**National Insensitive Munitions Information System (NIMIS-II)**

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## *I. Abstract*

The National Insensitive Munitions Information System (NIMIS-II) is a working and fielded analysis tool, specifically designed to provide the weapons development community with a centralized source of Insensitive Munitions (IM) test data and other related information. In order to avoid duplication of costly testing and to centralize the available IM test data, a national repository of these data was developed. This multi-service system comprises all IM testing and related work, to include such data as: Baseline tests, "for score" and "not for score", generic weapons development tests, as well as energetic materials test and qualification data. With a user base of over 500 previous and current users, this system has a proven track record of providing timely data to developers and managers on specific IM issues. It has served as a valuable tool to scientists, engineers, and managers throughout the weapon life cycle process. Serving as a repository of a broad data spectrum, NIMIS-II is a powerful analysis tool for those engaged in solving IM design problems. Distribution of the NIMIS-II is authorized to Government agencies and their Contractors.

## *II. Introduction*

The National Insensitive Munitions Information System (NIMIS-II) was designed to provide the entire IM community with a central repository of IM test data and related information. This national repository was initiated in 1986 as a Navy IM database (the Navy Insensitive Munitions Information system - NIMIS) and was officially distributed to the Navy IM community in 1987. As the Navy recognized the benefits of this system, it began offering it to other services and industry. The military-commercial IM community as a whole has benefited from using this compilation of IM data and NIMIS-II's user base has expanded rapidly.

Because of its broad user base, NIMIS-II transitioned to a tri-service system in early 1992. A tri-service working group was established to define baseline requirements for the new National Insensitive Munitions

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Information System (NIMIS-II). The working group based the NIMIS-II enhancements on the existing Navy (NIMIS) system, while incorporating the testing methods and reporting conventions of the Army and Air Force. The primary goal was to create a system that would be relatively easy to use, yet capable of performing certain relevant calculations, advanced queries and having reporting and graphing capabilities. As a result of the group's efforts the new system emerged as an even more useful tool for managers, engineers, formulators and research scientists investigating the field of insensitive munitions.

### *III. Database Features and Functions*

In order to create a tool both user friendly and yet powerful enough to assist in serious analyses, a system model was developed. This model incorporated recommendations from all the services as well as extensive input from industry. This model transitioned through conceptual, logical and functional design and was finally implemented using state-of-the-art database development techniques. The implementation phase consisted of building a series of prototype building blocks. These working database prototypes were developed in phases, each of which established additional functionality and served as a foundation for the next phase of implementation (Figure 1). This development approach proved to be productive and has delivered an excellent tool as well as offering the most value added for available funding.

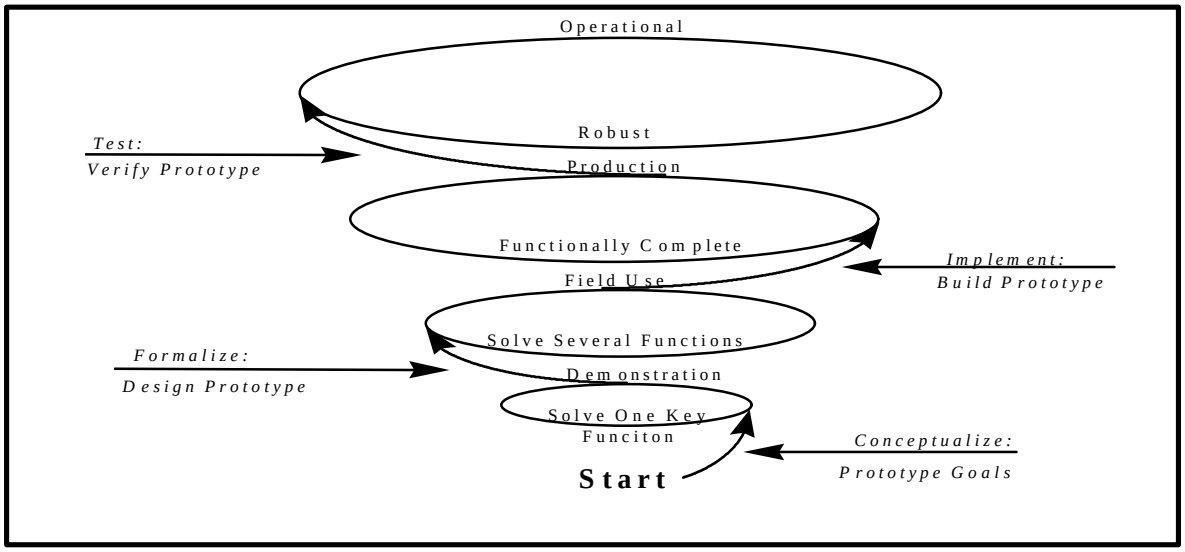


**Figure 1. Spiral Prototyping Approach**

*Operations*

Generally, the end user will observe data in the system with what is known as a table VIEW. Views provide access to specific portions of the NIMIS-II tables. Tables store specific groups of data in the database.

Views have been tailored by the system's developer to provide information about a particular table in a meaningful and organized manner. Views may be either a grid format, similar to a spread sheet, or a form layout, showing data in an organized, comprehensive manner.

*Queries*

NIMIS-II comes loaded with a query library. These queries were created based on common data requests from users over the years and have been parameterized so that values can be designated at run time. The user may also formulate customized queries when needed. When developing a query, the user first determines which table or tables must be searched to retrieve the required data.

Secondly, the user specifies which piece (field) of information is needed from, for example, the Explosive Sensitivity (EXPL) table. From this table, the user may select specifics such as: compound name, large scale gap test (density, pressure, and gap cards), impact drop heights (density, minimum and maximum heights), as well as run to detonation and Susan tests (density, and coefficients A, B, C, and D) data and all related references for each of these data elements. The user will specify all of these fields using the NIMIS-II query builder.

Because of the vast store of data within the database, users will often wish to limit the number of records retrieved in response to a query. Limiting is done by specifying and qualifying conditions. In the example case, the user may be interested in an explosive that may have impact heights of greater that 50 cm. The query builder allows such conditions to be imposed. The user may also specify the order in which records are displayed, either ascending or descending. Multiple tables may be joined to conduct cross table searches.

*Reports*

As with queries, reports can be printed using either standardized choices from the reports library, or with appropriate software, customized reports generated by the user or the database administrator. The report library has an extensive selection of pre-formatted reports appropriate for the needs of those conducting IM technology development and implementation efforts and for long-range planning evolution's.

*Context Sensitive Help*

NIMIS-II on-line help provides the user with several useful features such as "How to use NIMIS-II", reference information, and a glossary of terms. The reference data include such items as equations. For example: the Jacobs-Roslund equation to predict explosive response to fragment impact for a variety of fragment and target

conditions (Figure 2). Also provided are selected definitions form documents such as *Hazard Assessment Test for Non-Nuclear Munitions*, MIL-STD-2105(B), as well as other important reference information.

Fragment Impact Sensitivity

Controlled fragment impact tests against bare and covered explosive targets are used to establish sensitivity of explosives to fragment attack. NSWC experiments (443,444,445) have demonstrated that the critical impact velocity required for shock induced explosive detonation can be sharply defined in a fairly small number of tests when fragment/target conditions are carefully controlled. The size, shape and velocity of the fragment will determine its ability to initiate the target explosive.

An experimental form, known as the Jacobs-Roslund Equation, adequately represents fragment response of explosives for a variety of fragment and target conditions. In the equation, the critical impact velocity for target detonation is related to explosive sensitivity, fragment size and shape, and target cover thickness as follows:

$$V_C = (A/d^{1/2})(1+B)(1+CT/d)$$

where

Vc = critical impact velocity for target detonation (mm/microsececonds)

d = fragment critical dimension, e.g. diameter (mm)

T = target cover thickness (mm)

A = explosive sensitivity coefficient (mm^(3/2)/microseconds)

B = fragment shape coefficient (dimensionless) (B = 0 for flat-end fragments)

C = cover plate protection coefficient (dimensionless)

Coefficients for the Jacobs-Roslund Equation are experimentally established for various explosives through use of controlled fragments fired from a two-stage light gas gun (445). Typically, half-inch diameter flat-ended or hemisphere- tipped steel fragments are used. The explosive targets are either bare or else covered by mild steel plates. Results are listed in Sensitivity to Fragment Impact information in the EXPL table, with distinction made between the cover plate coefficients associated with the two fragment types. The fragment impact explosive sensitivity coefficient, A, provides an important figure of merit for use in ranking explosive sensitivity. Good correlation between "A" and "P50" of the Large Scale Gap Test has been demonstrated when comparable explosive test samples are used (443).

(Example From Available NIMIS-II On-Line Help)

**Figure 2. Fragment Impact Sensitivity**

### *IV. Examples of NIMIS-II Inquiries*

The number of user inquiries and requests for technical data has steadily risen over the past nine years. Technical data provided to the IM community has been instrumental in several critical areas of research and actual operational situations such as Desert Storm and Department of Transportation incidents. This database has proven itself useful in systems analysis, engineering modifications and fixes, and live multi service missions.

***Examples of NIMIS-II Inquiries***

- List explosives by percent weight of the ingredient RDX.
- Calculate expected detonation velocity of a particular low density charge.
- What formulations have a detonation velocity greater than 8400 m/sec?
- What formulations have impact heights of greater than 50 cm?
- What IM testing has been conducted using Firex as a thermal coating on rocket motors?
- How do propellants containing HMX behave in the fast cookoff test?
- What is the heat of formation of TATB, and where can I find a reference to verify how it was measured?
- What are the experimental and calculated heats of formation of NTO, including source data?
- Give all the bullet impact tests performed on a HARM rocket motor with a reaction greater than a type III reaction (explosion).

## *V. For More Information*

*More to be done:* We are continuing to expand the national database as well as our efforts to collect and disseminate information relative to the Insensitive Munitions community. Your help in this effort would be appreciated. Because of manpower limitations, collecting data is a primary difficulty for our NIMIS-II team. We would appreciate the cooperation of the weapons community in our efforts. Please place the China Lake IM Office on your standard distribution for IM related information.

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The NIMIS-II software application is available to US Government agencies and their contractors. No classified or proprietary data reside in the system, and the program has no plans to incorporate such data. However, in the interest of providing a comprehensive data set, references to sensitive information will be provided in the form of points of contact, allowing those with a need to know to obtain the required information. On-line requests for the NIMIS-II database may be submitted through the NIMIS-II Web site.

References:

1. *National Insensitive Munitions Information System (NIMIS-II) Physical Database Design*; 1 May 1994; Hilton Systems Technical Report 9063-017-1

2. Military Standards, *Hazard Assessment Tests for Non-Nuclear Munitions*, Mil-Std-2105(B)

3. Insensitive Munitions Technology Symposium, Munitions, San Diego California, March 18-21, 1996. *National Insensitive Munitions Information System* (NIMIS-II) ,Carolyn Dettling Naval Air Warfare Center Weapons Division, China Lake, California.