AMEC Project 1.1
Development and Manufacture of a Prototype Transportable Interim Storage Container for Damaged and Undamaged Spent Nuclear Fuel

Steinar Høibråten, Monica Endregard, Evelyn Foshaug, Robert S. Dyer, Radall L. Snipes, Vladimir Balkunov, Barry J. Spargo, Tatyana Makarchuk, Andrew R. Griffith

Forsvarets forskningsinstitutt/Norwegian Defence Research Establishment (FFI)

31. January 2007

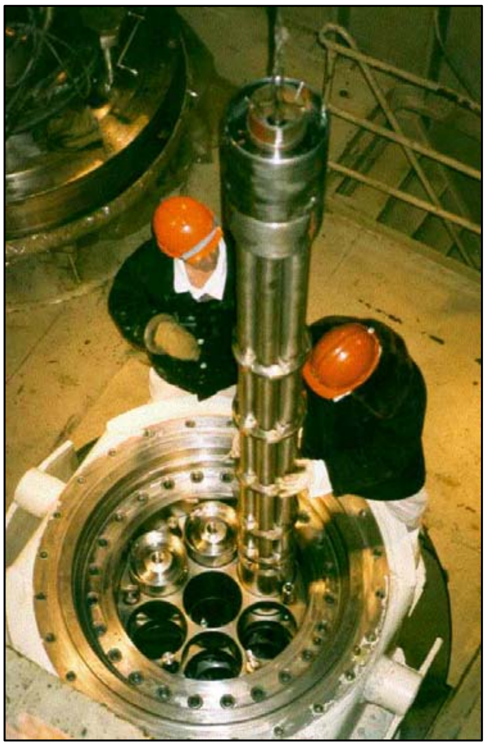
FFI/RAPPORT-2006/00048
ISBN 978-82-464-1065-4

PREFACE

FFI has published the official close-out reports for two other projects completed within the framework of the Arctic Military Environmental Cooperation (AMEC).[1] The present report concerns the first AMEC project to be completed and was originally written in 2001. It is published under FFI cover at this time mainly for completeness. Hopefully it will also contribute to spreading the word about a successful cooperation project beyond the inner circle of AMEC participants. The original close-out report was issued at the Naval Research Laboratory in the United States with reference number NRL/PU/6115—01-0039.

Since there are no illustrations in the close-out report itself, two pictures have been included below. The picture to the left shows the AMEC prototype container at Atomflot in Murmansk behind Ms. Eleonora Barnes from the U.S. Environmental Protection Agency. The picture to the right shows how the inside of the container is configured for storage of a total of 49 spent fuel assemblies in seven groups of seven assemblies each.

Kjeller, January 2007
Steinar Høibråten, Ph.D.
Norwegian Project Officer for AMEC Project 1.1



[1] AMEC Project 1.5 *Co-operation in Radiation and Environmental Safety* (FFI Report No. 2005/03620) and AMEC Project 1.5-1 *Radiation Control at Facilities: Application of the PICASSO System – Installation at FSUE Atomflot* (FFI Report No. 2005/03619).

Arctic Military Environmental Cooperation

Project Officers

Steinar Høibråten
Norwegian Defence Research Establishment

Robert S. Dyer
U.S. Environmental Protection Agency

Vladimir Balkunov
Russian Ministry of Defence

AMEC Project 1.1
Development and Manufacture of a Prototype Transportable Interim Storage Container for Damaged and Undamaged Spent Nuclear Fuel

Final Report

Barry J. Spargo
US Naval Research Laboratory
Washington, DC

Monica Endregard
Norwegian Defence Research Establishment
Kjeller, Norway

Tatyana Makarchuk
Interbranch Coordination Centre -Nuclide
St Petersburg, Russia

and

Andrew R. Griffith
US Department of Energy
Gaithersburg, Maryland

30 August 2001

AMEC Project 1.1

Development and Manufacture of a Prototype Transportable Interim Storage Container for Damaged and Undamaged Spent Nuclear Fuel

On behalf of the AMEC Principals, the Steering Group Co-Chairs have reviewed and accept this final project closeout report on 30 August 2001:

Ingjerd E. Kroken Steering Group Co-Chair Kingdom of Norway	Dieter K. Rudolph Steering Group Co-Chair United States of America	Viktor M. Sheremetev Steering Group Co-Chair Russian Federation

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The purpose of Arctic Military Environmental Cooperation (AMEC) Project 1.1 was to develop and manufacture a prototype 45 ton container for the interim storage of spent and damaged nuclear fuel removed from strategic submarines and icebreakers of the Russian Federation. These containers must be form, fit, and function identical to the TUK-18 and must be certified by Gostatomnadzor (GAN) for transportation and storage and by the Ministry of Railways for rail transportation of the spent and damaged nuclear fuel from strategic nuclear submarines and icebreakers.

Over a 4 year period, a group of government scientists and engineers, with the support of technical experts designed, manufactured, and tested a prototype cask for the purposes of storing and transporting spent nuclear fuel. This team was composed of government and private sector employees from the Kingdom of Norway, the United States of American and the Russian Federation working under the authority of AMEC.

A Certificate – Permission for Design, a License for Production, and aCertificate – Permission for Transportation were obtained. A License for Storage or a combined License for Transportation and Storage will need to be obtained before serially produced casks can be used for their intended purposes.

With the testing and certification of the prototype TUK-108 cask (with the exception of certification for transportation and licensing) this project is considered complete. Serially produced TUK-108/1 casks (the serial production designation) have been demonstrated by the Ministry of Atomic Energy of the Russian Federation. These casks are currently being put into use for purposes outside the mission of AMEC. However, the Cooperative for Threat Reduction (CTR) under the U.S. Defense Threat Reduction Agency is in the process of procuring TUK-108/1 casks for storing and transporting spent nuclear fuel from SSBN decommissioning activities in the Kola Peninsula region of the Russian Federation, which does support the mission of the AMEC Program.

INTRODUCTION

Background

The Arctic Military Environmental Cooperation (AMEC) was established to provide a forum for Norway, Russia, and the United States to work together in addressing military-related environmental problems in the Arctic. In September 1996, the Norwegian Minister of Defence, the Russian Minister of Defense, and the U.S. Secretary of Defense signed an historic Declaration calling for cooperation among the parties to jointly address these environmental concerns. The primary objectives of the AMEC Program are to: 1) share information on the impacts of military activities on the arctic environment, 2) develop cooperative relationships among military personnel in the participating countries, and 3) sponsor technical projects that assess the environmental impacts of military activities in the arctic and develop action plans and technologies for managing such impacts.

Initial discussions with the Russians on the development of a dual-purpose cask for transporting and storing Russian spent nuclear fuel (SNF) took place in June 1996. A proposal was prepared in October 1996 to make the project a part of the AMEC Program. A draft AMEC Project Task Management Profile Plan (TMPP) was discussed at the November 1996 AMEC meeting held in Moscow, Russia. The Russians were authorized to begin work on Task 1 -Development of a Technical and Economic Feasibility Study for Dual-Purpose Casks, in January 1997 utilizing U.S. Environmental Protection Agency (EPA) funds. The Project Officers approved the TMPP for AMEC Project 1.1 in February 1997 and by the AMEC Steering Group and Principals in May 1997. Public Law 105-56 made $5M available in fiscal year 1998 from the CTR budget. These funds were transferred to AMEC under MIPR 98-5000 and were used to develop the prototype cask starting September 1998. In May and November 1998, the Norwegian Government allocated a total of 5.345 million Norwegian Kroner (NOK) under her Plan of Action for Nuclear Safety to sponsor AMEC Project 1.1. The Project 1.1 TMPP was modified in February 1998, July 1998, and November 1998 to include the design, construction, testing and certification of a prototype cask.

Specific Aims

The primary goal of Arctic Military Environmental Cooperation (AMEC) Project 1.1 is to assist in eliminating the SNF bottleneck in Russian SLBM launcher dismantlement through the development of a prototype dual-purpose cask for interim storage and transportation for damaged and undamaged naval SNF.

TASKS

A TMPP for Project 1.1 was prepared in 1997 and finalized in November 1998. The funding is based on estimates and is for planning purposes only. Actual funding and cost accounting information for Project 1.1 can be found in the Expenditures section below.

Tasks	Country participant	Specific Result	Date of beginning and completion	Expected Contractor	Labor and Material Costs (Thousands USD)				Value (Thousands USD)			Total Value (Thousands USD)
					Total	USA	NOR	RUS	USA	NOR	RUS	
Phase 1												
1 Technical and economic feasibility study for the use of a transportable metal-concrete cask for the interim storage of spent naval nuclear fuel [1].	Russia	Report	1 Jun 96 28 Feb 97	MOD, KBSM							60	60
1.1 Feasibility of using this cask for storing fuel at various sites.	Russia		1 Jun 96 28 Feb 97	MOD, KBSM				20				
1.2 Check of compatibility of cask usage with existing transportation and technological infrastructure for handling spent nuclear fuel by the Russian Navy, Ministry of Transportation, and Ministry of Atomic Energy.	Russia		1 Jun 96 28 Feb 97	MOD, KBSM				25				
1.3 Economic feasibility of the development and use of this cask.	Russia		1 Jun 96 28 Feb 97	MOD, KBSM				15				
2 Development and approval of Statement of Work (SOW) for a transportable metal-concrete cask for interim storage of spent naval nuclear fuel. The SOW shall incorporate the following: • name and application; • basis for development; • quality control & acceptance procedures;	Russia	SOW	1 Mar 97 30 Apr 97	Nuclide, MOD				15	22.5	22.5		45

• manufacturer warranty; • operating conditions; • material conditions; • objective and content of development; • technical requirements; • work performance stages; • work organization and co-contractors; • analysis and preparation of initial data (bounding conditions) for designing the cask.												
Trilateral review of SOW.	Norway, Russia, USA	Steering Group Approval Protocol	1 May 97 15 May 97	AMEC								
3 Development of technical design for metal-concrete cask for interim storage of spent naval nuclear fuel.	Russia	Technical Design	15 May 97 30 Nov 97	KBSM								
3.1 Development of design documentation for the prototype metal concrete package, full-scale segment, simulated bottle, and other elements.	Russia	Design Documents	15 May 97 15 Sep 97	KBSM				35	52.5	52.5		105
3.2 Analysis to validate compliance of the metal-concrete cask with national safety and quality standards, and with special IAEA criteria.	Norway, Russia, USA[2]	Report	15 May 97 15 Sep 97	KBSM, Nuclide, NAC Int'l, IFE								
3.2.1 Conduct nuclear safety and radiation shielding analysis of the metal-concrete cask.	Norway, Russia, USA[2]	Report	15 May 97 15 Sep 97	KBSM, Nuclide, NAC Int'l, IFE				35	50	50		100
3.2.2 Conduct thermophysical analysis of the metal-concrete cask.	Norway, Russia, USA[2]	Report	15 Jul 97 15 Aug 97	KBSM, Nuclide, NAC Int'l, IFE				20	25	25		50
3.2.3 Conduct structural, seal, and reliability analyses of the metal-	Norway, Russia,	Report	15 Aug 97	KBSM, Nuclide, NAC Int'l, IFE				30	40	40		50

concrete cask.	USA[2]		15 Sep 97									
3.3 Issuance of safety analysis report for the metal-concrete cask.	Russia	Safety Analysis Report	15 Sep 97 30 Sep 97	IPPE				5	7.5	7.5	X	15+
3.4 Approval of technical design for the prototype transportable metal-concrete cask for interim storage of spent naval nuclear fuel by the Gosatomnadzor (GAN) and performance of Environmental Analysis.	Russia	GAN and State Committee EA Conclusions	1 Oct 97 30 Nov 97	GAN, Gosatomnadzor				15	20	20		40
3.5 Code Comparison	Norway, Russian, USA	Report	15 Nov 98 30 Sep 99									
Trilateral review of technical design.	Norway, Russia, USA	Steering Group Approval	1 Dec 97 31 Jan 98	AMEC								
Totals for Phase 1									217.5	217.5	60+	495+
Phase 2												
4 Fabrication of prototype transportable metal-concrete cask for interim storage of spent naval nuclear fuel, full-scale section, simulated bottle, and other elements including: • fabrication of spiral spacers (ring seals); • delivery of materials for concrete fabrication; • developer supervision.	Russia	Prototype Samples and Elements	1 Feb 98 31 Oct 98					40	182.5	182.5	X	365+
5 Testing of cask.	Russia		1 Nov 98 31 Jan 99	Commission								
5.1 Preliminary testing of the cask at manufacturing plant.	Russia	Testing Protocol	1 Nov 98 30 Nov 98	Commission				25	30	30	X	60+

5.2 Interagency testing of prototype in presence of U.S. and Norwegian observers.	Norway, Russia, USA	Testing Results	1 Dec 98 31 Jan 99	Commission				30	35	35	X	70+
6 Certification of prototype transportable metal-concrete cask for interim storage of spent naval nuclear fuel.	Russia	Certificate	1 Feb 99 30 Apr 99	Nuclide, Vnipiet				10	10	10	X	20+
Final trilateral review of technical summary of the results of the project.	Norway, Russia, USA	Steering Group Approval	1 May 99 30 May 99	AMEC								
Totals for Phase 2									257.5	257.5	X	515+

IFE - Institute for Energy Technology (Norway)
NAC Int'l - Nuclear Assurance Corporation International
MOD – Ministry of Defense of the Russian Federation
KBSM -
[1] Naval spent nuclear fuel is understood to mean defective, non-defective, damaged, and undamaged spent fuel.
[2] The parties will work on mutual verification of codes and procedures used for the safety analysis of the cask.
X - Plan to fund subject to availability of funds.

ACCOMPLISHMENTS

Feasibility of the MBK Cask

A feasibility study, entitled "Use of Transportable MBK for Interim Storage of the VMF SNF" was conducted (1). The study was designed to determine compatibility of the MBK cask for storage of SNF, including the performance data and the ability to transport the MBK cask using existing infrastructure within Russia. The study made the following conclusions: a) existing SNF storage in Russia is inadequate and does not meet modern safety practices for handling SNF; b) Long-term, dry storage of SNF in metal concrete containers can address radiation and ecological safety with minimal investment and will provide physical security and inventory control; c) it is technically feasible to integrate the MBK cask into the existing system for handling SNF; d) the use of the MBK cask for dry storage will accelerate the planned unloading of SNF by 8-9 years; e) the MBK cask is compatible with existing transport infrastructure, and; f) the cost of SNF storage in MBK casks is approximately 1.7 times lower than the current warehouse practices.

Design Documentation and Safety Analysis

A technical assignment to develop the TUK-MBK prototype cask was developed to initiate the design and engineering phases of this project. The report, "Development and Coordination of a Technical Assignment for Transportable Metal-Concrete Containers for Temporary Storage of Navy's SNF" fulfilled this task requirement (2). The technical design for the metal-concrete container was funded by this work effort, but the design documentation was not a deliverable because of the concern that the design contained classified data. However, a report on the "Development and Fabrication of a Prototype of Transportable Cask for Interim Storage of Navy (VMF) Spent Nuclear Fuel" addressing Task 3.1, Development of Design Documentation for a MBK Prototype; Task 3.2, Development of Technical Project, Accomplishment of Calculations for the Compliance of MBK with National and IAEA Regulations and Safety Rules, and; Task 3.3, Preparation of Conclusion on MBK Nuclear Safety was prepared and delivered (3). In response to a number of NAC International questions/comments on this report, ICC Nuclide prepared a detailed technical response (4).

Additional safety analyses of the TUK-MBK prototype cask were conducted. A safety analysis for fire and water immersion was conducted according to IAEA recommendations for SNF casks through the use of computer models rather than actual fire and immersion testing (5). The RF design codes, used to design the cask, were compared with US codes using a set of 'dummy' data and are documented in two reports (6,7). Preliminary tests of the TUK-MBK cask for concrete strength, weld tightness, concrete pour quality, hydraulic, pneumatic, alignment and lift capacity tests were conducted at the Izhora plant (8). The results of these tests indicate that the prototype cask meets the requirements of the design documentation and the technical assignment. Drop tests from 1 and 9 meters were conducted using a half scale model of the TUK-MBK prototype cask manufactured by the Izhora facility and loaded with simulated SNF (9). These dynamic tests showed that the half-scale model retained hermetic seal and physical integrity and the data suggest that under these emergency conditions the TUK-MBK cask functioned within design limits. Cold testing of the TUK-MBK prototype cask was conducted at RTP Atomflot (January 2000) and PO Mayak (February 2000). Extracts of the test reports indicate that the operations of the TUK-

MBK and auxiliary equipment are consistent with existing transportation, loading, and other infrastructure and activities at both RTP Atomflot and PO Mayak (10 and 11, respectively).

Hot testing was completed in August 2000 in Severodvinsk on a cask from the first serial production run of the TUK-MBK casks (serial production designation TUK-108/1). The tests were to collect additional data for the cask certification, determine the extent to which the TUK-108/1 casks meet the requirements of the technical specification and design documentation and transport scheme, fitness of the TUK-18 and TUK-108/1 auxiliary equipment for operation and maintenance of the cask, and to verify radiation safety, temperature and containment characteristics (12).

An additional analysis was conducted on the TUK-108/1 to evaluate the potential effects of allowable residual water on the performance of the cask (13). In particular, the effects of radiolysis were examined with respect to over pressurization and the generation of explosive gas concentrations. Also evaluated was the effect of high temperature fire events on the pressurization of the cask. The conclusions of this study suggest, based on the allowable water and the fuel characteristics, that with appropriate maintenance no undo safety gaps exist.

CERTIFICATION

During the development of the prototype cask, the legislative framework for licensing within the Russian Federation was undergoing rapid change. At the time AMEC Project 1.1 began, regulation of military nuclear issues took place on the basis of an informal agreement between the Ministry of Atomic Energy (Min Atom), Ministry of Defense (MOD), and the nuclear regulatory body Gosatomnadzor (GAN). During the course of AMEC, the legislative framework for licensing military uses of nuclear materials developed, changing the governing bodies and licenses required for the AMEC cask. The most notable change was the development of the military nuclear regulatory body (UGN YaRB MOD, "Military GAN" to separate the regulatory body for military applications of nuclear materials from GAN, the regulatory body for civilian uses of nuclear materials, such as nuclear power plants. The change in regulation was enacted through legislation. The RF Government Decree #1007, dated September 4, 1999, and signed by President Putin formalized the military nuclear regulatory procedures and clearly identifies Min Atom as the licensing authority for military nuclear issues in the RF. The decree also gave Min Atom the responsibility to propose the licensing framework for future military use of nuclear energy. Additionally, Min Atom was given the authority to authorize shipments or military SNF by rail, therefore licensing of the AMEC cask for rail shipment by the Ministry of Railroads is not required.

In a March 23-24, 2000 trilateral AMEC meeting, the US requested a decision from above the ministerial level to identify which RF entity has the authority and responsibility for licensing the prototype cask and the CTR serially produced 40 tonne casks. A May 29, 2000 internal RF meeting headed by Deputy Prime Minister Klebanov resolved the regulatory framework in relation to military spent nuclear fuel.

During a June 15, 2000 meeting, Min Atom provided to AMEC a memorandum detailing the certificates, licenses, and approving authorities for the prototype cask and the CTR serially produced casks. This memo clearly removes GAN from authority and responsibility in regard to military objects, which includes the prototype cask and the CTR serially produced casks. Therefore, it is no longer appropriate to include GAN in AMEC.

Four documents are needed to serially produce and use casks designed in AMEC project 1.1. These four documents are: (1) Certificate – Permission for Design (14), (2) License for Production, (3) Certificate – Permission for Transportation (15), and (4) License for Storage. The License for Production is issued to the production facility, and it should be ensure that the facility under contract has such a license prior to production of the casks. The License for Storage will also be needed prior to contracting for serial cask production.

STATUS OF THE PROTOPYE CASK

As of May 1, 2001 the prototype TUK-MBK cask has been decontaminated and returned to Severodvinsk. Further action on the prototype cask is pending CTR guidance for additional testing or destruction. It remains U.S. government property and notification of U.S intentions for this property should be directed to ICC Nuclide in the near future.

TECHNICAL EXPERTS

Issues related to the design and certification of the TUK 108/1 cask can be directed to the following points of contact:

Project Officers

Dr. Steinar Høibråten
Norwegian Defence Research Establishment (FFI)
P.O. Box 25
NO-2027 Kjeller, Norway
+47 63 80 75 67
+47 63 80 75 09 (fax)

Mr. Robert S. Dyer
US Environmental Protection Agency
1200 Pennsylvania Avenue
Washington, DC 20460
(202) 564-6113
(202) 565-2409 (fax)

Vladimir Reshetkin, Rear Admiral
Main Technical Directorate
Russian Federation Navy

Technical Experts / Contractors

Ms Evelyn Foshaug
Institute for Energy Technology (IFE)
OECD Halden Reactor Project
P.O. Box 173
N-1751 Halden, Norway
+47 69 21 21 15
+47 69 21 24 70 (fax)

Mr Randall L. Snipes
Oak Ridge National Laboratory
PO Box 2008 MS6305
Oak Ridge TN 37831-6305
(865) 241-9128
(864) 574-4624 (fax)

Ms. Jane M. Gunn
US Nuclear Regulatory Commission
Mail Stop T4D18
Washington, DC 20555
(301) 415-6390
(301) 415-5397 (fax)

Ms Tatyana Markarchuk
Senior Engineer
ICC Nuclide
64, Lesnoy pr.
St.Petersburg, 194100 Russia
7 (812) 542 93 42
7 (812) 542 62 28 (fax)

EXPENDITURES

U.S. Expenditures / Environmental Protection Agency

Description	Cost (USD)
Labor	0
Programmatic Expenses	9,259
Travel	165,633
Grants	5,900
Contracts	1,069,165
Total	**1,249,957**

Norwegian Expenditures / Norwegian Defence Research Establishment (FFI)

Description	Costs (NOK)	Cost (est USD)
Labour	453,496	48,244
Travel	296,035	31,493
Other costs	26,732	2,844
Contracts	874,652	97,479
Total	**1,650,915**	**180,060**

Russian Expenditures / ICC Nuclide from the Russian Federal Budget

Description of Work	Costs (RRu)	Cost (est USD)
Pre-design, Feasibility study, Baseline Data, TZ	1,410,000	58,000
Technical design, prototype documentation, testing models, fragments and other components	4,420,000	182,000
Prototype production, auxiliary equipment and factory testing, testing based on technical requirements, certification	5,320,000	220,000
Preparation and production at OAO Izhora	11,284,000	435,000
Production of test sample, preliminary and acceptance testing w/ working documentation for serial production, certification	6,128,000	235,000
Total	**28,562,000**	**1,131,000**

CONSIDERATIONS / LESSONS LEARNED

There are still ongoing negotiations between the three nations regarding a trilateral legal agreement for all AMEC projects. Pending an AMEC legal agreement, AMEC projects are included under related bilateral legal agreements.

AMEC project 1.1 has been granted legal coverage under the Cooperative Threat Reduction agreement between Russia and the U.S. Norway did not obtain legal coverage for the project before completion of all tasks of AMEC project 1.1. This prevented Norway from entering into contracts with the Russian side. Therefore, the majority of the Norwegian funds allocated for this project were unspent.

Certification and licensing is not a trivial task. This task should be considered from the very start of the project and necessary actions should be taken throughout the project period to monitor the process of these tasks.

It should be obvious that all three AMEC partners are parts of the entire project. However, experience shows that this must be recognized in the Task Management Profile Plan (TMPP) and in all contracts between any of the parties must ensure access to all reports and site visits by all three parties. Similarly, it is important that the TMPP lists all deliverables to avoid future disagreements over what should actually be provided.

CONCLUSIONS

Documentation provided to date by the Russian Federation includes the “Certificate – Permission for Design” and the “Certificate-Permission for Transportation.” Based on the review of this documentation and technical discussions between technical experts from the AMEC partner countries, it was determined that no significant technical issues remain. However, the working group has concerns related to long term monitoring of the casks. This is particularly important due to the amount of residual bulk water allowed to remain in the storage cask. This water creates the potential for over pressurization and corrosion of the cask structural and containment components, as well as the corrosion of the spent nuclear fuel itself.

To ensure the operation and maintenance of the casks remain safe, a maintenance protocol should be established. Performance evaluation over the entire lifetime of the cask is prudent. The use of cask pressure monitoring, headspace chemical analysis and replacing headspace with inert gases will reduce the potential for over pressurization and hydrogen accumulation. The inclusion of material tickets or coupons to monitor corrosion should be considered as a corrosion test program if experimental data on corrosion is not available. Information on corrosion of the cask and fuel under storage conditions will be valuable for estimating life expectancy of the cask, expected certification extensions, and to ensure cask integrity during the early years of their use. ICC Nuclide considered corrosion issues during the design phase of the cask. In addition, corrosion testing of the half-scale model and an examination of the prototype cask following hot testing was conducted. A summary report on corrosion was produced by Nuclide in July 2001 (16).

REFERENCES

1. ICC Nuclide (1998) Feasibility Study on Use of the Transportable MBK for Interim Storage of the VMF's SNF.

2. ICC Nuclide (1998) Development and Coordination of a Technical Assignment for Transportable Metal-Concrete Containers for Temporary Storage of the Navy's SNF.

3. ICC Nuclide (1999) Development and Fabrication of a Prototype of Transport Cask for Interim Storage of Navy (VMF) Spent Nuclear Fuel.

4. ICC Nuclide (1999) Development and Fabrication of a Prototype of Transport Cask for Interim Storage of Navy (VMF) Spent Nuclear Fuel : Answers to the NAC's Inquiry about Additional Information on TUK MBK-VMF Container.

5. ICC Nuclide (1999) Summary from Safety Analysis Report.

6. ICC Nuclide (1999) Basic Data for Code Comparison.

7. ICC Nuclide (1999) Results of the International Code Comparison on the Basis of the Comparison of Results of Test Tasks for the Model of TUK-MBK-VMF.

8. ICC Nuclide (1999) Results of Preliminary Tests of the Prototype TUK MBK-VMF Cask at Izhora Plant.

9. ICC Nuclide (1999) Dynamic Testing of the TUK MBK-VMF Model.

10. ICC Nuclide (2000) Extracts of the Test Report (RTP Atomflot).

11. ICC Nuclide (2000) Extracts of the Test Report (PO Mayak).

12. ICC Nulcide (2000) Results of Acceptance Tests of a Prototype TUK MBK-VMF with Loading Spent Nuclear Fuel.

13. Westinghouse Safety Management Solutions (2001) Transient Analysis of Residual Water Radiolysis within the TUK-108/1 Cask and Effects of Fire Exposure.

14. Certificate Permission for Design of a Package (Transportation Package Set TUK-108/1 Containing Spent Nuclear Fuel from Transport Nuclear Engine Installations on Military Purpose), 2000.

15. Certificate Permission for Transportation (Transportation Package Set of TUK MKB-VMF TUK 108/1 Type Containing SNF of Russian Navy Nuclear Submarines), 2001.

16. ICC Nuclide (2001) Summary from Corrosion Analysis Report.