HITACHI

GE Hitachi Nuclear Energy

Donald R. Krause
Manager, Regulatory Compliance and EHS
Vallecitos Nuclear Center

6705 Vallecitos Rd
Sunol, CA 94586
USA

T 925 862 4360
F 925 304-7435
Donald.Krause@ge.com

10 October 2012

Pierre Saverot, Sr. Project Manager
Licensing Branch
Division of Spent Fuel Storage and Transportation
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-001

ATTN: Document Control Desk

Ltr No.: DRK-2012-22

Subject: RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
Re. APPLICATION FOR LIMITED CONTINUED USE OF THE MODEL No. 1500 PACKAGE, CERTIFICATE OF COMPLIANCE No. 5939

References:
1) NRC Letter to GEH Re. Application for Limited Continued Use of the Model No. 1500 Package, Certificate of Compliance No. 6939, Dated October 1, 2012.
2) JLS&A Letter to GEH Re. Comparative Analysis: NPI Cask, Model NPI-20WC-6MKII, ES 10-160B, GE 1500, and AOS 100AS, Dated October 8, 2012.

Dear Mr. Saverot:

Enclosed is JL Shepherd & Associates (JLS&A) response to the NRC's letter of October 1, 2012 requesting additional information concerning GE Hitachi Nuclear Energy Americas ("GEH") application for continued limited use of the Model No. 1500 Package, Certificate of Compliance No 5939.[1, 2].

For over 40 years, GEH, with operations at the Vallecitos Nuclear Center, Sunol, California has manufactured Co-60 sealed sources for JLS&A, a manufacturer and distribution licensee by the State of California (CA 1777-19) for a wide variety of devices containing sealed sources.

If there are any questions on this transmittal, or additional information is required, please contact me or our Technical Contact: Mr. Carlos Martinez at (925) 862-4481.

Sincerely,

Donald R. Krause
2012.10.10
15:02:38 -07'00'

Donald R. Krause
Manager, Regulatory Compliance

Enclosures: JLS&A Response to NRC RAIs

Docket No. 71-5939
TAC No. L24654

cc: w/enclosure
Associate Administrator for Hazardous Material Safety
Pipeline and Hazardous Materials Safety Administration
U.S. Department of Transportation
1200 New Jersey Avenue, S.E.
Washington, D.C. 20590-0001
Attn: Special Permits, PHH-31

w/o enclosure
Bill Brown – JLS&A
Carlos Martinez - GEH
Anthony McFadden – GEH
Scott Murray - GEH
Earl Saito - GEH
Michael Schrag - GEH

J.L. Shepherd & Associates
1010 Arroyo St.
San Fernando, CA 91340
818-898-2361

October 8, 2012

Mr. Carlos Martinez
GE-Hitachi Vallecitos Nuclear Center
6705 Vallecitos Rd.
Sunol, CA 94586

Re: Comparative Analysis: NPI Cask, Model NPI-20WC-6MKII, ES 10-160B, GE 1500, and AOS 100AS

Dear Carlos:

At the request of the NRC, J.L. Shepherd & Associates has undertaken an extensive evaluation of the above model radioactive materials transportation packages with regard to a proposed shipment of 19,200 Curies of Co-60 to a government entity located in the Sacramento, California area.

This document is intended to answer the questions raised by NRC with regard a comparison of the benefits of use of several casks in table form, followed by a narrative conclusion.

Considerations are given to the following items:

1. 10 CFR Part 71. Will the cask carry the intended shipment? If modified, will the cask carry the modified shipment in accordance with the CoC?
2. Radiological Capability. Can each cask carry the proposed load?
3. Availability and Conditions of Use: Is the cask readily available? Is special training required? Will the owner permit JLS&A to load and unload the cask?
4. License capabilities of the owner of the cask. If the cask owner will not permit JLS&A to ship the cask, is the owner capable of loading the cask, taking possession of the radioactive material during transport of the cask, and then conducting the required source work in unloading the cask?
5. The number of nature of shipments required to move the radiological source material from city of origin to destination and then recovery of unwanted sources from that location.
6. The radiological output of the package during transportation (TI) and the type of shipment required.
7. Risk of exposure to both public and employee during transit, storage, and use.
8. Design and Certificate of Compliance restrictions that may impact any or all of the above.

DESCRIPTION OF SHIPMENT:

Intended shipment consists of three Cobalt 60 radioactive sources. Two sources are 9,500 Curies each; the third source is 200 Curies. All three sources are Sealed Sources configured per Drawing Number A-0484-W3799-CAD-1, attached hereto. Each of the 9,500 Curie sources, when configured for shipment measures approximately 13.700" in length and has an extreme diameter of approximately 1.142". The 200 Curie source has an overall length of approximately 10.1" and an extreme diameter of approximately 0.642".

As configured, the sources are locked onto the tungsten rods by roll pins which cannot be removed and re-installed in field locations. Installation of the tungsten rods and roll pins occurs in hot cells during capsule fabrication. The lengths of the tungsten rods are considered the minimum necessary to avoid the risk of handling exposure during installation/removal from transport shields and devices.

Area of Evaluation	GE-1500	NPI 20WC-6MKII	ES 10-160B	AOS-100-A AOS-100 A-S
10 CFR 71. Does the proposed cask meet the requirements of Part 71 with regard to the intended shipment?	YES	NO[1]	NO[2]	AOS-100-A: NO[3] AOS-100 A-S: YES
Can the proposed cask carry the proposed shipment(s) in accordance with the particular CoC?	YES	YES[4]	NO[5]	AOS 100-A: NO (200 Ci only) AOS 100 A-S: YES
Is the proposed cask available for use within the time required by the customer?	YES	YES	UNK Only 1 Cask Available	NO[6] (Both)

Ram License Restrictions Nature and Number of Shipments Required?	NO 2 Exclusive Use	YES 6 TOTAL 4 Shipments 2 Shipments require Special Arrangement	YES 3 Shipments	Limited AOS 100-A 2 Shipments 200 Ci Source Only.
Estimated Radiological Output (TI) of packages loaded with proposed contents.	WHITE 1 TI=0	YELLOW III 9,500 Ci = TI in excess of 20	YELLOW II TI= 0.2	(Both) WHITE 1 TI=0
Risk of Exposure during transport, handling, loading and unloading	Minimal JLS&A has tooling designed specifically for use.	Very High JLS&A has no tooling designed for use with this cask. Cask owner will not provide info.	Very High Use requires heavy lifting equipment and large work areas. Specified Insert does not offer sufficient shielding for safe, job-related handling.	(Both) Minimal Loading restricted to hot cell only. Shield will not accommodate adaptive tooling and allow seal to remain intact for future use. No company has a portable hot cell capable of handling 9,500 Curies Co-60.
Design Restrictions	Sources originally designed for transport in this cask	Spherical shield presents high radiation fields and exposure risk to personnel	Overhead lifting of large loads and high radiation fields.	Limited Co-60 capability of AOS 100-A and 100 A-S. Both have problems associated with loading/unloading

				and re-sealing.
CoC Restrictions	None	Limited to "Teletherapy Sources".	Shielded Insert may be loaded, but not unloaded, by CoC.	Interior Temperature and 3,320 Ci-Co 60 limit

1 Use of this package presents significant risk of radiation exposure to both employees and public. Applicable regulatory references presenting reasons for non-use are: 10 CFR 71.0; 10 CFR 71.37; 10CFR 71.47; 10 CFR 71.87; 10 CFR 71.89; 10 CFR 71.105; 10 CFR 71.127; and 10 CFR Part 20 as it applies to the above identified regulations and operations. While this package may be currently certificated, use requires multiple shipments thereby presenting multiple risk issues associated with radioactive shipments.

2 Limitations of Certificate of Compliance. CoC is waste only and allows shipments of sealed sources configured as waste. CoC permits loading of 10,000 Curies Co-60 into Shielded Insert, but not unloading.

3 Cask cavity dimensions after installation of required tungsten plates. Thermal issues with regard to decay heat and aluminum source cups (T-3 has a melting point of 975°F and CoC indicates a maximum internal temp of 1000°F). While new 200 Ci source can be configured with a 304 SS source cup, the existing Aluminum source cup cannot be removed in a field location. A hot cell is required.

4 The Cask is capable of a transporting the 9,500 Curie Co-60 source, but will have significantly high radiation levels at both exterior contact and at a distance of one meter. TI estimated to be 23, a prohibitive number.

5 JLS&A does not use containers licensed for transport of waste containing isotopes other than those for which JLS&A is licensed. In most instances, any transuranic contamination, fixed or removable, would violate both JLS&A and customer licenses as neither is licensed to posses the isotope. Co-60 may be covered by the CoC, but the specific authorized contents or use are not permitted for the sources covered in this request. This CoC is designed to transport radioactive "waste material in the type and form of byproduct, source, and special nuclear material, non-fissile or fissile excepted, as special forms, or non-special form in the form of process solids or resins. Either dewatered, solid, or solidified waste in secondary containers. Byproduct material as Co-60 loaded into the source insert." The ES 10-160B as modified by Rev 18 to CoC 9204 authorizes loading with up to 10,000 Curies, Co-60 and shipment of a loaded Source Insert as described under General Information of that revision in accordance with Condition 5(b)(2)(i) of the CoC. The language and terminology of Revision 18 is consistent. Paragraph 7.0, Package Operations, of this same Revision 18 clearly states: "It is to be noted that the Source Insert will not be unloaded". Therefore, in keeping with the Certificate of Compliance, the ES 10-160B is a "one-way" package and of

no use for this purpose. A check of subsequent revisions has revealed that there are no changes to this restriction.

6 The proposed cask is not yet fabricated and estimates place availability to the owner November/December 2012, beyond the customer's "must have" date.

RADIOLOGICAL CAPABILITY

The payload capability of the GE 1500 when transporting Co-60 is 3120 Watts or 200,000 Curies. The NPI Cask is restricted to 1000 Watts or 15,000 Curies, Co-60, requiring multiple shipments. If use is determined to be authorized by NRC, The ES 10-160B Cask is capable of transporting 200 Watts, or 10,000 Curies, Co-60, therefore requiring multiple shipments at great expense by a cask having limited availability. The AOS-100A is capable of transporting the 200 Curie Source only.

AVAILABILITY AND CONITIONS OF USE

GE 1500: The GE 1500 cask is readily available and certified for use by GE. J.L. Shepherd & Associates has requested "party status" from GE. GE has graciously requested party status from the DOT. Once approved, the GE 1500 use will be exclusive to J.L. Shepherd & Associates, with no operating restrictions imposed by GE beyond those normally associated with package operations and security.

NPI Cask: Neutron Products, Inc., has advised J.L. Shepherd & Associates that they will not allow a "Registered User" arrangement with regard to use of their cask because loading instructions are considered proprietary by NPI. There are two problems presented with this position. A) Sources made for J.L. Shepherd & Associates are manufactured by General Electric, Vallecitos Nuclear Center. While J.L. Shepherd & Associates enjoys a very favorable working relationship with GE, for liability concerns, all work accomplished within the GE compound must be performed by GE employees. NPI has advised JLS&A that they will not permit third parties to load the NPI cask. GE will not yield their position, which then poses an additional problem: How do we move the material from GE to a location that will allow loading into the NPI cask? An additional concern is that this restriction results in JLS&A needing to disclose proprietary information to NPI, a competitor. B) NPI has indicated that the NPI Model 20WC-6MKII may not be available in sufficient time to meet the government's need for the materials ordered.

LICENSE CAPABILITIES OF THE CASK OWNER:

General Electric, if designated as the required shipper of record, has the ability to possess the 19,200 Curies Co-60 during the shipment phase of the project. GE will also permit JLS&A technical staff to operate, unload, and re-load the GE 1500, under GE supervision.

NPI will not permit JLS&A staff to operate, unload, and re-load the NPI-20WC-6MKII cask. This presents a problem regarding disclosure of proprietary information to a known competitor. Additionally, safety issues are also presented due to NPI personnel not having any experience with the JLS&A methods, tooling, or loading configurations required to accomplish the source unloading at the identified customer's location. Lastly, it has come to the attention of JLS&A by representatives of the State of Maryland, that NPI has had their radioactive materials license terminated by the State of Maryland. This means that NPI cannot perform radiological work or possess radioactive materials at the required limits during transport of the isotope between locations. The State of Maryland also advised JLS&A that NPI had a storage license issued by the State of West Virginia which JLS&A has requested from NPI.

Energy Solutions is not capable of performing source work under their radioactive materials license and Alpha-Omega Services is restricted to teletherapy devices just the same as NPI.

NATURE AND NUMBER OF SHIPMENTS REQUIRED:

GE 1500: One shipment of 19,200 Curies, Co-60 in the form of two 9,500 Curie and one 200 Curie sources; followed by a return shipment of approximately 9,000 Curies, Co-60, both shipments made as "sole use".

NPI-20WC-MKII: Four shipments: One at 9,500 each, and one at 9,700 Curies; followed by a return shipment of approximately 9,000 Curies. Transport risk is increased by a factor of 3.

Use of the NPI cask requires an additional high activity shipment between GE and the intended customer, or a total of four shipments, three having a Transport Index In excess of 10, the limit for a Highway Route Control Shipment. Additionally, because of the activity levels and output of the cask, exposure considerations must be considered when evaluating drive times, workers and public in the immediate area of the cask, workers handling the inner shield within the cask, time taken to configure the shield for unloading into a transfer cask, and then re-loading used isotope (two approximately 4,500 to 4,800 Curie Co-60 sources).

If determined usable, the ES 10-160B Cask would require 3 shipments. One at 9,500 Curies, one at 9,700 Curies, and one at approximately 8,000 Curies (returned sources). In each case, the radiation output of the Source Insert would prohibit handling outside of a hot cell facility. Calculations are provided which indicate a dose rate to worker at a distance of one meter resulting from a 9,500 Curie Co-60 shipment would be 1.3 R/hr at ½ meter from Source Insert surface, or 63 times greater exposure than that estimated to be received from the GE 1500 cask.

RADIOLOGICAL OUTPUT OF PACKAGE AND TYPE OF SHIPMENT REQUIRED:

A Shielding Analysis was performed utilizing the NPI-20WC-6MKII Transport Cask. The analysis is attached to this document. Indications based upon industry accepted calculations are that the shield within the transport cask, when loaded with 9.500 Curies, Co-60 source, configured as necessary to re-load the government-owned irradiator will result in excessive radiological output from the shield as follows:

1) The shield is spherical. Any extension of the source beyond the exact center will result in a higher dose distribution at angular points extending toward the top/bottom of the shield which pose a significant exposure risk to persons handling the shield and those in proximity of the shield during source transfer. Loaded source configuration (for transportation) was obtained from Neutron Products drawing 240122, Sheet 1 of 2. This insert carries the 9,500 Curie source off-center and below the center of the shield. The specific source configuration was obtained from J.L. Shepherd & Associates drawing information relative to the specific irradiator. (Note: At the time of manufacture, the complete source assembly design was based upon continued availability of the GE 1500 or similar cask. TS-R-1 was not envisioned at that time).
2) Calculations reveal that transportation of the NPI cask must be done under Highway Route Control supervision, by SPECIAL ARRANGEMENT due to the radioactive output of the cask when loaded, requiring numerous inspections and increasing costs not otherwise necessary if the GE 1500 cask is used.

The GE 1500 cask presents minimal radioactive output at the surface and near background amounts at one meter when loaded with 19,200 Curies of Co-60, configured as necessary to effect a minimally invasive source transfer at the customer facility.

RISK OF EXPOSURE TO EMPLOYEES AND PUBLIC DURING TRANSPORT, STORAGE, AND USE:

The GE 1500 cask, as designed, offers a very large and stable mounting surface which can be used to mount a transfer shield and conduct a source transfer into a "mule" cask with very little exposure to workers and significantly reduced risk to public during all phases of cask operation. While very large, the cask presents a Transport Index of 0.05 (White I) when loaded with 19,200 Curies Co-60. The NPI cask (shield) does not offer a mating surface which easily accommodates alignment with JLS&A transfer cask resulting in an unstable (source tubes in drawer are off-center) working surface. By necessity, the source transfer must be done vertically which creates a very real danger of tipping. Tipping using this spherical shield could have extreme exposure consequences.

Additionally, the design of the NPI cask and shield, with insert as shown in Drawing A-0147-NPI-LC-2 (as received from NPI) prohibit achievement of low output readings due to the need to carry the source assembly off-center. The NPI shield is not designed for the intended type of source configuration. The intended use of the NPI shield is for transportation of teletherapy sources, typically 2" diameter by 2" long or smaller. The NPI shield when loaded with a 9,500 Curie JLS&A source capsule configured for handling and loading into the customer's device will present a surface reading as shown on the attached drawing of 1.398 R/hr. This high output is due to the source needing to be carried in an off-center verticle alignment, and extension below the center of the sphere, creating a "hot area" on the shield. This amount translates to a TI of 23.

During source transfer, this output will increase as the source begins to move closer to the end of the shield due to the radius of the shield and resulting reduction in lead volume as the source moves toward the edge of the shield opening. Estimates are that each worker (minimum of two required) will receive at least 500 mR total dose as a consequence of making one source transfer. Four source transfers are required to complete the task. Any misalignment, gap, or other problem occurring between the carrying shield and the transfer shield will result in significantly higher exposure and has the potential to put employees and public working in the area at substantial risk – all of which can be avoided by use of the GE 1500 cask. JLS&A adamantly believes that requiring such high exposure levels in order to "comply" with current regulation creates an excessive high risk environment at a facility that is uncontrolled and staffed with persons not classified as radiation workers. Accordingly, it is JLS&A's request that the GE 1500 be authorized under special permit for this shipment.

DESIGN RESTRICTIONS THAT IMPACT THE ABOVE:

The particular irradiator for which these sources are intended was manufactured in 1984. At the time of manufacture, there was no consideration given to the potential extinction of the GE 1500 cask, which was the basis for the source design configuration. An additional consideration was the fact that the GE 1500 presented a large center cavity which allowed design of large sources with fixed tungsten rods or plugs. These tungsten rods are attached at time of source manufacture while the source capsule is located in a hot cell and because of radiological output cannot be re-configured away from hot cell facilities without imposing unacceptable safety risks to the public and others in the immediate area. Any such activity would be a direct violation of 10 CFR Part 20 as it applies to transportation and handling of radioactive materials during loading, highway transportation, unloading, movement and storage.

Attached are detailed shielding analyses which highlight the comments made herein. As a part of those analyses, drawings are provided which substantiate the

calculations provided. Please note, that if an output rate of raw material is used (1.37 R/hr @ 1 meter), these values will increase.

None of the intended sources anticipated for shipment in the GE 1500 can be reconfigured into dimensionally acceptable designs for shipment or end use at customer locations, due to each design being unique and each shipment requiring Curie loading beyond the capabilities of those casks. Details of those intended shipments can be provided upon request.

Lastly, cost and availability of each package use must be addressed. Neither Energy Solutions nor AOS can provide more than one package at a time. (Note: AOS cask will not be delivered to the owner until November/December of this year). NPI cask use poses other problems: availability, registered use, cask-owner participation in another company's proprietary processes, and extreme risk of exposure during handling of the cask's inner shield. While cost is not a consideration of safety, safety is certainly a consideration of cost. In this case, the more expensive and higher risk casks are those costing much more then the larger, readily available and equally safe GE 1500. The cost of which are to be borne by the customer, in this case the United States Government.

The principle difference between these casks: The GE 1500 has an expired Certificate of Compliance due to the owner's desire to change its corporate model, not one of safety. In fact, as has been shown in the exposure risk calculations, the GE 1500 presents less risk to all involved: public and worker during transportation and handling, and only one shipment to the customer location instead of three, and one shipment from the location all at significantly reduced exposure levels due to the available shielding within the GE 1500 cask.

Best regards,

W.H. (Bill) Brown
Quality Assurance Manager

SHIELDING ANALYSIS FOR NPI CASK NPI-20WC-6MKII
RELATED TO OPERATOR EXPOSURE FOR USE OF CASK

BASIS.

Source; 9,500 Ci. Co-60 in Special Form capsule 1.077" diameter x 3.180" long permanently mounted to a Tungsten source rod 1 1/8" diameter x 10" long.

Location: centered in a 2.5" diameter SS tube mounted in Item 5 per NPI drawing 240122 Sheet 1 of 2. In this configuration the source extends 2 7/16"past the centerline of the spherical cask significantly reducing shielding surrounding the source and increasing radiation levels associated with cask usage.

The highest radiation level will be at a point located at a 45° angle from the end of the source. This is shown on the attached drawing.

To determine radiation levels the Co-60 content in the source was broken into 6 segments as shown on the drawing, 5 at 1728 Ci and 1 at 864 Ci. Calculations were made at the center line of each segment.

Calculations were made at surface, 12" from surface and 1 meter from surface. For cask use the exposure level to operating personnel would be conservatively considered at the 12" distance. Operating time for the multiple source exchanges, 2 each new 9,500 Ci sources to be shipped and loaded and 2 each ~ 4,000 Ci. Co-60 sources in the same configuration to be reloaded, including time to align the NPI cask with the JLS&A transfer cask, based on multiple previous source loadings using the GE 1500 cask is considered to be one hour. It is obvious that 2 each NPI casks would be required to ship 2 each 9,500 Ci. Co-60 sources because of the 15,000 Ci. limit for the cask.

The dose rate of 1.2 R/hour/Ci. of Co-60 at one meter distance was used for the basis of the calculations. This is a typical measured output per Ci. of Co-60 from a source of this configuration as measured using NIST traceable air equivalent ionization chamber and electrometers.

Shielding curves for both lead and Steel(SS) taken from NCRP report No.49 were used as the basis of shielding calculations

CALCULATIONS

Segment 1 at 1,728 Ci. (end of source).

Distance to surface is 9".

Dose rate is 3.97×10^7 mR/hr.
Shielding is 8" lead with reduction factor of 9×10^4, including shielding in lead plug in end of tube and 1/2" steel with reduction factor of 1.3 for total reduction factor of 1.17×10^5.

Dose rate at surface is 340 mR/hour
Dose rate at 1" from surface (21" total) is 62mR/hr.
Dose rate at 1 meter from surface is 12 mR/hr.

Segment # 2 at 1728Ci. (next in line to Segment # 1).

Distance to surface is 9 ½".
Dose rate is 3.6×10^7 mR/hr
Shielding is 7 ¾" lead with reduction factor of 6×10^4 and 3/4" steel with reduction factor of 1.5 for total reduction factor of 9×10^4.

Dose rate at surface is 400 mR./hr
Dose rate at 12" fro surface is 778 mr/hr
Dose rate at 1 meter from surface is 15 mR/hr.

Segment # 3, 864 Ci. (next to segment # 2).

Distance to surface is 9 ¾"
Dose rate is 1.69×10^7 mR/hr.
Shielding is 7 5/8" lead with reduction factor of 5×10^4 and 1 18" steel with reduction factor of 1.9 for total reduction factor of 9.5×10^4.

Dose rate at surface is 178 mR/hr
Dose rate at 12" from surface is 36 mR/hr
Dose rate at one meter from surface is 7 mR/hr

Segment # 4, 1,728Ci (next to segment # 3).

Distance to surface is 10".
Dose rate is 3.22×10^7 mR/hr.

Shielding is 7 ¾" lead with reduction factor of 6×10^4 and 1 1/8" steel with reduction factor of 1.9 for total reduction factor of 1.14×10^5.

Dose rate at surface is 281 mR/hr.
Dose rate at 12" from surface is 58 mR/hr.
Dose rate at one meter from surface is 12 mr/hr

Segment # 5, 1,728 Ci. (next to segment # 4).

Distance to surface is 10 ½"
Dose rate at surface is 2.92×10^7 mR/hr.
Shielding is 8 1/8" lad with reduction factor of 1.1×10^5 and 1 3/8" steel with reduction factor of 2.2 for total reduction factor of 2.42×10^5

Dose rate at surface is 121 mR/hr.
Dose rate a 12" from surface is 27 mR/hr
Dose rate at one meter from surface is 5.3 mr/hr.

Segment # 6, 1,728 Ci next to Segment # 5 at top end of source,

Distance to surface is 10 ½"
Dose rate at surface is 2.66×10^6 mR/hr.

Shielding is 8 3/8" lead with reduction factor of 1.55×10^5 and 1 3/8" steel with reduction factor of 2.2 for total reduction factor of 3.4×10^5.

Dose rate at surface is 78 mR/hr
Dose rate at 12" from surface is 18 mR/hr
Dose rate a one meter from surface is 3.8 mR/hr.

Total dose rates are:

Surface:	1,398 mRhr
12"from surface:	279 mRhr
One meter from surface:	55 mR/hr

Calculations were also made for points perpendicular to the centerline of the cask using a single 9,500 Ci. point located at centerline of source.

Distance is 10 1/4" with dose rate of a 1.68×10^8 mR/hr.

Shielding is 8 ½" lead with reduction factor of 1.85×10^5 and 1.7" steel with reduction factor of 1.7 for total reduction factor of 3.14×10^5.

Dose rate at surface is 535 mR/hr
Dose rate at 12" from surface is 114 mR/hr
Dose ate at 1 meter from surface is 23 mR/hr

CALCULATIONS FOR PROBABLE TRANSPORT INDEX OF NPI CASK WITH 9,500 CI. CO-60 SOURCE

BASIS

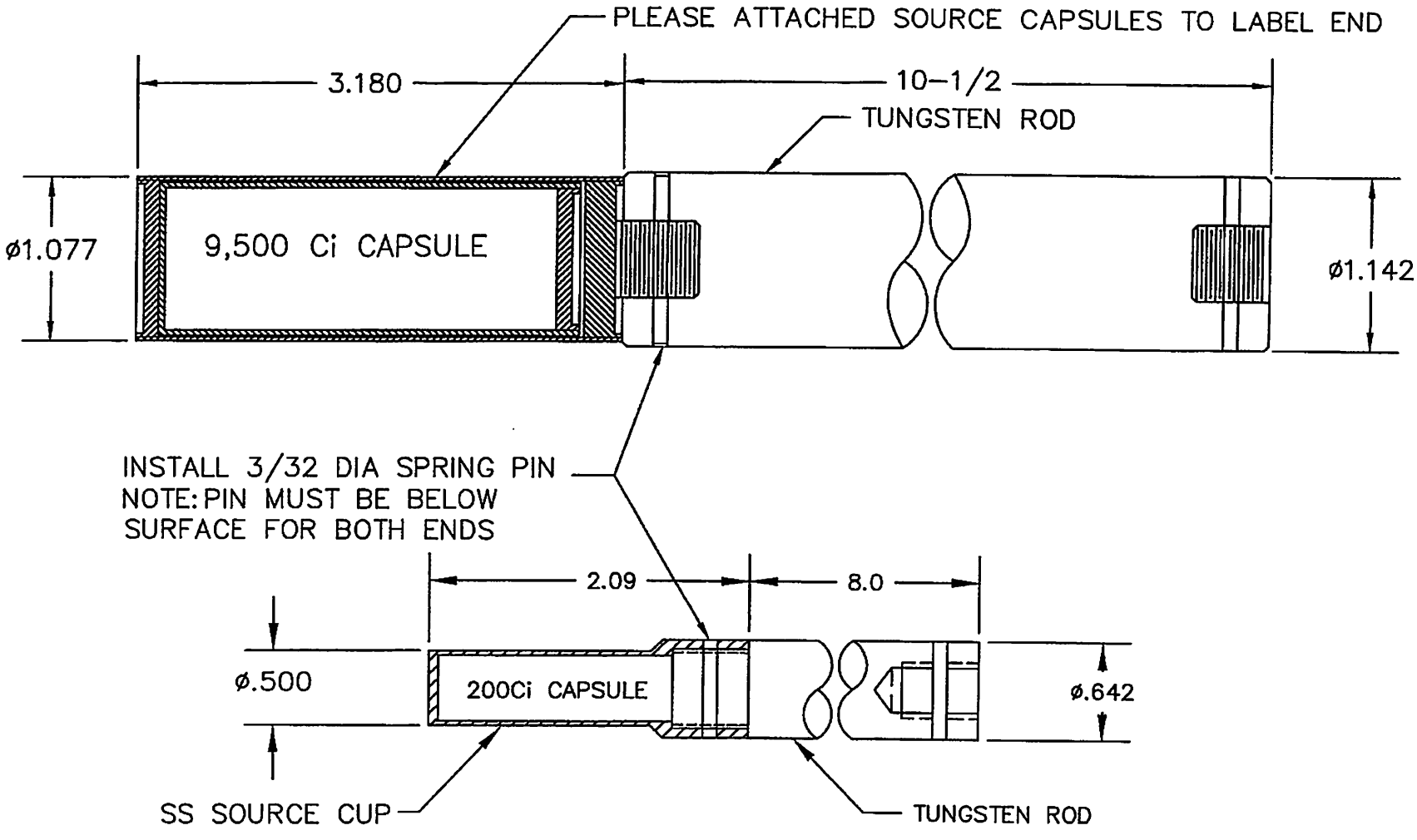
The 20WC6 is 49" diameter and the typical distance of the 9,500 Ci. Co-60 source from the end of the the cask is ~ 24". Therefore the diagonal distance from the source to the outside of the overpack is ~ 34" and the Transport Index distance is ~ 73.4".

The wood shielding in the overpack has minimal value and not considered in the calculations.

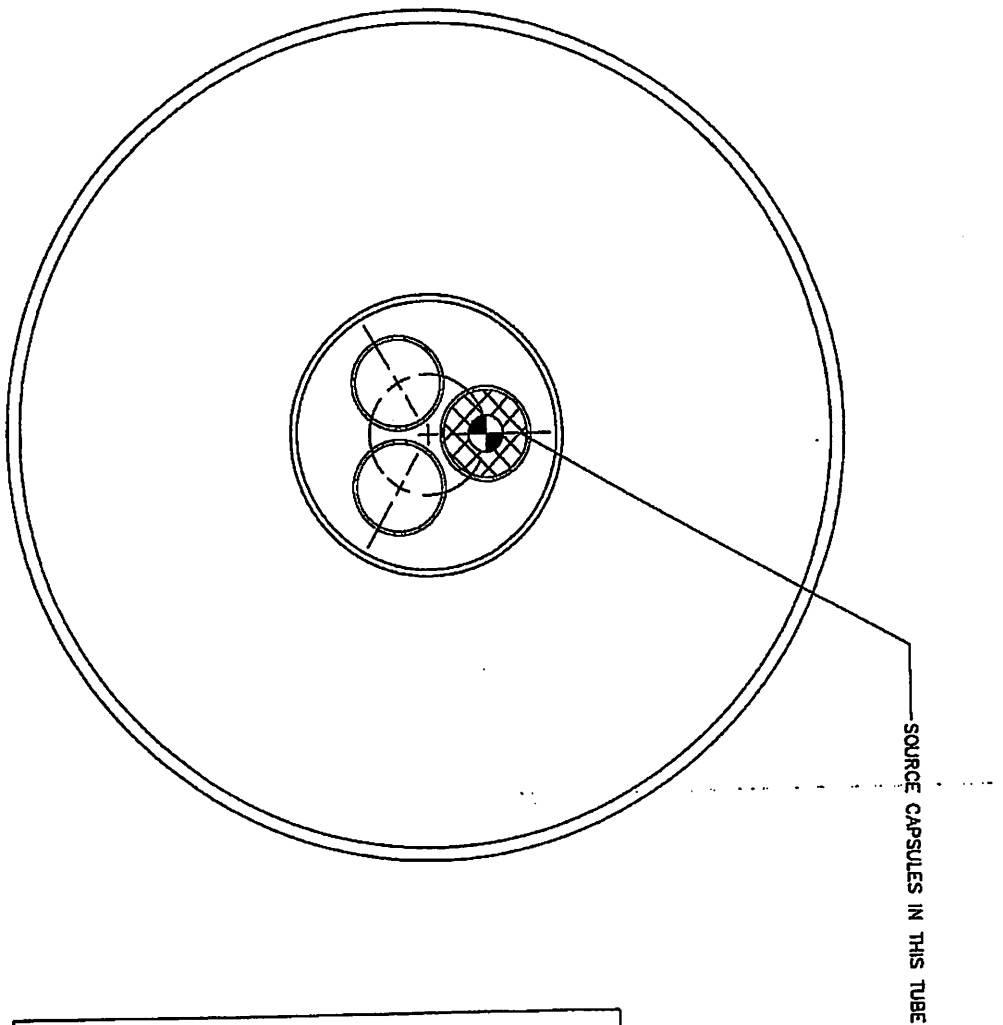
Use the 55 mR/hr dose rate at 1 meter from inner cask assuming that the average distance from source to exterior of inner cask is 10" for a total distance of 49.4"

At the surface of the overpack which is ~ 34" from the source the dose rate will be ~ 116 mR./hr.

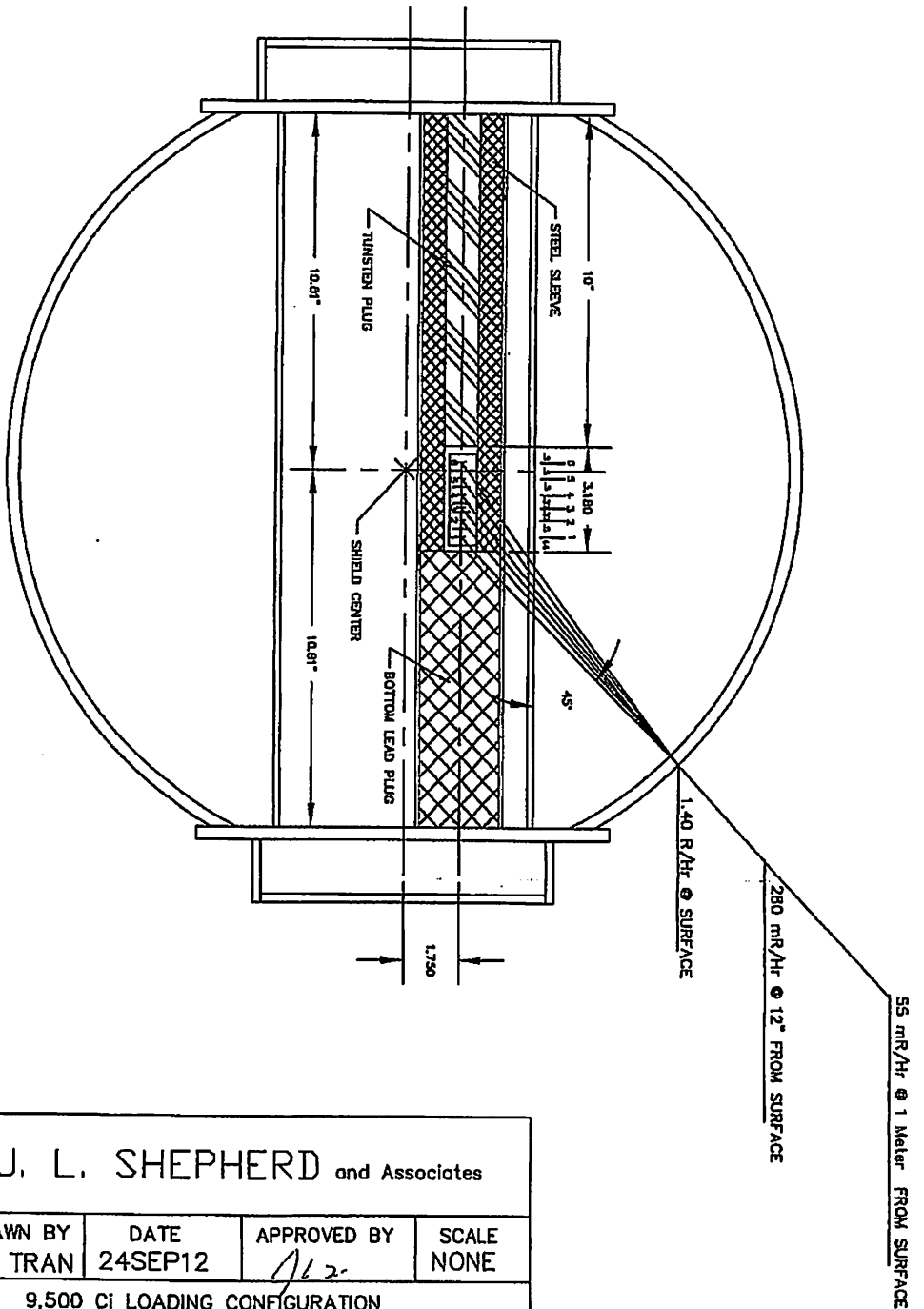
At one meter or 73.4" from the surface of the overpack, the Transport Index, the dose rate will be ~ 25 mR/hr which is 2.5 times the maximum allowable Transport Index of 10.



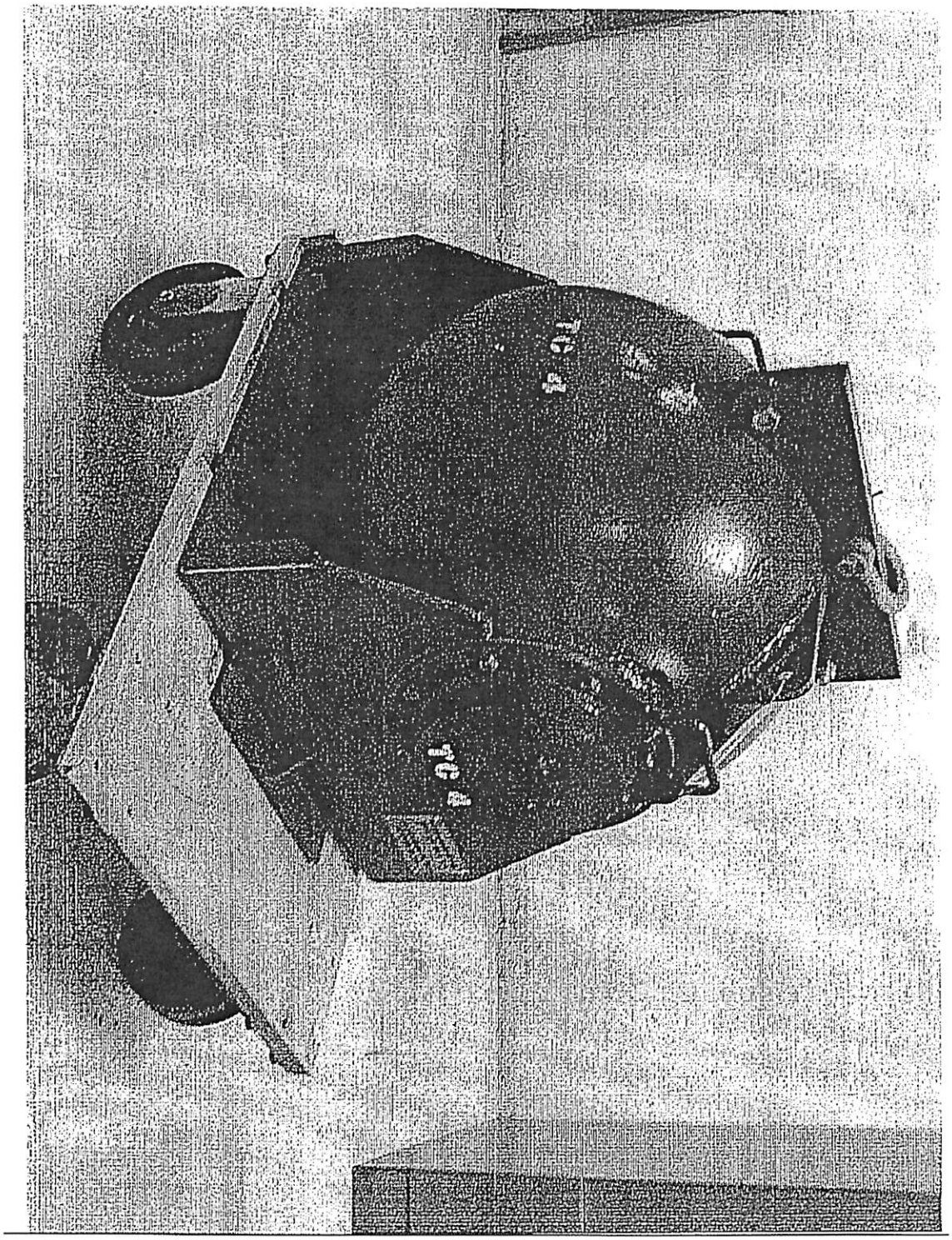
J. L. SHEPHERD and Associates			
DRAWN BY D. TRAN	DATE 21FEB12	APPROVED BY DJS	SCALE FULL
200 Ci & 6,500 Ci CAPSULE DETAIL			
MODEL 484		A-0484-W3799-CAD-1	



J. L. SHEPHERD and Associates			
DRAWN BY D. TRAN	DATE 24SEP12	APPROVED BY J L S	SCALE NONE
9,500 CI LOADING CONFIGURATION			
NPI CASK MODEL S/TC MKII		A-0147-NPI-LC-2	



J. L. SHEPHERD and Associates			
DRAWN BY D. TRAN	DATE 24SEP12	APPROVED BY JLS	SCALE NONE
9,500 Ci LOADING CONFIGURATION			
NPI CASK MODEL S/TC MKII		A-0147-NPI-LC-1	



Dose rate at surface is 535 mR/hr
Dose rate at 12" from surface is 114 mR/hr
Dose ate at 1 meter from surface is 23 mR/hr

CALCULATIONS FOR PROBABLE TRANSPORT INDEX OF NPI CASK WITH 9,500 CI. CO-60 SOURCE

BASIS

The 20WC6 is 49" diameter and the typical distance of the 9,500 Ci. Co-60 source from the end of the the cask is ~24". Therefore the diagonal distance from the source to the outside of the overpack is ~34" and the Transport Index distance is ~ 73.4".

The wood shielding in the overpack has minimal value and not considered in the calculations.

Use the 55 mR/hr dose rate at 1 meter from inner cask assuming that the average distance from source to exterior of inner cask is 10" for a total distance of 49.4"

At the surface of the overpack which is ~34" from the source the dose rate will be ~ 116 mR./hr.

At one meter or 73.4" from the surface of the overpack, the Transport Index, the dose rate will be ~25 mR/hr which is 2.5 times the maximum allowable Transport Index of 10.

SHELDING ANALYSIS FOR OPERATOR EXPOSURE USING SOURCE INSERT WHEN REMOVED FROM ENERGY SOLUTIONS 10-60B PACKAGE

BASIS

Source: 9,500 Ci. Co-60 in Special Form Capsule 1.077" diameter x 3.18" long permanently mounted to a Tungsten source rod 1 1/8" diameter x 10" long
Dose rate at one meter is 9,500 Ci. x 1,367 R/hr/Ci = 140,000 R/hr or 1.8×10^8 mR/hr.

Location: center of 24" diameter Source Insert of Energy Solutions 10-160B when removed from the 10-160B outer shield assembly. Note: The Source Insert must be removed to permit source transfers to JLS&A transfer shields.

Shielding values from NCRP Handbook 49.

Source Insert Shielding per COC: 6" lead with reduction factor of 5×10^3 plus 1.29" steel with reduction factor of 3.0. Total reduction factor of 1.5×10^4.

CALCULATIONS

Dose rate at surface of Source Insert at 12" from source = $(39.4 \div 12)^2 = 1.4 \times 10^8$ mR/hr $\div 1.5 \times 10^4 = 0.933 \times 10^4$ mR/hr or 9.33 R/hr.

Dose rate at ½ meter from Source Insert = 19.7" + 12" = 31.7"
Dose rate at 31.7" = $(12 \div 31.7)^2 = 0.143 \times 9{,}330$ mR/hr = 1,334 mR/hr

Dose rate at 1 meter from Source Insert = 12" + 39.4" = 51.4".
Dose rate at 51.4" = $(12 \div 51.4)^2 = 0.055 \times 9.330$ mR/hr = 509 mR/hr.

CONCLUSION

Each transfer, 2 at 9,500 Ci and 2 at ~ 4,000 Ci, requires operator to be in field surrounding the Source insert for a minimum of 10 to 15 minutes at ~ ½ meter from the Insert which would result in operator exposure of ~ 950 mR per operator. This is obviously impossible. Use of the GE 1500 Cask results in typical operator exposure of ≤ 5 mR/ 9,500 Ci. source transfer, total 15 mR maximum for 4 transfers, 1.6% of the probable exposure using the Energy Solutions 10-160B package with Source Insert. The Energy Solutions 10-160B cannot be used because source transfers would incur ~ 63 times greater radiation exposure to operating personnel, far exceeding both ALARA and regulatory radiation worker exposure requirements per 10CFR20.