Z-Plant Material Information Tracking System (ZMITS)
Alternatives Analysis

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Abstract:

This document provides an alternatives analysis for software and interface development governing the implementation of ZMITS. It addresses the ZMITS/LANMAS Interface and software development.

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**Z-PLANT MATERIAL INFORMATION TRACKING SYSTEM (ZMITS)
ALTERNATIVES ANALYSIS**

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LIST OF TERMS

COTS	commercial off-the-shelf
H/X	moderator to fissile material (ratio)
LABCORE	PFPA Analytical Lab, Laboratory Information Management System
LANMAS	Local Area Network Material Accountability System
LOI	letter of instruction
NMI	Nuclear Material Information (System)
NM	nuclear materials
NMM	Nuclear Materials Management
NMSS	Nuclear Material Safeguards System
PFPA	Plutonium Finishing Plant
PRE	Plutonium Retrieval System
PTH	Protection Technology Hanford
SRS	System Requirement Specification
ZMITS	Z-Plant Material Information Tracking System

DEFINITIONS

NMSS	Nuclear Materials Safeguards System is a nuclear material accountability system comprising the Plutonium Retrieval System (PRE) and the Nuclear Material Information System (NMI) databases. The PRE tracks individual nuclear material items. The Nuclear Material Information contains the information pertaining to inter MBA material transfers and adjustments
SRS	System Requirement Specification is a document that prescribes, in a complete, precise, proven manner, the requirements, design, behavior, or other characteristics of a system or system component.

EXECUTIVE SUMMARY

This alternatives analysis identifies and ranks software development options for the Z-Plant Material Information Tracking System (ZMITS). It addresses:

- The ZMITS/Local Area Network Material Accounting System (LANMAS) Interface
- Custom On-Site Development versus Integrated Monitoring and Surveillance System

There are two recommendations:

- The ZMITS/LANMAS Interface should use secure modems to link database tables
Although use of a secure modem does not permit use of ZMITS when LANMAS is down, LANMAS is expected to be available around the clock (but manned only during day shift).
- On-site custom development will best meet functional requirements
On-Site software development will provide the best match to requirements. In addition, it will be faster because it will utilize on-site knowledge of the LANMAS design and Hanford Site implementation, as well as have easy access to the technical experts.

From the ZMITS project management plan (HNF-4658¹) the total cost has been estimated at \$650K (4.2 FTE, 1818 hours/FTE, \$85/hr). The schedule to implement would take 12 months.

¹ Ibsen, T. G., 1999, *Z-Plant Material Information Tracking System (ZMITS) Project Management Plan*, HNF-4658, Rev.), B&W Hanford Company for Fluor Daniel Hanford, Inc., Richland, Washington.

1.0 INTRODUCTION

The Z-Plant Material Information Tracking System (ZMITS) will provide cradle-to-grave information related to the nuclear materials (NM) stored at the Plutonium Finishing Plant (PFP), on the Hanford Site in the state of Washington. 'Cradle-to-Grave' is meant from the effective beginning of operations for a material/item through stabilization, to its return to storage, and full disposition from PFP.

The information that ZMITS tracks will also be used to support the shipping manifests for material moved offsite and to provide the knowledge base for effective monitoring and safe storage of the material until it's processed or shipped from PFP.

1.1 PURPOSE

This alternatives analysis identifies and ranks software development options for ZMITS. It address:

- The ZMITS/LANMAS Interface
- Custom On-Site Development versus Integrated Monitoring and Surveillance System

1.2 SCOPE

This alternative analysis applies to the overall ZMITS system, hardware, and software.

1.3 OVERVIEW

ZMITS will track available information relating to all NM currently in storage at PFP or brought into PFP in the future. Information to be tracked includes:

- Chemical and Isotopic analysis data of the NM
- Historical information on the current storage environment (container type, material type)
- Processing history from the beginning of operations form into final stabilized form
- Container fabrication and testing results
- Current container identification.

ZMITS will report this information in a form suitable for supporting PFP Engineering, Operations, and shipping manifest preparation for final shipment of the NM.

ZMITS will NOT be used for any Safeguards and Security functions and will not be the system of record of any data that is primarily used for Safeguards and Security. ZMITS may contain such data only as necessary to assure correspondence between ZMITS and LANMAS.

Development and implementation will be accomplished in three phases:

- Phase 1 Provides a database capable of storing NMSS PRE data not supported by LANMAS but necessary to PFP Operations
- Phase 2 Expansion of capabilities to include process history and stabilization data
- Phase 3 Addition of electronic import capabilities for process and sample analysis (LABCORE) data.

The ZMITS data is expected to have an operational need on the order of 15 to 20 years, i.e., until the last NM is removed from PFP.

2.0 PROBLEM DESCRIPTION

The PFP mission is to stabilize material and ship it to long term storage. The information required to perform these tasks resides in multiple areas and must be consolidated to properly address the mission needs.

2.1 SYSTEM PERSPECTIVE

ZMITS will perform nine major functions:

1. Maintain material and waste stream data
2. Synchronize material and container information with LANMAS
3. Capture material processing history
4. Maintain container testing information
5. Provide information links
6. Identify Restricted Use Account Inventory
7. Provides system security
8. Permit data validation
9. Perform system administration functions.

2.2 PRODUCT PERSPECTIVE

ZMITS will receive data from two systems: LANMAS and LABCORE. ZMITS will send data to the nuclear materials management (NMM) system. At this time only the LANMAS connection may be a direct link. Data transfer to NMM will be by Jaz cartridge.

- LANMAS: Provides material item names, quantities, location, chemical & isotopic composition, and container data.
- LABCORE: Provides sample analysis results (e.g. Loss on Ignition [LOI]) and associated quality information.
- NMM: Will receive material data such as LOI, moderator to fissile material ratio (H/X), and thermal load.

ZMITS will retain pointers to reference information in hardcopy archives, photographs (Visual Image Digital Object Network [VIDON]) and documents (Records Management Information System [RMIS]).

The pointer will be correlated with the material item / container / process that is the document subject.

2.3 SYSTEM FUNCTIONS

Table 2-1 identifies each of the functions used in the evaluation and the weight assigned to each.

Table 2-1. Evaluation Items.

1	Linking ZMITS and LANMAS	10
2	Processing History Data	8
3	Item Traceability	8
4	Capture Chemical & Isotopic Data	5
5	Container Fabrication & Test Data	5
6	Current Container Information	5
7	System security	5

The weights for each item were assigned according to the following criteria:

- 10 Most Benefit (critical need)
- 8 Essential
- 5 Necessary

2.4 CONSTRAINTS, ASSUMPTIONS, AND DEPENDENCIES

Constraints on the ZMITS are:

- The basic system software and hardware systems procured are adequate to meet all requirements, including system response time.
- Any work performed on the source code by an individual without a clearance must be reviewed by a knowledgeable cleared person to ensure nothing harmful was introduced into the program that would compromise the safeguards or security components of the system.

3.0 ALTERNATIVES DESCRIPTIONS

Alternatives were divided into two groups: the ZMITS/LANMAS Interface and software development options.

3.1 ZMITS/LANMAS INTERFACE

The ZMITS/LANMAS Interface can be a significant impact on system design, cost, and schedule because of security and synchronization considerations. The options are: Media transfer (Jaz cartridge), using an STU3 secure modem, placing the ZMITS system on the LANMAS network, and extending the LANMAS network. Placing ZMITS on the LANMAS file server was not considered a viable option because of the need to protect and isolate safeguards information. Table 4-1, ZMITS/LANMAS Interface, provides a summary. See APPENDIX A, ZMITS/LANMAS Interface Evaluation for details on the evaluation.

Media transfer is the most difficult of the four options to implement from a software development aspect. LANMAS is the system of record for material items, chemical and isotopic composition, and containers that would need to be copied for each data transfer. The quantity of data would be in the hundreds of megabytes. However this option would allow ZMITS to run even if LANMAS is down with the last available LANMAS data.

STU3 secure modems would permit sharing of LANMAS data without having to copy any data and move it. The hardware cost is relatively low. The problem with modems would be the possibly slow response time. ZMITS would not run if LANMAS were down.

Placing the ZMITS on the LANMAS network by using an existing drop located in 2704-Z or 234-5 would permit sharing of LANMAS data without having to copy any data and move it, just like with the secure modems. The hardware cost is lowest for this option and it provides the fastest possible response time. Access to the ZMITS workstation would probably be inconvenient. ZMITS would not run if LANMAS were down.

Extending the LANMAS network to the 270-Z building is the final option. This option has all the advantages of placing ZMITS on the LANMAS network, and makes access convenient. However the cost would be very high to install secure conduit and the schedule would be very much longer. Neither the cost nor the schedule have been estimated as they are not considered reasonable given the need for ZMITS to be operational as soon as possible.

3.2 SOFTWARE DEVELOPMENT EVALUATION CRITERIA

Two options were evaluated for meeting the evaluation criteria: Custom On-Site development, and adapting the INEEL IMSS central database. Table 4-2, Evaluation, provides a summary. See APPENDIX B – Evaluation Criteria Analysis for details on the evaluation. An Internet search for commercial off-the-shelf (COTS) products was made but none could be found. Seven criteria were used for the evaluation:

- Linking ZMITS and LANMAS
- Capture Chemical and Isotopic Data
- Processing History
- Container Fabrication and Testing
- Current Container Information
- Item Traceability
- System Security.

Each of these is explained below.

Linking ZMITS and LANMAS is the most critical and difficult aspect of the task. In order to provide material item, container, element, and chemical and isotopic data, access to data in a large number of LANMAS tables is required, including transactions. One major difficulty will involve synchronizing ZMITS and LANMAS. ZMITS will “know” about new material items and containers before LANMAS is officially updated by Safeguards.

Capture Chemical and Isotopic Data is necessary to understand what items can be processed together, and to aid in process knowledge and waste disposal.

Processing History data capture is difficult because of the different data involved in each of the seven or more stabilization processes. In addition, the data to be captured is not fully defined at this time and will likely change as time goes on. The system must permit the users to add or subtract what data is required.

Container Fabrication and Testing Data is container information that is in addition to that known by LANMAS. Again, synchronizing with LANMAS will be necessary.

Current Container Information is necessary for shipping and disposal. Again, synchronizing with LANMAS will be necessary for all containers with material items.

Item Traceability is difficult in that access to LANMAS transaction history is required, in addition to ZMITS "knowledge" of the activities before LANMAS is officially updated. The system will need to call up chemical and isotopic data for parents and ancestors of an item.

System Security requires certain features to be implemented for classified data processing. As a single user system the restrictions are less involved than those for a multi-user system (as in phase 4).

3.3 HARDWARE AND SOFTWARE

There are no reasons not to use site standard hardware and software.

Software for the system should be based on Windows² NT, Microsoft³ SQL Server, and Visual Basic⁴. These are the tools used for LANMAS and their use will allow use of existing LANMAS code within ZMITS and ease design and sharing of LANMAS data.

4.0 SELECTION DESCRIPTION

The selection process involved identification of each solutions ability to meet the required needs and provide flexibility.

Each of the alternatives was evaluated for how well they met the criteria based on technical knowledge. The detail for the evaluations can be found in Appendix B, Evaluation Criteria Analysis.

4.1 RECOMMENDED ALTERNATIVES

There are two recommendations:

- The ZMITS/LANMAS Interface should use secure modems to link database tables
- On-site custom development will best meet functional requirements.

4.1.1 Secure Modem Interface

Although use of a secure modem does not permit use of ZMITS when LANMAS is down, LANMAS is expected to be available around the clock (but manned only during day shift). Slow response of the modem may prove to be inconvenient, however locating a workstation in 2704-Z building (using existing network drop) would impact the Protection Technology Hanford (PTH) Safeguards organization, and locating within 234-5 would be inconvenient for PFP Engineering, but the secure modem would permit changing the location of the ZMITS workstation if necessary.

² Windows is a trademark of Microsoft Corporation, Redmond, Washington.

³ Microsoft is a registered trademark of Microsoft Corporation, Redmond, Washington.

⁴ Visual Basic is a trademark of Microsoft Corporation, Redmond, Washington.

4.1.2 On-Site Custom Software Development

On-Site software development will provide the best match to requirements. In addition, it will be faster because it will utilize on-site knowledge of the LANMAS design and Hanford Site implementation, as well as have easy access to the technical experts.

The use of the INEEL knowledge for container fabrication and test data is a mini-option that can be investigated. INEEL knowledge comes from their experience with the Integrated Monitoring and Surveillance System. However, their involvement may impact cost and schedule.

The following software is recommended:

- Windows™ NT, SQL Server 7.0™, Visual Basic 6.0™, and RoboHELP⁵
Using SL Server will permit authorized users to perform ad hoc queries using MS Access, if desired.

Access is not recommended for the following reasons:

- Access requires a user to have full read-write access to the share areas. User access differs by user type (SA, Engineering, Operations, etc)
- Transaction logging is required to track changes to material items and Access will not track to this level
- The database(s) (ZMITS and LANMAS) are expected to grow over 300 megabytes and Access response will be slow for a system of this size
- When applications have more than 20 tables, Access response will be slow.

The following hardware is recommended:

- Site standard workstation with removable hard drives.

4.2 RANKING CHART

Table 4-1 summarizes the ranking received by each of the ZMITS/LANMAS Interface alternatives. Details on the points assigned can be found in Appendix A.
ZMITS/LANMAS Interface Evaluation.

Ranking: 1- least desirable, 5 - most desirable.

⁵ RoboHELP is a trademark of Blue Sky Software Corporation, La Jolla, California.

Table 4-1. ZMITS/LANMAS Interface.

1	Development Cost	1	5	5	5
2	Implementation Cost	5	3	5	*
3	Benefits/Advantages	2	3	5	5
	Total	8	11	15	10*
	Rank	3	2	1	4

Note:

* indicates very high cost

Table 4-2 summarizes the ranking received for each of the evaluation criteria. Details can be found in Appendix B, Software Development Evaluation Criteria Analysis.

Weight Ranking: 1 – least benefit, 10 – most benefit (critical)

Table 4-2. Software Development Evaluation Criteria.

1	Linking ZMITS & LANMAS	10	5	50	1	10
2	Processing History	8	2	16	2	16
3	Item Traceability	8	4	32	2	16
4	Capture Chemical & Isotopic Data	5	5	25	1	5
5	Container Fabrication & Test Data	5	2	10	5	25
6	Current Container Information	5	2	10	5	25
7	System Security	5	5	25	3	15
	Total			168		112

5.0 IMPLEMENTATION DESCRIPTION

It is recommended that the implementation of ZMITS will follow a modified traditional waterfall methodology. This is the most appropriate technique, which allows overlapping software development phases when sufficient knowledge is available to proceed on selected tasks.

From the ZMITS project management plan (HNF-4658 [Ibsen 1999]) the total cost (excluding data input and maintenance) has been estimated at \$650K (4.2 FTE, 1818 hours/FTE, \$85/hr). The schedule to implement would take 12 months.

The baseline schedule can be found in Appendix C, Baseline Schedule.

5.1 SCHEDULE AND COST CONSTRAINTS

This is an original project and therefore has no cost or schedule impact at this time. However, during the design phase it will be necessary to address how the interface to LANMAS will be established and any alternatives that may impact cost and schedule.

5.2 RESOURCE REQUIREMENTS AND IMPACTS

BWHC will provide, funding, technical expertise in engineering and operation needs, and procurement support (including subcontracts as necessary).

Lockheed Martin Services, Inc. will provide the software project lead, a software technical lead and software engineering support as needed.

The risks specific to the ZMITS project are: development and staffing.

Development risks for Hanford Site specific needs are considered typical for an intermediate sized project. Development is hampered because of the data classification environment. As a contingency, clearances will be requested for selected team members, specifically the project technical lead and a software engineer. To mitigate impacts, an unclassified data set will be created for use in design, construction, and testing.

The staffing risk is typical for a small team. Any personnel loss will impact progress because of the specific knowledge and clearances required for the project. As a contingency, additional resources will be found within the organization, if needed. To mitigate a staff loss, project management will be kept aware of progress through weekly reports and monthly schedule status reviews.

6.0 COST JUSTIFICATION

The long term costs are justified by the necessity to document and track stabilization efforts from both a processing and disposal aspect, as well as a nuclear material control aspect. ZMITS will support these efforts.

6.1 DEVELOPMENT AND CONVERSION COST

There are no conversion costs associated with this project, however data transfers are required (LANMAS and LABCORE).

As much of the LANMAS Hanford Site specific software as practical will be reused in ZMITS to assist with compatibility and reduce costs of development.

6.2 SAVINGS

Savings will be accomplished by reusing LANMAS source code and using members of the LANAMS development team that worked on the Hanford Site specific applications.

7.0 REFERENCES

Ibsen, T. G., 1999, *Z-Plant Material Information Tracking System (ZMITS) Project Management Plan*, HNF-4658, Rev. 0, B&W Hanford Company for Fluor Daniel Hanford, Inc., Richland, Washington.

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APPENDIX A – ZMITS/LANMAS INTERFACE EVALUATION

To evaluate the ZMITS/LANMAS Interface the following criteria were used:

Development Cost	<p>For Media transfer this includes design and construction cost to dump data to a Jaz cartridge and read it into ZMITS.</p> <p>For Secure Modem, Existing Network Drop, and Network Extension there are no additional development costs.</p>
Implementation Cost	<p>Includes the cost of procurement for items such as a Jaz Drive, secure modems, network interface cards, facility construction, etc.</p> <p>Network extension is considered a significant construction effort that would require a separate engineering effort.</p>
Benefits/Advantages	<p>This is concerned with the overall ability of the system to operate.</p> <p>Media Transfer provides the ability to operate even when LANMAS is down. However, a significant effort is required to design, construct the code, and implement. In addition, the data would not be as up-to-date as a direct link.</p> <p>Secure Modems would be relatively easy to implement (using existing phone circuits), permit use of almost any location, and provide a direct link to the LANMAS data, but response time may be slow when queries to LANMAS are involved.</p> <p>Using an Existing Network Drop or Extending the Network would provide the best possible system response time and direct access to the LANMAS data. (Note that use of the existing network drops will be inconvenient and extension of the network is very expensive.)</p>

APPENDIX B – EVALUATION CRITERIA ANALYSIS

Note: The INEEL IMSS application is a demonstration test bed (proof-of-concept) project. The application is not ready for production use and needs to be rewritten because it is currently developed in Visual FoxPro*. It would need to be converted to SQL Server™ and Visual Basic™ to be compatible with LANMAS and be robust enough for the quantity of data required by ZMITS.

Linking ZMITS and LANMAS

This is the most critical aspect of the overall software design.

On-Site Custom Development has extensive knowledge of the LANMAS architecture gained during the past year of implementing LANMAS and development of site specific applications to work with LANMAS.

The INEEL IMSS team has not yet worked on the LANMAS interface.

Processing History

This will be custom development for any group working on the project.

Item Traceability

On-Site Custom Development has familiarity with Hanford Site nuclear material accounting practices and extensive knowledge of the LANMAS architecture gained during the past year of implementing LANMAS and developing site specific applications to work with LANMAS.

The INEEL IMSS team has not yet worked on the LANMAS interface and is not familiar with Hanford Site nuclear material accounting practices.

Capture Chemical & Isotopic Data

Requires knowledge of the PRE (NMSS History) data structures. On-Site Custom Development created the NMSS History application.

The INEEL IMSS team is not familiar with the data structures.

*Visual FoxPro is a trademark of Microsoft Corporation, Redmond, Washington.

Container Fabrication and Testing

On-Site Custom Development team does not have extensive knowledge of the requirements.

The INEEL IMSS team has implemented this feature in the IMSS demonstration test bed. However, the work would need to be converted (re-written) in SQL Server™ and Visual Basic™.

Current Container Information

On-Site Custom Development team does not have extensive knowledge of the requirements.

The INEEL IMSS team has implemented this feature in the IMSS demonstration test bed. However, the work would need to be converted (re-written) in SQL Server™ and Visual Basic™.

System Security

On-Site Custom Development team has just implemented these requirements for the LANMAS implementation and the team is quite familiar with them.

The INEEL IMSS team would need to become familiar with the requirements.

APPENDIX C – BASELINE SCHEDULE

ID	❶	WBS	Task Name	3rd Quarter			4th Quarter			1st Quarter			2nd Quarter			3rd Quarter			
				Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1			PROJECT ADMINISTRATION																
2	■	1.1	Project Management																
3	■	1.2	Program Management																
4	■	1.3	Project Oversight																
5	■	1.4	ZMITS Change Board																
6	■	1.5	LMSI SQA Review																
7	■	1.6	DSRB Review																
8			DOCUMENTATION																
9	■	2.1	Project Management Plan																
10	■	2.2	System Requirement Specifications																
11	■	2.3	Alternatives Analysis																
12	■	2.4	System Design Document																
13	■	2.5	Development Guidelines																
14	■	2.6	Configuration Mgmt & Testing																
15	■	2.7	System Security Plan																
16	■	2.8	System Operation Guides																
17	■	2.9	On-Line Help/User Manual																
18	■	2.1	Disaster Recovery/Contingency Plan																
19			SOFTWARE DEVELOPMENT																
20	■	3.1	Interim Process Support Database																
21	■	3.2	ZMITS Core System																

ID	WBS	Task Name	3rd Quarter			4th Quarter			1st Quarter			2nd Quarter			3rd Quarter			
			Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
4	3.3	ZMITS Security																
5	3.4	Item Decay																
6	3.5	Reports																
7	3.6	PRE (NMSS/LANIMAS) Data Load																
8	3.7	NMM Interface																
9	3.8	LABCORE Interface																
10	3.9	QA/Integrity Scripts																
11	3.1	System Administration																
12		TESTING																
13	4.1	ZMITS Interim System Test																
14	4.2	ZMITS Core System Test																
15		TRAINING																
16	5.1	Development Team Training																
17	5.2	User Training																
18		PROCUREMENT SUPPORT																
19	6.1	Software Procurement																
20	6.2	Workstation Procurement Specification																
21	6.3	Workstation Procurement																
22	6.4	Network Setup																