SANDIA NATIONAL LABORATORIES

NATIONAL SPENT NUCLEAR FUEL PROGRAM (NSNFP)

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Revision 1

FUNCTIONAL AND OPERATIONAL REQUIREMENTS OF N-CART

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This document was authored jointing by Idaho National Engineering and Environmental Laboratory (INEEL) and Sandia National Laboratories (SNL) staff members comprising the N-CART project's Technical Working Group (TWG).

Revision History

Revision	***Summary***
01	The header should say "*Page ___ of 6*" because there are only 6 pages. Added REQUIREMENTS OF N-CART" [for clarification]

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ACRONYMS

ANL-E	Argonne National Laboratory East
BEMR	Baseline Environmental Management Report
BNL	Brookhaven National Laboratory
LANL	Los Alamos National Laboratory
D&D	decommissioning and decontamination
DOE	U. S. Department of Energy
DOE-EM	U. S. Department of Energy - Division of Environmental Management
FY	fiscal year
HEU	highly enriched uranium
HLW	high-level [radioactive] waste
INEEL	Idaho National Engineering and Environmental Laboratory
N-CART	National Spent Nuclear Fuel Program -- Cost Analysis and Risk Tool
NSNFP	National Spent Nuclear Fuel Program
NPV	net present value
O&M	operation and maintenance
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation (includes ORNL, K-25, and Y-12)
PA	performance assessment
QA	quality assurance
R&D	research and development
RADTRAN	risk assessment model for transportation of radioactive materials
ROD	record of decision
SFD	spent fuel database
SNF	spent nuclear fuel
SNL	Sandia National Laboratories
SRS	Savannah River Site
UCNI	unclassified controlled nuclear information
WVDP	West Valley Demonstration Project

DEFINITIONS

activity	a single action that is part of the spent fuel program: e.g., characterization of spent fuel using gamma spectroscopy is an activity; use of a particular cask for transportation is an activity. An activity may be subdivided into multiple activities as additional levels of detail are added to the model.
activity set	a combination of activities that define a continuos path of activities: e.g., several characterization methods used together constitute an activity set; canisterization plus use of a particular transportation cask plus transporting by train constitutes an activity set.
attribute	a quantifiable or semi-quantifiable property of an activity. The attributes in this model are cost, time, risk, economic benefit, secondary waste, and appropriate subdivisions of these (e.g. occupational risk, non-radiation risk).
constraint	a factor which may be either internal or external to the system, that dictates or influences the allowable or necessary activities that precede or follow a given activity.
data	any characteristic of the SNF or of an activity associated with SNF that provides a functional variable or parameter in N-CART.
decision logic	the rationale of N-CART and its sub-models.
sequence logic	the sequence of activities.
stakeholder	anyone interested in, or affected by, DOE activities.
strategy	an activity set.

1. Introduction

The DOE-EM National Spent Nuclear Fuel Program (NSNFP) - Cost Analysis and Risk Tool (N-CART) is being developed to aid in safe, cost-effective, and timely management of DOE-owned spent nuclear fuel. N-CART Functional and Operational Requirements are defined below. Requirements are provided for the software, decision logic, sequence logic, and data used in N-CART.

The N-CART Functional and Operational Requirements are expected to evolve as N-CART itself evolves (refinement and expansion of applicability). Evolution of the requirements will consist primarily of the addition of detail, but may also include addition and deletion of requirements. N-CART evolution will include the development of prototypes, the use of which may indicate where changes in the functional requirements are needed

The N-CART Functional and Operational Requirements for FY97 are less demanding than the ultimate tool requirements. Requirements deemed essential for FY97 are identified in *italics*; the FY97 requirements will not include all of the decision alternatives that will be included when N-CART is fully developed. Requirements not italicized, while not mandatory, will be considered in the FY97 N-CART development process and will be included to the extent appropriate.

2. N-CART Purpose

N-CART is a decision-aiding tool that supports the NSNFP in the safe, timely, and cost-effective management of DOE SNF from its current state through disposal. This support includes:

2.1 *Performing decision-aiding analyses for the SNF management process, including comparisons and sensitivity analyses of multiple alternatives.*

2.2 *Allowing the user to perform quick turn-around "what if" studies.*

2.3 Integrating program knowledge into one unified model that will readily identify gaps and overlaps in efforts.

2.4 Providing centralized documentation of the bases of program alternatives and program decisions.

2.5 Supporting response to stake-holder concerns.

3. N-CART Scope

3.1 Materials to be considered

3.1.1 N-CART will support management decisions concerning SNF that is currently or will eventually come under the management responsibility of DOE-EM (i.e., all material included in the current Spent Fuel Database, SFD-96). SNF for which there is an ROD for processing will only be given high level consideration, and the conditions of the ROD will be treated as constraints.

3.1.2 Materials other than DOE-owned SNF will be addressed to the extent that they may affect management of DOE SNF.

3.2 Activities to be considered

3.2.1 N-CART will include the full life-cycle of SNF management from current location through ultimate disposition. The level of detail to which each phase of management is modeled may not be uniform and may change over time.

3.2.2 N-CART does not address SNF disposal activities beyond preparation and transport to the repository. PA results will serve as input to N-CART to allow for the consideration of input parameter effects on repository performance.

3.2.3 While N-CART analyses will include the SNF generated by foreign, university, government, and commercial domestic research reactors, the tool is not required to address current storage issues and SNF management activities at these sites. The only sites that must be included in N-CART analyses are Hanford, INEL, and SRS. Other sites where DOE has ownership of the SNF (ANL-E, BNL, LANL, ORR, SNL, WVDP, and Fort St. Vrain will be included only to the extent necessary for full impact considerations.

4. N-CART Capabilities

4.1 N-CART will have the capability to account for fuel-specific and SNF group differences at the lowest activity level applicable.

4.2 N-CART will have the capability to account for facility- and site-specific differences.

4.3 N-CART will have the capability to accommodate conditional links and internal transfers.

4.4 N-CART will have the capability to account for regulatory and other decisional constraints on the SNF management system.

4.5 N-CART will have the capability to link to spreadsheets, data bases, and electronic documents.

4.6 N-CART will have the capability to retain a clearly defined Base Case with the capability to address alternative cases and to maintain multiple predetermined cases, in addition to the Base Case. For example, the user may decide between BEMR, the Sector Integration 10-Year Plan, current budgets and schedule, or other predefined cases.

4.7 The N-CART structure will allow high-level modules to be developed or to be replaced by multiple detailed modules.

4.8 N-CART will provide a visual overview of DOE SNF management activities allowing the user to:

- *drill down to specific activities,*
- *identify interdependencies and interactions of different parts of the SNF management program, and*
- *identify R&D activities supporting each activity and the activities for which no R&D is underway.*

4.9 The user will be able to define, revise (if appropriate), save, and recall the following:

- *criteria that define an individual or group of SNFs included in the analysis,*
- *constraints, such as regulations, with appropriate interpretations and explanatory text,*
- *assumptions used in N-CART analyses strategies, and*
- *other input data.*

4.10 N-CART will include online documentation of input data, regulations, program documents, assumption bases, logic, and other inputs.

4.11 The Base Case shall be tied to existing program documents, schedules, and budgets.

4.12 N-CART will have the capability to portray results graphically, including capabilities allowing the user to manipulate the graphic presentation (e.g., use of log scales, chart type, etc.).

4.13 N-CART will be capable of generating reports that will include a listing of data, logic, and assumption changes from a specified standard case; results in various user-selectable graphical and tabular formats; and generation of data output files.

4.14 N-CART shall prevent unauthorized revisions of data and logic.

4.15 Display of N-CART results will include both expected values and distributions.

4.16 N-CART will have hypertext capability.

4.17 N-CART will have the capability to compare activity sets.

4.18 N-CART will have the capability to perform probabilistic analyses.

4.19 Cost output shall include at least:

- *capital costs on a periodic basis,*
- *O&M costs on an annual basis,*
- *capability to provide results on a constant-year or NPV basis, and*
- *capability to aggregate results.*

4.20 N-CART will have the capability to perform cost/schedule calculations for user-defined portions of the life cycle of SNF management (e.g., calculate costs separately for characterization activities).

4.21 N-CART will have initial provisions in the FY97 prototype to support cost and schedule results.

4.22 N-CART will have a user-friendly "point-and-click" interface.

4.23 N-CART will have the capability to provide results for costs, schedules (time), occupational and public health and safety risks, technological risks, economic benefits, secondary waste generation, and other SNF management attributes.

4.24 N-CART will allow the qualified users to structure their own cases.

4.25 On-line help is desirable.

4.26 N-CART will inform the user when a constraint is violated.

4.27 N-CART will have the capability to segregate direct from indirect costs, EM from non-EM costs, DOE from non-DOE costs.

4.28 N-CART will have the capability to adjust data entered on a constant year dollar basis to a common basis.

5. Data and Sequence Logic Requirements

5.1 Selection

5.1.1 The data and sequential logic collection effort will include identification and consideration of readily available and relevant sources.

5.1.2 NSNFP documents will be used as the preferred source for the Base Case, unless they are known to be in error.

5.2 Review

5.2.1 Data and sequence logic shall be reviewed by NSNFP and INEEL site personnel. Reviewers may suggest alternate data and sequence logic, and these suggested revisions shall either be incorporated or a basis for not using them will be prepared.

5.3 Documentation

5.3.1 The rationale for selection of one data and sequence logic source over others will be documented, including the basis for the selection, the differences between sources, and an assessment of the impacts of using another source.

5.3.2 Data will include identification of their source (e.g., a reference with page number).

6. Project Requirements

6.1 N-CART is not subject to the requirements of RW-0333P[1] or NQA-1[2]. Although N-CART analyses may form the basis for decisions, N-CART itself is a planning tool and will not, in and of itself, make or implement decisions. Therefore, N-CART is subject to QA that is consistent with good business practice. While not a requirement, IEEE-730[3] should be used as general guidance for good business practice. Validation of data used in N-CART will be consistent with good engineering practice and the validation process may, therefore, occasionally use methods consistent with NQA-1 or RW-0333P.

6.2 N-CART will not contain classified or UCNI information, or any information identified as sensitive or proprietary. N-CART will only interface with unclassified systems that have no UCNI content.

6.3 Off-the-shelf software shall be used in the development of N-CART to the extent possible. Development of new software shall be done

only after a documented determination that existing software will not meet N-CART needs.

6.4 The preferred operating system for N-CART is Windows 95, or a further development of Windows software. Other operating systems will be considered if performance and capability dictate.

6.5 The preferred platform for N-CART is Pentium class PC computers, however, more powerful hardware requirements will be considered if performance dictates.

6.6 The FY97 N-CART prototype will operate as a shared-file system rather than a client-server system. The prototype may convert to a client server system.

6.7 Capability to support a network operation with access for up to 50 people is desirable for N-CART. Simultaneous use by up to 5 users is also desirable. If necessary, N-CART may convert from a shared-file system to a client-server system.

6.8 Distribution of N-CART in a run-time version is not necessary. Users will be required to purchase/license software.

6.8 Configuration control and software documentation will be maintained.

6.9 The source code will remain the exclusive property of the NSNFP.

7. References

1. "Office of Civilian Radioactive Waste Management (OCRWM) Quality Assurance Requirements & Description (QARD)," RW-0333P, Rev. 4, August 4, 1995.
2. American Society of Mechanical Engineers/Nuclear Quality Assurance-1 (ASME/NQA-1), Quality Assurance Program Requirements for Nuclear Facilities
3. "IEEE Standard for Software Quality Assurance Plans," IEEE 730.1-1989, August 17, 1989.