited to the following:

- Organization, direction, and control of all project resources to accomplish technical and contractual objectives of the proposed effort.
- Adequate professional staffing of the proposed effort.
- Timely delivery of all required technical and administrative reports, technical documentation, and computer software.
- Maintenance of adequate project technical, administrative, and contractual records (support provided by NUSAC's Manager of Accounting).
- Technical quality of all work and deliverables (support provided by the project's TQA Officer).
- Recognition and prompt resolution of all technical and administrative contingencies and problems.
- Representation of NUSAC in all matters of technical negotiation before the NRC.

B. Cost Control and Management of Project Resources

During the past two years, NUSAC's experience in the financial management of government cost re-embursable contracts has resulted in significant evolutionary improvements in its accounting system. These improvements have benefited not only the management of government contracts, but also the management of commercial contracts.

Most significant is a cost-reporting procedure which guarantees that each NUSAC PM will have a report on Tuesday morning which indicates all accrued project expenses (i.e., direct labor, overhead, other direct costs, G&A, fee) as of Friday of the previous week. This means that each NUSAC PM will be within one working day of current accrued charges for his project every Tuesday.

Additionally, each NUSAC PM is informed automatically by accounting when 70% of project resources have been expended. PM's are then subjected to a senior management audit and are required to perform a "cost-to-complete" analysis for projects.

These new procedures were implemented some three months ago with very favorable results. NUSAC has also augmented its WANG Word Processing System with a mathematics package and is currently working with this system to automate the project management reporting system described above.

C. Documentation of Project Contingencies

NUSAC has been complimented by the NRC Division of Contracts and by the NRC PO on its diligence and thoroughness in documenting project contingencies and problem areas, and on its proper exercise of the formal channels of technical and contractual communications during the current AMASS-related contracts.

NUSAC understands the importance of this documentation process and will continue the practice during the proposed MCLAMS Modification.

D. Project Organization and Staffing Plan

Figure III-1 (also shown as Figure I-2) presents NUSAC's project management organization and staffing plan for the proposed effort.

It is important to note that although TS Infosystems (TSI) will be acting as a subcontractor to NUSAC for software development, the TSI project team will in fact be integrated as a component of the NUSAC project organization in order to facilitate communication with those NUSAC personnel who have designed AMASS and its modifications as required by this RFP.

E. Key* Personnel and Other Staff

NUSAC proposes to use the same key personnel who are working on NUSAC's two current AMASS-related efforts. These individuals are:

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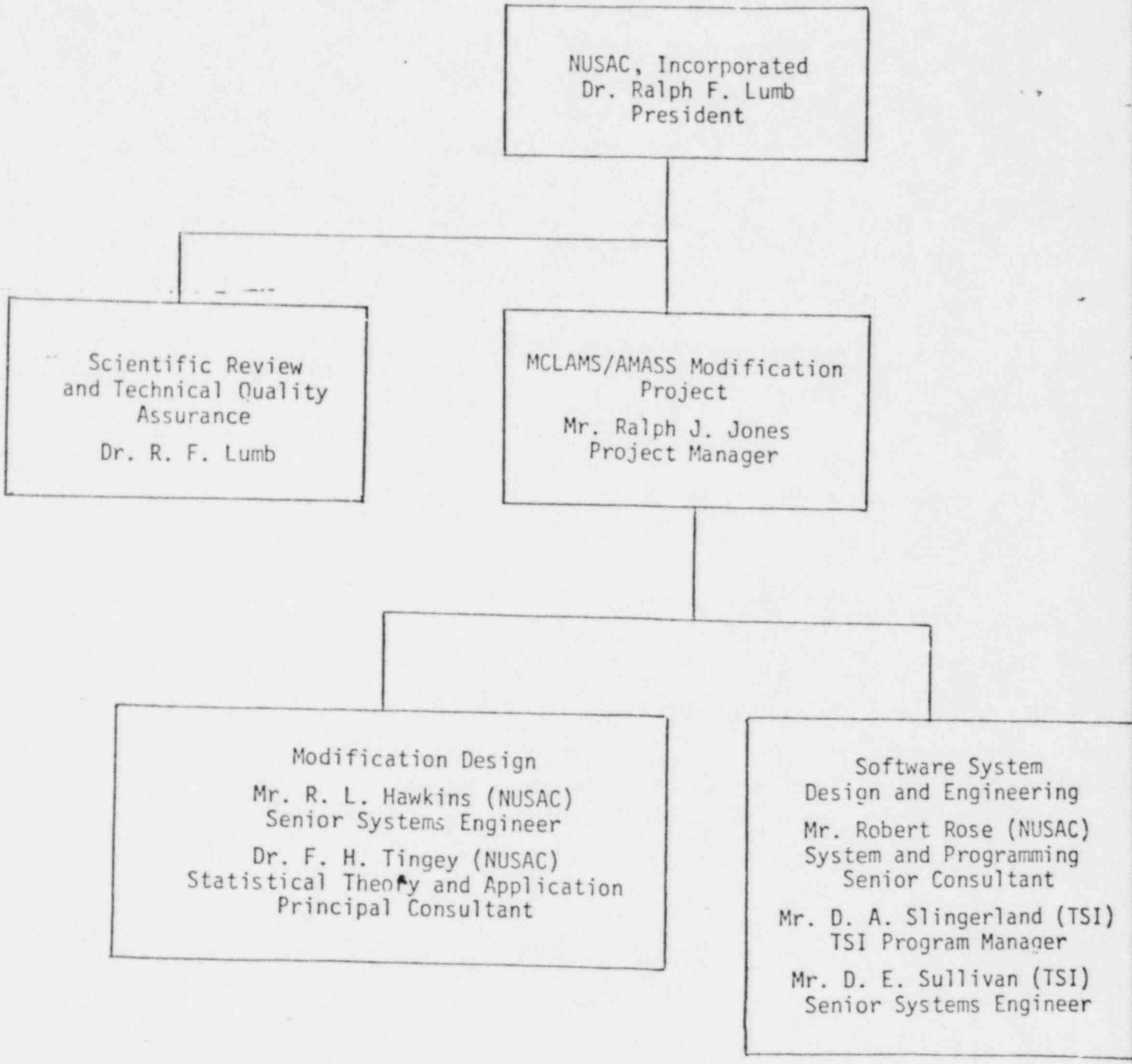
*NUSAC understands and accepts that the term "Key Personnel" is precisely defined in the RFP under Article VI, page 35 of 50, and understands and accepts that the designation of key personnel in this proposal is subject contractually to the provisions of this definition.



NUSAC/TSI MCLAMS/AMASS Modification Project

Project Organization and Staffing

Figure III-1

- o Mr. Ralph J. Jones - Project Manager/Principal Investigator
- o Mr. Ron L. Hawkins - Nuclear Material Control and Accountability Systems Engineer
- o Dr. Fred H. Tingey - Consulting Mathematical Statistician; Developer of the AMASS Mathematics
- o Dr. Ralph F. Lumb - Senior Scientist, Nuclear Safeguards/Material Management; Technical Quality Assurance Officer; NUSAC President

The professional qualifications, past experience, and ongoing work and contributions to the current AMASS-related efforts of each of the above individuals is well known to the NRC and in particular to the NRC Office of Nuclear Materials Safety and Safeguards. NUSAC is pleased to present these individuals once again as key personnel on the proposed effort. Resumes of each of these individuals and other nonkey professionals are included in Appendix A to this proposal.

In addition to the above NUSAC personnel, NUSAC names the following TS Infosystems professionals as key personnel:

- o Mr. Douglas A. Slingerland - Software Development Program Manager for TS Infosystems, Inc. (under subcontract to NUSAC)
- o Mr. David E. Sullivan - Senior Software Systems Engineer for TS Infosystems, Inc. (under subcontract to NUSAC)

Resumes of each of these individuals are also included in Appendix A.

Other TSI personnel who may be expected to work on the proposed AMASS Software modification are:

- o Mr. Larry A Liesner - Software Systems Analyst
- o Mr. Chet Bhimani - Senior Programmer

NUSAC also proposes to use as a software quality assurance oversight reviewer, its own consultant, Mr. Robert Rose, Consulting Senior Software Systems Engineer.

Resumes of all of these individuals are included in Appendix A.

In response to RFP Evaluation Criteria 3.b), NUSAC has determined that the key project personnel and other TSI personnel will, throughout the 52 week life of the project be dedicated from 10% to 30% of full time per week depending upon the individual and the particular task being performed.

Average, uniform distribution of labor hours per person per week is not a realistic way of perceiving the commitment of personnel because of the potential for great variance in percentage month to month based upon the task or tasks being executed.

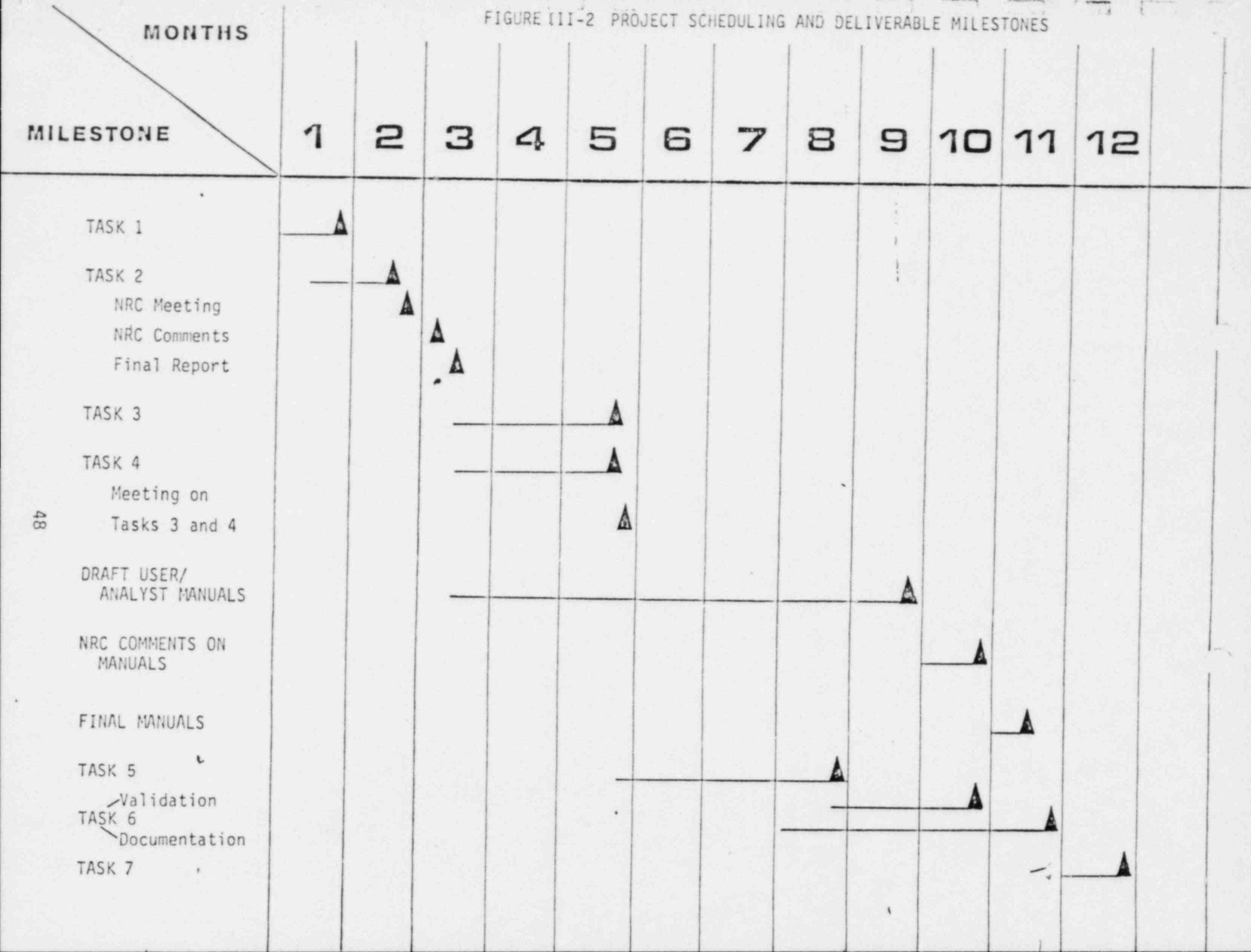
F. <u>Project Schedule and Deliverable Milestones</u>

Figure III-2 (also shown as Figure I-1) shows the schedule of project task performance and contract-deliverable milestones for the proposed effort.

G. <u>Estimated Distribution of Level of Effort By Project Staff and Task</u>

Figure III-3 presents a distribution of professional labor hours by project staff and tasks. NUSAC estimates that the proposed effort can be accomplished in nine (9) full man-months of professional effort or 0.75 man-years. Using a full 2080 man-hours per man-year, NUSAC estimates that its team can accomplish the objectives and requirements of the proposed effort in 1,560 man-hours.

FIGURE III-2 PROJECT SCHEDULING AND DELIVERABLE MILESTONES



PROJECT STAFF \ PROJECT TASK	1.	2.	3	4	5	6	7	Total Labor Hours By Staff
Mr. Ralph J. Jones Project Manager/Princip.Inv(NUSAC)	20	20	20	20	20	20	20	140
Mr. Ron L. Hawkins NUC MAT Control & Acct. Syst.Egn.(NUSAC)	-	20	20	20	20	30	20	130
D. Fred H. Tingey Mathematical Statistician (NUSAC)	30	40	40	-	40	40	20	210
Dr. Ralph F. Lumb (Sr. Scientist/TQA Officer (NUSAC)	10	10	10	-	-	10	10	50
Mr. Robert Rose (NUSAC) Software Systems Engineer& Software TQA	-	20	40	40	40	40	-	180
Mr. Douglas A. Slingerland Software Development Proj. Mgr. (TSI)	-	-	20	-	40	20	-	80
Mr. David E. Sullivan Software Systems Engineer (TSI)			30	25	120	40		215
Staff Senior Programmer (TSI)			40	-	305	30		375
Staff Software Systems (TSI) Analyst			10		40	30		80
Staff Software Documentation Specialist (TSI)			20	20	60			100
Total Labor Hours By Task	60	110	250	125	685	260	70	1560

FIGURE III-3

ESTIMATED LEVEL OF EFFORT DISTRIBUTION

BY PROJECT STAFF AND TASKS

Clerical and administrative effort are accommodated in NUSAC's DCAA-audited overhead and G&A; therefore, such support is not costed as direct labor.

H. Government Furnished Equipment

NUSAC understands that the AMASS software as it currently exists on both the NIH and Oak Ridge computer facilities will remain available to the Company and its project team on the same basis as for the two current AMASS-related efforts. Additionally, NUSAC understands that the NIH interactive account which has been established for the current AMASS-related efforts will continue to remain active.

I. Technical Quality Assurance

As with NUSAC's current AMASS-related projects, Dr. Ralph F. Lumb, NUSAC President and Senior Scientist, will serve as the Technical Quality Assurance (TQA) Officer for the proposed effort. As TQA Officer, Dr. Lumb will routinely monitor the work of the project team and will continue to be available to NRC cognizant technical personnel as required to assist in the resolution of technical difficulties. NUSAC will confirm to the requirement for technical quality assurance as stated in paragraph G, Article I - Statement of Work, RFP page 33 of 50.

J. Limitation of Liability

Subject to the limitation hereinafter provided for, NUSAC, Incorporated shall indemnify client, its officers, directors, employees, and agents from and against any and all demands, claims, suits, or causes of action of every kind and nature whatsoever including, but not limited to, those causes of action for bodily injury, including death to person or persons, and damage to any and all property caused by NUSAC's negligent acts, errors, or omissions in the performance of its work pursuant to the contract; provided, however, that in no event shall NUSAC be liable to client for special, consequential or penal losses or damages, including but not limited to losses, damages or claims related to the unavailability of a plant, shut downs or service interruptions, loss of use, profits or revenue, inventory or use charges or costs of capital or claims of client's customers; and it is understood that NUSAC's liability hereunder shall be limited to the amount of the insurance coverage required to be maintained by NUSAC hereunder (with respect to insured claims), or to the amount of the contract price paid or payable by client for services performed (with respect to uninsured claims or in the event that such contract price shall be greater than the amount of insurance coverage required hereunder), and client shall indemnify NUSAC, its officers, directors, employees, and agents with respect to demands, claims, suits, or causes of action, for any sums in excess thereof.

All subrogation rights of client, its officers, directors, employees and agents, shall be subject to the provisions of the preceding paragraph.

K. Statement of Concurrence

NUSAC concurs with the NRC in the objective, tasks of the statement of work, and in the level of effort and project duration estimates for successful completion of the proposed effort.

L. Contingencies and Special Situations

NUSAC's experience with the current AMASS-related work indicates that there could possibly arise unforeseen situations which could adversely affect the performance of project tasks. However, given the base of knowledge gained by the proposed NUSAC project team through the current AMASS-related efforts, together with the present state of the AMASS software, NUSAC believes that the probability of occurrence of such contingencies is quite low.

An additional argument to support the position of a low occurrence probability of contingencies is with regard to new mathematical development required to satisfy RFP requirements. NUSAC has already foreseen these requirements for AMASS modification and already possesses the mathematical bases from which these modifications will be derived.

M. Potential for Conflict of Interest

Experience which both NUSAC and the NRC have gained during the two current AMASS-related efforts demonstrates conclusively that no conflict of interest exists or has existed for NUSAC under the definition supplied in 41 CFR 20-1.5402(a). This situation should not change for the proposed effort; therefore, NUSAC is aware of no situation which presently exists or is likely to exist in the future which could result in a conflict of interest.

APPENDIX A

STAFF RESUMES

(Resumes have been deleted as proprietary information.)

APPENDIX B: RELEVANT CORPORATE EXPERIENCE:

- NUSAC, Incorporated
- TS Infosystems, Incorporated

NUSAC, INCORPORATED

RELEVANT CORPORATE EXPERIENCE:
NUSAC, INCORPORATED

NUSAC, Incorporated and its professional staff - especially the designated key personnel for the proposed MCLAMS modificatior are well-known to the NRC Office of Nuclear Material Safety and Safeguards (NRC/ONMSS) through two currently on-going AMASS-realted contracts:

- o AMASS Development (Contract No. NRC-02-80-024)
- o Evaluation of Material Accounting Performance at Nuclear Fuel Cycle Facilities (Contract No. NRC-02-81-028)

1. AMASS Development (Contract No. NRC-02-80-024)

AMASS Development, begun in June, 1980 and currently ongoing, involved the mathematical derivation, software development, and test and validation of an advanced material accounting system which could compute all contributors to inventory difference and the variances of such contributors. Additionally, innovative aspects of AMASS design were the accommodation of covariant relationships among a series of inventory periods and the computation of unmeasured process variability as a means by which the potential for theft or diversion may be tested. Another innovative aspect of AMASS was the method by which inventory difference data are organized for input to the program.

AMASS departs significantly from it predecessor, MCLAMS, in that AMASS uses no Monte Carlo simulation mechanism to generate inventory difference variances or covariances. All computations are made using analytical expressions which accept conventionally available input data from a variety of different types of fuel fabrication facilities. Thus is AMASS spared the weakness of having to assume theoretical probability distributions of inventory difference data. As indicated in the present RFP, the analytical approach is preferred to a Monte Carlo approach by the NRC.

AMASS was tested and validated using a specially designed set of data which was based upon actual data collected from several fuel fabrication facilities. This test data was required in order to validate all aspects of the AMASS computational capabilities. No single set of data from one full fabrication facility was found to be sufficiently comprehensive to test the AMASS mathematics in their entirety. The AMASS software was mounted at the NIH Computer Facility in Bethesda, Maryland for unclassified data and on the Oak Ridge Computer Facility to accommodate classified data.

The AMASS concept and mathematics were presented to the nuclear industry at the 22nd Annual Meeting of the Institute of Nuclear Materials Management (INMM) in San Francisco through a joint paper presented by Dr. Martin Messinger, NRC PO for the AMASS Development and Drs. Ralph H. Lumb and Fred H. Tingey of NUSAC.*

The response from private industry over the potential for the use of AMASS and its data input requirements as a future MC&A standard appeared to be most favorable.

On October 27, 1981, the NUSAC Project Manager/Principal Investigator, Mr. Ralph J. Jones demonstrated the AMASS program using data from the Babcock and Wilcox Plant in Lynchburg, Virginia to a group of NRC managers and senior technical professionals. The reception to this highly user-oriented system which is controlled by a desk-top portable computer terminal was most gratifying.

A contract modification awarded to NUSAC in September requires the development of MC&A guidance based upon the experience gained in building and testing AMASS. The results of this guidance may ultimately serve as inputs for the development of improved standards for MC&A. Preliminary indication gained by NUSAC from its contacts in the nuclear industry indicate that such standards development would be well-received.

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* M. Messinger, R.F. Lumb, and F.H. Tingey, "Automated Material Accounting Statistics System (AMASS)." Proceedings of the 22nd Annual Meeting of the Institute of Nuclear Materials Management, Volume X, July 13-15, 1981. pp. 125-131.

2. Evaluation of Material Accounting Performance at Nuclear Fuel Cycle Facilities (NRC-02-81-028)

In December, 1981, NUSAC was awarded a two-year effort to evaluate the MC&A performance at seven commercial fuel fabrication facilities using the AMASS software.

This project afforded the NRC a unique opportunity to have a heretofore untried MC&A computer program tested and evaluated under field conditions both for accuracy, reliability, utility, and ease of implementation. In effect, this contract would force NUSAC, the AMASS developer, to live with its creation, and if necessary to correct significant faults which adversely impacted its use to satisfy the contract. As a management control device, this strategy worked successfully for the NRC PO, Dr. Messinger. In the course of formatting input data for the first facility, NUSAC recognized certain deficiencies in the efficient management of the required core usage. These deficiencies were corrected by NUSAC project personnel. Additionally, NUSAC recognized other opportunities for improvement of the AMASS software. These opportunities were documented and reported to Dr. Messinger. NUSAC is gratified to see that many of the recommendations that its project team made for AMASS improvements have been accommodated in the present RFP.

To date, NUSAC has visited three facilities:

- NFS - Erwin, Tennessee
- Babcock and Wilcox - Lynchburg, Virginia
- Exxon Nuclear - Richland, Washington

A final report on NFS has been prepared, submitted, and briefed to the NRC. Reports for Babcock and Wilcox and Exxon are in process. By the end of 1982, NUSAC expects to have completed AMASS evaluations of four additional facilities.

Additionally, NUSAC was awarded a contract modification in September to study shipper-receiver differences using the AMASS methodology. Also presently under negotiation is a contract modification for routine maintenance of the current AMASS software.

3. A Synergy in AMASS-Related Effort

The award of the proposed effort to NUSAC offers the government certain unique and obvious advantages which cannot possibly be obtained with another contractor. Foremost is the base of experience which the NUSAC project team (designated for the proposed effort) has built up after nearly two years of work designing, testing, and implementing AMASS in the field. NUSAC has not only built a "corporate" base of experience, but also has managed to maintain a continuity of key personnel who have demonstrated their dedication to the success of AMASS. This continuity of key personnel extends from NUSAC's President through the Division Manager, PM/PI, and the architect of the AMASS methodology, Dr. Fred H. Tingey.

Added to this base of AMASS contract experience and key technical personnel must be NUSAC's reputation as one of the nuclear industry's leading and most respected nuclear material management organizations. NUSAC's standing as a practical innovator in the field of MC&A technology together with the personal reputations of the key project personnel have insured an unprecedented degree of industry cooperation and enthusiasm for the AMASS program. Moreover, NUSAC suggests that the future cooperation of industry by way of acceptance of improved MC&A standards and/or the adoption of AMASS as a standard MC&A system may well be influenced by NUSAC's good offices.

Finally, NUSAC has made a significant long-range planning commitment to its parent company, the Wackenhut Corporation to become the world's leading firm in nuclear MC&A technology. As a result, NUSAC believes that it has a significant investment in the cadre of key personnel who are performing the current AMASS work and who will perform the proposed project. NUSAC is committed to preserving this investment and its professional reputation; therefore, the NRC can be expected to benefit significantly from the level of dedication which will be shown in support of the entire AMASS program.

TS INFOSYSTEMS, INCORPORATED

CORPORATE CAPABILITIES:

TS INFOSYSTEMS, INC.

TS Infosystems, Inc. is a handicapped-owned/operated small business management, engineering and scientific firm specializing in the provision, configuration and management of information systems and research services. TSI was originally formed in 1976 to provide reprographic and micrographic services. Since its inception, the company has grown steadily and diversified its operations to include communications systems, information storage and retrieval systems, and aerospace and energy applications. TSI currently employs approximately 100 people in its various operating divisions, with annual sales estimated at two million dollars.

Certified by the Small Business Administration (SBA) under the authority of Section 8(a) of the SBA regulations, TSI is eligible to contract with Federal agencies on a limited competition or sole source basis. Accordingly, TSI's operational philosophy and objectives are to develop business areas that provide for the maximum employment potential for disadvantaged Americans.

Believing that any organization's most valuable assets are its human resources, TSI has placed a strong emphasis on opportunities for professional growth and development. The success of these efforts is reflected in the steady expansion of TSI over the past four years.

TSI has structured its business growth around the provision of diversified research and information products and services to clients in both the government and private sector. This approach has enabled TSI to develop significant capabilities in high technology areas, including hardware fabrication, as well as labor intensive and production oriented services.

TSI's two primary operating divisions, Advanced Office Information Services and Technology Systems, provide a diversified, professional approach to the solution of information management problems in addition to research and development activities in such areas as energy, communications, social science, program design and evaluation, and training. TSI's capabilities are so structured as to permit the utilization of new and different technologies to improve efficiency, performance and to reduce overall costs.

TSI realizes that externally, a client generally sees only the products of such efforts. Therefore it is of the utmost importance that we deliver a high quality product in as short a time as possible. We are committed to client satisfaction measured by these criteria.

The following sections briefly summarize TSI's background and experience.

IN HOUSE CAPABILITIES

TSI maintains its corporate offices on three floors of the Annapolis Federal Savings and Loan Building in Oxon Hill, Maryland.

In addition to general administrative offices, this facillity supports a complete micrographics center capable of providing total micrographics services for TSI's contract operations. TSI's corporate records and files are also processed through this center, reflecting TSI's total commitment to the use of microform media not only as a corporate product but also as a successful management tool incorporated into its own operations.

A full service copy center is also maintained at the corporate headquarters. This facility includes both hard copy reproduction machinery and various bindery equipment such as paper drills, joggers, collators, folding and labeling machines. This center provides overflow support to TSI's contract operations as well as all of its corporate publications requirements.

TSI operates a data processing facility at its Oxon Hill site as well. Including both word processing and automated data entry functions, this unit is supported by TSI's mini-computer system. The present system is a key to disc configuration with 192k memory capacity, expandable to 480k, and multiple 67.5 megabyte disc storage units. Data entry is carried out through VDT workstations with output capability on 9-track 1600 or 800 BPI magnetic tape and high speed printer. In addition to client operations, this center is also responsible for TSI's corporate information management requirements.

Contract operations for TSI's reprographics, data processing, micrographics services and technology systems activities are also carried out at approximately 20 government furnished installations managed by TSI. Our off-site copy centers house over 230 pieces of equipment each staffed with a full compliment of TSI personnel.

A field office is maintained in Boulder Colorado to support technology applications in that area. A Philidelphia branch office is contemplated in the near future.

TECHNOLOGY SYSTEMS DIVISION

The Technology Systems Division (TSD) is comprised of a diversified group of senior technical managers who are dedicated to satisfying a wide range of high technology requirements for both the government and private sectors. The expertise represented is founded in aerospace systems, energy systems, military command, control and communications systems, and automated data processing information systems. The Division can organize and manage appropriate work teams to develop, produce, operate and maintain sophisticated electronic computer-based systems as well as prepare and implement related training programs.

On-going contracts encompas systems engineering support functions for the National Oceanic and Atmospheric Administration (NOAA) and the Federal Aviation Administration (FAA). For NOAA, in Boulder, Colorado, TSD Senior Systems Analysts and Programmers design and implement a Prototype Regional Observation and Forecasting Service, which is a state-of-the-art, computer-controlled, modern approach to improving the quality and timeliness of weather information at the local level. For NOAA in Rockville, Maryland, TSD Systems Analysts and Programmers support the development of an effective data base management system for the National Geodetic Survey. Another TSD element under the NOAA contract designs and executes programs to convert scientific data collected by the Environmental Data and Information Service at a Washington, D.C. site.

Current activity for the FAA includes use of TSD in-house mini-computers to design airborne data acquisition systems, to be followed by TSD fabrication, test and deployment of the systems in a test scenario.

TSD, then is a broad-based, quick-reaction, high technology organization that can meet high technology needs of both commercial and government customers. Activities typical of TSD operations include:

INTEGRATED SYSTEMS MANAGEMENT	SYSTEMS ENGINEERING
SYSTEMS ANALYSIS	PRODUCTION ENGINEERING
PROGRAMMING	CONFIGURATION MANAGEMENT
CONTRACT MANAGEMENT	PRODUCT ASSURANCE
MATERIAL MANAGEMENT	TRAINING PROGRAMS
INFORMATION SYSTEMS	OPERATIONS SUPPORT
ADMINISTRATION	INTEGRATED LOGISTICS SUPPORT
TESTING	FABRICATION
HARDWARE/SOFTWARE DESIGN	

STATEMENT OF EXPERIENCE

TSI staff members have performed in a management or technical role on many contracts, some of which are valued in the multi-million dollar category. TSI personnel have worked with such diverse agencies and organizations as:

- U.S. Department of HHS, Federal Assistance Finance Branch
- U.S. Department of Labor, Employment and Training Adminstration
- The U.S. Securities and Exchange Commission
- The Environmental Protection Agency
- U.S. Department of Health and Human Services, Rehabilitation Services Administration
- USDHHS, Office for Handicapped Individuals
- USDHHS, Bureau for the Education of the Handicapped
- USDHHS, Office of Civil Rights
- USDHHS, Architectural and Transportation Barriers Compliance Board
- USDHHS, National Institutes of Health
- USDHHS, Public Health Service
- USDHHS, Food and Drug Administration
- The Federal Aviation Administration
- NASA
- The National Technical Information Service
- The National Transportation Safety Board
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- U.S. Department of Commerce
- U.S. General Accounting Office
- U.S. Department of the Interior
- The Executive Office of the President
- World Bank
- U.S. Department of Treasury, Internal Revenue Service
- U.S. Department of Energy, Federal Energy Regulatory Commission

Currently TSI is performing on contracts with the U.S. Department of Labor, the National Institues of Health, the Public Health Service, the Department of Commerce, the U.S. Department of Health and Human Services, the U. S. Department of Education, the U.S. Department of Energy, the Food and Drug Administration, the Internal Revenue Service, the Federal Aviation Administration, the National Oceanagrapnic and Atmospheric Administration, Alaska Natural Gas Pipline, and [ ] A summary matrix and a brief description of each follows.

A more detailed discusson of TSI's various contract activities is available upon request.

(Commercial customers deleted as proprietary information.)