

ASSESSMENT OF THE FL 10-1 PACKAGE  
PURSUANT TO THE 1973 IAEA REGULATIONS  
FOR SOLID FORM CONTENTS

GENERAL ELECTRIC COMPANY  
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## Section I - Package Description

### A. Packaging

The packaging is described as Model No. FL 10-1, two 16-gage 55-gallon drums welded end to end containing a stainless steel pressure vessel closed by eight steel bolts supported by fire resistant phenolic foam. A more detailed description is given in NRC Certificate No. 9009, paragraph 5(a)(2).

### B. Contents

Dry compounds and mixtures of fissile plutonium- uranium-235 not to exceed 30 watts decay heat load, nor 4.5 kilograms fissile material and packaged within DOT Specification 2R Containers (49CFR 178.34) which, in turn, are placed within an inner container constructed and leak tested as specified on General Electric Illustration AFL 1105.

## Section II - Packaging and Packaging Design Assessment

### 201 Handling and Securing

The FL 10-1 packaging can be handled with standard equipment e.g. barrel trucks, fork lifts, etc. and, either as palletized or unpalletized, presents a uniform array for tie down or freight containerization.

### 202 Manual Handling

The package weighs in excess of 50 kg and thus is not designed to be handled manually.

### 203 Mechanical Handling

Although there are no attached lifting devices, standard barrel and drum handling techniques may be safely employed.

### 204 Lifting Attachments

None. No possibility for "snatch" lifting

### 205 Lifting Devices

None

### 206 Surface Water Retention

Standard metal drum cover minimizes water retention.

### 207 Decontaminable Surface

Sealed inner containment permits removal of radioactive contents from outer packaging without contaminating outer surfaces. Innermost containment (2R) is disposable.

- 208 Added features for Transport  
None
- 210 Smallest External Dimension  
Greater than 10 centimeters (22.5 inches diameter)
- 211 Outer Seal  
Ring bolt is drilled to receive security seal.
- 212 Protrusions  
None other than ring locking bolt which is minor and standard.
- 213 Environmental Temperature Range  
None of the packaging material is subject to significant degradation in the range of -40°C to 70°C.
- 214 Welding  
The welds of the bottom plate and 300 pound slipon flange to the schedule 40 pipe containment vessel are as prescribed in INCO Drawing DSD-480-D, Rev. C.
- 215 Transport Vibration  
Containment vessel closure by eight 3/4-inch steel bolts precludes loosening during shipment.
- 216 Containment Vessel Closure  
Closure bolts require tools for opening; operating pressure varies insignificantly from ambient during normal transport.
- 217 Special form  
Not applicable
- 218 Independent Containment Closure  
Containment system closure, i.e. bolted blind flange, is independent and positive.
- 219 Chemical Compatibility  
All materials are chemically compatible and not radioactivity degradable.

- 220 Radiolysis  
Not applicable
- 221 Reduced Ambient Pressure  
Containment system pretests assure retention of contents under 0.25 Kg/cm<sup>2</sup>.
- 222 Valve Closure  
During shipment the O-ring groove pressure tap is sealed with a pipe plug wrapped in teflon tape.
- 223 Radiation Shielding  
None required.
- 224 Tie Down Attachments  
None
- 225 Normal "Rough Handling" Conditions  
Containment integrity is not impaired under the accident conditions of paras 718-721 and the proposed contents generate no significant heat. The normal transport conditions specified in paras 709-714 are therefore of no effect. The annual test of the containment vessel is at 10<sup>-6</sup> atm cc/sec at STP. This test is sufficiently sensitive to ensure that the loss of contents is no more than A<sub>2</sub> × 10<sup>-6</sup> per hour. (Ref. ANSI 14.5)
- 226 Liquid Containability  
Not applicable. Only solids proposed at this time.
- 227 Gaseous form Containability  
Not applicable.
- 228 Type A Requirements  
See paras 210-227 above.
- 229 Radiation Shielding  
Proposed contents in inner 2R pipe containers will be less than the permissible post-accident radiation levels set forth in para 229.

230 Containment Test Results

- a. Normal transport conditions - See para 225 (above). Normal conditions of transport would not effect the leak rate for the containment vessel. In addition, the containment vessel is leak tested prior to each shipment to a sensitivity of  $10^{-3}$  atm cc/sec at STP and the inner capsule is leak tested at  $10^{-7}$  atm cc/sec at STP (Leak -tight per ANSI 14.5).
- b. Accident test conditions -

The FL 10-1 packaging was designed within the design concepts that had been used for several packagings of similar size and which had been demonstrated by tests to meet conditions of paras 718-720 i.e., free drop, penetration and thermal tests. Results of these tests were compared with the FL 10-1 package. (See application by International Nuclear Co., Elizabethtown, Tenn. 4-27-72). By that assessment, the FL 10-1 was judged to be at least equivalent, if not superior, to the protection of containment integrity and subcritical configuration of the tested packagings.

With respect to the water immersion test of paragraph 721, added by the 1973 IAEA revision, the following facts support the reasonable conclusion that initial leaktightness is retained following the 718-720 tests:

- (1) There was no unexplained leakage of the inner housings after testing of the package models 5A, 8A and 12A protective packagings as reported in K-1661 and K-1714.
- (2) The FL 10-1 packagaing design employs the same 22½" id drums with fire resistant and impact-mitigating fiberfoam as the tested models 5A, 8A and 12A.
- (3) Each FL 10-1 package containment vessel will be tested at 100 psig prior to shipment to at least  $10^{-3}$  atm cc/sec at STP to assure initial leak tightness and annually to at least  $10^{-6}$  atm cc/sec.
- (4) The radioactive contents within the containment vessel will be further encapsulated, firstly within USDOT specification 2R containers (49 CFR 178.34) and secondly within a special stainless steel canister which is completely seal welded and leak tested prior to placement in the containment vessel.
- (5) Following the accident damage tests the accumulated loss of contents would not exceed  $A_2 \times 10^{-3}$  in a period of one week, based on the requirements for annual leak test, two (2) preshipment leak tests and that the accident damage tests will have minimal effect on the containment vessel.

231 Decay Heat

The package has been analyzed for decay heat loads that would generate up to 30 watts without damage to the O ring seals. (See USA/9009/B( )F).

232 Conditions for Heat Assessment

Included in 231 above.

233 Protection of Insulating Media

Fiberfoam is enclosed within the outer steel drums which protects it from abuse during normal transport.

234 Filters, Mechanical Cooling

Not applicable.

235 Designed Venting

Not applicable.

236 Pressure Relief System

Not applicable.

237 Reduced Containment Vessel Pressure

Since the Containment vessel is initially and annually tested to withstand 300 psig and determined to be leaktight, there is no question of leaktightness at 0.25 Kg/cm<sup>2</sup> (0.2 psig).

238 Pressure-temperature

The maximum 200°F internal temperature of the containment vessels tested in the diesel oil fire (temperatures measured to 2200°F) would increase the pressure of the containment vessels, packaged and sealed at atmospheric pressure and room temperature from 1 atm to 1.25 atm which in this 300 psi tested vessel is insignificant.

239 Normal Operating Pressure

The maximum heat load specified for dry compounds in NRC certificate 9009 was based on results of heat dissipation capability tests of an FL 10-1 prototype. It was determined that the temperature of the pressure vessel containing the maximum decay heat load would reach equilibrium at about 195°F. The corresponding change in pressure is well within both the capability of the pressure vessels and the specified 7 Kg/cm<sup>2</sup> (100 psi).

240 Surface Temperature

Because of the fiberfoam insulation, the surface temperatures during normal transport remain below 82°C.

241 Low Temperature Environment

Since no liquids are to be packaged, this paragraph is not applicable.

Section III - Fissile Materials

The criticality analysis for the FL 10-1 satisfies the Section VI IAEA requirements for the shipment of the package as Fissile Class I.

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