71-6078

ABB

Docket No. 71-6078

Director, Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Subject: **Request for Amendment for the Model 927 Shipping Package**

References: 1) USNRC Certificate of Compliance No 6078, Revision 22, August 6, 1996
2) Letter to NRC from Combustion Engineering Inc., "NOTIFICATION OF SHIPPING PACKAGE DEVIATION" May, 1, 1998

Enclosures: I) Outline of Modifications to licensing drawings.
II) Replacement Pages for Certificate of Compliance No. 6078 Application

Dear Sir:

Combustion Engineering hereby request an amendment for the above referenced Certificate of Compliance. In connection with Reference 2, the Certificate of Compliance drawings have been revised to emphasize those details of the two model designs (927A1 and 927C1) which are important to safety. These drawings are submitted for replacement of the drawings referenced in the present certificate.

The drawings included herein are licensing drawings rather than fabrication or operations drawings and have been simplified by removing unnecessary detail and views. In addition, the drawings have been clarified to present the components or features which are optional, and to include realized dimensional tolerances compatible with fabrication techniques. A limited scope repair plan is also included.

The purpose of the repair plan is to maintain the packages essentially in their original functional design condition. The repair plan defines the techniques to be used during surface reconditioning, shell repair, and hole repair. Welding repair, including personnel and process qualification, testing, inspection, etc., will be done in accordance with the American Welding Society Code for Structural Welding (AWS D1.1) or the American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Welding and Brazing Qualification (ASME Code Section IX).

NMSS

Ltr Encl

Change: 4 0

ABB CENO Fuel Operations

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3300 State Road P
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St. Louis (314) 296-5640
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Although both model designs (927A1 and 927C1) are currently authorized in the Certificate of Compliance, some of the detail differentiating the two designs has not consistently been maintained on the licensed drawings. Over time, the drawings have evolved into a composite description of the two designs and focused on the information necessary to demonstrate the safety basis and reliability of the package.

During a meeting with Mr. C. Ross Chappell and others of his staff on April 7, 1998 details of the major deviations between the asbuilt packages and the drawings were discussed to better understand the required level of information necessary to demonstrate the safety basis of the shipping package. Based on the information gathered in the meeting, the drawings have been revised accordingly.

The requested changes and tolerances do not reduce the safety of the package nor invalidate the original tests of the package or the nuclear criticality safety analysis.

Combustion Engineering, Inc., requests approval as soon as possible in order to perform the repair work requested in the amendment and must have approval by June 15, 1998 in order to support upcoming fuel shipments.

If there are questions regarding this matter, please feel free to contact Mr. Robert Freeman of my staff at (314) 937-4691 Ext. 425 or myself at (314) 937-4691 Ext. 399.

Sincerely,

COMBUSTION ENGINEERING, INC.

Robert W. Sharkey
Director, Regulatory Affairs

5-7-98
Date

RA98/733

cc: C. Ross Chappell

Enclosure I
to RA98/733

COMBUSTION ENGINEERING, INC.
OUTLINE OF MODIFICATIONS TO THE DRAWINGS
FOR 927 SHIPPING PACKAGES

References:

1) Letter from Combustion Engineering Inc., to Atomic Energy Commission, Docket 70-1100, SNM-1067, July 3, 1969.
2) Letter from Combustion Engineering Inc., to Atomic Energy Commission, Docket 70-1100, SNM-1067, Aug 19, 1969.
3) Letter from Combustion Engineering Inc., to Atomic Energy Commission, Docket 70-1100, SNM-1067, June 21, 1971.
4) "Manual of Steel Construction, Allowable Stress Design," 9th Edition, American Institute of Steel Construction, Inc., 1989.
5) Annual Book of ASTM Standards, Volume. 01.03, American Society for Testing and Materials, 1997.
6) Metals Handbook, Ninth Edition, Volume 1, "Properties and Selection: Iron and Steels," American Society For Metals, 1978.

Sheet 1 of 4

Zone A1
No Changes

Zone B1
The informational view showing the holddown bracket was clarified to show the entire length bracket and the independent holddown bracket (used for loading and unloading) was removed.

Zone C1
The following items are shown for information only and have been consistently labeled as optional:
- Dessicant Hatch
- Humidity Indicator
- Filling Valve
- Manual Pressure relief valve
- Drainage hole added

The Bill of Material callout for the Automatic Relief Valve (Item 37) was removed and reissued for a different component on Sheet 4. The Relief valve was also labeled to allow a variance in the location from package to package.

Zone A2
No Changes

Zone B2
The Item (20) callout was relocated to be adjacent to the note and clearly labeled as optional on the upper end brace assembly.

A note was added to Item (23) to point out that the longer 927C1 model contains 7 stiffener braces instead of the 6 shown for the shorter 927A1 model.

The view of the strongback support assembly was removed completely and Item (24) was renamed on Sheet 2. The strongback support assembly is used only for loading and unloading and is not part of the shipping package. The view was previously shown for information only and has been removed from the licensed drawings.

The Special Lifting Trunion Item (40) was removed from Sheet 1, and is shown for information only on Sheet 2 in the isometric view. The lifting trunion is used for loading and unloading purposes of some of CE's shorter assemblies.

The dessicant storage tray located below the strongback was labeled as optional and is shown for information only.

The description of the strongback shock mounts was removed from Sheet 1 since it also is shown in greater detail on Sheet 2.

The mock assembly grid details have been removed and were previously shown for information only. In actuality, the location and number of grids is dependent on the assembly design being shipped.

Zone C2
The drainage plug has been labeled as optional on the lower portion of the package shell wall. This drain plug is manually operated and does not perform a safety function during transportation.

The 1/8 typical weld on the top shell stacking brackets was removed since it already exists on Sheet 3.

View G-G has been deleted on both Sheet 1 and Sheet 2 which provided details on the locator pins. The locator pins have been labeled as optional and function only to align the shell cover with the shell base during loading and unloading.

The informational notes on Item (8) have been removed. The lifting brackets are used only for loading, unloading and fastening the package to the conveyance vehicle and does not provide any nuclear safety function.

The shell stiffener braces (Item 10) were incorrectly shown on Sheet 1 and have been revised to be in agreement with the actual configuration and that shown on Sheet 3. There is only one center stiffener brace on both the 927A1 and 927 C1 models. The current licensed drawings show two braces on the top and one on the bottom, whereas there is only one aligned centrally located brace on top and bottom.

A butt weld designation has been added to the upper and lower portions of the shell to be in agreement with the actual configuration. The weld location varies between packages and was part of the original design of each model. Referring to the documentation provided by the fabricator to the Atomic Energy Commission (Reference 3):

> *"Multi-piece construction may be employed to obtain parts unless otherwise noted. When multi-piece construction is employed, the following procedure shall be employed."*
>
> *Shells and heads:*
> *No. 11 GA and lighter: Weld outside only, grinding not required. Where part fitup requires smooth surface, weld both sides in this area and grind smooth only on that side required for fitup.*
>
> *Heavier than 11 GA: Consult Project Engineer for required welding.*
>
> *Where part fitup requires smooth surface, grind smooth in this area only on one side.*
>
> *Optional weld joints are not to fall beneath rollovers, lifting eyes, etc.*

The locator pins of Item 15 have been labeled as optional and function only to align the shell cover with the shell base during loading and unloading.

The "O" ring seal between the base and cover assembly has been labeled as optional and does not provide a safety function during transport. This item has been labeled as Item (33). The "O" ring seal provides protection to external contaminants such as dust and sand from entering the package.

The "E" dimension was renamed to "D" since it is dimensionally the same on each package design. Refer to the Table in Zone A3.

Item (4) was renamed to Item (3) since it is dimensionally and functionally identical.

Zone A3
The Table of model dimensions has been revised to allow tolerances of +/- 2 inches on Dimensions "A" "B" "C" and "D". The justification of this tolerance is that the current criticality safety analysis assumes an infinite length and a package shell which is collapsed down to the top of the safety brackets, the bottom of the strongback, and 2.25 inches from the sides of the strongback. In addition, the number of shock mounts and separator block information was removed from the Table since it did not have any safety significance.

Note 4 was added to allow for minor dents in the container shell and the allowance to remove dents mechanically.

The Bill of Materials has been revised significantly:

Bolt lengths were removed or labeled with minimum length requirements
Bolt and nut specifications were made consistent
Standard nut and locking nuts were included
Any referenced component to another drawing not included in the license was removed
All washers and lockwashers were removed and a note added to allow washers to be optional on any nut and bolt arrangement.
Information regarding Items which are optional was minimized

Sheet 2 of 4

Zone A1
The independent holddown brackets shown in View D were not credited in the drop test as contributing to the retention of the fuel assemblies and are used for the loading and unloading process to retain the fuel assembly in place when the strongback cavity is raised to the vertical position. The dimensions and BOM callouts were removed and the wording was clarified to explicitly note that all 3 designs are optional.

Zone B1
Dimensional Tolerances have been added in the height and width of the upper and lower end fitting braces in View B. The dimensional tolerances are consistent with those proposed in View C for the strongback. The proposed tolerances on the height and width of the upper and lower end brackets does not impact the function of the brackets, it simply allows for slight variations in manufactured dimensions.

The dimensions of the outside wall of the upper and lower end fitting support bracket (9 inches) has been removed from View B since it does not add any information relevant to the safety analysis and has only previously been included for informational purposes.

Item (64) has been corrected to be required when the optional end bracket is included and Item (65) has been added as the complimenting hex head bolt.

The side view shown in View B has been revised to be consistent with the actual configuration and show the alternate design of the upper and lower end brace center support bracket and lower support angle. The current licensed drawings show a single 2 inch by 4 inch tubular steel support brace in the center of the upper and lower end brace which is the correct configuration for the model 927C1, however, the model 927A1 packages have two 2 inch by 2 inch tubular steel braces welded together to form the 2 inch by 4 inch support. The model 927A1 design was the configuration which was actually drop tested. Although the information in Reference 1 and 2 does not supply detail on the specific item, photographs of the drop test show the welded double tubular steel support.

In addition, a clarifying note (typ) was added to the dimensions on the side view of the upper and lower end fitting braces in order to allow for slight deviations in measured thickness.

Zone C1

The reference to View B SH-2 on the Strongback - Upper End and the Strongback-Lower End was removed, in that it did not add any value to the prints.

View H-H was renamed to View E-E.

On the Strongback- Lower End, Items (31) and (32) were added to point out the presence of the supporting gussets and the pipe hinge. The pipe hinge is used as the focal point in the raising of the strongback for loading and unloading of the fuel assemblies.

Items (39) and (35) were labeled as optional, since they are used only for loading and unloading of the package and may be shipped separately.

Zone A2

The lifting trunion shown in View F was removed, since it pertains to loading and unloading of the package only.

View G-G was also removed since the locator pins were labeled as optional on Sheet 1 and serve only to align the upper shell with the lower shell during loading and unloading of the package.

The rubber gasket Item (33) from the deleted view G-G was re-identified and labeled as optional.

Section H-H The note has been clarified to be less confusing.

The two end brace designs were included on the end braces assembly as Items (24) and (47) on View H-H, and Item (25) was fixed to the actual configuration of an angle bracket instead of a tubular support.

Zone B2
View C was modified to include dimensional tolerances on the width and height. The current criticality safety analysis bounds this increase in width dimensions and is also covered in the vertical direction by allowing a maximum assembly height above the separator block of 1.5 inches. Other dimensions were listed as reference dimensions.

Item (43) was added as a part on the Bill of Material. This part is present of the current drawing, however, it was not clear that it is a welded piece attached to the bracket.

The nut and bolt arrangement has been clarified as Item (54) and (55) on the Bill of Materials and the specificity of the washers and lockwashers has been removed.

Item (57) has been added, and Item (65) and (68) have been renamed as Item (58)

Zone C2
The wording on the isometric view has been slightly refined to show the lifting trunion as optional and the notes on the separator block were removed.

Zone A3
The lifting bracket details have been removed

Zone B3
The weld locations were made less specific and the amount of minimum weld has been reduced to 10 inches. The justification for this is reduction in minimum weld length is provided in the attached revised page 2B-12 of the application.

Dimensional tolerances were added to the safety bracket to be consistent with those placed on the strongback and end brace assembly.

Items (57) and (58) were added to show the bolting arrangement which holds the safety brackets in place during transport. The bolting arrangement is the same as that used on the holddown brackets in View C.

View A was replicated to outline and emphasize the difference in the channel orientation under the shock mount support Item 34.

View K-K has been renamed to View I-I.

An optional tapered end cut was added to View A and the optional angle bracket designs which secure the strongback to the bridge supports were moved to Sheet 4 and further detail was added to distinguish the differences between the Model A and Model C designs. An additional view was added to show the different orientation of the lower channel support which holds the shock mount. The Model A packages have the new outward facing channel orientation, whereas the current drawings only show the Model C inward facing orientation.

Notes 5-7 were added. Note 5 allows both washers and or lock washers to be optional on the various nut and bolt arrangements. As noted in the introduction, the current set of drawings have evolved from the original fabrication drawings and have been historically used during the loading and unloading process. Previously, the washer dimensions were specified primarily for the operations staff to maintain consistency while loading and unloading. However that level of detail is not necessary to demonstrate the safety of the package.

Note 6 allows for tack welding of bolts and studs throughout the package. The purpose of the tack welding is simply to hold the bolt or stud in place either vertical or horizontal while loading and unloading.

Note 7 provides guidance for the required length of bolts, studs, and pins. The current set of drawings provides an unnecessary level of detail regarding the length of the bolts, studs, and pins. The defining parameters for these components are the diameter, and the material specifications, whereas the length only needs to be sufficient to fit the intended purpose.

Sheet 3 of 4

Zone A1
View B-B was removed.

Zone B1
No changes

Zone A2
Items (5), (6) and (11) were called out on the upper shell and replaced the dimensional description.

An option was included for the inclusion of an optional protective flange cover or coating to help reduce the amount of environmental exposure to the flange surface.

Item (66) was also added as an optional protective wear plate around each T-bolt area. The wear plates would be either riveted or tack welded in place and would function to facilitate opening and closing of the container as well as protection of the flange surface.

Zone B2
The details describing the mounting bracket and View A-A have been removed from the drawings. This view provided details on the trunnion used for lifting the strongback to it's vertical position during the loading and unloading process.

Items (3) and (6) were included as callouts referring back to the Bill of Materials instead of the dimensional description on the current set of drawings.

Small holes in the skids were shown for information only and labeled as optional.

A butt weld designation has been added to the upper and lower portions of the shell to be in agreement with the actual configuration. The weld location varies between packages and was part of the original design of each model. Please refer to the information in Zone C2 of Sheet 1.

Zone A3, Zone B3
The information in these zones have been added for this amendment and focus on the welding repair specifications and standards required for weld repair. This information is also contained in the Revision to Section 8.0 of the Certificate of Compliance application.

Sheet 4 of 4

Zone A1

Item (37) has been added on the drawing to show the optional lifting hook design, Item (37) is a welded piece of channel stock which accommodates the lifting hook which is used to raise the strongback during the loading and unloading of the fuel assemblies.

The three piece strongback for the Model A1 is clearly shown with a descriptive note differentiating it from the continuous Model C1 design. The Model A1 was the package model which was originally drop tested. Refer to Reference 3.

In connection with the three piece strongback, the supporting cross angle brackets were added to the underside of the strongback detail for clarity.

Detail P was added, as was a defining note on the number of strongback braces for the two model designs.

Detail B was changed to Detail L to allow continuity in the labeling of the details and views.

A butt weld designation was added to the strongback. This butt weld was part of the original design and is covered under the welding and fabrication guidelines provided in the description for Zone C2 of Sheet 1.

Item (4) was added to the cross sectional cut of the strongback in place of the dimensional description.

The end of the Model A type containers have an optional ¼ inch thick plate welded to the strongback sides which simply extends the strongback length approximately 2 inches. The extension was attached with a full penetration weld and has an additional ¼ inch overlapping support plate fillet welded to the outside.

The strength of the extension is evaluated below:

> The extension plate is welded to the strongback with a full penetration groove weld. Then a second overlapping plate is welded to both the strongback and the extension plate. Three of the bolts holding the end support bracket bolt through the double plate thickness.
>
> To show that the strength of the extension plate is adequate, its strength is compared to the strength of the bolts holding the end support brackets in position. The strongback and bolt materials are specified as follows:
>
> strong back - A569 or A415 carbon steel

bolts - SAE grade 1

Reference 5 states that the A569 is a commercial quality hot rolled carbon steel. (The A415 standard has been discontinued and replaced by the A569 standard.) Reference 6 provides the following minimum yield stress for commercial grade steel:

F_y = minimum yield stress = 28,000 psi

Reference 6 also provides the following minimum tensile strength for an SAE grade 1 bolt:

F_u = minimum tensile strength = 60,000 psi

Allowable Load for the Bolts

The allowable shear stress for a bolt when the threads are excluded from the shear plane is given by Reference 4:

F_v = allowable shear stress = 0.22 F_u

Therefore, the allowable load for the three bolts which pass through the extension plate is the following:

Allowable Load = $(3)(0.22)(60000)(\pi/4)(0.75^2)$ = 17,495 lbs

Allowable Load for the Extension Plate

For a full penetration groove weld loaded in tension, the allowable stress is the same as the base metal (Reference 4). In tension, the allowable stress is the following:

F_t = allowable stress in tension = 0.6 F_y

Therefore the allowable tensile load on the extension plate, considering only the full penetration groove weld, is the following:

Allowable Load = $(0.6)(28000)(0.25)(11.5 - (3)(1.0))$ = 35,700 psi

The allowable load on the extension plate would be significantly higher if the reinforcing plate weld were considered. This calculation shows that the extension plate is much stronger than the bolts holding the end support bracket in place. Therefore, the strongback extension is not limiting.

Zone B1

Item 69 was included for clarity, this end cross brace has always been present, however it was not shown in the current drawings.

The note regarding the three angles per side and the supporting information has been removed since these small angles are welded to the top of the strongback to accommodate the optional independent holddown brackets and do not serve any nuclear safety function.

Detail A has been renamed as Detail K.

View C-C has been renamed to View M-M

Detail N has been added.

A clarification note has been added to clearly mark the three piece optional strongback on the Model A1 package design

The circled area defining the holes present in the strongback has been modified to allow for various holes to be drilled in the side of the strongback in accordance with good industry bolting practice. A maximum hole diameter, minimum distance between holes and minimum distance from the free edge in the direction of the force has been specified based on the following justification:

The end fitting support brackets prevent the fuel assemblies from moving axially in the strongback. These brackets are connected to the strongback by five bolts on each side. The end fitting brackets, bolts and strongback were qualified by a thirty foot axial drop test (Reference 7 page 2B-18)

The bolts connecting the end fitting support brackets to the strongback require a pattern of five bolt holes on each side of the strongback. An inspection of shipping container strongbacks has found that additional bolt hole patterns have been drilled in the strongbacks to permit alternate placement of the end support brackets for shipment of varying length fuel assemblies. In some cases these hole patterns are closer together than good bolting practice would recommend.

Strongbacks which have bolt hole patterns which are too close will be repaired by welding in a plug with a full penetration weld, making these strongbacks as strong as they were before the additional holes were drilled. After the repairs are complete, the separation of hole patterns will conform to the AISC Code (Reference 4) such that the adjacent hole patterns will not compromise the allowable bearing stress of the strongback at the bolt holes being used to fasten the end support brackets. The calculation of the minimum separation distance is described below.

The end support bracket design was qualified by a 30 foot axial drop test. Reference 7 page 2B-18 documents the drop test. The simulated fuel assemblies in this test weighed 1653 ibs, which is heavier than the heaviest fuel assembly shipped in the container. The following statement was taken from the vertical drop test section of the test report:

> "…. the container was lifted to an elevation of 30 feet as measured from the lowest portion of the container and allowed to free fall to the test pad. The container struck perfectly on its end as evidenced by the fact that it remained in the vertical position when it struck the test pad. The container was then lowered from the vertical to the horizontal position and its cover removed for examination. There was a surprisingly small amount of damage from this drop. The outside ring on the container on the impact end snapped off and slight bowing was evident on the outside of the container for approximately 17 inches from the end. On the inside, the 14 bolts attaching the strong back cross beam to the shock mount assembly sheared off and allowed the strong back to shift in the direction of impact. The end of the strong back up to the end thrust plate crumpled. **The end thrust plate remained intact and in position. All bolts attaching the end thrust plate to the strong back remained in position, and no failure was observed.** The strong back remained in the container and the fuel assemblies remained essentially in perfect position in the strong back."

This test demonstrated the adequacy of the end thrust plates, the bolts holding them to the strongback and the strongback to hold the fuel assemblies in position within the strongback during a 30 foot axial drop. The repairs to the strongbacks ensures that they remain as strong as the tested unit.

The calculation of the minimum separation distance of bolt hole patterns is done in a conservative manner by considering the edge of the adjacent bolt hole pattern to be a free surface and calculating the minimum distance for which the allowable bearing stress at the bolt holes supporting the end plate is not compromised.

Section J3.7 of Reference 4 states that the allowable bearing stress at bolt holes closest to a free edge in all connections with a single bolt in the line of force is given by the following equation:

$$F_p = L_e F_u / 2d \leq 1.2 F_u$$

where: F_p = allowable bearing stress
L_e = distance from the free edge to the center of the bolt
F_u = minimum tensile strength of the strongback material
d = bolt diameter (in)

As long as $L_e \geq 2.4$ d, the allowable bearing stress at the hole will not be compromised by adjacent hole patterns in the strongback.

This distance applies to standard size bolt holes. If the bolt holes are oversized then this distance has to be increased by ½ of the increase in the hole diameter. Since the actual hole diameters may vary up to 1.0 inch, the solid metal distance from a free surface to the edge of a hole is calculated. For the 3/4 inch bolt in an oversized 1.0 inch diameter hole, this distance is the following:

$$S = (2.4 - 0.5)(0.750) + (0.5)(1.0 - 0.8125) = 1.5 \text{ in.}$$

As long as the solid metal distance between bolt holes of adjacent hole patterns in the direction of the applied force is at least 1.5 inches, the adjacent hole pattern does not compromise the strength of the strongback. In addition, as long as the solid metal distance between the free edge of the strongback end and the first set of bolt holes is at least 1.5 inches the strength of the strongback is not compromised.

Since a portion of the Model A packages contain strongbacks with welded extensions and reinforcing plates which provide twice the wall thickness only half the thickness of solid metal is required. Therefore, for the Model A packages which contain the extension plate option, the required minimum solid metal thickness between the free edge of the strongback and the bolt holes is 0.75 inches.

Zone C1

The information describing the hole configuration was added during revision 22 of the Certificate of Compliance for clarity. At that time, the scope of the differences in the hole patterns between packages was unknown and was inadequately described in the diagram provided. The approach requested for this amendment is to allow hole patterns such that good industry standard practices are followed, i.e., a maximum hole diameter, minimum distance between holes and minimum distance from the free edge in the direction of the force has been specified. **Solid metal**

Details N and P were added for clarification of the side strongback angle support brackets for both model designs.

Zone A2

Detail A was changed to Detail K and Detail B was changed to Detail L.

Item (31) and (32) were added to connect the components to the Bill of Material listing.

Item (22) was clarified dimensionally and the weld specification was corrected, the current drawing shows two different weld specifications on the base of the strongback. The inconsistency was corrected and the 1/8 inch fillet weld was specified for both sides.

Enclosure II
to RA98/733

Replacement pages to Certificate of Compliance No 6078 Application

Combustion Engineering, Inc.
Certificate Application List of Affected Pages

Date: May 7, 1998

Combustion Engineering, Inc., provides for information those pages affected by this amendment request. Those replacement pages are provided in this enclosure with the changes to the text marked with a vertical line in the right hand margin.

Page	Rev.	Date
1-3	1	5/7/98
1-4	1	5/7/98
1-5	1	5/7/98
1-6	1	5/7/98
1-7	1	5/7/98
2-1	1	5/7/98
2B-12	1	5/7/98
4-1	1	5/7/98
6-2	1	5/7/98
8-1	1	5/7/98

conservatisms result in a nominal implied (calculated) fuel assembly weight of 1,505 pounds, which exceeds the limit of Table 2A-1 by five pounds. The actual fuel assembly weight will not, however, exceed 1,500 pounds.

For the 17x17 fuel assembly, the maximum shall be 33.70 Kgs U235. This exceeds the value implied by column (e) of Section 6.4.2 of 32.86 Kgs U235 because of a conservative value of assumed pellet density of 10.41 gm/cc.

Appendix 1A Licensing Drawings

Dimensional details of both containers are described in the licensing drawings [L-6078-01 Rev. 0, 927 Shipping Container (4 sheets)] provided on the following pages.

FIGURE WITHHELD UNDER 10 CFR 2.390

(3)

3-TRUNNION SHOWN IS AN OPTIONAL COMPONENT APPLICABLE TO ONLY THOSE CONTAINERS TRANSPORTING CERTAIN TYPES OF FUEL.

4-CONTAINER SHELLS MAY HAVE DENTS AND MAY BE MECHANICALLY REMOVED

9805140301-01

REV	BY	DATE	APP'D	DATE	DESCRIPTION
DRAWN BY: D. MOSBY		5/16/98			
- APPROVALS -					
FACILITIES ENGINEER					
QUALITY MANAGER					
REG. AFFAIRS					
OTHERS/					

ABB

NUCLEAR POWER

SCALE: 1" = 1'

TOLERANCES UNLESS OTHERWISE SPECIFIED
FRACTIONAL ±
DECIMAL ±
ANGULAR ±

927 SHIPPING CONTAINER

SHT 1 OF 4 | DRAWING NUMBER L-6078-01 | REV 0

Figure 1A-1 Page 1-4

FIGURE WITHHELD UNDER 10 CFR 2.390

9805140301-02

Figure 1A-1 Page 1-5

REV	BY	DATE	APP'D	DATE	DESCRIPTION
DRAWN BY: D. MOSBY		4/6/98			ABB
- APPROVALS -					
FACILITIES ENGINEER:					NUCLEAR POWER
QUALITY MANAGER:				5/7/98	
REG. AFFAIRS:				5/7/98	
OTHERS/				/ /	
SCALE: 1/8" = 1"					927 SHIPPING CONTAINER
TOLERANCES UNLESS OTHERWISE SPECIFIED					
FRACTIONAL ±					
DECIMAL ±					
ANGULAR ±					
SHT 2 OF 4		DRAWING NUMBER L-6078-01			REV 0

FIGURE WITHHELD UNDER 10 CFR 2.390

9805140301-03

REV	BY	DATE	APP'D	DATE	DESCRIPTION
DRAWN BY: D. MOSBY		5/8/98			ABB
- APPROVALS -					
ENGR'G CS ENGINEER				5/7/98	NUCLEAR POWER
QUALITY MANAGER				5/7/98	
REG. AFFAIRS				5/7/98	
DRAWN BY				/ /	
SCALE: 1" = 1"					
TOLERANCES UNLESS OTHERWISE SPECIFIED					927 SHIPPING CONTAINER
FRACTIONS ±					
DECIMALS ±					
ANGULAR ±					
SHT 3 OF 4			DRAWING NUMBER	L-6078-01	REV 0

Figure 1A-1 Page 1-6

FIGURE WITHHELD UNDER 10 CFR 2.390

9805140301-04

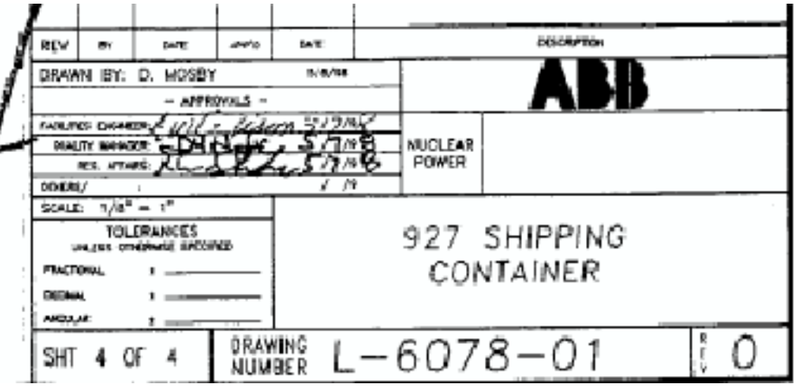

Figure 1A-1 Page 1-7

2. STRUCTURAL EVALUATION

2.1 Structural Design

2.1.1 Discussion

The containment vessel for the fuel assemblies consists of the 43" diameter carbon steel outer shell. The internal and external structures supporting and protecting the containment vessel for the fuel bundle(s) are shown in the licensing drawing provided in Appendix 1A as well as the internal structures for supporting the fuel bundles within the containment vessel. The external shell is supported by "L" shaped steel flanges, 1/4 inch thick, welded transversely to each half of the shell.

2.1.2 Design Criteria

The design test results described in Appendix 2B support the structural requirements specified in 10CFR71.

2.2 Weights and Centers of Gravity

The Model No. 927A1 container weighs approximately 6,700 lbs. when loaded. The bundles weigh approximately 1,400 lbs. each with the container weighing approximately 3,900 lbs.

The Model No. 927C1 container weighs approximately 7,300 lbs. when loaded. The bundles weigh approximately 1,500 lbs. each with the container weighing approximately 4,300 lbs.

The containers are approximately symmetrical; the center of gravity being at the center of the container. When the bundles are in the container, the center of gravity shifts vertically to a lower point because the bundles are vertically positioned below the center of the container.

2.3 Mechanical Properties of Materials

The container is fabricated of carbon steel.

The margin of safety for the safety bracket is therefore:

29880/22100 = 1.35

These calculations are conservative because a dynamic load condition has been analyzed using allowable stresses for a static load case. The allowable stresses could be increased significantly to account for the high strain rate with which the loading would actually be applied to the safety bracket.

The top safety bracket extensions were also checked to ensure that they will not crush during the impact. The compressive stress in the side walls of the tubing was found to be 6,300 psi. The buckling load for the side walls was also calculated and found to be 1.5 times the applied load. These analyses demonstrate that the fuel assemblies cannot rise above the separator block by more than 1.25 inches.

The independent brackets provide very little restraint to the fuel assemblies during a top drop and were not considered in this analysis. As shown in Figure 2B-4, hold down and safety brackets are uniformly spaced along the fuel assemblies with one or two additional safety brackets adjacent to the independent bracket to ensure a uniform loading of the brackets in a top drop. Changes in the independent bracket design will not affect the validity of this analysis.

In order to allow for dimensional tolerances in the weld length, the minimum weld length holding the two rectangular tubes of the safety bracket together has been established as 10 inches of 1/8 inch fillet weld on each side and 1 inch of 1/16 inch fillet weld at each end of the lower tube. Using the same equations stated above, with only 10 inches of weld length per side:

A_W = (13,600 psi)[(20 in)(0.125 in) + (2 in)(0.0625)]/ $\sqrt{2}$ = 25244 lbs
A_b = (0.5)(30000 psi)(20 in)(0.083 in) = 24900 lbs

The margin of safety for the safety bracket weld is therefore:

[(24900-22100)/24900]x100 = 11.2%

2B-3.3 Spacing Between Fuel Assemblies and Container Wall

Following a 30 ft. cover drop the fuel assemblies would be in the upmost position with respect to the hold down and safety brackets as shown in Figure 2B-9. The spacing between the fuel assemblies and the shipping container inner surface, assuming that the shipping container shell is flattened, is the thickness of the safety brackets (5 inches).

4. CONTAINMENT

4.1 Containment Boundary

The primary containment of the Model Nos. 927A1 and 927C1 packages is the 11 gauge steel shell. The unirradiated UO2 fuel pellets are placed within zircaloy tubes of approximately .025 inch thick walls. These fuel rods are then assembled into fuel assemblies.

4.1.1 Containment Vessel

The outer shell is composed of 11 gauge steel.

4.1.2 Containment Penetrations

There are a total of 5 penetrations into the primary containment. Of these, only 2 are presently needed. The remaining three are listed as optional and may be eliminated upon construction of any new containers.

4.1.3 Seals and Welds

All seals and welds are specified on the licensing drawing provided in Appendix 1A.

4.1.4 Closure

The "T" Head Special-Bolt is presently being used for closure of the containers. An approved alternate closure bolt is shown in Appendix 2A. The replacement bolt is equal to or greater than the "T" Head Special Bolt in mechanical properties. The bolts are interchangeable on a location basis.

4.2 Requirements for Normal Conditions of Transport

It is concluded that under normal conditions of transport, as specified in 10CFR71, the results described in Section 2.6 of this application indicate the following results:

1. There will be no release of radioactive material from the containment vessel.

2. The effectiveness of the packaging will not be reduced.

Results of the criticality evaluations are summarized below:

		Packages/Shipment
A.	Normal Transportation Conditions	16
B.	Accident Conditions	8 (14x14, 16x16, 17x17)

6.2 Package Fuel Loading

The Model Nos. 927A1 and 927C1 shipping containers are approximately 43 inches in diameter, up to 216 inches long, and may contain a maximum of two (2) fuel assemblies of the types described in Section 1.2.3 of this application, or other less reactive fuel assemblies. The criteria for making this assessment are given in Section 6.4.2, below.

6.3 Model Specification

6.3.1 Description of Calculation Model

The analytical model for the shipping container is based on the dimensional data contained in the licensing drawing provided in Appendix 1A. The fuel assembly type employed as being representative of the 14x14 and 16x16 fuel assembly types is that of subparagraph (d) of Section 1.2.3. The 17x17 fuel assembly type is that of subparagraph e) of Section 1.2.3.

6.3.1.1 Normal Transportation Mode

In the normal transportation mode, each shipping container is assumed to contain two fuel assemblies.

The outer shell of the shipping container is represented as circular, as illustrated in Figure 6.3-1 for the 16 x 16 fuel assembly design and Figure 6.3-2 for the 17 x 17 fuel assembly design. These figures also illustrate the geometry and dimensions of the material compositions employed in the KENO model. The container array is 4 x 4 in each case. The fuel assemblies are assumed to be of infinite extent and the array is assumed to be reflected by twelve inches of water on all four sides.

6.3.1.2 Accident Mode

In the accident mode, the shipping container employs a conservative description. The outer shell is assumed to be collapsed about the strongback structure. The

8. ACCEPTANCE TESTS AND MAINTENANCE PROGRAM

8.1 Acceptance Tests

All containers to be fabricated will be constructed in accordance with the Combustion Engineering licensing drawings provided in Appendix 1A and shall be source inspected prior to use. Changes to the design of the container which fall outside of the safety envelope specified in this application will be submitted to NRC for approval. Containers which are currently fabricated and require repair work will be visually inspected following the repair work prior to use.

8.2 Maintenance Program

Maintenance for the Model No. 927 type shipping container is accomplished through an on-going in-service inspection program. Maintenance is performed, as necessary, as a result of the shipping container loading process inspections discussed in Section 7.1. Each container is treated as a separate entity and undergoes inspection and replacement of parts or repair when a deficiency is noted during the inspection process. If appropriate replacement or repair cannot be made in a timely manner the container is removed from service until corrective maintenance action is completed.

Repair work will be performed under procedural guidance in connection with the current Quality Plan. The procedures will identify proper equipment or techniques, operator qualification requirements, acceptance criteria, and required routine inspections. Welding repair work will be in accordance with the criteria specified on the licensing drawings provided in Appendix 1A.