TN Americas LLC

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May 3, 2019
E-53683

U.S. Department of Transportation
Attn: Mr. Richard W. Boyle, Chief
Pipeline & Hazardous Materials Safety Administration
Radioactive Materials Branch
1200 New Jersey Avenue, S.E.
East Building, PHH-20
Washington, DC 20590

Subject: Supplement to Request for Revalidation of French Competent Authority Certificate F/410/B(U)-96 for the Model No. MANON Cask

References: [1] TN Americas LLC Letter E-52358, dated October 30, 2018 to Richard W. Boyle (U.S. Department of Transportation) from W. Scott Edwards (TN Americas LLC), "Request for Revalidation of French Competent Authority Certificate F/410/B(U)-96 for the Model No. MANON Cask"

[2] TN Americas LLC Letter E-53179 dated November 29, 2018 to Richard W. Boyle (U.S. Department of Transportation) from W. Scott Edwards (TN Americas LLC), "Supplement to Request for Revalidation of French Competent Authority Certificate F/410/B(U)-96 for the Model No. MANON Cask"

[3] NRC letter dated December 20, 2018 to Richard W. Boyle (U.S. Department of Transportation) from Bernard White (U.S. NRC), Subject: Application for the Model No. MANON Transport Package – Supplemental Information Needed, (ADAMS Accession No.: ML18355A571)

[4] French Approval Certificate of a Package Design, Number F/410/B(U)-96 (Revision Ad), dated June 11, 2017

[5] DAHER CSI Package Design Safety Report DS LME50291001, Revision B, dated July 13, 2012

Dear Mr. Boyle:

By TN Americas LLC letter dated October 30, 2018 [1], as supplemented by TN Americas LLC letter dated November 29, 2018 [2] and this supplement, TN Americas LLC provides a response to RSI 1-1, forwarded as the NRC letter [3] for an application for validation of the French Competent Authority Certificate of Approval of Package Model MANON [4]. This submittal contains the following enclosures:

- Enclosure 1 provides a response to RSI 1-1.
- Enclosure 2 provides drawings requested in RSI 1-1, Item 3
- Enclosure 3 provides Declaration for Shipping MANON as an example of external radiation measurements

TN Americas LLC respectfully requests a review and issuance of a Competent Authority Certification (CAC) for the MANON package design [5] to include the continued revalidation for the French Certificate of Approval F/410/B(U)-96 Revision Ad, specifically for the Marguerite 20 content described in Appendix 3, on or before March 29, 2019, in order to support a shipment in second quarter 2019.

Should you or your staff have any questions or require additional information to support review of this application, please contact Mr. Peter Vescovi by telephone at 336-420-8325, or by e-mail at Peter.Vescovi@Orano.group.

Sincerely,

Digitally signed by EDWARDS William
DN: o=AREVA GROUP, 2.5.4.45=5A3923106548495977FBD, cn=EDWARDS William
Date: 2019.05.03 08:05:07 -07'00'

W. Scott Edwards
Director of Transportation
TN Americas LLC

cc: Michael Conroy, U.S. Department of Transportation

Enclosures:

1. Response to RSI 1-1
2. Drawings requested in RSI 1-1, Item 3
3. Example of Declaration for Shipping of MANON.

SHIELDING EVALUATION

RSI-1 Provide the analysis demonstrating that the package shielding is sufficient to account for the bremsstrahlung source.

The applicant requested revalidation of the MANON package with contents for the Marguerite 20 generator containing 38 kCi of Sr-90. Sr-90 is a beta emitter, which decays to Y-90, which is also a beta emitter, before decaying to a stable nuclide. The beta radiation would be stopped within the MANON packaging. However, high energy betas, especially those emitted from Y-90 which has a maximum beta energy of 2.27 MeV, when interacting with high Z material, such as the lead in the Marguerite 20 generator, will generate bremsstrahlung photons. The applicant states in document U-8021-NT-01 Revision 1, page 9 that "The source term is evaluated with ORTGEN [sic] 2.2 <1> and incorporates bremsstrahlung."

The staff does not have enough information on how the bremsstrahlung source was generated or how the package materials were credited to provide sufficient shielding for this source. The information in Section 5.3 in document U-8021-NT-01 Revision 1, page 11 credits enough material to attenuate the beta source, but this is not sufficient to appropriately shield the bremsstrahlung source.

The staff requests that the applicant provide the following:

1. The bremsstrahlung source (i.e. energy spectrum and photons/sec).
2. Additional information on how the applicant generated the bremsstrahlung source. It is not clear from the statement above if it uses ORIGEN to do this or if it is evaluated using some other method. If it does use ORIGEN, the staff requests that the applicant provide the input file.
3. Materials and thicknesses of the packaging components credited within the shielding evaluation.
4. Drawing and tolerances for the credited components, with sufficient detail to justify the amount credited.

The staff needs this information to verify whether the MANON package meets the International Atomic Agency's Specific Safety Requirements No. SSR-6, "Regulations for the Safe Transport of Radioactive Material 20122 Edition", requirements relating to allowable maximum radiation levels in paragraphs 526, 527, 648(b), 659(b)(i).

Response to RSI 1-1

1. *The bremsstrahlung source (i.e. energy spectrum and photons/sec).*

Simulation of the MARGUERITE 20 Sr-90/Y-90 Bremsstrahlung radiation

Gilles Barouch

CEA/DEN/DSN/STMR/LEPE

For strong beta sources, specific attention should be paid to the Bremsstrahlung radiation induced in the source encapsulation, especially for emitters with high beta endpoint energy.
This is the case of the Sr-90 and its daughter the Y-90. Bremsstrahlung radiation is produced when inelastic radiative collisions occur between charged particles and the nuclei of the material they are traversing.

This technical note reports how we calculated the equivalent dose form a Sr-90/Y-90 source in the cask.

Monte Carlo simulation

The equivalent dose rate from Bremsstrahlung for the source has been calculated by Monte Carlo simulations using MCNP 6.1 [1]. MCNP is ran in the Research and Technology Computing Center (*CCRT - Centre de calcul pour la recherche et la technologie*) in parallel computing mode using over 1000 CPUs. This high number of CPUs allows us to perform this challenging deep penetration problem (18 cm of lead).

Source energy spectrum

Sr-90 and Y-90 are in secular equilibrium which means that the activity is considered similar. Sr-90 Bremsstrahlung dose rate has been neglected due to differences in their beta-endpoint energies: Eβmax: 546.2 KeV for Sr-90, 2281.5 keV for Y-90.
The range of the 2281 KeV electron from Y-90 is approximatively 1 mm in iron.
Note that only Bremsstralhung radiation can create dose after the 18 lead shield.
The beta energy spectrum from Y-90 is taken from [2] and is shown in Fig. 1.

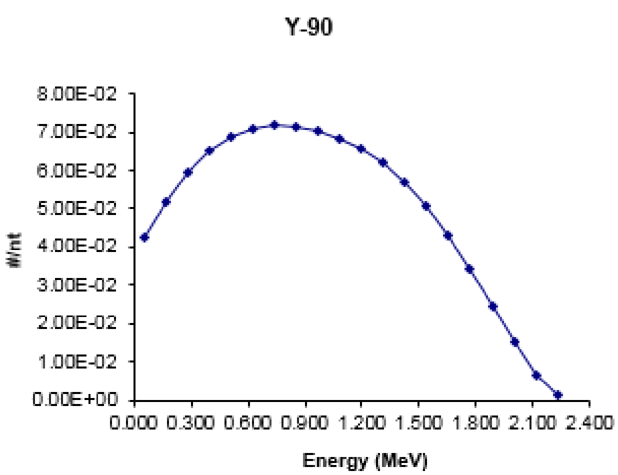

Fig. 1: beta energy spectrum for Y-90

The source has an activity of 1700 TBq.

Geometry

In this simulation, it is supposed that the point radioactive sources is surrounded by cylindrically shaped capsules. The capsules is in iron. In this work, we will assume that the Bremsstrahlung photons are produced in lead (matrix). This assumption provides a conservative estimate of the equivalent dose since the cross section for bremsstrahlung production (yield) is proportional to Z^2.

The X-ray spectrum is a superposition of a continuous bremsstrahlung spectrum and a characteristic K X-ray peak. Figure 2 shows the energy spectrum from a lead target.

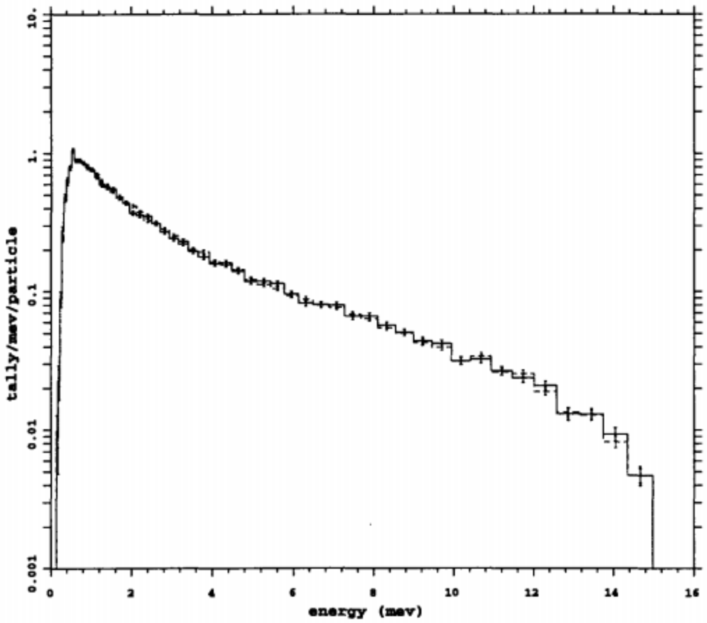

Fig. 2: bremsstrahlung X-ray energy spectrum in lead target for a beta from Y-90.

The source capsule is usually surrounded by a shield. In the case of Marguerite, the shield is a 18 cm lead cylinder. In this simulation, target and shield are the same. The simulated geometry is shown in Fig. 3.

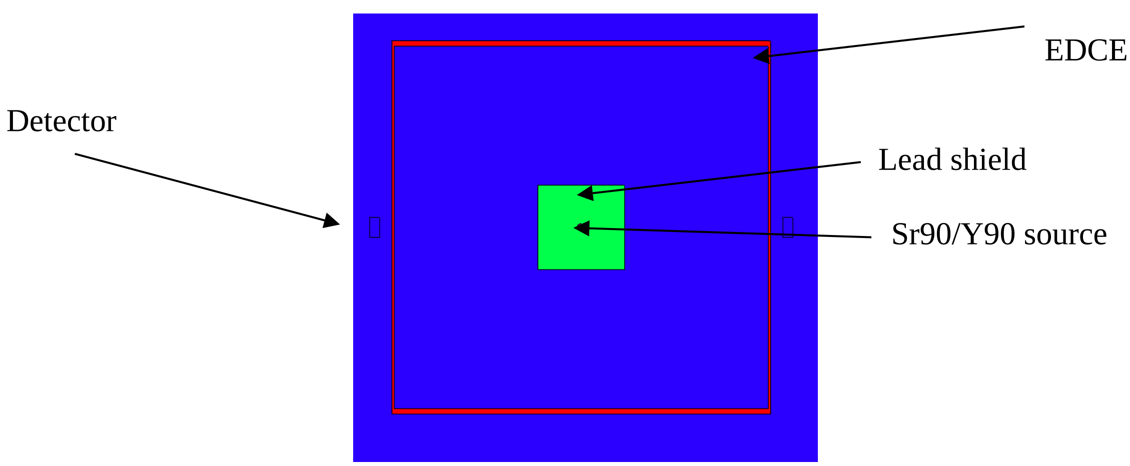

Fig. 3: Geometry simulated of the Marguerite 20 source with the EDCE cask

The Sr-90/Y-90 source is shielded by a 18 cm lead cylinder. The shield is surrounded by a 1.5 mm thick stainless steel cask (with a radius of 73 cm). The dose rate is calculated at contact with the EDCE cask.

To compare the results with the previous radioprotection study, we placed the MARGUERITE 20 source in the same configuration i.e. off center of the cask. This geometry is plotted on Figure 4. The centered geometry offers a big advantage for the efficiency of the simulation due to its cylindrical symmetry about the z-axis (axis of the cylinder).

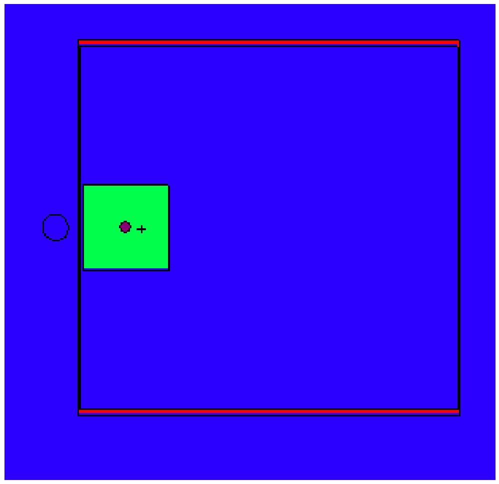

Fig. 4: Off-centered geometry of the Marguerite 20 source with the EDCE cask

Tallies

The bremsstrahlung equivalent dose were tallied using cell flux (tally F4) and detector flux tallies (tally F5). The spectral data over individual energy bins were also tallied, although the primary item of interest was the bremsstrahlung yield integrated over all energies to calculate the dose equivalent.

F4 tally is a track length estimates of flux averaged over a cell. For f4 tally type, all energy transferred to electrons is assumed to be deposited locally. In the case of f4, double counting of photon heating can occur if a photon produces an electron and the latter secondary electron is allowed to produce another bremsstrahlung photon that interacts locally.

Detector tallies tend to converge faster than cell tallies because they are deterministic estimates of flux, rather than the result of actual particle transport to the detector region. However, this faster convergence is done at the expense of a higher bias.

Therefore, detector and cell flux tallies are calculated in fundamentally different ways. A detailed explanation of the difference between those two tallies is given in [3]. In our study, the cell flux tally and detector tally are compared. Note that the range of the relative error R (1-sigma estimated uncertainty in the tally mean) to get acceptable results depends on the type of tally used: $R<0.1$ will be reliable for the cell flux tally whereas $R<0.05$ will be needed for point detectors tallies.

In the centered geometry, ring detectors around the cask were used rather than point detectors for maximum efficiency. The cell tally were based on an annular cylinder around the cask to increase as well the efficiency.

Electrons and photons transport

Simulation has been carried out using a coupled electron-photon mode (mode p e). The electron transport is computationally intensive but this mode is formally recommended when bremsstrahlung photons is important. This mode allows to get a detailed energy spectrum of the Bremsstrahlung photons depending on the target (lead in our case). The less accurate Thick-Target Bremsstrahlung (TTB) option not have to be turned off since with electron transport, bremsstrahlung photons is produced automatically.

MCNP uses two options for the energy indexing algorithm: the default and the ITS indexing mode. Some works [5] have shown that a systematic error in results are introduced when the default option is used, so that, in the present work all calculation were done in ITS mode.

Splitting Schemes for Bremsstrahlung Production

The effect of bremsstrahlung sampling using the PHYS:E BNUM biasing parameter was explored in some detail. BNUM is a variance reduction tool that specifies the production of BNUM times the analog number of bremsstrahlung photons, each with weight 1/BNUM. Simulations with different value of BNUM were

compared to verify the consistency of the results and to quantify improvements in the tally Figure-of-Merit (FOM). Simulations were done for BNUM values of 1, 3, 10, 20, 30, and 100.
We first note that the statistics of the energy spectrum of bremsstrahlung photons are greatly improved using the modified BNUM sampling.
We also note that for BNUM greater than 20, the FOM begin to drop off. This is essentially the result of the tally having already converged, with the additional photons created for higher values of BNUM resulting only in an increase in computer time.
As a result, we choose a value of BNUM of 20 which is commonly used in dose Bremsstrahlung calculations.

Other physics parameters
We choose to stop electron transport under 50 KeV since those electrons can’t produce Bremsstrahlung photons. Coherent scattering can lead to larger detector tally variances. As coherent scattering does not produce significant dose, we choose to turn it off.

Fluence-to-dose conversion factor
The F4 and F5 tallies are modified by a fluence to dose conversion factors as a function of energy. The fluence-to-dose conversion factors incorporated into the MCNP model were those for the ambient dose equivalent (H*(10), the dose equivalent at 10-cm depth in the ICRP spherical phantom illuminated by a plane-parallel beam of radiation incident on the sphere) [4]. The result of the calculation is an ambient dose equivalent in Sievert.

Validation of our model
A detailed method for calculating the lead shielding requirement for radioactive bremsstrahlung sources incorporating Sr-90/Y-90 is presented in [3]. This paper contains a description of a method of estimating shield thickness for sources of this type. To validate our MCNP parameters choices, we simulated the geometry presented in [3] with MCNP and compared the results. The geometry is similar to the one of MARGUERITE 20 source: a Sr90/Y90 source encapsulated in a lead cylinder. For the comparison, we choose the maximal thickness of lead shield presented in the paper i.e. 10 cm. The dose rate expressed in mrem/h is converted them in mSv/h. On the basis of the results of reference [3], the dose for a given activity of a Sr90/Y90 can be determined using the formula:

$$D\ (msV/h) = \frac{9.722\times10^{-3}\times A(GBq)}{F\times \mathrm{r}^2(m)} \quad \textit{eq. 1}$$

Where A is the activity of the source in GBq, F the attenuation factor for the lead shield and r the distance in meters between the detector and the source. This results comes from a numerical analysis and an experimental confirmation.
A 10 cm thick lead shield has an attenuation factor F is 4300 [3]. Table 1 shows a comparison between the calculation from [3] using eq. 1 and our MCNP simulation for a 1 GBq source at a distance of 1 meter.

	Calculation from [3]	**MCNP (F4 tally)**	**Difference (%)**
DeD (mSv/h)	2.26×10^{-6}	1.88×10^{-6}	19

Table 1 : comparison between our simulation and reference [8]

Our result is in good agreement knowing that the dose conversion coefficient used are not the same (ICRP74 for our simulation and mrem for [3]).
This level of agreement between a reference paper and our MCNP calculation gives confidence in the physics parameter choice to provide accurate bremsstrahlung dose assessments.

Convergence
In most cases, the tallies passed all ten of the statistical checks for the cell and detector tallies. In some cases, one statistical check does not pass. But we know by experience that not passing one out of ten checks does not necessarily indicate problems with the overall tally.

Summary of the input data
The input data are summarized in Table 2.

Input Data		
Source	**Isotopes**	Sr-90/Y-90
	Activity (TBq)	1700
Matrix	**Type**	Lead
	Density (g/cm3)	11.3
	Height (cm)	18
	Radius (cm)	18
EDCE	**Internal Radius (cm)**	72.5
	External Radius (cm)	73.3
	Height (cm)	142.4
Calculation point		Contact of EDCE

Table 2: summary of the input data

Results
The dose equivalent rate in H*(10) calculated with MCNP at the contact of the cask for a 1700 TBq Sr-90/Y-90 are tabulated in Table 3.

	Dose equivalent H*(10) (µSv/h)			
	Cell flux tally (F4)		Detector tally (F5)	
	µSv/h	Relative Error (1 σ)	µSv/h	Relative Error (1 σ)
Centered geometry	87	0.09	73	0.04
Off-center geometry	171	0.08	148	0.06

Table 3: results of the MCNP calculation of the dose equivalent rate.

Conclusion
The dose equivalent rate for such a high attenuation shield is a very challenging calculation. We note that despite the very high activity of the source, the dose rate is very low. Enclosure 3 to E-53665 provides an example of external radiation measurements prior to shipment of a MANON cask containing apoproximatley 1400 TBq. Measured radiation levels are less than 5 µSv/h.

Reference
[1] MCNP6 User's Manual - Code Version 6.1.1beta, LA-CP-14-00745 (June 2014).
[2] https://www.doseinfo-radar.com/RADARDecay.html
[3] Electron Photon Calculations using MCNP, D. P. Gierga, MIT, February 1998.
[4] ICRP, Conversion Coefficients for Use in Radiological Protection against External Radiation, Report 74, Annals of the ICRP, Vol 26, No. 3/4 (1996).
[5] A comparison of MCNP4C electron transport with ITS 3.0 and experimental at incident energies between 100 KeV and 20 MeV: influence of voxel size, substeps and energy indexing algorithm, Schaart D R et al, Physics for Medicine and Biology, 47 (2002).

2. Additional information on how the applicant generated the bremsstrahlung source. It is not clear from the statement above if it uses ORIGEN to do this or if it is evaluated using some other method. If it does use ORIGEN, the staff requests that the applicant provide the input file.

Equivalent dose rate is evaluated using MCNP as described in the response provided for RSI 1-1 item number 1. The generation of the bremsstrahlung source is implicit in the MCNP simulation has been carried out using a coupled electron-photon mode (mode p e).

3. *Drawing and tolerances for the credited components, with sufficient detail to justify the amount credited*

Drawings as follows show details of the credited components with sufficient detail to justify the amounts credited in the shielding evaluation. The drawings and tolerances are provided as Enlosure 2 to E-53665.

Drawing 1ME50291101 – Shipment Packaging Shell Body (definition),

Drawing 1ME50291102 - Shipment Packaging Outer Shell Lid - welding,

Drawing 1ME50291103 - Shipment Packaging Short Locating Device, and

Drawing 1ME50291104 - Shipment Packaging Shell Long Locating Device).

A separate document, Extract of NF EN 10029, provides the tolerance for the dimensions shown on the drawing.

4. *Materials and thicknesses of the packaging components credited within the shielding evaluation.*

In the Model, the source is considered punctual and the shielding is composed by:

- In the axial direction : 20 mm of stainless steel
- In the radial direction : 8 mm of stainless steel

On a conservative basis:

- the upper and lower casing (puncture protection plate and shock absorbers) are not modelled,
- the top and bottom foam absorbers of the EDCE are not modelled,
- the non-removable equipment is not modelled.

On the packaging, the real shielding is composed by:

- **EDCE** (according to the plans DD 1ME50291501 and DD 1ME50291502 – Tolerances according to the standard NF EN 10029 – The foam is not listed)
  - o In the axial direction:

        - 20 mm +/- 0,8 mm of stainless steel
        - 3 mm +/- 0,5 mm of stainless steel
    - In the radial direction:
        - 8 mm +/- 0,6 mm of stainless steel
        - 3 mm +/- 0,5 mm of stainless steel (not present on the entire height)
- **MANON** (according to the plans DD 1ME50291101 and DD 1ME50291102 – Tolerances according to the standard NF EN 10029 – The foam is not listed)
    - In the axial direction:
        - 20 mm +/- 0,8 mm of stainless steel
        - 3 mm +/- 0,5 mm of stainless steel
    - In the radial direction:
        - 20mm +/- 0,8 mm of stainless steel

To compare:

	Shielding	
	Modeled	**Real (at least)**
Axial	20 mm	43,4 mm
Radial	8 mm	29,1 mm

Enclosure 2 to E-53683

Drawing 1ME50291101 – Shipment Packaging Shell Body (definition),

Drawing 1ME50291102 - Shipment Packaging Outer Shell Lid - welding,

Drawing 1ME50291103 - Shipment Packaging Short Locating Device, and

Drawing 1ME50291104 - Shipment Packaging Shell Long Locating Device).

Extract of NF EN 10029 - Tolerances on dimensions

The following drawings have been withheld as Sensitive Unclassified Non-Safeguards Information-Security-Related Information:

Drawing 1ME50291101 – Shipment Packaging Shell Body (definition),

Drawing 1ME50291102 - Shipment Packaging Outer Shell Lid - welding,

Drawing 1ME50291103 - Shipment Packaging Short Locating Device, and

Drawing 1ME50291104 - Shipment Packaging Shell Long Locating Device).

6 Tolérances sur les dimensions

6.1 Épaisseur

6.1.1 Les tolérances sur l'épaisseur sont données dans le Tableau 1. Les tôles peuvent être livrées avec :

— classe A : avec une tolérance sur l'épaisseur en moins en fonction de l'épaisseur nominale ;

— classe B : avec une tolérance en moins fixe de 0,3 mm :

— classe C : avec une tolérance en moins fixe de 0,0 mm ;

— classe D : avec des tolérances symétriques.

Tableau 1 — Tolérances sur l'épaisseur

Dimensions en millimètres

Épaisseur nominale *t*	Tolérances sur l'épaisseur nominale (voir 6.1.1)							
	Classe A		Classe B		Classe C		Classe D	
	inférieure	supérieure	inférieure	supérieure	inférieure	supérieure	inférieure	supérieure
$3 \leq t < 5$	− 0,3	+ 0,7	− 0,3	+ 0,7	0	+ 1,0	− 0,5	+ 0,5
$5 \leq t < 8$	− 0,4	+ 0,8	− 0,3	+ 0,9	0	+ 1,2	− 0,6	+ 0,6
$8 \leq t < 15$	− 0,5	+ 0,9	− 0,3	+ 1,1	0	+ 1,4	− 0,7	+ 0,7
$15 \leq t < 25$	− 0,6	+ 1,0	− 0,3	+ 1,3	0	+ 1,6	− 0,8	+ 0,8
$25 \leq t < 40$	− 0,7	+ 1,3	− 0,3	+ 1,7	0	+ 2,0	− 1,0	+ 1,0
$40 \leq t < 80$	− 0.9	+ 1,7	− 0,3	+ 2,3	0	+ 2,6	− 1,3	+ 1,3
$80 \leq t < 150$	− 1,1	+ 2,1	− 0,3	+ 2,9	0	+ 3,2	− 1,6	+ 1,6
$150 \leq t < 250$	− 1,2	+ 2,4	− 0,3	+ 3,3	0	+ 3,6	− 1,8	+ 1,8
$250 \leq t \leq 400$	− 1,3	+ 3,5	− 0,3	+ 4,5	0	+ 4,8	− 2,4	+ 2,4
Ces tolérances sur l'épaisseur s'appliquent hors des zones meulées (voir 6.1.2)								

Au moment de l'appel d'offres et de la commande, l'acheteur doit indiquer si la classe A, B, C ou D de tolérance est demandée (voir 4.1 et 4.2). Si aucune classe n'est indiquée, la classe A s'applique.

6.1.2 Pour les limites admissibles des défauts de surface et les exigences de réparation, l'EN 10163-1 et l'EN 10163-2 s'appliquent.

6.2 Largeur

6.2.1 Les tolérances sur la largeur pour les tôles à rives cisaillées sont données dans le Tableau 2 suivant l'épaisseur de la tôle.

Enclosure 3 to E-53683

MANON

Declaration D’Expedition de Matieres Radioactives

(Declaration of dispatch of radioactive materials)

DECLARATION D'EXPEDITION DE MATIERES RADIOACTIVES

N° de Dossier : BT 091/17	N° EXP : OS 28026 / DT FARTCEA201700314

UN 2916, MATIERES RADIOACTIVES EN COLIS DE TYPE B(U), non fissiles, 7, (E)

Désignation de la matière : ONU-ADR — Arrêté du 29/05/09 dit arrêté TMD

EXPEDITEUR		DESTINATAIRE	
Nom	YAHYAOUY Zhour	**Nom**	NAUDET Laurent
Société	CEA FONTENAY-AUX-ROSES	**Société**	CEA SACLAY
Service	DEN/DDCC/UADF/CCOD	**Service**	DEN/DDCC/UADS/SIAD/SE72
Adresse	18 ROUTE DU PANORAMA	**Adresse**	
Ville	FONTENAY AUX ROSES	**Ville**	GIF SUR YVETTE
CP	92 265	**CP**	91 191
Téléphone	01 46 54 77 88	**Téléphone**	01 69 08 89 27
Télécopie	01 46 54 95 88	**Télécopie**	01 69 08 52 75

Emballage	Contenu(s)
Type : B(U) SUR-COQUE MANON **Nombre de colis :** 1	**Description :** Enceinte de confinement externe (EDCE) contenant l'appareil indémontable Marguerite 20 INB165 + calage K2
Certificat d'agrément : F/410/B(U)-96Ac valide jusqu'au 31 mars 2020	**Activité totale :** 1,41 PBq ou 4,68E+03 A2

Masse Brute du colis : 11,9 tonnes

Radioélément(s) : SR-90

Description de l'état physique et chimique de la matière	
Solide	
Forme Spéciale	
Oui	
Non	X

Envoi sous utilisation exclusive	
Oui	
Non	X
Matière Fissile Exceptée	
Oui	
Non	X

Catégorie des colis	
I Blanc	
II Jaune	x
III Jaune	
Indice de Transport	
0,5	

Remarque(s) :	
	N° scellé : TBE 521876 Caisse à outil hors ADR chargée sur la remorque + Caisse test étanchéité TNI Colis transféré du hall10 du bâtiment 18 de l'INB165 à l'extension du bâtiment 53 de l'INB166 (voir FS53) - Unité de transport stationnée du 04/10 au 09/10 sur l'extension du bâtiment 53 de l'INB166

ADR - § 5.4.1.2.5.2	
Prescriptions complémentaires pour le transport données en pièce jointe	X
Aucune prescription complémentaire n'est applicable à ce transport	

La nature de la marchandise et le (ou les) emballage(s) sont conformes aux prescriptions de l'ADR.
En tant qu'expéditeur je certifie que j'ai respecté les dispositions de l'arrêté TMD modifié.

Fait à Fontenay aux Roses le 6 octobre 2017

P.O.

Nom et qualité du signataire : YAHYAOUY Zhour (Expéditeur) Signature :

RAPPELS non exhaustifs

L'intensité de rayonnement ne doit pas dépasser 2 mSv/h en tout point de la surface externe du colis et 0,1 mSv/h à 1 m du colis.
En usage exclusif l'intensité maximale en tout point de la surface externe du colis peut dépasser 2 mSv/h mais pas 10 mSv/h.
Dans tous les cas : - - l'intensité de rayonnement ne doit pas dépasser 2 mSv/h en tout point de la surface externe du véhicule et 0,1 mSv/h à 2 m de la surface externe du véhicule.
- Contamination maximale admissible non fixée sur surface accessible du colis 0,4 Bq/cm² en alpha et 4 Bq/cm² en béta-gamma

Exemplaires -- **Expéditeur** : 1 copie **Conducteur** : 1 original **Destinataire** : 1 original

DEN/DANS DRSN/SCED-BT	**PRESCRIPTIONS COMPLEMENTAIRES POUR LE TRANSPORT DE MATIERES RADIOACTIVES**

N° de Dossier : 091/17	**N° Exp :** OS 28026/FARTCEA201700314

Conformément au chapitre 5.4.1.2.5.2 de l'ADR le présent document a pour but de préciser les mesures devant être prises, le cas échéant, par le transporteur.

Prescriptions complémentaires pour le chargement

Prescriptions complémentaires pour l'arrimage
Spécification pour l'arrimage : Pièce 7 de la notice d'utilisation de la sur-coque MANON référencée DSN STMR/LEPE S-MANON NUT0089 Indice 01 + Référence plan d'arrimage NCT : PL-CEA-04 indice 00 du 11/09/2017

Prescriptions complémentaires pour l'acheminement
Vitesse du transport limitée à 80 km/h sur autoroute et 70 km/h sur autres routes (sans préjudice du respect pour le type de véhicule utilisé des prescriptions du code de la route)

Prescriptions compémentaires pour la manutention
Manutention de la sur-coque : levage droit

Prescriptions complémentaires pour le déchargement

Prescriptions complémentaires pour la dissipation de la chaleur
Température du colis < Température ambiante du local d'ouverture/fermeture de l'emballage + 10 °C Si la puissance thermique est inférieure à 410 W, le transport en moyen de transport confiné est autorisé Si la puissance thermique est supérieure à 410 W, le transport en moyen de transport confiné n'est pas autorisé, sauf autorisation de l'Autorité compétente

Restrictions concernant le mode de transport ou le véhicule

Instructions particulières quant à l'itinéraire à suivre
Voir notification

Dispositions à prendre en cas d'urgence
Voir consignes de sécurité dans véhicule + annexe sécurité CEA

~~Aucune disposition complémentaire n'est à appliquer pour la réalisation du présent transport.~~

Fait à Fontenay-aux-Roses, le 09/10/2016

Expéditeur	Chauffeur
Z YAHYAOUY	A NANCEY

ANNEXE A LA DECLARATION D'EXPEDITION DE MATIERES RADIOACTIVES

N° de Dossier : BT 091/17	N° EXP : OS 28026 / DT FARTCEA201700314

EXPEDITEUR		DESTINATAIRE	
Nom :	YAHYAOUY Zhour	**Nom :**	NAUDET Laurent
Société :	CEA FONTENAY-AUX-ROSES	**Société :**	CEA SACLAY

Type emballage :	B(U)	**Contenu(s) :**	Enceinte de confinement externe (EDCE) contenant l'appareil indémontable Margueritte 20 INB165 + calage K2
Numéro :	SUR-COQUE MANON	**Activité Totale :**	1,41 PBq ou 4,68E+03 A2

TRANSPORTEUR — **Société / Service :** NCT

Je soussigné MASSE Cédric/NANCEY Antoine titulaire de l'attestation de formation au transport de matières dangereuses de classe 7 numéro FR-0/0107061010/FR-0/0664001 valable jusqu'au 07/09/2020/07/02/18

* avoir pris connaissance de consignes de sécurité qui m'ont été remises pour ce transport,
* avoir vérifier le chargement (arrimage des colis, signalisation et étiquetage du véhicule),
* disposer des équipements de première intervention réglementaires et de ceux décrits dans les consignes,
* que mon véhicule est muni de son (ses) certificat(s) d'agrément en cours de validité(s) et adapté(s) à ce transport.

Date : 06/10/2017 Signature :

Nombre de colis effectivement chargés : 1 — 09/10/17

RADIOPROTECTION AU DEPART — **Unité :** SPRE

Je soussigné CHÉVRÉ déclare :

* avoir vérifié la conformité de l'étiquetage des colis
* et certifie que les mesures de radioprotection suivantes restent en dessous des limites fixées :

Débit d'équivalent de dose (mSv/h)	
Contact Colis :	<0,005
A 1 mètre du colis :	<0,005
Contact véhicule :	<0,005
A 2 mètre du véhicule :	<0,001
Cabine :	<0,001

Contamination résiduelle (Bq/cm²)		
Colis :	α < <0,04	βγ < 0,4
Véhicule :	α < 0,04	βγ < 0,4

Date : 06/10/2017 Signature :

Observations : RAS Contaminamètre : 4849 Débitmétre : 31267

EXPEDITEUR — **Unité :**

Je soussigné YAHYAOUY Zhour déclare correct les déclarations faites ci-dessus par le conducteur et donne mon accord pour le départ.

Date : 06/10/2017 Signature :

RADIOPROTECTION A L'ARRIVEE — **Unité :** SPRE

Nom de l'agent : Date :

Débit d'équivalent de dose (mSv/h)	
Contact colis :	<5.10-3
Contact véhicule :	<5.10-3

Contamination résiduelle (Bq/cm²) :		
Colis :	α : <0,04	βγ : <0,4
Véhicule :	α : <0,04	βγ : <0,4

Observations : RAS

Signature :

DESTINATAIRE — **Unité :** SIAD/SCTL

Nom de l'agent : NAUDET

Observations :

Signature :

*** Rappels des valeurs sur la fiche de déclaration d'expédition correspondant au code UN.**

Exemplaires --	**Expéditeur** : 1 copie	**Conducteur** : 1 original	**Destinataire** : 1 original