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# 1.0 GENERAL INFORMATION

## 1.1 Introduction

This application is for a Certificate of Compliance for shipping container Model 51032-2. The 51032-2 container is similar to the 51032-1 container presently licensed by Siemens, Docket Number 71-6581. Slight variations are present in the separator block design and the 51032-2 shall be licensed to transport BWFC type fuel assemblies that differ in design than those licensed for the 51032-1 packaging. The differences are addressed in Section 1.1.1.

The Model 51032-2 shipping container is to be used for transporting unirradiated fuel assemblies. The maximum enrichment for any fuel assembly type is 5.0 wt% U-235 and all shipments may be made as Fissile Class I.

### 1.1.1 Differences Between the 51032-1 and the 51032-2

Essentially, the 51032-2 shipping container is identical to the 51032-1 container (Docket 71-6581) which was based on the 927A shipping container (Docket 71-6078). The differences are discussed in this section below.

A. The 51032-2 container employs a spacer for each fuel assembly in the aft (upper) end of the container strongback, see BWFC Drawing 1216010-01. The spacer provides axial adjustment and restraint between a fuel assembly (FA) and the 51032-2 container's End Thrust Bracket (BWFC Dwg. 1215930D-02). The spacer also provides axial adjustment and restraint between a control component assembly (CCA), shipped fully inserted into a fuel assembly, and the End Thrust Bracket. The spacers are used as an option, and their use is preferred by BWFC's customers for FA/CCA shipments. No credit is taken for CCA neutron absorption in the 51032-2 criticality analysis.

   There is no mention of a spacer used for the 51032-1 container operations, nor is there mention of a spacer used for the 927C container.

B. BWFC performed an analysis to determine the effects on the 51032-2 container in a 30 foot side drop situation, see Appendix D. The analysis results recommend that a 3/8" rectangular gusset be fillet welded within each separator, perpendicular to the length of the tubing and located lengthwise between the holes/slots. The gussets serve as structural reinforcements, stiffening the separators, minimizing deformation due to impact loads, and most likely eliminating interference of the separators with the other adjacent fuel assembly.

There is no mention of separator gussets used for the 51032-1 or 927C container operations.

C. Also, as a result of the analysis referenced in B., BWFC has upgraded the separator bolts/studs from 5/8" diameter, SAE Grade 2 bolts/studs to 1" diameter, SAE J429 Grade 8 bolts/studs. The heavier bolts/studs serve as additional structural reinforcements, to withstand the shear of a fuel assembly impact force, although testing has shown that the occurrence of the fuel assembly breaking loose and impacting the separators is unlikely.

The 51032-1 container still uses 5/8" diameter, SAE Grade 2 bolts/studs.

D. Due to the addition of spacers, used for shipping CCA's inside FA's (See Section A above), separator gussets, which provide extra lateral support inside the separators (See Section B above), and larger separator fasteners (See Section C above), the 51032-2 empty container weight is approximately 100 pounds heavier than an empty 51032-1 container. The extra weight only includes the added weight of structural reinforcements as described in A. and B above. The maximum fuel weight drop tested in the 51032-1 container (3306 lbs.) is the maximum allowable FA + CCA weight to be shipped in the 51032-2 container.

E. BWFC has determined that the 51032-2 will use SAE J429, Grade 5 bolts at the following significant locations:

1) The full clamp assembly bolts, which attach the clamps to the strongback channel flanges (2 per full clamp assembly).
2) The full clamp assembly bolts, which attach the fuel assembly grid clamps to the clamp angles (4 per full clamp assembly).
3) The restraining bar assembly bolts, which attach the restraining bars to the strongback channel flanges (2 per restr. bar assy.).
4) The bolts which attach the strongback to the strongback support tubes (7 tubes total, 2 bolts per tube).
5) The bolts which attach the shock mounts to the container base (4 per shock mount, 56 total).

F. The 51032-2 container utilizes 3/8" thick separators (tubes), made from ASTM A500, Grade B steel, reinforced with a 3/8" thick ASTM A36 structural steel gusset fillet welded inside to separate the two fuel assemblies within the strongback channel (See Section B. on prev. pages, see BWFC Dwg. 1215929D, Rev. 2, Detail B).

The 927C container utilizes 3/16" thick tubes as separators, without any reinforcing gussets whatsoever.

G. Unlike the 51032-1 and the 927C containers, the 51032-2 container will use full clamp assemblies at all fuel assembly spacer grid and end fitting locations during fuel assembly shipments. Half clamp assemblies will be used to maintain the spacers in the strongback (See Section A.) or will be shipped so that they make no contact with the fuel assemblies.

As described in previous submittals of 71-9252, the half clamp assemblies are used as operational features for loading and unloading the fuel assemblies into and from the 51032-2 containers.

The 51032-1 and 927C containers use half clamp assemblies at grid and or end fitting locations (two locations each fuel assembly) where the 51032-2 container uses the sturdier full clamp assemblies. Therefore, the 51032-2 container provides a degree of extra structural support for the fuel assemblies in the strongback.

H. The last major difference between the 51032-2 container and either the 51032-1 or the 927C container is the container appearance, which will be different in color and ID labeling. The 51032-2 container will be legibly marked with its own Doc. ID number, according to Part 71.

## 1.2 Package Description

As specified in 10 CFR 71.33, the Model 51032-2 shipping container and its contents are described herein. For ready reference, a listing of the safety and licensing related drawings and their current revision number is provided in Section 1.3, Table 1.1.

### 1.2.1 Packaging

#### 1.2.1.1 Structure

The empty weight of the Model 51032-2 packaging is 4100 ± 100 pounds. Specific materials of construction, weights, dimensions, and fabrication methods of the packaging components are described below.

The containment vessel, including stiffening rings, is a 43-inch diameter (nominal dimension) right cylinder 216 inches long, fabricated of 11-gauge (0.1196 inch) steel (see BWFC Drawings 1215935D and 1215929D). The containment vessel is fabricated in two sections: base and cover assemblies (see BWFC Drawings 1215931D and 1215932D). Continuous closure flanges are welded to

the base and cover assemblies, and an "0" ring gasket is fitted between the mating flanges. Using 10 steel alignment pins permanently fixed to the closure flange of the base assembly, the two halves of the containment vessel are mated and sealed together with 58 closure bolts. Steel washers are inserted between the mating flanges to prevent excessive distortion of the "0" ring gasket as nuts are tightly seated to complete the closure.

Seven steel stiffening rings (five rollover angles and two end rings) are welded to each of the base and cover assemblies to strengthen the containment vessel shell. Rollover rings are fabricated of 2½ X 2½ X 5/16 inch angles, and end rings are fabricated of 3½ X 2½ X 3/8 inch angles.

Four steel skids are welded to the base assembly. These skids support the package and are designed to permit bolting the stacking brackets when packages are stacked for storage or transport. Stacked packages, however, are not normally bolted together during transport.

Four stacking brackets are welded to the cover assembly. A steel lifting lug is welded to each set of stacking brackets. These lugs may be used to support the loaded package.

Two forklift pickup channels are welded to the base assembly to facilitate package handling.

Fourteen (seven per side) shock-mount support brackets are welded to the interior side of the base assembly shell. The weight of the fuel elements and the related support mechanism is transferred to these brackets through 14 shock mounts.

The shock-mounted strongback supports and protects the fuel elements. The standard strongback (see BWFC Drawing 1215933D) is designed to securely hold two 11.5 or 13.5 foot long fuel elements in place with a minimum spacing of six inches between the two fuel element cavities formed by the strongback components. The main strongback member is a single "U" shaped channel formed of ¼-inch steel. The standard strongback channel is about 196 inches long, 25-3/8 inches wide, and 12½ inches high.

Side and bottom steel angle supports are welded to the exterior of the strongback channel in seven locations on the strongback.

Separator blocks are bolted to the strongback channel such that the centerline of the spacer blocks corresponds to the centerline of the strongback channel.

Seven strongback support tubes provide support and hold the strongback assembly in place during shipping and storage. The

support tubes are attached to the interior of the containment vessel through shock mounts (two per support tube), to the shock mount support brackets. The shock mounts minimize vibrational effects on the fuel elements during transport and handling. In the event of a fire severe enough to destroy the natural rubber portion of the shock mounts, the fuel elements remain in essentially the same position within the package as the result of the steel bolts, washers, and nuts incorporated into the shock mount assemblies (see BWFC Drawing 1251926C).

Steel end thrust brackets (see BWFC Drawing 1215930D) are bolted to the strongback at both ends of the fuel elements to prevent longitudinal movement. These are adjustable in order to ship fuel assemblies of differing lengths.

When control component assemblies are shipped along with fuel elements, the control assembly is fully inserted into the fuel element and a spacer assembly or filler, is added to the strongback between the control assembly and the end thrust bracket to provide extra longitudinal support. The spacer assembly (see BWFC drawing 1216010D) is composed primarily of 300 series stainless steel and has an adjustable clamp which contacts the end of the control assembly. The clamp, when tightened, holds the control assembly firmly between the fuel element and the end thrust bracket.

There are no structural or mechanical means provided or required for the transfer or dissipation of heat and there are no coolants utilized in the packages. (Decay heat for the unirradiated fuels to be transported is negligible, <20W).

There are no materials specifically used as non-fissile neutron absorbers or moderators in this packaging. When control components are shipped with the fuel assemblies, no credit for their poisons was given from a criticality perspective.

### 1.2.1.2 Fuel Element Clamps, Shock Mounts, and Separator Blocks

Fuel elements are clamped in-place within the strongback and restrained from lateral or vertical movement (see BWFC Drawing 1215929D). These clamping devices hold the fuel elements against the bottom and sides of the strongback channel such that the maximum fuel element separation distance is achieved. The adjustable clamps are mounted on steel angle brackets that extend laterally across the top of the strongback channel. These brackets are clamped to the top of the strongback channel. The clamps are designed to clamp against the spacers of PWR fuel elements (see BWFC Drawing 1215926D).

When transporting fuel elements, restraining bars are included in the package. Restraining bars consist of steel angle brackets that

extend across the top of the strongback channel and are clamped to the strongback flanges in the same manner as are the full clamps (see BWFC Drawing 1215934D). The restraining bars are provided for additional restraint in the event of an accident.

Strongback components required for each package vary with the size of the fuel elements shipped.

1. The number of full clamps to be used is dependent upon the number of spacers in the fuel assembly. One full clamp is to be used for each spacer and end fitting The maximum weight supported by each full clamp assembly under hypothetical accident conditions is depicted in the table below.

**MODEL 51032-2 PACKAGE**
**FUEL ASSEMBLY CLAMP REQUIREMENTS**

| FA Type | FA + CCA Max. Wt. (2 each) | No. Full Clamps Reqd. | Maximum Weight Supported by Each Full Clamp Assy. (lbs) |
|---|---|---|---|
| **MK-B** | 3300 lbs | 10 | 3300 / (3300 + 710) = 82.29%<br>(168,000 / 10) (82.29%) = **13,825** |
| **MK-BW** | 3016 lbs | 10 | 3016 / (3016 + 710) = 80.94%<br>(168,000 / 10) (82.29%) = **13,599** |
| **C-Y** | 2510 lbs | 9 | 2510 / (2510 + 710) = 77.95%<br>(168,000 / 9) (77.95%) = **14,551** |

2. The number of separator blocks to be utilized is nine (9). See section 2.10 for the 30 foot side drop analysis which determines separator block spacing.

3. The number of restraining bars employed for transporting fuel elements shall be one fewer than the number of fuel element spacers (one between each spacer full clamp).

1.2.1.3 **CONTAINMENT VESSEL PENETRATIONS**

There are no sampling ports.

There are two valves on the containment vessel: one allows pressurization (with dry air or nitrogen) of the containment vessel, and the other is used for relieving the pressure prior to opening the vessel. As such, both valves are located in one end of the containment vessel. These valves are not of safety

significance.

There are also four viewports in the container shell through which shock indicating instruments mounted on the strongback may be viewed. The containment vessel is not required to be pressurized except during leak testing.

### 1.2.2 Operational Features

Not Applicable.

### 1.2.3 Contents of Package

Each fuel element is enclosed in an unsealed polyethylene sheath. The ends of which are neither taped nor folded in any manner that would prevent the flow of liquids into or out of the ends of sheathed fuel elements.

The maximum content weight for the Model 51032-2 package is 3400 pounds. Fuel assembly parameters are given in Section 6.

## 1.3 Associated Drawings

The 51032-2 drawings are provided in Table 1.1. With two exceptions, the drawings contain material specifications for the components on the drawing. The two detail drawings (1215926C and 1215934C) supplement other drawings and do not contain the material specifications. The table references the drawing that material specifications can be located for these two drawings.

TABLE 1.1 APPLICABLE LICENSING DRAWINGS

| | |
|---|---|
| 1215926C-01 | Shipping Container Detail: Full Clamp Assembly, Thrust Plate and shock mount details. Material specifications on 1215935D. |
| 1215929D-02 | Model 51032-2 Vessel - Isometric |
| 1215930D-02 | End Thrust Bracket Shipping Container Detail |
| 1215931D-02 | Base Assembly Model 51032-2 Shipping Container |
| 1215932D-02 | Cover Assembly Model 51032-2 Shipping Container |
| 1215933D-02 | Strongback Assembly Details 51032-2 Container |
| 1215934C-01 | Model 51032-2 Details: Restraining Bar, Half Clamp, Closure Bolt, and Guide Pin details. Material specifications for the Restraining Bar, Closure Bolt, and Guide Pin on 1215935D. Material specifications for Half Clamp on 1215935D. |
| 1215935D-02 | Fuel Packaging Model 51032-2 Layout |
| 1216010D-01 | Shipping Container Spacer Assembly |

# FIGURE WITHHELD UNDER 10 CFR 2.390

| TOLERANCES | | | | |
|---|---|---|---|---|
| FRACTION: | UP TO 6" | ±1/64 | DWN. BY | L WITT |
| | OVER 6" THRU 24" | ±1/32 | CHD. BY | BAUCOM |
| | OVER 24" | ±1/16 | PASSED BY | SHUMAKER |
| DECIMAL: | 2-PLACES - .XX | ±.02 | APPD. BY | CARR |
| | 3-PLACES - .XXX | ±.005 | DATE | 9/9/92 |
| ANGLE: | ±1° | | CONTRACT NO. | |
| ANGULAR DIM. FOR CHAM. & C'SINKS ± 5° | | | | |
| FILLET RADII .03 R MAX. | | | ME/92-52/1/07 | |
| BREAK CORNERS .02 MAX. R OR CHAM. | | | | |
| ALL MACHINED SURFACES 125/AA FINISH | | | | |

MODEL 51032-2 VESSEL
(ISOMETRIC VIEW)



DO NOT SCALE USE DIMENSIONS ONLY | SCALE NONE

DRAWING NO. 1215929 D | SHT 2

# FIGURE WITHHELD UNDER 10 CFR 2.390

| TOLERANCES | | | |
|---|---|---|---|
| FRACTION: | UP TO 6" | ±1/64 | |
| | OVER 6" THRU 24" | ±1/32 | |
| | OVER 24" | ±1/16 | |
| DECIMAL: | 2-PLACES - .XX | ±.02 | |
| | 3-PLACES - .XXX | ±.005 | |
| ANGLE: | ±1° | | |
| ANGULAR DIM. FOR CHAM. & C'SINKS ±5° | | | |
| FILLET RADII .03 R MAX. | | | |
| BREAK CORNERS .02 MAX. R OR CHAM. | | | |
| ALL MACHINED SURFACES 125/AA FINISH | | | |

| | |
|---|---|
| DRN. BY | L WITT |
| CHKD. BY | SAUCOM |
| PASSED BY | SHUMAKER |
| APPVD. BY | CARR |
| DATE | 8/24/92 |
| CONTRACT NO. | |
| | ME/92-52/1/D8 |

END THRUST BRACKET
SHIPPING CONTAINER
DETAIL



DO NOT SCALE LINE DIMENSIONS ONLY | SCALE NONE

DRAWING NO. 1215930 D | SHT. NO. 2

# FIGURE WITHHELD UNDER 10 CFR 2.390

| | |
|---|---|
| CHKD. BY | SAUCOM |
| PASSED BY | SHUMAKER |
| APPRD. BY | CARR |
| DATE | 8/28/92 |
| CONTRACT NO. | |
| | ME/92-52/1/09 |

BASE ASSEMBLY
MODEL 51032-2
SHIPPING CONTAINER

THIS DRAWING IS THE PROPERTY OF
B & W FUEL COMPANY

| | |
|---|---|
| DO NOT SCALE USE DIMENSIONS ONLY | SCALE NONE |
| DRAWING NO. 1215931 D | REV. NO. 2 |

# FIGURE WITHHELD UNDER 10 CFR 2.390

| TOLERANCES | | | | | |
|---|---|---|---|---|---|
| FRACTION: | UP TO 6" | ±1/64 | DWN. BY | L WITT | COVER ASSEMBLY<br>MODEL 51032-2<br>SHIPPING CONTAINER |
| | OVER 6" THRU 24" | ±1/32 | CHD. BY | BALCOM | |
| | OVER 24" | ±1/16 | PASSED BY | SHUMAKER | |
| DECIMAL: | 2-PLACES - .XX | ±.02 | APPD. BY | CARR | |
| | 3-PLACES - .XXX | ±.005 | DATE | 8/27/92 | |
| ANGLE: | ±1° | | CONTRACT NO. | | |
| ANGULAR DIM. FOR CHAM. & C'SINKS ±5° | | | | | |
| FILLET RADII .03 R MAX. | | | ME/92-52/1/D10 | | |
| BREAK CORNERS .02 MAX. R OR CHAM. | | | | | |
| ALL MACHINED SURFACES 125/AA FINISH | | | | | |



DO NOT SCALE USE DIMENSIONS ONLY | SCALE: NONE

DRAWING NO. 1215932 D | SHT. NO. 2

# FIGURE WITHHELD UNDER 10 CFR 2.390

| TOLERANCES | | | |
|---|---|---|---|
| FRACTION: | UP TO 6" | ±1/64 | |
| | OVER 6" THRU 24" | ±1/32 | |
| | OVER 24" | ±1/16 | |
| DECIMAL: | 2-PLACES - .XX | ±.02 | |
| | 3-PLACES - .XXX | ±.005 | |
| ANGLE: | ±1° | | |

ANGULAR DIM. FOR CHAM. & C'SINKS ± 5°
FILLET RADII .03 R MAX.
BREAK CORNERS .02 MAX. R OR CHAM.
ALL MACHINED SURFACES 125/AA FINISH

| | |
|---|---|
| DRN. BY | L. WITT |
| CHKD. BY | BAUCOM |
| PASSED BY | SHUMAKER |
| APPD. BY | CARR |
| DATE | 9/1/92 |
| CONTRACT NO. | |
| | ME/92-32/1/D11 |

STRONGBACK
ASSEMBLY DETAILS
51032-2 CONTAINER



DO NOT SCALE USE DIMENSIONS ONLY | SCALE NONE

DRAWING NO. 1215933 D | REV. 2

# FIGURE WITHHELD UNDER 10 CFR 2.390

| TOLERANCES | | | | | |
|---|---|---|---|---|---|
| FRACTION: | UP TO 6" | ±1/64 | DRN. BY | L. WITT | FUEL PACKAGING MODEL NO 51032-2 LAYOUT |
| | OVER 6" THRU 24" | ±1/32 | CHD. BY | SAUCOM | |
| | OVER 24" | ±1/16 | PASSED BY | SHUMAKER | |
| DECIMAL: | 2-PLACES = .XX | ±.02 | APPD. BY | CARR | |
| | 3-PLACES = .XXX | ±.005 | DATE | 9/2/92 | |
| ANGLE: | ±1° | | CONTRACT NO. | | |
| ANGULAR DIM. FOR CHAM. & C'SINKS ±5° | | | | | |
| FILLET RADII .03 R MAX. | | | ME/92-52/1/013 | | |
| BREAK CORNERS .02 MAX. R OR CHAM. | | | | | |
| ALL MACHINED SURFACES 125/AA FINISH | | | | | |



DO NOT SCALE USE DIMENSIONS ONLY | SCALE NONE

DRAWING NO. 1215935 D | REV. NO. 2

TABLE 6.1
Fuel Assembly Parameters

| Category/Parameter | Mk-B 15x15 | Mk-BW 15x15 | Mk-C 17x17 | Mk-BW 17x17 | Conn Yankee | W15[c] |
|---|---|---|---|---|---|---|
| Assembly Type | 15x15 | 15x15 | 17x17 | 17x17 | 15x15 | 15x15 |
| Fuel Rods per Assembly | 208 | 204 | 264 | 264 | 204 | 204 |
| Nominal Rod Pitch, (nom), in. | .568 | .563 | .501 | .496 | .5625 | .563 |
| Pellet Diameter, (max), in. | .3707 | .3671 | .3252 | .3232 | .3672 | **[d] |
| Nominal Cladding OD (nom), in. | .430 | .422 | .379 | .374 | .422 | |
| Nominal Cladding ID (nom), in. | .377 | .370 | .332 | .326 | .368 | |
| Assembly Size (nom), in.[a] | 8.520 | 8.445 | 8.517 | 8.432 | 8.438 | 8.445 |
| Active Fuel Stack Length, in. | 144 | 144 | 144 | 144 | 120 | 196 |
| Maximum Assembly wt% U-235[b] | 5.05 | 5.05 | 5.05 | 5.05 | 5.05 | 5.00 |
| Shipment Fissile Class | 1 | 1 | 1 | 1 | 1 | 1 |
| Fuel Pellet Density, %TD | 97.5 | 97.5 | 97.5 | 97.5 | 97.5 | |
| Maximum U-235 Loading, kg | 25.20 | 24.24 | 24.62 | 24.32 | 20.20 | |

[a] The "assembly size" parameter is defined as the product of the rod pitch and the number of rods per edge (e.g., 8.520=15*0.568)

[b] Maximum enrichment includes enrichment tolerance.

[c] Siemens Nuclear Power Corporation Consolidated License Application for Model 51032-1 Shipping Container, Rev 5, 5A and 5B.

[d] .364/.370/.410 in., pellet OD/clad ID/clad OD damaged array
.384/.390/.430 in., pellet OD/clad ID/clad OD normal array

APPENDIX B

"EXHIBIT P"
APPLICATION FOR LICENSING OF COMBUSTION ENGINNERING
MODEL 51032-1 SHIPPING CONTAINER, DOCKET 71-6581

*THE CALCULATION SHEETS, PHOTOGRAPHS AND DRAWINGS CONTAINED WITHIN THIS APPENDIX WERE DIFFICULT TO REPRODUCE. THE QUALITY AND LEGIBILITY IS SUBSTANDARD IN SOME CASES. THE ORIGINALS ARE CONTAINED IN THE TEST REPORT FROM CONSOLIDATED LICENSE APPLICATION FOR COMBUSTION ENGINEERING, INC. MODEL 927A SHIPPING CONTAINER, DOCKET 71-6078 LOCATED IN THE NRC PUBLIC DOCUMENT ROOM.*