PDR 71-5926

DEPARTMENT OF TRANSPORTATION
RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION
WASHINGTON, D.C. 20590

REFER TO:

DEC 17 1979

Mr. C. E. MacDonald
Chief, Transportation Branch
Fuel Cycle and Material Safety
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. MacDonald:

Enclosed are six copies of a request that the Department of Transportation has received for issuance of an IAEA Certificate of Competent Authority based on the 1973 Revised Edition of the IAEA transport regulations. Your technical review and evaluation of this request will be most appreciated. As the request states, the review need only be for "special form" material and as an extension of previously performed evaluations in support of USNRC Certificate No. 5926.

Sincerely,

Richard R. Rawl
Health Physicist
Office of Hazardous
Materials Regulation
Materials Transportation Bureau

FEE EXEMPT

Enclosures

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GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, P.O. BOX 460, PLEASANTON, CALIFORNIA 94566

NUCLEAR ENERGY
ENGINEERING
DIVISION

December 11, 1979

U. S. Dept. of Transportation
Office of Hazardous Materials Operations
Washington, D.C. 20590

ATTENTION: Mr. Richard R. Rawl

Ref: 1) USNRC Certificate of Compliance No. 5926
2) IAEA Certificate of Competent Authority No. USE/5926/B( )F

Dear Mr. Rawl:

The General Electric Company, Vallecitos Nuclear Center (VNC), currently holds IAEA Certificate of Competent Authority No. USA/5926B( )F (Ref. 2) for the G.E. Model 100 Shipping Container. This Certificate is based on the NRC Certificate No. 5926 (Ref. 1) and the IAEA 1967 Edition of "The Regulations for the Safe Transport of Radioactive Materials."

As numerous countries have adapted the 1973 Edition of the IAEA regulations as their standard, VNC wishes to request that the DOT issue a Certificate of Competent Authority for the Model 100 under the provisions of the 1973 Edition of the IAEA regulations.

In support of this application, VNC encloses Attachment A to this letter which makes a paragraph-by-paragraph assessment of the Model 100 in reference to the 1973 IAEA regulations. With two exceptions (discussed below) all of the information contained in Attachment A has been previously submitted to the NRC as the bases for issuing Certificate No. 5926. For your convenience a compilation of those applications is enclosed as Attachment B to this letter.

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The two exceptions cited above are Paragraphs 230 and 721 of the IAEA 1973 Edition which establish leak rate criteria and describe an immersion test. In order to preclude the necessity for developing tests at this time which demonstrate that the Model 100 meets these two requirements, VNC proposes to limit the contents for foreign shipments to Special Form materials only. Such limitation will provide the necessary assurance that no leakage would occur under normal or accident conditions. All such Special Form materials would, of course, receive prior approval and certification to the 1973 IAEA regulations by the DOT.

In summary, VNC then requests a 1973 IAEA certification for the Model 100 Shipping Container based on the applications supporting NRC Certificate No. 5926 but limited to Special Form materials meeting the 1973 IAEA requirements.

Sincerely,

G. E. Cunningham
Senior Licensing Engineer

GEC:sl
Enclosure

ATTACHMENT A

DESIGN REQUIREMENTS

The standards of safety for packaging radioactive materials for international transport are contained in the International Atomic Energy (IAEA) Safety Series No. 6, "Regulations for the Safe Transport of Radioactive Materials", 1973 Revised Edition. Compliance of the Model 100 package with the pertinent sections is discussed by paragraph number.

Section I - Definitions

The Model 100 transport package is designed to fall under the category defined in paragraph 127 and 131 as a Type B (U) package.

Section II - Packaging and Package Design Requirements

General Design Requirements

201 The package is equipped with adequate provision for fork type material handling equipment and adequate hardware to secure the package during transport.

202 Not applicable. (package weight is in excess of 50 kg)

203 Reference Paragraph 201.

204 The package is intended to be lifted either by fork type equipment or by the shackles and ears attached to the side of the jacket.

205 Two rectangular "eyes" for lifting the jacket off the base are provided adjacent to the tie-down ears. During transport, cover plates are bolted over these "eyes" to preclude their use for lifting or tie-down of the complete package. The cover plates are stamped with a warning "NOT FOR TIE-DOWN".

206 The outer surface of the package is designed to avoid the collection and retention of rainwater.

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Section II - Packaging and Package Design Requirements - continued

General Design Requirements - continued

207 The external surface of the package is smooth and painted for easy decontamination.

208 General Electric Standard Operating Procedures (SOP) preclude adding or deleting features of the package without a complete Engineering Analysis and review.

Additional Requirements for Strong Industrial Packages

209 Not applicable.

Additional Requirements for Type A Packages

210 All external dimensions exceed 4 inches (10cm).

211 The outside package is sealed with a wire and lead seal which prevents the protective jacket from being removed from the pallet-base assembly without breaking the seal or wire.

212 The cask is designed so that the external surface is free from protruding features except for the fixtures required for tie-down.

213 The structural properties of the materials used in the packaging components, i.e., steel jacket, steel shell, and lead metal, are suitable for service between the temperature extremes of -40°F (-40°C) and 148°F (70°C). The package is not highly stressed during normal transit and reduction of ductility at low temperatures is not expected to impair serviceability.

Section II - Packaging and Package Design Requirements - continued

Additional Requirements for Type A Packages - continued

214 All welds are made in accordance with General Electric standard welding practices including dye penetrant examination and mass spectrometer leak detection tests. These standards are based on ASME and AWS code requirements.

215 Inspections of the Model 100 packages used for Type B and large quantity shipments since 1969 reveals no evidence of vibratory or acceleration-induced damage of significance to transport safety.

216 The containment system of the radioactive material is the special form encapsulation with welded closure. Prototypes of these encapsulations have been tested in accordance with the requirements of paragraphs 726-737, and have demonstrated retention of their contents. The containment is retained in the cask cavity which is sealed by the gasket and lid and the drain line plug. This seal is used only to retain the special form capsule in the cask cavity. Demonstration of cask cavity leak rate is not required for special form contents.

217 Competent authority certification of special form material will be considered to be evidence of leak-tightness for the purpose of normal and accident conditions of transport.

218 While not defined as part of the containment system, it is noted that the cask lid is bolted in place and those bolts are independent of any other part of the package.

219 Ten years of experience with the Model 100 show no problems of material incompatibility or pressure generation.

Section II - Packaging and Package Design Requirements - continued

Additional Requirements for Type A Packages - continued

220 Not applicable - No liquid contents authorized.

221 The containment system is unaffected by full vacuum conditions as demonstrated in the special form leakage tests.

222 No valves are used in the design.

223 The cask shielding closure is independent of the containment system, and cannot be opened inadvertently without removing the jacket hold-down bolts and breaking the seal wire.

224 The protective jacket is bolted closed during transport. If the lug structures, used in the tie-down system, failed in such a manner to allow the package to become detached from the vehicle, the basic protective features of the protective jacket and the enclosed cask would remain unchanged.

225 Comments pertinent to normal conditions of transport are addressed in Section IX.

226 Not applicable - no liquid contents authorized.

227 Not applicable - no gaseous contents authorized.

Basic Additional Requirements

The Model 100 package meets all Basic Additional Requirements for Type B(U) Packages (paragraphs 228 through 233) with pertinent details as follows:

Basic Additional Requirements - continued

228 The cask meets all additional requirements specified for Type A packages.

229 and 230 The analysis of accident conditions described in Section IX demonstrates the Model 100 is able to withstand these conditions with no degradation of radiation shielding or loss of radioactive contents through leakage. The 30 ft drop test results showed no measurable deformation to the shielding cask or assembly bolts and only minor damage to the thermal shield. The 30 minute thermal test results showed a maximum internal temperature well below the melting point of the lead shielding. Special form contents, during these tests, would therefore have been subjected to conditions less severe than those required to demonstrate special form qualification. The special form containment would therefore be retained in the cask cavity and would suffer no reduction in its certified integrity. A separate leak test of the cask cavity would only be redundant in meeting the requirements of paragraph 230.

231a When the solar energy absorption under normal ambient conditions is added to the internal heat generation, the maximum cask cavity temperature of the package will reach about 440°F (226°C). This cavity temperature was achieved by loading the cavity with a 387 watt Co-60 source and allowing it to come to equilibrium (5 days). This temperature is far below the special form test temperature of 800°C which causes no damage to the source. Since the solar effect is minimal and since the package has been used for over 10 years with routine internal heat loads approaching 400 watts without evidence of damage, the package fully meets the requirements of this paragraph.

231b With an ambient temperature of 100°F (38°C) in the shade, the surface temperature of the package will not exceed 110°F (43°C) with a 400-watt

Section II - Packaging and Package Design Requirements - continued

Basic Additional Requirements - continued

231b continued

decay heat load. Data for this information was obtained by installing a 387-watt (25,000 Ci) Cobalt-60 heat source in a lead liner in the cask cavity and obtaining the heat transfer parameters. A General Electric computer program (Frecon) was then used to recalculate temperature response at various loadings at 100°F (38°C) ambient.

232 Conditions used as stated in paragraph 232 and Table III.[1]

233 The thermal protective jacket will not be degraded by the tests specified in paragraphs 709 through 714 and 719, nor will it be rendered ineffective by common material handling mishaps. (See Section IX).

Specific Additional Requirements

The Model 100 package meets all Specific Additional Requirements for Type B (U) Packages (paragraphs 234 through 241) as follows:

234 No filter or cooling system is used.

235 and 236 No venting or pressure relief system is used on the Model 100 package.

237 Normal operating pressure in the void space of the special form encapsulation (assuming 387 watts and 440°F (225°C) cavity temperature during transport) is approximately 14 psig (0.98 kg/cm^2). The testing required for special form certification demonstrates that the containment is adequate to withstand pressures substantially higher

Section II - Packaging and Package Design Requirements - continued

Specific Additional Requirements - continued

237 continued

than 1.5 times the sum of this and reduced atmospheric pressure without failure.

238 Maximum cavity temperature during the thermal test of paragraph 720 is shown to be 440°F (226°C). This results in a 16 psi (1.13 kg/cm^2) pressure rise in the void space of the source. Again the special form test assures that the source will remain intact.

239 Maximum operating pressure is less than 100 psi (7 kg/cm^2).

240 The maximum surface temperature of the Model 100 package has been estimated at 156°F (68°C) under normal conditions of transport (decay heat plus solar radiation absorbed).

241 Not applicable - no liquid authorized.

Section III - Exemptions - No exemptions authorized.

Section IV - Activity Limits

The demonstration of leak tightness required to successfully pass the Special Form Certification tests effectively eliminates the need for the individual activity limits. The activity limits of the package are therefore set by the practical heat transfer and radiation shielding capability. The activity limits for the Model 100 can be generically stated as: Any Solid Radionuclide in Certified Special Form containment with a decay heat load up to 400 thermal watts.

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Section V - Controls for Transport and Storage in Transit Mixed Packing

501 Mixed packaging is not authorized.

502 The painted exterior surface of the package is designed to be easily decontaminated so the nonfixed radioactive contamination can be kept below the levels specified in Table XI, IAEA Section V.

503 The Model 100 package is categorized after loading in accordance with the surface radiation and transport index measured prior to consignment.

504-509 See paragraph 503, and 510-513.

510-513 The package will be labeled as required by IAEA and USDOT regulations.

514 The gross weight of the Model 100 package is marked in lbs. and kilograms on the nameplate.

515 Not applicable to Type B packages.

516 The package is marked with the identification of the competent authority and Type B (U) designation on the metal nameplate.

517 The outside of the package is marked with the Trefoil symbol on a metal nameplate

518-519 The package will be labeled as required by IAEA and USDOT regulations.

Section VI - Fissile Materials

Fissile contents will be in special form and will not exceed the 15 gram limit stated in paragraph 601a.

ANALYSIS OF THE MODEL 100 PACKAGE FOR
NORMAL AND ACCIDENT TEST CONDITIONS

IAEA Section VII. Test and Inspection Procedures

Demonstration of Compliance With the Tests

701 A combination of tests with the full size prototype and calculations based on conservative methods and assumptions were used to demonstrate the performance of the Model 100 package under normal and accident conditions.

702 Initial test conditions are based on equilibrium with a 400-watt decay heat load and 100°F (38°C) ambient temperature.

Tests of Packaging

703 One Model 100 package was assembled as a prototype in 1968. All destructive tests were accomplished on this prototype. Following the test series the damaged prototype overpack was replaced and the assembly is in routine service.

704 The assembly was examined before testing, with no detrimental corrosion and deterioration observed. Some superficial scratching and rusting of the cask surface was observed, but these were due to normal material handling (since the cask had been in prior service for some 11 years) and would have no effect on the performance of the package. The prototype Model 100 package used for the demonstration tests was within design tolerances.

705 The Model 100 package prototype was dropped with its cavity full of water. The cask drain plug impacted the protective jacket base causing a partial fracture of the protruding plug. A minor amount

Tests of Packaging - continued

705 continued

of water leaked out through this plug following the test, but no other leaks were sustained during the drop tests and no other evidence of cask deformation, fastener breakage, or other loss of integrity was observed. The drain plug was subsequently replaced by a socket head type which is fully recessed in the cask body. This replacement clearly eliminates the potential for reoccurrence of this failure of integrity. For IAEA certification, the containment system is defined as the special form containment. Since the test conditions required for Qualification of Special Form encapsulations are significantly more severe than the conditions that this encapsulation would experience in the Model 100 cavity during IAEA accident conditions, no reduction in special form integrity would result and no loss of radioactive material would occur.

706 External photographs were taken of the package during assembly and external and internal photos clearly demonstrate the location and extent of damage to the protective jacket and absence of damage (see 705) to the cask itself.

707 The ingetrity of the Model 100 package radioactive containment and radiation shielding following the IAEA specified normal and accident conditions is demonstrated by three separate bases. First, the tests required for Special Form Certification demonstrates that the source integrity is maintained under severe conditions (Ref. 705). Second, the drop test series (Rev. 719) demonstrate that the cask

Tests of Packaging - continued

707 continued

and protective jacket are not damaged by severe impact conditions and finally, the Transient Heat Transfer Analysis demonstrates that no melting of lead would occur as a result of the 30-minute thermal test.

708 The target for the drop test series (Ref. 719) was a concrete pad 20 ft. by 15 ft. by 6 ft. thick covered with a 10 ft. square by 3-inch thick carbon steel plate. The total weight of the pad is estimated at 29,000 lbs., and it was placed on 3 ft. of 95% engineered fill. The ratio of package weight to target pad was therefore approximately 1:64. The target for the second drop was a vertical 6-inch diameter steel bar with a 1/4-inch edge radius, bolted vertically to the steel target pad.

Normal Transport Test Conditions (paragraphs 709 through 714)

709-710 (Ref. 711)

711 Water Spray Test. The protective jacket is constructed of welded and painted steel. Water spray will have no detrimental affect on this package.

712 Free Drop Test. The package is demonstrated to withstand a 30 ft. (9 m) free fall with no impairment of radiation shielding, and no loss of dispersal of radioactive material (Ref. 719); therefore, it meets the requirements of the 1.2-meter (4-foot) free fall.

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Normal Transport Test Conditions (paragraphs 709 through 714) continued

713 Compression Test. This test was deemed unnecessary as it is less restrictive than the 25 psig (187,000 kg/m^2) external pressure required by the USNRC.

714 Penetration Test. This test is less severe than the penetration test of 719b and was, therefore, not conducted on the Model 100 package.

715-717 No liquids or gases authorized.

Summary and Conclusions

The tests or assessments set forth above provide assurance there is no loss or dispersal of the contents during normal transport conditions, and there is no reduction in shielding effectiveness of the package.

Accident Test Conditions (paragraphs 718 through 721)

718 The Model 100 package prototype was subjected to the drop tests of paragraph 719a and 719b. The thermal test of paragraph 720 was examined analytically. The damage indicated in the photographs taken after the drop tests are judged to have no significant effect on the transient thermal analysis.

719 Mechanical Test. The Model 100 prototype was dropped 30 feet (9 m) on the drop pad described in paragraph 708. It was then dropped 40 inches (1 m) on the vertical punch bar. No evidence was found that the integrity of the package was diminished by these tests, nor that the damage would have any significant effect on the thermal analyses.

Accident Test Conditions (paragraphs 718 through 721) - continued

720 Thermal Test. The Model 100 package was analyzed for thermal transient effects due to the specified fire conditions using widely accepted computer codes to model the actual package. The results indicate that the maximum temperature rise in the lead shielding temperature would be 440°F (226°C). On this basis, no melting of lead would be expected and the shielding integrity of the cask would be assured.

721 Water Immersion Test. Prevention of water in leakage is not necessary since the special form contents will not release any radioactivity and criticality is not a consideration.

722-724 Fissile material will be limited to the 15 gram exemption of paragraph 601a.

Summary and Conclusions

725 The results of the tests of 719 and 720 indicate no degradation to the Model 100 package that would adversely affect the integrity of either the radiation shielding or the special form radioactive containment.

ATTACHMENT B

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, P.O. BOX 460, PLEASANTON, CALIFORNIA 94566

NUCLEAR ENERGY
ENGINEERING
DIVISION

October 8, 1979

Mr. Charles E. MacDonald, Chief
Transportation Branch
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Ref: Certificate of Compliance No. 5926

Dear Mr. MacDonald:

The General Electric Co., Vallecitos Nuclear Center (VNC), hereby requests that Section 5.(b)1 of Certificate of Compliance No. 5926 be amended in part to read:

"..... or solid oxide form or in special form."

VNC also requests that Section 6. be amended in part to read:

"..... General Electric Company's submittal dated June 13, 1969, or in special form."

As special form material has more stringent requirements than previously approved contents for the container, the addition of special form material to the permitted contents poses no safety question.

A check for $150.00 for an administrative amendment fee is enclosed.

Sincerely,

G. E. Cunningham
Sr. Licensing Engineer

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enclosure

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GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, P.O. BOX 460, PLEASANTON, CALIFORNIA 94566

NUCLEAR ENERGY
ENGINEERING
DIVISION

April 9, 1979

Mr. Charles E. MacDonald, Chief
Transportation Branch
Division of Fuel Cycle and Material Safety
U.S. Nuclear Regulatory Commission
Washington, D. C., 20555

Reference: Certificate of Compliance 5926

Dear Mr. MacDonald:

The General Electric Company, Vallecitos Nuclear Center (VNC), has for several years made shipments of radioactive materials in the G.E. Model 100 shipping container. Over this period a number of minor changes have been made in the drawings for this container. These changes are editorial (e.g., the transfer of information from one drawing to another, changes in drawing titles, changes in paint color) or reflect the "as built" characteristics of the container system. None of the changes have any safety significance and have no effect on our previous safety evaluations as submitted to the NRC.

Accordingly, VNC is submitting copies of the updated versions of the drawings listed in Certificate of Compliance 5926. In addition, as Attachment A to this letter there is a listing of each revision to these drawings with explanations, where appropriate, demonstrating their lack of safety significance.

Two new assembly drawings have been added for clarity and the old assembly drawing removed.

Accordingly, VNC requests that Section 5.(a)(3) be ammended to read:

5.(a)(3) Drawings:

The packaging is constructed in accordance with the following General Electric Drawing Nos.:

913E390 Rev. 1	985C575 Rev. 2	706E594 Rev. 7
612D137 Rev. 4	693C293 Rev. 3	153C4270 Rev. 2
612D139 Rev. 5	135C5371 Rev. 2	
693C292 Rev. 5	153F902 Rev	
985C540 Rev. 2	135C5529 Re	

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