NUREG-1419

Directory of Certificates of Compliance for Dry Spent Fuel Storage Casks

U.S. Nuclear Regulatory Commission

Office of Nuclear Material Safety and Safeguards

NUREG-1439

DIRECTORY OF CERTIFICATES OF COMPLIANCE FOR DRY SPENT FUEL STORAGE CASKS

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Division of Industrial and Medical Nuclear Safety
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555

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ABSTRACT

This directory contains (1) Certificates of Compliance for all dry spent fuel storage casks approved by the U.S. Nuclear Regulatory Commission, (2) Summary Reports of each approved cask model. Later directories will contain (3) A list of cask users, and (4) a list of cask locations.

The purpose of this directory is to make available a convenient source of information on spent fuel storage casks which have been approved by the U.S. Nuclear Regulatory Commission. Storage of fuel assemblies using these casks must be in accordance with the provisions of 10 CFR Part 72.

Comments which would make future revisions of this directory more useful are invited and should be directed to:

Fuel Cycle Safety Branch
Division of Industrial and
Medical Nuclear Safety, NMSS
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

CONTENTS

Certificates of Compliance and Conditions for Use

In 1990 the Nuclear Regulatory Commission amended its regulations to authorize a nuclear power plant licensee to store its spent fuel at the reactor site in approved storage casks that have Certificates of Compliance. Reactor licensees would not be required to get a site-specific license under 10 CFR Part 72 to use a certified storage cask.

Reactor licensees must ensure that there are no unreviewed safety questions or changes needed to use the casks at their sites. They also have to comply with the conditions of the cask's Certificate of Compliance and develop operating procedures for use of the casks. Onsite spent fuel storage in certified casks, under the general license provisions of 10 CFR Part 72, could continue after the reactor shuts down permanently (as long as the 10 CFR Part 50 license is maintained). The licensee would have to indicate how the spent fuel would be removed from storage and shipped off site prior to decommissioning.

To obtain NRC approval of a storage cask, a cask vendor has to submit a safety analysis report describing the proposed cask and how it should be used to store spent fuel safely. A Certificate of Compliance is valid for 20 years, after that the cask would have to be reapproved by the NRC.

The Certificates of Compliance for casks that have been approved are included in this section.

Certificate of Compliance
FOR DRY SPENT FUEL STORAGE CASKS

10 CFR 72

AUG 1 7 1993

1. a. CERTIFICATE NUMBER: 1000
   b. REVISION NUMBER: 0
   c. PACKAGE IDENTIFICATION NUMBER: USA/72-1000
   d. PAGE NUMBER: 1
   e. TOTAL NUMBER OF PAGES: 3

2. Preamble This certificate is issued to certify that the cask and contents, described in item 5 below, meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste."

3. THIS CERTIFICATE is issued on the basis of a safety analysis report of the cask design.

a. PREPARED BY (Name and Address)	b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION
General Nuclear Systems, Inc. 220 Stoneridge Drive Columbia, SC 29210	Topical Safety Analysis Report for the CASTOR V/21 Cask Independent Spent Fuel Storage Installation (Dry Storage) (TSAR) c. DOCKET NUMBER 72-1000

4. CONDITIONS This certificate is conditional upon fulfilling the requirements of 10 CFR 72, as applicable, and the conditions specified below.

5. Cask
   a. Model No: CASTOR V/21
   b. Description
   The CASTOR V/21 cask is designed for the storage and shipment of irradiated spent fuel assemblies. The cask was designed to meet International Atomic Energy Agency's international specifications for Type B(U) packaging corresponding to Nuclear Safety Fissile Class I. However, this certificate addresses spent fuel handling, transfer, and storage on an NRC-licensed nuclear reactor

site but does not address any use or certification of this cask design for offsite transport of spent fuel.

The CASTOR V/21 cask body consists of a thick-walled nodular iron casting. The overall length is 4,886 mm (192.4 in), and the side wall thickness (without fins) is 379 mm (14.9 in). The cross-sectional diameter of the cask body, which weighs approximately 92.3 tonne (101.8 ton), is 2,400 mm (94.5 in). The cask cavity has a diameter of 1,527 mm (60.1 in) and a length of 4,154 mm (163.5 in). It holds a fuel basket and is designed to accommodate 21 PWR fuel assemblies. The loaded weight of the cask is about 106 tonne (117 ton). Four trunnions are bolted on, two at the head end and two at the bottom end of the body.

Gamma and neutron radiation is shielded by the cast iron wall of the cask body. Also for neutron shielding, two concentric rows of axial holes in the wall of the cask body are filled with polyethylene rods. The bottom and the secondary cover each have a slab of the same material inserted for the same purpose

The cask is sealed, to maintain a helium atmosphere, with a multiple-cover system consisting of a primary lid and a secondary lid. The primary lid is constructed of stainless steel. The overall thickness is 290 mm (11.4 in). It is fastened to the body with 44 bolts. The primary lid has two penetrations, used for flushing and venting of the cask cavity as well as the performance of the leak test. The flushing and venting connections are sealed with separate lids. The secondary lid is also made of stainless steel. The overall thickness is 90 mm (3.5 in). It is bolted to the body. A combination of multiple elastomer and metal seals for each lid provide leak tightness. However, no credit is claimed in the TSAR (see Section 3.3.2.2) or given by NRC for elastomer seals for the 20-year storage period.

The fuel basket accepts the spent fuel assemblies and ensures that criticality will not occur. In addition, it ensures exact positioning of the individual fuel assemblies. It is of welded construction and is made either of stainless steel or stainless steel and borated stainless steel sections. At the top end of the cask there is a flushing connection for rinsing, cleaning, and drying of the interior during loading and unloading procedures at the nuclear power plant. The flushing channel runs inside the wall of the body; it has one end at the top and the other end at the bottom of the inside of the cask. Gas intake and exhaust are via the valve in the primary lid. The lid system is fitted with a leak-testing device, a pressure gauge, which is also a cask component classified as important to safety in Section 3.4 of the TSAR. The gauge monitors the gas pressure in the interlid space between the primary and secondary lids. This space is used for a gas barrier with an above atmospheric pressure maintained in it.

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The insids of the cask, including the sealing surface, has a nickel coating for corrosion protection. On the outside, the cask is protected by an epoxy resin coating in the fin area and nickel coating elsewhere. The internal heat-transfer medium is an inert gas (helium), which also serves to inhibit corrosion.

Impact limiters are attached at the top and bottom of the loaded CASTOR V/21 cask when it is transferred at a height greater than 15 inches from the reactor to emplacement on the concrete storage pad at the independent spent fuel storage installation. One impact limiter design is used for both the top and bottom cask limiters. It consists of a ring of a dozen 9-inch lengths of 6-inch diameter Schedule 80 stainless steel pipe contained between half-inch thick stainless steel plates. A cask drop would crush the impacted pipe lengths between the steel plates reducing the impact load on the cask.

c. Drawing

The Model No. CASTOR V/21 dry spent fuel storage cask is described by drawings in Appendix 1 of the TSAR.

d. Basic Components

The Basic Components of the Model No. CASTOR V/21 storage cask that are important to safety are listed in Table 3.4-1 of the TSAR.

6. Cask fabrication activities shall be conducted in accordance with the reviewed and approved quality assurance program submitted with the TSAR.

7. Notification of cask fabrication schedules shall be made in accordance with the requirements of §72.232(c), 10 CFR Part 72.

8. Casks of the Model No. CASTOR V/21 authorized by this certificate are hereby approved for general use by holders of 10 CFR Part 50 licenses for nuclear reactors at reactor sites under the general license issued oursuant to §72.210, 10 CFR Part 72, subject to the conditions specified by §72.212 and the attached Conditions for Cask Use.

9. **Expiration Date:**

August 31, 2010

FOR THE NUCLEAR REGULATORY COMMISSION

Charles J. Haughney
SIGNATURE

Chief, Fuel Cycle Safety Branch
Division of Industrial and
Medical Nuclear Safety
Office of Nuclear Material Safety
and Safeguards

CONDITIONS FOR CASK USE
CERTIFICATE OF COMPLIANCE
72-1000

CONTENTS

1.0 INTRODUCTION

These Conditions for Cask Use govern the safety of the receipt, possession, and storage of irradiated nuclear fuel at an Independent Spent Fuel Storage Installation (ISFSI) and the transfer of such irradiated nuclear fuel to and from a Nuclear Power Station and its ISFSI.

1.1 General Conditions

1.1.1 Operating Procedures

Written operating procedures shall be prepared for cask handling, movement, emplacement, surveillance, and maintenance.

1.1.2 Quality Assurance

Activities at the ISFSI shall be conducted in accordance with the requirements of Appendix B, 10 CFR Part 50.

1.2 Preoperational Conditions

The user shall not allow the initial loading of spent nuclear fuel in the Model No. CASTOR V/21 cask until such time as the following preoperational license conditions are satisfied:

(1) A training module shall be developed for the Station Training Program establishing an ISFSI Training and Certification Program which will cover the following:

a. Cask Design (overview)

b. ISFSI Facility Design (overview)

c. ISFSI Safety Analysis (overview)

d. Fuel loading and cask handling procedures and abnormal procedures

e. Certificate of Compliance (overview).

(2) A training exercise (Dry Run) of cask loading and handling activities shall be held which shall include but not be limited to:

a. Moving cask in and out of spent fuel pool area.

b. Loading a fuel assembly (using dummy assemblies).

c. Cask sealing and cover gas backfitting operations.

d. Moving cask to and placing it on the storage pad.

e. Returning the cask to the reactor.

f. Unloading the cask assuming fuel cladding failure.

g. Cask decontamination.

2.0 FUNCTIONAL AND OPERATING LIMITS

2.1 Fuel To Be Stored At ISFSI

2.1.1 Specification

The spent nuclear fuel to be received and stored at the ISFSI in CASTOR V/21 casks shall meet the following requirements:

(1) Only irradiated 14 x 14, 15 x 15 and 17 x 17 PWR fuel assemblies with Zircaloy fuel rod cladding may be used. Total assemblies per cask ≤ 21.

(2) Maximum initial enrichment shall not exceed 2.2 weight percent U-235 for fuel stored in the stainless steel basket reviewed and found acceptable. Maximum initial enrichment shall not exceed 3.5 weight percent U-235, for fuel stored in the borated stainless steel basket reviewed and found acceptable.

(3) Maximum assembly average burnup shall not exceed 35,000 megawatt-days per metric ton uranium and specific power shall not exceed 35 kW/kg.

(4) Maximum heat generation rate shall not exceed 1 kilowatt per fuel assembly.

(5) Fuel shall be intact unconsolidated fuel. Partial fuel assemblies, that is, fuel assemblies from which fuel pins are missing must not be stored unless dummy fuel pins are used to displace an amount of water equal to that displaced by the original pins.

(6) Fuel assemblies known or suspected to have structural defects sufficiently severe to adversely affect fuel handling and transfer capability unless canned shall not be loaded into the cask for storage.

(7) A procedure shall be developed for the documentation of the characterizations performed to select spent fuel to be stored in the casks. Such procedure shall include independent verification of fuel assembly selection by an individual other than the original individual making the selection.

(8) Immediately prior to insertion of a spent fuel assembly into a cask, the identity of the assembly shall be independently verified by two individuals.

2.1.2 Basis

The design criteria and subsequent safety analysis assumed certain characteristics and limitations for the fuels that are to be received and stored. Specification 2.1.1 assures that these bases remain valid by defining the type of spent fuel, maximum initial enrichment, irradiation history, and maximum thermal heat generation.

2.2 GNSI CASTOR V/21 Dry Storage Cask

2.2.1 Specification

The GNSI CASTOR V/21 Dry Storage Casks used to store spent nuclear fuel at an ISFSI shall have the operating limits shown in Table 2-1.

2.2.2 Basis

The design criteria and subsequent safety analysis of the GNSI CASTOR V/21 assumed certain characteristics and operating limits for the use of the casks. This specification assures that those design criteria are not exceeded.

Table 2-1
GNSI CASTOR V/21 Operating Limits

	Operating Limit
Max. Lifting Height with a Non-Redundant Lifting Device	
• with impact limiters	5 feet
• without impact limiters	15 inches
Dose Rate	
• 2 m Distance	≤ 10 mrem/hr
• Surface	≤ 200 mrem/hr
Cask Tightness	
(Standard H_2-Leak Rate)	
• Primary Lid Seal	$\leq 10^{-8}$ mbar l/s
• Secondary lid Seal	$\leq 10^{-8}$ mbar l/s
Max. Specific Power of One Fuel Assembly	1.0 kW
Helium Pressure limit (Cask Cavity)	800 ± 100 mbar

2.3 Limiting Condition – Handling Height

2.3.1 Specification

This specification applies to handling of a cask being used for spent fuel storage outside of the Fuel Building and Crane Enclosure Building.

(1) The CASTOR V/21 dry storage cask shall not be handled at a height of greater than 15 inches without an impact limiter.

(2) With the impact limiter the CASTOR V/21 dry storage cask shall not be handled at a height greater than 5 feet.

2.3.2 Basis

The drop analyses performed for the CASTOR V/21 dry storage cask requires that an impact limiter be used for postulated cask drop incidents on the ISFSI storage pad for drops greater than 15 inches up to 60 inches without sustaining unacceptable damage to the storage cask and fuel basket. This limiting condition ensures that the handling height limits will not be exceeded at the storage pad or in transit to and from the reactor.

2.4 Dry Storage Cask Surface Contamination

2.4.1 Specification

Initial removable contamination on the dry storage cask shall not exceed 2200 dis/min/100 cm^2 from beta-gamma sources, and 220 dis/min/100 cm^2 from alpha sources.

2.4.2 Basis

Compliance with this limit ensures that the decontamination requirements of 49 CFR 173.443 will be met.

2.5 Dry Storage Cask Internal Cover Gas

2.5.1 Specification

The dry storage casks shall be backfilled with helium.

2.5.2 Basis

The thermal analysis performed for the dry storage casks assumes the use of helium as a cover gas. In addition, the use of an inert gas (helium) is to ensure long-term maintenance of fuel clad integrity.

2.6 Limiting Condition – Pressure Switch

2.6.1 Specification

The pressure switch used to monitor the leak tightness of the CASTOR V/21 dry storage cask shall have the performance characteristics shown in Table 3.3-6 of the TSAR.

3.0 Surveillance Requirements

Requirements for surveillance of various radiation levels, cask internal pressure, contamination levels, cask seal leak rates, and fuel related parameters are contained in this section. These requirements are summarized in Table 3-1 from details contained in Section 3.1 through 3.6. Specified time intervals may be adjusted plus or minus 25 percent to accommodate normal test schedules.

Table 3-1
Surveillance Requirements Summary

Section	Quantity or Item	Period
3.1.1	Cask Loading Measurements	P
3.2.1	Cask Seal Testing	L
3.3.1	Cask Contamination	L
3.4.1	Dose Rates (Cask surface or up to 2 meters from cask surface)	L
	Dose Rates (Fence)	Q
3.5.1	Safety Status Surveillance	Q
3.6.1	Pressure Switch Parameters	P & L
3.7.1	Alarm System	A

P - Prior to cask loading
L - During loading operations
Q - Quarterly
A - Annually

3.1 Cask Loading Measurements

3.1.1 Specification

For the first loading of a cask model, cask side-wall surface dose rate shall be measured upon cask draining. Prior to moving the cask to the storage pad, cask surface temperature shall be measured after the cask has been sealed for an appropriate period, which should not be less than that expected for the cask surface temperature to come into approximate equilibrium. These dose rate and temperature measurements shall be made at the cask side-wall mid-line at three locations 120° apart around the cask circumference and shall be recorded to establish a baseline of comparison for all subsequent loadings of this model of cask.

For all subsequent loadings of casks of this model, measure and record cask side-wall surface dose rates and temperatures at the cask side-wall mid-line at three locations 120° apart and compare these to the baseline established during first cask use. Do not transfer the cask to the storage pad if unexplained variations (which can not be resolved through known differences in spent fuel assemblies loaded) are found.

3.1.2 Basis

These measurements are to assure that casks have been properly loaded.

3.2 Cask Seal Testing

3.2.1 Specification

Prior to storage, the cask must be properly sealed by testing as specified in Section 10.2.2.1 of the TSAR.

3.2.2 Basis

The safety analysis of leak tightness of the cask as discussed in the topical report is based on the seals being leak tight to 10^{-6} mbar l/s. This check is done to ensure compliance with this design criteria.

3.3 Cask Contamination

3.3.1 Specification

After cask loading and prior to moving the cask to the storage pad, the cask shall be swiped to ensure that removable surface contamination levels are less than 2200 dis/min/100 cm^2 from beta-gamma emitting sources, and 220 dis/min/100 cm^2 from alpha emitting sources.

3.3.2 Basis

This surveillance requirement will ensure compliance with the decontamination requirements of 49 CFR 173.443 prior to storage in the ISFSI.

3.4 Dose Rates

3.4.1 Specification

The following dose rate measurements shall be made for the ISFSI:

(1) Cask Surface Gamma and Neutron Dose Rates: After completion of cask loading, gamma and neutron measurements shall be taken on the outside

surface (or within 2 meters of the cask surface). The combined gamma and neutron dose rates shall be less than the surface dose rate stated in Table 2-1 (or the specified rate at a distance of up to 2 meters from the cask surface).

(2) Dry Cask ISFSI Boundary: Doses shall be determined by measurement at the Dry Cask ISFSI site fence and shall be evaluated on a quarterly basis to demonstrate compliance with §20.105(b)(2), 10 CFR Part 20.

3.4.2 Basis

These measurements are necessary to assure compliance with the cask specifications and that the dose rates at the security fence meet Part 20 limits as additional casks are placed in storage.

3.5 Safety Status Surveillance

3.5.1 Specification

A visual surveillance shall be performed on a quarterly basis of the ISFSI to determine that no significant damage or deterioration of the exterior of the emplaced casks has occurred. Surveillance shall also include observation to determine that no significant accumulation of debris on cask surfaces has occurred.

3.5.2 Basis

This surveillance requirement shall ensure cask maintenance.

3.6 Cask Interlid Pressure (CASTOR V/21)

3.6.1 Specification

The cask interlid pressure shall be monitored by use of a pressure switch having the characteristics described in Table 3.3-6 of the TSAR. The switching pressure shall be factory set at 4 bar for the interlid space, and a functional test shall be performed during cask preparation.

3.6.2 Basis

This specification requires the interlid space to be maintained to detect any possible leakage of either cask seal.

3.7 Alarm System

3.7.1 Specification

An alarm system to which all of the pressure switches are connected shall be installed at the storage site and functionally tested annually to ensure proper operation of the system.

3.7.2 Basis

The alarm system must be capable of alerting surveillance personnel of possible cask seal failure and must permit identification of the specific cask indicating a seal failure.

Certificate of Compliance
FOR DRY SPENT FUEL STORAGE CASKS

10 CFR 72

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1. a. CERTIFICATE NUMBER: 1001
   b. REVISION NUMBER: 0
   c. PACKAGE IDENTIFICATION NUMBER: USA/72-1001
   d. PAGE NUMBER: 1
   e. TOTAL NUMBER OF PAGES: 3

2. **Preamble** This certificate is issued to certify that the cask and contents, described in item 5 below, meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste."

3. ***THIS CERTIFICATE*** is issued on the basis of a safety analysis report of the cask design.

   a. PREPARED BY (Name and Address)

   Westinghouse Electric Corp.
   Power Systems
   P.O. Box 355
   Pittsburgh, PA 15230-0355 (USA)

   b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

   Topical Safety Analysis Report for the Westinghouse MC-10 Cask for an Independent Spent Fuel Storage Installation (Dry Storage) (TSAR)

   c. DOCKET NUMBER 72-1001

4. **CONDITIONS** This certificate is conditional upon fulfilling the requirements of 10 CFR 72, as applicable, and the conditions specified below.

5. Cask
   a. Model No: MC-10
   b. Description

   The MC-10 cask is designed for the storage and shipment of irradiated spent fuel assemblies. This certificate addresses spent fuel handling, transfer, and storage on an NRC-licensed nuclear reactor site but does not address any use or certification of this cask design for offsite transport of spent fuel.

The MC-10 cask consists of a thick-walled forged steel cylinder and weighs approximately 85.2 tonne (94 ton). The cask has a cylindrical cask cavity which holds a fuel basket and is designed to accommodate 24 PWR fuel assemblies. The loaded weight of the cask is about 103 tonne (113.3 ton).

The overall length is 4775 mm (188 in), and the side wall thickness including neutron absorber and without fins is 333.8 mm(13.1 in). The cross-sectional diameter of the cask including neutron absorber is 2394 mm (94.3 in). The overall diameter including fins is 2725 mm (107.28 in). The cask cavity has a diameter of 1727 mm (68 in) and a length of 4130 mm (162.6 in). The cask body is low alloy steel approximately 2235 mm (88 in) in diameter and 4699 mm (185 in) long. The forged steel walls and bottom are approximately 254 mm (10 in) thick to provide radiation (gamma) shielding and structural integrity. Three covers seal the top end of the cask cylinder. A low alloy steel cover, approximately 127 mm (5 in) thick with metallic O-rings provides initial seal and shielding following fuel loading. A carbon steel cover approximately 89 mm (3.5 in) thick with a metallic O-ring provides the primary seal.

The cask contains a basket assembly which consists of 24 storage locations utilizing a honeycomb-type basket structure. The stainless steel basket structure maintains the subcritical array of storage locations, provides lateral structural integrity, and conducts fuel assembly decay heat to the cask wall.

Each of the 24 removable cell storage locations consists of an enclosure, neutron poison material, and wrappers. The enclosure is a stainless steel sheet, 2 mm (.75 in) thick by 890 mm (35.06 in) basket structure. The upper ends of the enclosure walls are flared to facilitate fuel loading. Neutron absorbing material is attached to the enclosure walls and held in place with a stainless steel wrapper welded to the panel.

c. Drawing

The Model No. MC-10 dry spent fuel storage cask is described by drawings in Figures 4.2-1 thru 4.2-10 of the TSAR.

d. Basic Components

The Basic Components of the Model No. MC-10 storage cask that are important to safety are listed on page 3.4-1 of the TSAR.

6. Cask fabrication activities shall be conducted in accordance with the reviewed and approved quality assurance program submitted with the TSAR.

7. Notification of cask fabrication schedules shall be made in accordance with the requirements of §72.232(c), 10 CFR Part 72.

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8. Casks of the Model No. MC-10 authorized by this certificate are hereby approved for general use by holders of 10 CFR Part 50 licenses for nuclear reactors at reactor sites under the general license issued pursuant to §72.210, 10 CFR Part 72, subject to the conditions specified by §72.212 and the attached Conditions for Cask Use.

9. Expiration Date:
August 31, 2010

FOR THE NUCLEAR REGULATORY COMMISSION

Charles L. Haughney
SIGNATURE

Chief, Fuel Cycle Safety Branch
Division of Industrial and
Medical Nuclear Safety
Office of Nuclear Material Safety
and Safeguards

CONDITIONS FOR CASK USE
CERTIFICATE OF COMPLIANCE
72-1001

CONTENTS

1.0 INTRODUCTION

These Conditions for Cask Use govern the safety of the receipt, possession, and storage of irradiated nuclear fuel at an Independent Spent Fuel Storage Installation (ISFSI) and the transfer of such irradiated nuclear fuel to and from a Nuclear Power Station and its ISFSI.

1.1 General Conditions

1.1.1 Operating Procedures

Written operating procedures shall be prepared for cask handling, movement, emplacement, surveillance, and maintenance.

1.1.2 Quality Assurance

Activities at the ISFSI shall be conducted in accordance with the requirements of Appendix B, 10 CFR Part 50.

1.2 Preoperational Conditions

The user shall not allow the initial loading of spent nuclear fuel in the Model No. MC-10 cask until such time as the following preoperational license conditions are satisfied:

(1) A training module shall be developed for the Station Training Program establishing an ISFSI Training and Certification Program which will cover the following :

a. Cask Design (overview)

b. ISFSI Facility Design (overview)

c. ISFSI Safety Analysis (overview)

d. Fuel loading and cask handling procedures and abnormal procedures

e. Certificate of Compliance (overview).

(2) A training exercise (Dry Run) of cask loading and handling activities shall be held which shall include but not be limited to:

a. Moving cask in and out of spent fuel pool area.

b. Loading a fuel assembly (using dummy assembly).

c. Cask sealing and cover gas backfitting operations.

d. Moving cask to and placing it on the storage pad.

e. Returning the cask to the reactor.

f. Unloading the cask assuming fuel cladding failure.

g. Cask decontamination.

2.0 FUNCTIONAL AND OPERATING LIMITS

2.1 Fuel To Be Stored At ISFSI

2.1.1 Specification

The spent nuclear fuel to be received and stored at the ISFSI in MC-10 casks shall meet the following requirements:

(1) Only irradiated 14 x 14, 15 x 15 and 17 x 17 PWR fuel assemblies with Zircaloy fuel rod cladding may be used. Total assemblies per cask $\leq$ 24.

(2) Maximum initial enrichment shall not exceed 3.7 weight percent U-235 for fuel stored in the stainless steel basket (with bore plates attached to each of the 24 cell enclosure walls) reviewed and found acceptable.

(3) Maximum assembly average burnup shall not exceed 35,000 megawatt-days per metric ton uranium and specific power shall not exceed 35 kW/kg.

(4) Maximum heat generation rate shall not exceed 0.5625 kilowatt per fuel assembly.

(5) Fuel shall be intact unconsolidated fuel. Partial fuel assemblies, that is, fuel assemblies from which fuel pins are missing must not be stored unless dummy fuel pins are used to displace an amount of water equal to that displaced by the original pins.

(6) Fuel assemblies known or suspected to have structural defects sufficiently severe to adversely affect fuel handling and transfer capability unless canned shall not be loaded into the cask for storage.

(7) A procedure shall be developed for the documentation of the characterizations performed to select spent fuel to be stored in the casks. Such procedure shall include independent verification of fuel assembly selection by an individual other than the original individual making the selection.

(8) Immediately prior to insertion of a spent fuel assembly into a cask, the identity of the assembly shall be independently verified by two individuals.

2.1.2 Basis

The design criteria and subsequent safety analysis assumed certain characteristics and limitations for the fuels that are to be received and stored. Specification 2.1.1 assures that these bases remain valid by defining the type of spent fuel, maximum initial enrichment, irradiation history, and maximum thermal heat generation.

2.2 MC-10 Dry Storage Cask

2.2.1 Specification

The MC-10 Dry Storage Casks used to store spent nuclear fuel at an ISFSI shall have the operating limits shown in Table 2-1.

2.2.2 Basis

The design criteria and subsequent safety analysis of the MC-10 assumed certain characteristics and operating limits for the use of the casks. This specification assures that those design criteria are not exceeded.

Table 2-1
MC-10 Operating Limits

	Operating Limit
Max. Lifting Height with a Non-Redundant Lifting Device	5 feet
Dose Rate	
• 2 m Distance	$\leq$ 10 mrem/hr
• Surface	$\leq$ 200 mrem/hr
Cask Tightness (at closure): (Standard He-Leak Rate)	
• Primary Cover Seal	$\leq 10^{-8}$ std cc/s
• Primary Cover, Vent, Drain and Pressure Sensing Element Penetrations	$\leq 10^{-8}$ std cc/s
Optional Seal Cover Weld	$\leq 2 \times 10^{-4}$ std cc/s
Max. Specific Power of One Fuel Assembly	0.5625 kW
Initial Helium Pressure limit (Cask Cavity)	$\leq$ 1.5 atmospheres

2.3 Limiting Condition – Handling Height

2.3.1 Specification

This specification applies to handling of a cask being used for spent fuel storage outside of the Fuel Building and Crane Enclosure Building.

The MC-10 dry storage cask shall not be handled at a height of greater than 5 feet.

2.3.2 Basis

The drop analyses performed for the MC-10 dry storage cask for postulated cask drop incidents on the ISFSI storage pad indicates that the material of the fuel basket and cask body has sufficient ductility and and toughness to sustain a drop of 5 feet or less without sustaining unacceptable damage to the casks and fuel basket This limiting condition ensures that the handling height limits will not be exceeded at the storage pad or in transit to and from the reactor.

2.4 Dry Storage Cask Surface Contamination

2.4.1 Specification

Initial removable contamination on the dry storage cask shall not exceed 2200 dis/min/100 cm^2 from beta-gamma sources, and 220 dis/min/100 cm^2 from alpha sources.

2.4.2 Basis

Compliance with this limit ensures that the decontamination requirements of 49 CFR 173.443 will be met over the lifetime of the cask in storage.

2.5 Dry Storage Cask Internal Cover Gas

2.5.1 Specification

The dry storage casks shall be backfilled with helium.

2.5.2 Basis

The thermal analysis performed for the dry storage casks assumes the use of helium as a cover gas. In addition, the use of an inert gas (helium) is to ensure long-term maintenance of fuel clad integrity.

2.6 Limiting Condition – Pressure Monitoring Device

2.6.1 Specification

The pressure monitoring device used to monitor the leak tightness of MC-10 dry storage cask or fuel rod integrity shall have the performance characteristics shown in Figure 5.1-1 of the TSAR.

3.0 Surveillance Requirements

Requirements for surveillance of various radiation levels, cask internal pressure, contamination levels, cask seal leak rates, and fuel related parameters are contained in this section. These requirements are summarized in Table 3-1 from details contained in Section 3.1 through 3.6. Specified time intervals may be adjusted plus or minus 25 percent to accommodate normal test schedules.

Table 3-1
Surveillance Requirements Summary

Section	Quantity or Item	Period
3.1.1	Cask Loading Measurements	P
3.2.1	Cask Seal Testing	L
3.3.1	Cask Contamination	L
3.4.1	Dose Rates (Cask surface or up to 2 meters from cask surface)	L
	Dose Rates (Fence)	Q
3.5.1	Safety Status Surveillance	Q
3.6.1	Pressure Monitoring Device Parameters	P & L
3.7.1	Alarm System	A

P - Prior to cask loading
L - During loading operations
Q - Quarterly
A - Annually

3.1 Cask Loading Measurements

3.1.1 Specification

For the first loading of a cask model, cask side-wall surface dose rate shall be measured upon cask draining. Prior to moving the cask to the storage pad, cask surface temperature shall be measured after the cask has been sealed for an appropriate period, which should not be less than that expected for the cask surface temperature to come into approximate equilibrium. These dose rate and temperature measurements shall be made at the cask side-wall mid-line at three locations 120° apart around the cask circumference and shall be recorded to establish a baseline of comparison for all subsequent loadings of this model of cask.

For all subsequent loadings of casks of this model, measure and record cask side-wall surface dose rates and temperatures at the cask side-wall mid-line at three locations 120° apart and compare these to the baseline established during first cask use. Do not transfer the cask to the storage pad if unexplained variations (which can not be resolved through known differences in spent fuel assemblies loaded) are found.

3.1.2 Basis

These measurements are to assure that casks have been properly loaded.

3.2 Cask Seal Testing

3.2.1 Specification

Prior to storage, the cask must be properly sealed by testing as specified in Section 10.2.6 of the TSAR to an initial leak rate of 10^{-6} std cc/sec.

3.2.2 Basis

The safety analysis of leak tightness of the cask as discussed in the topical report is based on the seals after 20 years being leak tight to 10^{-4} std cc/sec. This check is done to ensure compliance with this design.

3.3 Cask Contamination

3.3.1 Specification

After cask loading and prior to moving the cask to the storage pad, the cask shall be swiped to ensure that removable surface contamination levels are less than 2200 dis/min/100 cm^2 from beta-gamma emitting sources, and 220 dis/min/100 cm^2 from alpha emitting sources.

3.3.2 Basis

This surveillance requirement will ensure compliance with the decontamination requirements of 49 CFR 173.443 prior to storage in the ISFSI.

3.4 Dose Rates

3.4.1 Specification

The following dose rate measurements shall be made for the ISFSI:

(1) Cask Surface Gamma and Neutron Dose Rates: After completion of cask loading, gamma and neu-

surface (or within 2 meters of the cask surface). The combined gamma and neutron dose rates shall be less than the surface dose rate stated in Table 2-1 (or the specified rate at a distance of up to 2 meters from the cask surface).

(2) Dry Cask ISFSI Boundary: Doses shall be determined by measurement at the Dry Cask ISFSI site fence and shall be evaluated on a quarterly basis to demonstrate compliance with §20.105(b)(2), 10 CFR Part 20.

3.4.2 Basis

These measurements are necessary to assure compliance with the cask specifications and that the dose rates at the security fence meet Part 20 limits as additional casks are placed in storage.

3.5 Safety Status Surveillance

3.5.1 Specification

A visual surveillance shall be performed on a quarterly basis of the ISFSI to determine that no significant damage or deterioration of the exterior of the emplaced casks has occurred. Surveillance shall also include observation to determine that no significant accumulation of debris on cask surfaces has occurred.

3.5.2 Basis

This surveillance requirement shall ensure cask maintenance.

3.6 Cask Confinement Integrity (MC-10)

3.6.1 Specification

The cask confinement integrity shall be monitored by use of a pressure monitoring device to verify the leak tightness of the cask. A functional test shall be performed during cask preparation.

3.6.2 Basis

This specification requires the cask cavity atmosphere be maintained and monitored to detect any possible leakage of cask seals.

3.7 Alarm System

3.7.1 Specification

An alarm system to which all of the pressure monitoring devices are connected shall be installed at the storage site and functionally tested annually to ensure proper operation of the system.

3.7.2 Basis

The alarm system must be capable of alerting surveillance personnel of possible cask seal failure and must permit identification of the specific cask indicating a seal failure.

Certificate of Compliance
FOR DRY SPENT FUEL STORAGE CASKS

10 CFR 72

AUG 17 1990

1. a. CERTIFICATE NUMBER: 1002
   b. REVISION NUMBER: 0
   c. PACKAGE IDENTIFICATION NUMBER: USA/72-1002
   d. PAGE NUMBER: 1
   e. TOTAL NUMBER OF PAGES: 3

2. **Preamble** This certificate is issued to certify that the cask and contents, described in item 5 below, meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste."

3. *THIS CERTIFICATE* is issued on the basis of a safety analysis report of the cask design.

   a. PREPARED BY (Name and Address)

   Nuclear Assurance Corporation
   6251 Crooked Creek Road
   Suite 200
   Norcross, GA 30092

   b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

   Topical Safety Analysis Report for the NAC Storage/Transport Cask for use at an Independent Spent Fuel Storage Installation

   c. DOCKET NUMBER 72-1002

4. **CONDITIONS** This certificate is conditional upon fulfilling the requirements of 10 CFR 72, as applicable, and the conditions specified below.

5. **Cask**
   a. Model No: NAC S/T
   b. Description
   The Nuclear Assurance Corporation Storage/Transport (NAC S/T) cask is designed for the storage and shipment of irradiated fuel assemblies. This certificate addresses spent fuel handling, transfer, and storage on an NRC-licensed nuclear reactor site but does not address any use of this cask for offsite transport of spent fuel.

The NAC S/T is a multi-wall cylinder with a 38.1 mm (1.5 in) thick inner shell and a 66.8 mm (2.63 in) thick outer shell, both made of stainless steel, separated by 81.3 mm (3.2 in) of lead. There is a 177.8 mm (7.0 in) thick solid neutron shield around the Outer shell which is encased in 6.35 mm (.25 in) thick stainless steel. The cask body is 4605 mm (181.3 in) long and 2388 mm (94 in) in diameter. When loaded with fuel and water the cask weighs 95.3 tonne (105.1 tons), empty it weighs 73.6 tonne (81.1 tons). The fuel basket has 26 cavities which are 223 mm (8.78 in) square for storage of PWR fuel assemblies. Six trunnions can be attached to the cask, four around the top and two on each side at the bottom.

Gamma and neutron radiation is shielded by the lead, stainless steel, and Bisco (solid neutron shield) in the wall. The bottom and lid are also made of lead encased in a stainless steel shell. A 152.4 mm (6 in) thick stainless steel and Bisco neutron shield cap is placed on top of the cask after fuel loading to further reduce radiation.

The cask is sealed, to maintain an inert helium atmosphere, using a 215.9 mm (8.5 in) thick lid with two metallic O-rings. The lid is secured by 24 bolts. The lid has four penetrations: (1) cask cavity drain, (2) cask cavity vent, (3) interseal test port, (4) interseal pressure transducer. Each is sealed using two metal O-rings.

The 26 fuel cavities are square aluminum tubes which are held by aluminum and stainless steel spacers and tie bars. Sheets of boral are attached to the outside of the tubes to absorb neutrons.

Impact limiters are attached to the top and bottom of the cask during transport and storage. They are made of Aluminum honeycomb inside a stainless shell. The cask may never be lifted higher than six feet and must be moved in a vertical position.

c. Drawing

The NAC S/T cask is described by drawings in Chapter 4 of the TSAR.

d. Basic Components

The Basic Components of the Model No. NAC S/T cask, that are important to safety, are listed in Section 3.4 of the TSAR.

6. Cask fabrication activities shall be conducted in accordance with the reviewed and approved quality assurance program submitted with the TSAR.

7. Notification of cask fabrication schedules shall be made in accordance with the requirements of §72.232(c), 10 CFR Part 72.

8. Casks of the Model No. NAC S/T authorized by this certificate are hereby approved for general use by holders of 10 CFR Part 50 licenses for nuclear reactors at reactor sites under the general license issued pursuant to §72.210, 10 CFR Part 72, subject to the conditions specified by §72.212 and the attached Conditions for Cask Use.

9. **Expiration Date:**
August 31, 2010

FOR THE NUCLEAR REGULATORY COMMISSION

(SIGNATURE)

Chief, Fuel Cycle Safety Branch
Division of Industrial and
Medical Nuclear Safety
Office of Nuclear Material Safety
and Safeguards

CONDITIONS FOR CASK USE
CERTIFICATE OF COMPLIANCE
72-1002

CONTENTS

1.0 INTRODUCTION

These Conditions for Cask Use govern the safety of the receipt, possession, and storage of irradiated nuclear fuel at an Independent Spent Fuel Storage Installation (ISFSI) and the transfer of such irradiated nuclear fuel to and from a Nuclear Power Station and its ISFSI.

1.1 General Conditions

1.1.1 Operating Procedures

Written operating procedures shall be prepared for cask handling, movement, emplacement, surveillance, and maintenance.

1.1.2 Quality Assurance

Activities at the ISFSI shall be conducted in accordance with the requirements of Appendix B, 10 CFR Part 50.

1.2 Preoperational Conditions

The user shall not allow the initial loading of spent nuclear fuel in the Model No. NAC S/T cask until such time as the following preoperational license conditions are satisfied:

(1) A training module shall be developed for the Station Training Program establishing an ISFSI Training and Certification Program which will cover the following :

a. Cask Design (overview)

b. ISFSI Facility Design (overview)

c. ISFSI Safety Analysis (overview)

d. Fuel loading and cask handling procedures and abnormal procedures

e. Certificate of Compliance (overview).

(2) A training exercise (Dry Run) of cask loading and handling activities shall be held which shall include but not be limited to:

a. Moving cask in and out of spent fuel pool area.

b. Loading a fuel assembly (using dummy assembly).

c. Cask sealing and cover gas backfilling operations.

d. Moving cask to and placing it on the storage pad.

e. Returning the cask to the reactor.

f. Unloading the cask assuming fuel cladding failure.

g. Cask decontamination.

2.0 FUNCTIONAL AND OPERATING LIMITS

2.1 Fuel To Be Stored At ISFSI

2.1.1 Specification

The spent nuclear fuel to be received and stored at the ISFSI in NAC S/T casks shall meet the following requirements:

(1) Zircaloy clad Westinghouse W-STD 15 x 15 PWR fuel assemblies may be stored in the NAC S/T cask. The maximum number of fuel assemblies that may be stored is 26.

(2) Maximum initial enrichment shall not exceed 3.3 weight percent U-235.

(3) Maximum assembly average burnup shall not exceed 35,000 megawatt-days per metric ton uranium.

(4) Maximum heat generation rate shall not exceed 1 kilowatt per fuel assembly.

(5) Fuel shall be intact unconsolidated fuel. Partial fuel assemblies, that is, fuel assemblies from which fuel pins are missing must not be stored unless dummy fuel pins are used to displace an amount of water equal to that displaced by the original pins.

(6) Fuel assemblies known or suspected to have structural defects sufficiently severe to adversely affect fuel handling and transfer capability unless canned shall not be loaded into the cask for storage.

(7) A procedure shall be developed for the documentation of the characterizations performed to select spent fuel to be stored in the casks. Such procedure shall include independent verification of fuel assembly selection by an individual other than the original individual making the selection.

(8) Immediately prior to insertion of a spent fuel assembly into a cask, the identity of the assembly shall be independently verified by two individuals.

2.1.2 Basis

The design criteria and subsequent safety analysis assumed certain characteristics and limitations for the fuels that are to be received and stored. Specification 2.1.1 assures that these bases remain valid by defining the type of spent fuel, maximum initial enrichment, irradiation history, and maximum thermal heat generation.

2.2 NAC S/T Dry Storage Cask

2.2.1 Specification

NAC S/T Dry Storage Casks used to store spent nuclear fuel at an ISFSI shall have the operating limits shown in Table 2-1.

2.2.2 Basis

The design criteria and subsequent safety analysis of the NAC S/T assumed certain characteristics and operating limits for the use of the casks. This specification assures that those design criteria are not exceeded.

Table 2-1
NAC S/T Operating Limits

	Operating Limit
Max. Lifting Height with a Non-Redundant Lifting Device and Impact Limiters	6 feet
Dose Rate	
• 2 m Distance	$\leq$ 10 mrem/hr
• Surface	$\leq$ 200 mrem/hr
Cask Tightness (Standard He-Leak Rate)	
• Primary Lid Seal	$\leq 10^{-6}$ atm cm^3/sec
• Secondary lid Seal	$\leq 10^{-6}$ atm cm^3/sec
Max. Specific Power of One Fuel Assembly	1.0 kW
Initial Helium Pressure Limit (Cask Cavity)	$\leq$ 32 psia

2.3 Limiting Condition — Handling Height

2.3.1 Specification

This specification applies to handling of a cask being used for spent fuel storage outside of the Fuel Building and Crane Enclosure Building.

(1) The NAC S/T dry storage cask shall not be lifted higher than 6 feet.

(2) The NAC S/T must always be handled in a vertical orientation.

(3) The bottom impact limiter must be used when handling a loaded cask.

2.3.2 Basis

The drop analyses performed for the NAC S/T dry storage cask requires these conditions to avoid sustaining unacceptable damage to the storage cask and fuel basket in the event of a cask drop. The limiting condition ensures that the handling height limits will not be exceeded at the storage pad or in transit to and from the reactor.

2.4 Dry Storage Cask Surface Contamination

2.4.1 Specification

Initial removable contamination shall not exceed 2200 dis/min/100 cm^2 from beta-gamma sources, and 220 dis/min/100 cm^2 from alpha sources.

2.4.2 Basis

Compliance with this limit ensures that the decontamination requirements of 49 CFR 173.443 will be met.

2.5 Dry Storage Cask Internal Cover Gas

2.5.1 Specification

The dry storage casks shall be backfilled with helium.

2.5.2 Basis

The thermal analysis performed for the dry storage casks assumes the use of helium as a cover gas. In addition, the use of an inert gas (helium) is to ensure long-term fuel clad integrity.

3.0 Surveillance Requirements

Requirements for surveillance of various radiation levels, cask internal pressure, contamination levels, cask seal leak rates, and fuel related parameters are contained in this section. These requirements are summarized in Table 3-1 from details contained in Section 3.1 through 3.6. Specified time intervals may be adjusted plus or minus 25 percent to accommodate normal test schedules.

Table 3-1
Surveillance Requirements Summary

Section	Quantity or Item	Period
3.1.1	Cask Loading Measurements	P
3.2.1	Cask Seal Testing	L
3.3.1	Cask Contamination	L
3.4.1	Dose Rates (Cask surface or up to 2 meters from cask surface)	L
	Dose Rates (Fence)	Q
3.5.1	Safety Status Surveillance	Q
3.6.1	Pressure Transducer System Parameters	P & L
3.7.1	Alarm System	A

P = Prior to cask loading
L = During loading operations
Q = Quarterly
A = Annually

3.1 Cask Loading Measurements

3.1.1 Specification

For the first loading of a cask model, cask side-wall surface dose rate shall be measured upon cask draining. Prior to moving the cask to the storage pad, cask surface temperature shall be measured after the cask has been sealed for an appropriate period, which should not be less than that expected for the cask surface temperature to come into approximate equilibrium. These dose rate and temperature measurements shall be made at the cask side-wall mid-line at three locations 120° apart around the cask circumference and shall be recorded to establish a baseline of comparison for all subsequent loadings of this model of cask.

For all subsequent loadings of casks of this model, measure and record cask side-wall surface dose rates and temperatures at the cask side-wall mid-line at three locations 120° apart and compare these to the baseline established during first cask use. Do not transfer the cask to the storage pad if unexplained variations (which can not be resolved through known differences in spent fuel assemblies loaded) are found.

3.1.2 Basis

These measurements are to assure that casks have been properly loaded.

3.2 Cask Seal Testing

3.2.1 Specification

Prior to storage, the cask seals must be tested as specified in Section 3.3.2.2 of the TSAR.

3.2.2 Basis

The safety analysis of leak tightness of the cask as discussed in the topical report is based on the seals being leak tight to 10^{-6} atm cm³/s. This check is done to ensure compliance with this design criteria.

3.3 Cask Contamination

3.3.1 Specification

After cask loading and prior to moving the cask to the storage pad, the cask shall be swiped to ensure that removable surface contamination levels are less than 2200 dis/min/100 cm² from beta-gamma emitting sources, and 220 dis/min/100 cm² from alpha emitting sources.

3.3.2 Basis

This surveillance requirement will ensure compliance with the decontamination requirements of 49 CFR 173.443 prior to storage in the ISFSI.

3.4 Dose Rates

3.4.1 Specification

The following dose rate measurements shall be made for the ISFSI:

(1) Cask Surface Gamma and Neutron Dose Rates: After completion of cask loading, gamma and neutron measurements shall be taken on the outside

surface (or within 2 meters of the cask surface). The combined gamma and neutron dose rates shall be less than the surface dose rate stated in Table 2-1 (or the specified rate at a distance of up to 2 meters from the cask surface).

(2) Dry Cask ISFSI Boundary: Doses shall be determined by measurement at the Dry Cask ISFSI site fence and shall be evaluated on a quarterly basis to demonstrate compliance with §20.105, 10 CFR Part 20.

3.4.2 Basis

These measurements are necessary to assure compliance with the cask specifications and that the dose rates at the security fence meet Part 20 limits as additional casks are placed in storage.

3.5 Safety Status Surveillance

3.5.1 Specification

A visual surveillance shall be performed on a quarterly basis of the ISFSI to determine that no significant damage or deterioration of the exterior of the emplaced casks has occurred. Surveillance shall also include observation to determine that no significant accumulation of debris on cask surfaces has occurred.

3.5.2 Basis

This surveillance requirement shall ensure cask maintenance.

3.6 Cask Interseal Pressure

3.6.1 Specification

The cask interseal pressure shall be monitored by use of a pressure transducer system as described in Section 3.3.3.7 of the TSAR.

3.6.2 Basis

This specification requires the interseal space to be monitored to detect any leakage of either cask seal.

3.7 Alarm System

3.7.1 Specification

An alarm system to which all of the pressure transducer systems are connected shall be installed at the storage site and functionally tested annually to ensure proper operation of the system.

3.7.2 Basis

The alarm system must be capable of alerting surveillance personnel of possible cask seal failure and must permit identification of the specific cask indicating a seal failure.

Certificate of Compliance
FOR DRY SPENT FUEL STORAGE CASKS

10 CFR 72

AUG 17 1990

1. a. CERTIFICATE NUMBER: 1003
   b. REVISION NUMBER: 0
   c. PACKAGE IDENTIFICATION NUMBER: USA/72-1003
   d. PAGE NUMBER: 1
   e. TOTAL NUMBER OF PAGES: 3

2. **Preamble** This certificate is issued to certify that the cask and contents, described in item 5 below, meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 72; "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste."

3. ***THIS CERTIFICATE*** is issued on the basis of a safety analysis report of the cask design.

a. PREPARED BY (Name and Address)

Nuclear Assurance Corporation
6251 Crooked Creek Road
Suite 300
Norcross, GA 30092

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION

Topical Safety Analysis Report for the NAC Storage/Transport Cask Containing Consolidated Fuel for use at an Independent Spent Fuel Storage Installation

c. DOCKET NUMBER 72-1003

4. **CONDITIONS** This certificate is conditional upon fulfilling the requirements of 10 CFR 72, as applicable, and the conditions specified below.

5. **Cask**
   a. Model No: NAC-C28 S/T
   b. Description
   The Nuclear Assurance Corporation Storage/Transport cask for consolidated fuel (NAC-C28 S/T) is designed for the storage and shipment of irradiated fuel rods placed in canisters. This certificate addresses spent fuel handling, transfer, and storage on an NRC-licensed nuclear reactor site but does not address any use of this cask for offsite transport of spent fuel.

AUG 17 1990

The NAC-C28 S/T is a multi-wall cylinder with a 38.86 mm (1.53 in) thick inner shell and a 66.07 mm (2.68 in) thick outer shell, both made of stainless steel, separated by 81.3 mm (3.2 in) of lead. There is a 177.8 mm (7.0 in) thick solid neutron shield around the outer shell which is encased in 6.35 mm (.25 in) thick stainless steel. The cask body is 4605 mm (181.3 in) long and 2419 mm (95.24 in) in diameter. The loaded cask including fuel, water, and lifting yoke weighs less than 113 tonne (125 tons), empty it weighs approximately 75 tonne (83 tons). The fuel basket has 28 cavities which are 223 mm (8.78 in) square for storage of PWR fuel assemblies. Six trunnions can be attached to the cask, four around the top and two opposite each other near the bottom.

Gamma and neutron radiation is shielded by the lead, stainless steel, and Bisco (solid neutron shield) in the wall. The bottom and lid are also made of lead encased in a stainless steel shell. A 96.5 mm (3.8 in) thick stainless steel and Bisco neutron shield cap is placed on top of the cask after fuel loading to further reduce radiation.

The cask is sealed, to maintain an inert helium atmosphere, using a 215.9 mm (8.5 in) thick lid with two metallic O-rings. The lid is secured by 24 bolts. The lid has four penetrations: (1) cask cavity drain, (2) cask cavity vent, (3) interseal test port, (4) interseal pressure transducer. Each is sealed using two metal O-rings.

The 28 fuel cavities are square aluminum tubes tubes which are held by aluminum castings at its periphery. Sheets of boral are attached to the outside of the tubes to absorb neutrons.

Impact limiters are attached to the top and bottom of the cask during transport and storage. They are made of Aluminum honeycomb inside a stainless shell. The cask may never be lifted higher than 59 inches and must be moved in a vertical position.

c. **Drawing**

The NAC-C28 S/T cask is described by drawings in Chapter 4 of the TSAR.

d. **Basic Components**

The Basic Components of the NAC-C28 S/T cask, that are important to safety, are listed in Section 3.4 of the TSAR.

6. Cask fabrication activities shall be conducted in accordance with the reviewed and approved quality assurance program submitted with the TSAR.

AUG 17 1990

7. Notification of cask fabrication schedules shall be made in accordance with the requirements of §72.232(c), 10 CFR Part 72.

8. Casks of the Model No. NAC-C28 S/T authorized by this certificate are hereby approved for general use by holders of 10 CFR Part 50 licenses for nuclear reactors at reactor sites under the general license issued pursuant to §72.210, 10 CFR Part 72, subject to the conditions specified by §72.212 and the attached Conditions for Cask Use.

9. Expiration Date:

August 31, 2010

FOR THE NUCLEAR REGULATORY COMMISSION

Charles J. Haughney
SIGNATURE

Chief, Fuel Cycle Safety Branch
Division of Industrial and
Medical Nuclear Safety
Office of Nuclear Material Safety
and Safeguards

CONDITIONS FOR CASK USE
CERTIFICATE OF COMPLIANCE
72-1003

CONTENTS

1.0 INTRODUCTION

These Conditions for Cask Use govern the safety of the receipt, possession, and storage of irradiated nuclear fuel at an Independent Spent Fuel Storage Installation (ISFSI) and the transfer of such irradiated nuclear fuel to and from a Nuclear Power Station and its ISFSI.

1.1 General Conditions

1.1.1 Operating Procedures

Written operating procedures shall be prepared for cask handling, movement, emplacement, surveillance, and maintenance.

1.1.2 Quality Assurance

Activities at the ISFSI shall be conducted in accordance with the requirements of Appendix B, 10 CFR Part 50.

1.2 Preoperational Conditions

The user shall not allow the initial loading of spent nuclear fuel in the Model No. NAC-C28 S/T cask until such time as the following preoperational license conditions are satisfied:

(1) A training module shall be developed for the Station Training Program establishing an ISFSI Training and Certification Program which will cover the following :

a. Cask Design (overview)

b. ISFSI Facility Design (overview)

c. ISFSI Safety Analysis (overview)

d. Fuel loading and cask handling procedures and abnormal procedures

e. Certificate of Compliance (overview).

(2) A training exercise (Dry Run) of cask loading and handling activities shall be held which shall include but not be limited to:

a. Moving cask in and out of spent fuel pool area.

b. Loading a fuel assembly (using dummy assembly).

c. Cask sealing and cover gas backfitting operations.

d. Moving cask to and placing it on the storage pad.

e. Returning the cask to the reactor.

f. Unloading the cask assuming fuel cladding failure.

g. Cask decontamination.

2.0 FUNCTIONAL AND OPERATING LIMITS

2.1 Fuel To Be Stored At ISFSI

2.1.1 Specification

The spent nuclear fuel to be received and stored at the ISFSI in NAC S/T casks shall meet the following requirements:

(1) Consolidated Zircaloy clad PWR fuel rods in canisters that have the characteristics listed in Table 10.1-1 of the TSAR may be stored in the NAC-C28 S/T cask. The maximum number of canisters that may be stored is 28.

(2) Maximum initial enrichment shall not exceed 3.5 weight percent U-235.

(3) Maximum assembly average burnup shall not exceed 35,000 megawatt-days per metric ton uranium.

(4) Maximum heat generation rate shall not exceed .714 kilowatt per fuel canister.

(5) Fuel canisgters shall contain no fewer than 361 fuel rods and no more than 408 fuel rods.

(6) Fuel canisters known or suspected to have structural defects sufficiently severe to adversely affect fuel handling and transfer capability shall not be loaded into the cask for storage.

(7) A procedure shall be developed for the documentation of the characterizations performed to select spent fuel to be stored in the casks. Such procedure shall include independent verification of fuel assembly selection by an individual other than the original individual making the selection.

(8) Immediately prior to insertion of a spent fuel assembly into a cask, the identity of the canister shall be independently verified by two individuals.

2.1.2 Basis

The design criteria and subsequent safety analysis assumed certain characteristics and limitations for the fuels that are to be received and stored. Specification 2.1.1 assures that these bases remain valid by defining the type of spent fuel, maximum initial enrichment, irradiation history, and maximum thermal heat generation.

2.2 NAC-C28 S/T Dry Storage Cask

2.2.1 Specification

NAC-C28 S/T Dry Storage Casks used to store spent nuclear fuel at an ISFSI shall have the operating limits shown in Table 2-1.

2.2.2 Basis

The design criteria and subsequent safety analysis of the NAC-C28 S/T assumed certain characteristics and operating limits for the use of the casks. This specification assures that those design criteria are not exceeded.

Table 2-1
NAC-C28 S/T Operating Limits

	Operating Limit
Max. Lifting Height with a Non-Redundant Lifting Device	
• With Impact Limiters	≤ 4 feet, 11 in.
• Without Impact Limiters	≤ 15 inches
Dose Rate	
• 2 m Distance	≤ 10 mrem/hr
• Surface	≤ 200 mrem/hr
Cask Tightness (Standard He-Leak Rate)	
• Primary Lid Seal	≤ 1[illegible] cm³/sec
• Secondary lid Seal	≤ 10⁻⁴ [illegible] cm³/sec
Max. Specific Power of One Fuel Canister	.714 kW
Initial Helium Pressure Limit (Cask Cavity)	32.4 psia

2.3 Limiting Condition – Handling Height

2.3.1 Specification

This specification applies to handling of a cask being used for spent fuel storage outside of the Fuel Building and Crane Enclosure Building.

(1) The NAC-C28 S/T dry storage cask shall not be lifted higher than 59 inches.

(2) The NAC-C28 S/T must always be handled in a vertical orientation.

(3) The bottom impact limiter must be used when handling a loaded cask above a height of 15 inches.

2.3.2 Basis

The drop analyses performed for the NAC S/T dry storage cask requires these conditions to avoid sustaining unacceptable damage to the storage cask and fuel basket in the event of a cask drop. The limiting condition ensures that the handling height limits will not be exceeded at the storage pad or in transit to and from the reactor.

2.4 Dry Storage Cask Surface Contamination

2.4.1 Specification

Initial removable contamination shall not exceed 2200 dis/min/100 cm^2 from beta-gamma sources, and 220 dis/min/100 cm^2 from alpha sources.

2.4.2 Basis

Compliance with this limit ensures that the decontamination requirements of 49 CFR 173.443 will be met.

2.5 Dry Storage Cask Internal Cover Gas

2.5.1 Specification

The dry storage casks shall be backfilled with helium.

2.5.2 Basis

The thermal analysis performed for the dry storage casks assumes the use of helium as a cover gas. In addition, the use of an inert gas (helium) is to ensure long-term fuel clad integrity.

3.0 Surveillance Requirements

Requirements for surveillance of various radiation levels, cask internal pressure, contamination levels, cask seal leak rates, and fuel related parameters are contained in this section. These requirements are summarized in Table 3-1 from details contained in Section 3.1 through 3.6. Specified time intervals may be adjusted plus or minus 25 percent to accommodate normal test schedules.

Table 3-1
Surveillance Requirements Summary

Section	Quantity or Item	Period
3.1.1	Cask Loading Measurements	P
3.2.1	Cask Seal Testing	L
3.3.1	Cask Contamination	L
3.4.1	Dose Rates (Cask surface or up to 2 meters from cask surface)	L
	Dose Rates (Fence)	Q
3.5.1	Safety Status Surveillance	Q
3.6.1	Pressure Transducer System Parameters	P & L
3.7.1	Alarm System	A

P - Prior to cask loading
L - During loading operations
Q - Quarterly
A - Annually

3.1 Cask Loading Measurements

3.1.1 Specification

For the first loading of a cask model, cask side-wall surface dose rate shall be measured upon cask draining. Prior to moving the cask to the storage pad, cask surface temperature shall be measured after the cask has been sealed for an appropriate period, which should not be less than that expected for the cask surface temperature to come into approximate equilibrium. These dose rate and temperature measurements shall be made at the cask side-wall mid-line at three locations 120° apart around the cask circumference and shall be recorded to establish a baseline of comparison for all subsequent loadings of this model of cask.

For all subsequent loadings of casks of this model, measure and record cask side-wall surface dose rates and temperatures at the cask side-wall mid-line at three locations 120° apart and compare these to the baseline established during first cask use. Do not transfer the cask to the storage pad if unexplained variations (which can not be resolved through known differences in spent fuel assemblies loaded) are found.

3.1.2 Basis

These measurements are to assure that casks have been properly loaded.

3.2 Cask Seal Testing

3.2.1 Specification

Prior to storage, the cask seals must be tested as specified in Section 3.3.2.2 of the TSAR.

3.2.2 Basis

The safety analysis of leak tightness of the cask as discussed in the topical report is based on the seals being leak tight to 10^{-6} atm cm^3/s. This check is done to ensure compliance with this design criteria.

3.3 Cask Contamination

3.3.1 Specification

After cask loading and prior to moving the cask to the storage pad, the cask shall be swiped to ensure that removable surface contamination levels are less than 2200 dis/min/100 cm^2 from beta-gamma emitting sources, and 220 dis/min/100 cm^2 from alpha emitting sources.

3.3.2 Basis

This surveillance requirement will ensure compliance with the decontamination requirements of 49 CFR 173.443 prior to storage in the ISFSI.

3.4 Dose Rates

3.4.1 Specification

The following dose rate measurements shall be made for the ISFSI:

(1) Cask Surface Gamma and Neutron Dose Rates: After completion of cask loading, gamma and neutron measurements shall be taken on the outside

surface (or within 2 meters of the cask surface). The combined gamma and neutron dose rates shall be less than the surface dose rate stated in Table 2-1 (or the specified rate at a distance of up to 2 meters from the cask surface).

(2) Dry Cask ISFSI Boundary: Doses shall be determined by measurement at the Dry Cask ISFSI site fence and shall be evaluated on a quarterly basis to demonstrate compliance with §20.105, 10 CFR Part 20.

3.4.2 Basis

These measurements are necessary to assure compliance with the cask specifications and that the dose rates at the security fence meet Part 20 limits as additional casks are placed in storage.

3.5 Safety Status Surveillance

3.5.1 Specification

A visual surveillance shall be performed on a quarterly basis of the ISFSI to determine that no significant damage or deterioration of the exterior of the emplaced casks has occurred. Surveillance shall also include observation to determine that no significant accumulation of debris on cask surfaces has occurred.

3.5.2 Basis

This surveillance requirement shall ensure cask maintenance.

3.6 Cask Interseal Pressure

3.6.1 Specification

The cask interseal pressure shall be monitored by use of a pressure transducer system as described in Section 3.3.3.2 of the TSAR.

3.6.2 Basis

This specification requires the interseal space to be monitored to detect any leakage of either cask seal.

3.7 Alarm System

3.7.1 Specification

An alarm system to which all of the pressure transducer systems are connected shall be installed at the storage site and functionally tested annually to ensure proper operation of the system.

3.7.2 Basis

The alarm system must be capable of alerting surveillance personnel of possible cask seal failure and must permit identification of the specific cask indicating a seal failure.

General Nuclear Systems Inc. (GNSI)
220 Stoneridge Drive
Columbia, SC 29210

Model:	Castor V/21
Project No.:	M-37
Docket No.:	72-1000
Certificate No.:	1000

Shield Material:	Polyethylene and Nodular Cast Iron
Structural Material:	Nodular Cast Iron
Comments:	Can use a 3.5% enriched fuel with boron in basket.

OPERATING LIMITS

Leak Rate:	10E-6 mBar l/s
Burnup:	35,000 MWD/MTU
Fill Gas:	Helium
Pressure:	.8 Bar Abs.
Capacity:	21 PWR
Dose at 2 m:	10 mrem/hr
Surface Dose:	200 mrem/hr
Gross Weight:	107.6 tons
Minimum Fuel Age:	5 years
Initial Enrichment:	2.2%
Alpha Contamination:	220 dpm/100 sq cm
Beta and Gamma Cont.:	2200 dpm/100 sq cm
Heat Generated Per Assembly:	1 kW
Cavity Pressure While Drying:	3 mBar
Lift Height With Impact Limiter:	60 in
Lift Height Without Impact Limiter:	15 in

Westinghouse Electric Corp. (WEC)
Box 355
Pittsburgh, PA 15230-0355

Model: MC-10
Project No.: M-41
Docket No.: 72-1001
Certificate No.: 1001

Shield Material: Bisco NS-3
Structural Material: Steel
Comments:

OPERATING LIMITS	
Leak Rate:	10E-6 mBar 1/s
Burnup:	35,000 MWD/MTU
Fill Gas:	Helium
Pressure:	2.5 Bar Abs.
Capacity:	24 PWR
Dose at 2 m:	10 mrem/hr
Surface Dose:	200 mrem/hr
Gross Weight:	122.7 tons
Minimum Fuel Age:	10 years
Initial Enrichment:	3.7%
Alpha Contamination:	220 dpm/100 sq cm
Beta and Gamma Cont.:	2200 dpm/100 sq cm
Heat Generated Per Assembly:	.5625 kW
Cavity Pressure While Drying:	0 mBar
Lift Height With Impact Limiter:	N/A
Lift Height Without Impact Limiter:	60 in

Nuclear Assurance Corporation (NAC)
6521 Crooked Creek Rd., #200
Norcross, GA 30092

Model: NAC S/T
Project No.: M-40
Docket No.: 72-1002
Certificate No.: 1002

Shield Material: Bisco NS-4, and lead
Structural Material: Stainless Steel
Comments:

OPERATING LIMITS	
Leak Rate:	10E-6 mBar l/s
Burnup:	35,000 MWD/MTU
Fill Gas:	Helium
Pressure:	2.2 Bar Abs.
Capacity:	26 PWR
Dose at 2 m:	10 mrem/hr
Surface Dose:	200 mrem/hr
Gross Weight:	105.1 tons
Minimum Fuel Age:	5 years
Initial Enrichment:	3.3%
Alpha Contamination:	220 dpm/100 sq cm
Beta and Gamma Cont.:	2200 dpm/100 sq cm
Heat Generated Per Assembly:	1 kW
Cavity Pressure While Drying:	0 mBar
Lift Height With Impact Limiter:	72 in
Lift Height Without Impact Limiter:	N/A

Nuclear Assurance Corporation (NAC)
6521 Crooked Creek Rd., #260
Norcross, GA 30092

Model: NAC-C28 S/T
Project No.: M-51
Docket No.: 72-1003
Certificate No.: 1003

Shield Material: Bisco NS-4, and lead
Structural Material: Stainless Steel
Comments: Holds 56 assemblies consolidated in 28 canisters

OPERATING LIMITS	
Leak Rate:	10E-6 mBar l/s
Burnup:	35,000 MWD/MTU
Fill Gas:	Helium
Pressure:	.2.2 Bar Abs.
Capacity:	56 PWR (consolidated)
Dose at 2 m:	10 mrem/hr
Surface Dose:	200 mrem/hr
Gross Weight:	125.0 tons
Minimum Fuel Age:	10 years
Initial Enrichment:	3.5%
Alpha Contamination:	220 dpm/100 sq cm
Beta and Gamma Cont.:	2200 dpm/100 sq cm
Heat Generated Per Assembly:	.714 kW
Cavity Pressure While Drying:	0 mBar
Lift Height With Impact Limiter:	59 in
Lift Height Without Impact Limiter:	15 in

Cask Users

Currently there are no users of certified casks. However, there is one user who started using some of these casks under a site-specific license, before the casks were certified.

Cask Locations

Currently there are no users of certified casks. However, there is one user who started using some of these casks under a site-specific license, before the casks were certified.

NRC FORM 335 (2-89) NRCM 1102, 3201, 3202

U.S. NUCLEAR REGULATORY COMMISSION

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(See instructions on the reverse)

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11. ABSTRACT (200 words or less)

This directory contains (1) Certificates of Compliance for all dry spent fuel storage casks approved by the U.S. Nuclear Regulatory Commission, (2) Summary Reports of each approved cask model. Later directories will contain (3) A list of cask users, and (4) a list of cask Locations.

The purpose of this directory is to make available a convenient source of information on spent fuel storage casks which have been approved by the U.S. Nuclear Regulatory Commission. Storage of fuel assemblies using these casks must be in accordance with the provisions of 10 CFR Part 72.

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