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## 1.0 GENERAL INFORMATION

### 1.1 Introduction

This document represents a consolidated application for renewal of Certificate of Compliance No. 5492 for the Model No. RMG-181-I shipping container. The container is used for the shipment of unirradiated Uranium, Uranium compounds or solutions. The containers shipped Fissile Class III are limited to 18 containers per shipment. Fissile Class II containers have H/U-235 ratios not exceeding 3 with a maximum transport index of 1.3.

The applicable portions of the format described in Regulatory Guide 7.9 "Standard Format and Content of Part 71 Application for Approval of Packaging of Type B, Large Quantity, and Fissile Radioactive Material," will be followed in this application.

### 1.2 Package Description

#### 1.2.1 Packaging

The packaging authorized by this certificate consists of an outer DOT Specification 17H steel drum and sealed inner container of 5-inch Schedule 40 steel pipe. The contents are further contained in polyethylene bottles and/or metal cans. The inner container is centered and supported within the metal drum by two sets of 1" x 1" x 1/4" angle iron framework. The void space between drum and inner container is filled with vermiculite. Each end of the inner container shall have a minimum 1" thick by 4-3/4" diameter wood block plus 3 inches of vermiculite. A 1/8" asbestos sheet or equivalent material is placed between both ends of the inner container and the outer drum. The package is identified as Model No. RMG-181-I, and is described on Nuclear Fuel Services' drawing number RMG-181-I (see Section 1.3, Appendix A).

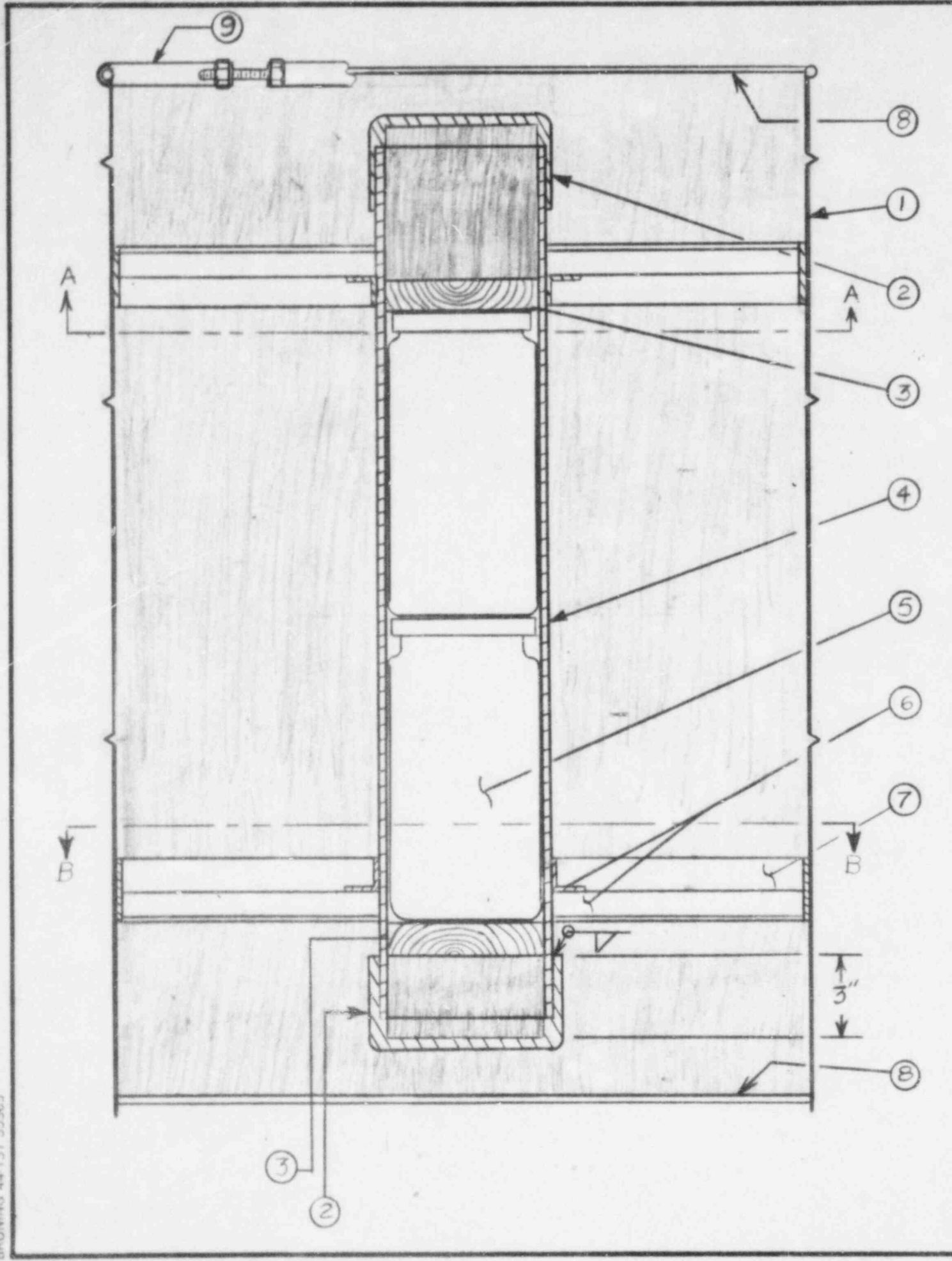
#### 1.2.2 Operational Features

The package does not utilize any special operational features.

#### 1.2.3 Contents of Packaging


The authorized contents consist of large quantities of fissile radioactive material as:

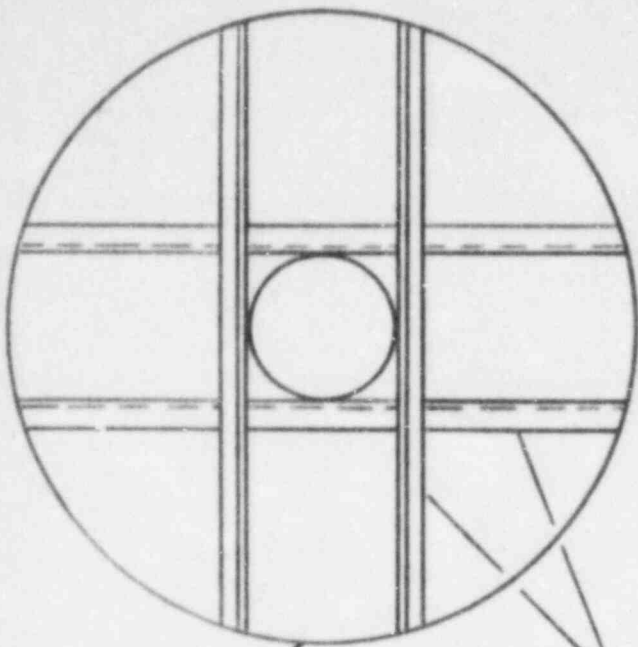
- a. Uranium or any Uranium compound or solution, of any enrichment, with no more than 10 kilograms of U-235 contained in not more than 100 pounds of material. Shipment authorized as Fissile Class III with not more than 18 packages per transport vehicle or stowage area.
- b. U-235 as metal, compounds or alloys having an H/U-235 ratio of not more than 3 considering all sources of hydrogen in the inner container, and not more than 14 kilograms of



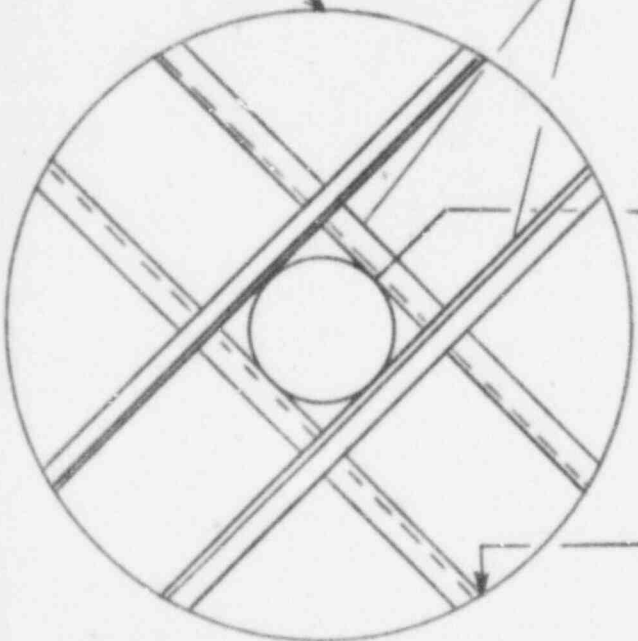
44-131 55363

### LEGEND

- ① 55 GAL. DOT 17H DRUM
  - ② 5" THD. CAP (STEEL)
  - ③ 1" THK. WOODEN BLOCK
  - ④ 5" SCH. 40 STEEL PIPE
  - ⑤ MATERIAL CONTAINER'S
  - ⑥ 1" X 1" X 1/4" CS ANGLE IRON
  - ⑦ 2" X 1/8" STEEL BAND
  - ⑧ 1/2" THK. ASBESTOS SHEET (OR EQUIV.)
  - ⑨ CLOSING RING W/ 5/8" DIA. BOLT
- VERMICULITE = 




⑦ SECTION "A-A" ⑥



SECTION "B-B"

 (TYP.)

 (TYP.)

ALL WELDED CONSTRUCTION

**NUCLEAR FUEL SERVICES, INC.**  
ERWIN, TENNESSEE

NAME  
55 GAL. BIRD CAGE W/ 5" DIA. SCH. 40 STEEL PIPE SLEEVE

MADE BY B. MS SCALE 1/4" = 1" DATE 11-22-82

TRACED BY  
CHECKED BY  
APPROVED BY R.P.D. et al **RMG 181-I**

DRAWING NO.

BY	DATE	REVISIONS	LET.

THIS DRAWING AND ALL INFORMATION CONTAINED HEREON IS THE PROPERTY OF NUCLEAR FUEL SERVICES, INC. AND SHALL NOT BE USED OR DISCLOSED FOR ANY PURPOSES OTHER THAN THAT FOR WHICH IT HAS BEEN FURNISHED WITHOUT THE EXPRESS WRITTEN CONSENT OF NFS.

## 2.0 STRUCTURAL EVALUATION

### 2.1 Structural Design

#### 2.1.1 Discussion

The containment vessel is a 5" I.D. Schedule 40 steel pipe with an ASA standard threaded pipe cap closure at both ends; the cap on the bottom end is tightened and then welded to the pipe. The containment vessel is supported in a DOT Specification 17H steel drum by two supports, consisting of the 1" x 1" x 1/4" angle iron framework shown in drawing number RMG-181-I, (see Section 1.3 Appendix A). Vermiculite is used to fill the entire void between the containment vessel and outer container; 1/8" asbestos sheet or equivalent material is placed between both ends of the containment vessel and outer container. Three inches of vermiculite and a 1" thick by 4-3/4" diameter wooden block are located in bottom and top of containment vessel. The sealed polyethylene bottles and/or sealed metal cans containing uranium materials are positioned between the wooden blocks in the containment vessel.

#### 2.1.2 Design Criteria

The outer container meets or exceeds the design criteria for DOT Specification 17H (Title 49 CFR 178.118) steel drums. The 5-inch I.D. Schedule 40 steel pipe supported by the angle iron framework further strengthens the package. Also, see Section 2.5 for additional design criteria.

### 2.2 Weights and Centers of Gravity

<u>Package Constituents</u>	<u>Weight (lbs.)</u>
55-gallon drum	52
Uranium-bearing Material	100 (Maximum)
Vermiculite	59
Supporting Structure	4
Pipe	18
RMG-181-I Total	233

The center of gravity is located 16" from the bottom of the drum along the vertical axis of symmetry in the center of the package.

### 2.3 Mechanical Properties of Materials

The outer containment 55-gallon drum meets DOT 17H specifications. The containment vessel is a 5-inch Schedule 40 steel pipe centered inside the drum.

## 2.4 General Standards for all Packages

### 2.4.1 Chemical and Galvanic Reactions

Uranium metal, compounds, or solutions are contained within polyethylene bottles and/or metal cans. Packaging in this manner inhibits any chemical or galvanic reactions.

### 2.4.2 Positive Closure

The polyethylene bottles and metal cans have affixed to them a tamper proof wire lock and seal. The polyethylene bottles and/or metal cans are then contained within a 5" I.D. pipe sleeve. The pipe has an ASA standard threaded pipe cap closure on both ends, with the bottom one welded to the pipe. The 55-gallon drum closure utilizes a 12-gauge bolted ring with drop forged lugs, one of which is threaded, having a 5/8" bolt. The 55-gallon drum closure meets Title 49 CFR 178.118-8 requirements.

### 2.4.3 Lifting Devices

The RMG-181-I package does not utilize any lifting devices.

### 2.4.4 Tiedown Devices

The RMG-181-I package does not utilize any tiedown devices.

## 2.5 Standards for Type B and Large Quantity Packaging

This package, when properly constructed and assembled, meets the standards prescribed in DOT Regulations Section 173.395(c)(2), 173.396(c)(3), and 173.398(c), thereby qualifying the package as a Type B and Large Quantity Package.

The package consists of a metal drum-type birdcage which conforms to a 55-gallon size DOT Specification 6L, except for the following modifications:

- a. A 3-inch thickness of vermiculite must be placed at each end of the inner containment vessel.
- b. A 1/8" asbestos sheet or equivalent material must be placed between each end of the inner containment vessel and the outer drum.
- c. In lieu of the centering mechanism as prescribed in 178.103-3(c), an angle iron framework, 1" x 1" by 1/4" is utilized.
- d. A minimum 1" thick x 4-3/4" diameter wood disc must be inserted at each end of the inner containment vessel so that the contents are between these blocks. The specified thickness of vermiculite at each end may be reduced by an amount equal to the thickness of each wood block.



## 2.6 Normal Conditions of Transport

The package design has proven to withstand hypothetical accident conditions in prototype testing; see Section 2.7. Referring to these tests, external temperatures would have negligible effects, if any, on the internal pressures, chemical composition, or the geometric or material buckling of the package under normal transport conditions. The 55-gallon drum (17H container) also must pass the testing specified in Title 49 CFR 178.118-12 and 13.

## 2.7 Hypothetical Accident Conditions

A prototype package was prepared as stated in Section 1.2.1, with 100 lbs. of material, and then tested.

### 2.7.1 Free Drop

First, the package was dropped 30 feet onto solid concrete. The package shown in Section 1.3 deformed to a minimum diameter of 22-1/2" with the sleeve displaced off-center by 1/2".

### 2.7.2 Puncture

The package was then dropped 3-1/2 feet onto a 6" diameter ram. The outer drum was only slightly deformed and the inner pipe was not damaged by such tests.

### 2.7.3 Thermal

The package was tested in a fuel oil fire for 30 minutes. The temperature of the fire read 200C to 2100°F by optical pyrometer; readings were taken at ten minute intervals.

### 2.7.4 Water Immersion

After the fire test, the drum was immersed for 24 hours in water. The depth at the drum lid was four feet.

### 2.7.5 Summary of Damage

The inner containers showed no signs of excessive heat. No water leaked into the pipe sleeve and no water leaked out of the containers with water sealed inside (see Section 3.5). The bottle with no water in it remained dry inside and out.

## 2.8 Special Form

The package does not claim to be used for Special Form Material.

#### 4.0 CONTAINMENT

##### 4.1 Containment Boundary

The RMG-181-I shipping package has three levels of containment:

- a. inner containment - sealed polyethylene bottles and/or sealed metal cans.
- b. containment vessel - 5-inch I.D. steel pipe.
- c. outer containment - 55-gallon drum.

##### 4.1.1 Containment Vessel

The containment vessel is a 5-inch I.D. Schedule 40 steel pipe with an ASA standard threaded pipe cap on both ends, with the bottom one welded to the pipe. The outer containment meets the requirements specified for a DOT 17H container as stated in Title 49 CFR 178.118.

##### 4.1.2 Containment Penetrations

To gain access to the contained material within a closed RMG-181-I package, one must go through the following in sequence;

- a. Head of a 55-gallon drum, closed by the means of a 12-gauge bolted ring with drop forged lugs, one of which is threaded,
- b. 1/8" asbestos sheet or equivalent material in between the containment vessel and the outer containment,
- c. vermiculite inside the top portion of the outer containment,
- d. an ASA standard threaded pipe cap closure over a 5-inch Schedule 40 steel pipe,
- e. three inches of vermiculite and a 1" thick wooden block in the top of containment vessel, and
- f. a sealed polyethylene bottle or sealed metal can.

##### 4.1.3 Seals and Welds

All body seams on the 55-gallon drum are welded. An 1/8" asbestos gasket or equivalent material is placed between the containment vessel and the 55-gallon drum. The containment vessel has pipe dope applied to pipe cap threads, then the pipe caps are tightened with a 36" pipe wrench. The cap on the bottom is also welded to the containment vessel.

## 7.0 OPERATING PROCEDURE

### 7.1 Procedure for Loading the Package

- a. Prior to loading, the package is inspected for any significant damages. The closure of the package and any sealing gaskets are ensured to be present and free from defects.
- b. A 1/8" sheet of asbestos or equivalent material is placed in the bottom of the drum. The drum is then fitted with the 5" I.D. pipe sleeve with a pipe cap welded on the bottom end. The void space between the drum and the sleeve is filled with vermiculite. Vermiculite is also poured 3" deep in the sleeve; then a 1" thick by 4-3/4" diameter wooden disc is inserted on top of the 3" of vermiculite in the sleeve.
- c. The inner containers, polyethylene bottles or metal cans, are added to the sleeve.
- d. A 1" thick wooden disc is added to the sleeve on top of the bottles or cans. Any remaining void spaces at the top of the sleeve are filled with vermiculite.
- e. Pipe dope is applied to the pipe cap threads, and the pipe cap is tightened with a 36" pipe wrench. All remaining void spaces in the drum are filled with vermiculite, except for that needed to insert a 1/8" sheet of asbestos or equivalent material just under the drum lid. The lid is then put on the drum and the closing ring bolted.
- f. The package is physically inspected for leaks. The package and its surface are surveyed.
- g. All checks and inspections are documented.

### 7.2 Procedure for Unloading the Package

- a. The package is first inspected for physical damage and leaks. The package and its surface are surveyed.
- b. The closing ring is unbolted and the drum lid removed.
- c. The 1/8" sheet of insulating material is removed and bagged into a plastic liner. Vermiculite is removed from the top of the package until the pipe cap is accessible. The vermiculite removed from the package is to also be contained in a plastic liner until the integrity of the polyethylene bottles and/or metal cans is verified.
- d. The pipe cap is removed using a 36" pipe wrench.
- e. The vermiculite and wooden disc are removed from within the pipe and placed into a plastic liner.

- f. The polyethylene bottles and/or metal cans are now accessible and are examined for physical damage and leaks.
- g. All checks and inspections are documented.

7.3 Preparation of an Empty Package for Transport

Empty packages are shipped in accordance with Title 49 CFR 173.29(a) and (e).

- a. The external surface must be free of significant removable contamination. The radiation level at the external surface of the package must not exceed 0.5 millirem per hour.
- b. All openings, including removable heads, filling, and vent holes, must be tightly closed.
- c. A label signifying that the package is empty must be affixed to the package. All other labeling must be removed, obliterated, or completely covered.