Russian Federation Radioactive Waste Transportation Management Safe Practice and Prospective Operations Plans - 10195

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ABSTRACT

The metal transportation containers description and technical data are presented in this work. These containers are designed and being used by JSC ECOMET-S for solid LLW transportation. Delivery to the facility and use for disposal results are presented also. The KTBN-3000 and standard UKTN-24000 heavy load containers' transportation volumes and economic indicators are given. Transportation containers' operations experience has shown that LLW deliveries don't provide the radiation threat both to the personnel and population. Through the whole operations period there were no accidents or deviations from normal conditions. The conclusion on safety and reliability of UKTN-24000 heavy load containers operations is made.

INTRODUCTION

Radioactive waste transportation problem in Russian Federation is caused by approach to the radioactive waste management, which have been formed in USSR and in early 90-s in Russian Federation.
That approach defined:

- Waste accumulation at the formation sites (e.g. nuclear power plants) or at nearby temporary storage sites (former RADON system) without conditioning
- The focus on the SNF and HLW. Leftovers – to the ILW, LLW.
- LLW repositories and centralized processing facilities absence.

Generally, by many reasons, radioactive waste management approach was the 'delayed problem'.
The aggravation connected with radioactive wastes critical quantities accumulation coincided with USSR collapse.
Newly formed Russian Federation implemented the local conditioning facilities concept as the solution.
The first and the second approaches consequence was the practical absence of massive and regular ILW and LLW movements (transportations). That's why there was no containers need at all.
However insufficient effectiveness of local decisions in general and effective metal LLW processing technology absence in particular requested for concept changes and metal LLW processing centralized facility construction.
Such a facility was constructed by ECOMET-S JSC.
In fact there were no any suitable certified containers for LLW transportation to the facility at all. So the company should solve this problem by itself to keep its operations.
The problem solving results and implemented containers operations' experience are presented in this paper.

THE MAIN INFORMATION ABOUT "ECOMET-S" JSC

"ECOMET-S" JSC, Russian Federation, St. Petersburg, was founded in 1994 for the environmental, resources saving and ecological technologies implementing. The main enterprise activity is NPP and nuclear industry metal radioactive waste treatment. Treatment provides waste volume reduction and decontaminated material return for unrestricted use. Secondary waste from treatment is being sent for disposal.

Enterprise has its own production metal radioactive waste processing facilities with the 6000mt/year capacity in the Sosnovy Bor (Leningrad region, North-Western Russia).
Facilities and license obtained from respective regulation board to operate with the LLW only.

Company uses two types of containers for initial LLW delivery to own facilities and secondary solid LLW disposal. The 1st type is **B**asic **C**ontainer for **L**LW **T**ransportation (Russian acronym is KTBN-3000) and the 2nd one is **H**eavy load **T**ransportation **C**ontainer (Russian acronym – UKTN-24000).

DESCRIPTION AND MAIN CHARACTERISTICS OF THE TRANSPORT CONTAINERS

KTBN-3000 was designed and implemented by "ECOMET-S" JSC for operational service in 1999. The container is authorized in the respective way as the type "A" package for metal LLW transportation and storage. LLW allowed for transportation refers to the low specific activity materials (LSA-I,-II, Russian acronym is NUA-I, -II) and to the surface radioactive contaminated objects (SCO-I, -II, Russian acronym is OPRZ-I, -II). The full information about KTBN-3000 is presented in the report [1]. This container is used in cases of waste pieces insignificant volumes or heavy load containers operations technical limitations (access, lifting mechanisms, etc.). The basic technical characteristics are resulted in Table I.

Table I. KTBN-3000 container basic technical characteristics.

No.	Name	Unit	Value
1.	capacity	Kg	3 000
2.	volume	m^3	2.0
3.	overall dimensions: -length -width -height	Mm	 2 050 1 125 1 170
4.	weight (net)	Kg	3 000

UKTN-24000 was designed in 2005 by "ECOMET-S" JSC and "VNIPIET" Research Institute on the standard ICC 20′ (5 895mm) DC base and presents its modified version [2]. The container appearance could be seen on fig. 1.

Fig. 1. UKTN-24000 container appearance.

UKTN-24000 corresponds to the Russian industrial package type 2 (IP 2) requirements. The container is implemented for LLW transportation by auto, railways and sea vessels. The LLW allowed for transportation refers to the group II low specific activity materials (LSA-II, Russian acronym is NUA-II) and the group II surface radioactive contaminated objects (SCO-II, Russian acronym is OPRZ -II). UKTN-24000 basic technical characteristics are resulted in Table II.

Table II. The UKTN-24000 container basic technical characteristics.

No.	Name	Unit	Value
1.	Maximum weight gross	Kg	24 000
2.	Weight of the empty container	Kg	2 550
3.	The internal dimensions:		
	-length	mm	5 895
	-width	mm	2 270
	-height	mm	2 381
4.	The external dimensions:		
	-length	mm	6 058
	-width	mm	2 438
	-height	mm	2 591
5.	The dimensions of the doorway:		
	-width	mm	2 336
	-height	mm	2 293
6.	Capacity	m^3	32.2

The container is made according to the national design guidelines and corresponds to national technical conditions. The estimated container's operational term is 10 years.

Materials and container manufacturing techniques correspond to Russian Maritime Register requirements. UKTN-24000 is certified By the Russian Maritime Register for class 7 LLW transportation.

UKTN-24000 has the Federal Agency of Atomic Energy certificate-permission RUS/6051/I-96T (Rev.2). It is valid until 18.12.2011.

CHARACTERISATION OF THE TRANSPORTED LLW

Transportation and storage of solid LLW in UKTN-24000 are permitted in the form of:

- metal equipment and / or its parts from power plants, industrial, marine and other nuclear applications;
- glass, ceramic, plastic and rubber items, debris, soil, sorbents, ion-exchange resins, paper, cardboard, wood, the biological waste in primary package (plastic or craft bags).

LLW should correspond to the low specific activity materials, group II (LSA-II) and surface contaminated objects, group II (SCO-II).

However radionuclides specific activity in materials should not exceed the values resulted in Table III for LSA-II and in Table IV for SCO-II.

Table III. Specific activity in materials (LSA-II)

Radionuclide	Maximum Allowed Specific Activity, kBq/g
K-40	$9 \cdot 10^4$
Mn-54	$1 \cdot 10^5$
Fe-59	$9 \cdot 10^4$
Co-60	$4 \cdot 10^4$
Zn-65	$2 \cdot 10^5$
Sr-90	$3 \cdot 10^4$
Nb-94	$7 \cdot 10^4$
Zr-95	$8 \cdot 10^4$
Ru-106	$2 \cdot 10^4$
Cs-134	$7 \cdot 10^4$
Cs-137	$6 \cdot 10^4$
Ce-144	$2 \cdot 10^4$
Eu-154	$6 \cdot 10^4$
Ra-226	300
Th-232	Unlimited
U-232	100
U-234	600
U-235 a	Unlimited
U-238	Unlimited
Only β- or γ-emitters are detected	$2 \cdot 10^3$
α-emitters are detected	9
There is no corresponding data	9

a U-235 total activity in UKTN-24000 should not exceed 1.2 MBq (15g).

Table IV. Permitted contamination levels (SCO-II)

Contamination type	Bq/cm^2	
	β- γ-emitters, low toxicity α-emitters	all other α-emitters
Unfixed contamination, accessible surface	400	40
Fixed contamination, accessible surface	$8 \cdot 10^5$	$8 \cdot 10^4$
Unfixed contamination + fixed contamination, inaccessible surface	$8 \cdot 10^5$	$8 \cdot 10^4$

Radionuclides total activity in loading materials is to be limited and supervised by permitted radiation levels which are resulted in Table V. Materials should correspond to requirements for specific activity and surface contamination resulted in Tables III and IV.

Table V. UKTN-24000 permitted emission and contamination levels.

Container emission levels. Non-exclusive operation.	≤ 2 mSv/hour (200 mrem/hour) at external container surface
	≤ 0.033 mSv/hour (3.3 mrem /hour) at 1m distance from container external surface

Unfixed (removable) contamination at container external surface	≤ 4 Bq/sm^2 for both β- γ-emitters, low toxicity α-emitters
	≤ 0.4 Bq/sm^2 for all other α-emitters
Empty container emission levels.	≤ 0.005 mSv/hour (0.5 mrem /hour) at external container surface
Empty container inner surface contamination	≤ 400 Bq/sm^2 for both β-, low toxicity α-emitters
	≤ 40 Bq/sm^2 for all other α-emitters

γ-emission equivalent dose capacity and surface contamination measurements are to be made before, during and after container loading. Container external and internal surface contamination levels should be measured after each transportation cycle.

UKTN-24000 TRANSPORTATION

LLW loaded UKTN-24000 transportation could be carried out by railway, auto or sea transport in accordance with appropriate transportation safety regulations for class 7 GOST 19433-88 hazardous cargoes, category «III-YELLOW».

The transport index (TI) should not exceed 10. The containers quantity on a vehicle shouldn't make TI to exceed 50. Total TI shouldn't exceed 200 during transportation by marine vessel.
UKTN-24000 is related to the heavy load cargo containers. Its transportation could be carried only on the terms of category "«III-YELLOW», exclusive use". LLW loaded container TI could exceed 10, and total containers' TI on the same vehicle it is not limited in this case.

Solid LLW could be delivered for UKTN-24000loading in secure (primary) packages or without primary packages (equipment parts) in the following forms:
- In 1-4 m^3 volume square shaped containers;
- In 200l and other barrels;
- 100-200 mm diameter tubes with up to 5.8m lengths in bundles;
- large-size equipment in weight up to 5mt per a unit.

LLW placing and fastening should be made according to «Specifications of cargo fixture in containers». It is acceptable to place 6-4 units of the large-size equipment in weight of 3-5mt/unit in order not to exceed cargo gross weight of 20mt. Total barrels quantity (624 x 820mm, approx. 400kg) is 34 pieces per container with 14mt gross weight. 5 KTBN-3000 containers with gross weight up to 15mt could be placed in one UKTN-24000container.

Transportation by rail is carried out on specialized platforms and in open top railway cars according to the "Railway cargo transportation regulations". Auto transportation is carried out by trucks equipped with container trailers and half-trailers. Sea transportation could be carried both by container carriers and general cargo vessels.

OPERATING EXPERIENCE

As of the middle of 2009 the enterprise container park consists of 68 UKTN-24000 and 81 KTBN-3000 containers. The available container park provides same time loading, transportation and temporary storage of up to 1500mt of solid LLW. Operating experience has shown that approx. 30% of containers total number is constantly used for arriving metal or secondary solid LLW temporary storage.

The LLW majority is transported by railway in UKTN-24000 containers. The UKTN-24000 containers use reasonability is defined by neighborhood railway stations presence, the railways approaches to the sites and facilities, and, finally, weighting equipment with at least 30mt capacity availability. KTBN-

3000 containers could be used in the absence of access roads, lifting mechanisms etc., and also for the LLW small lots transportations.

"ECOMET-S" JSC operates KTBN-3000 containers since 1999. In those times containers were used for metal LLW test lots delivery from «Chepetsky Mechanical Plant» JSC. Technology tests have been conducted before new recycling facility was put into operation in 2002. These containers were also used for small deliveries from the enterprises and the sites located in St. Petersburg and Leningrad region.

In 2004 treatment and recycling were provided for 40.6mt of the naval legacy metal LLW from Andreev Bay at Kola Peninsula (Polar Russia) under the contract with State Enterprise "SevRAO". 20 KTBN-3000 containers were occupied.
The LLW was composed by the removed equipment parts, pipelines, armatures, metal structures, carbon steel rails and chains with corrosion deposits considerable presence. Apart from adopting processing technology the transportation technological scheme for the certain territory has been worked out.

The “ECOMET-S” JSC uses the UKTN-24000 containers since October, 2005. The containers are generally utilized for metal LLW transportation from Concern "Energoatom" nuclear power plants to enterprise facilities and the secondary solid LLW disposal. More than 3500mt of LLW have been transported since the operations beginning. The metal LLW is being transported in primary packages (metal boxes, industrial containers). Large-sized equipment is being transported as is. The secondary solid LLW is being transported in accordance with the container operation manual in barrels.

Enterprise has positive transportation experience of the large-sized NPP equipment without dismantling. In 2006 highly contaminated reactor main pump (21mt) was transported by railway from Kola NPP to Novovoronezh NPP.

Besides its own operations the "ECOMET-S" JSC has authorized Saratov branch of the “RADON” State Enterprise to operate UKTN-24000 for radioactive materials transportation to their sites.

The following accompanying documents are required for the transportation organization:
- waybill,
- container passport,
- official sanitary-epidemiologic statement,
- emergency card,
- cargo identity statement issued by the Home Office,
- cargo explosion and fire safety statement.

The cargo acceptance from the railway carrier is completed against waybill after cargo checking in accordance with accompanying documents. Delivery receipt is issued after cargo acceptance by quantity and quality.

Up to now "ECOMET-S" has developed solid LLW deliveries logistic schemes from the most of the regions where the nuclear power plants and nuclear industry facilities are situated. Since the operations beginning more than 800mt of solid LLW were transported by KTBN-3000 containers and more than 4 300mt by UKTN-24000 ones.

During containers operations it was calculated that railway transportation cost for solid LLW in UKTN-24000 container is USD 0.06 per mt per km. For KTBN-3000 containers this cost is USD 0.2÷ 0.3 per mt per km. Generally "ECOMET-S" JSC operational costs per 1mt of solid LLW are ten times less than the costs of transportation services provided by "Radon" state enterprises (USD 1.3÷2 per mt per km).

PROSPECTIVE PLANS

Enterprise prospective radioactive materials transportation management plans include design of new and modifying of existing transportation units, 20’ (6096mm) open top containers and special top load railway cars (60mt capacity) certification and implementation. The 20’ (6096mm) open top container with dismountable top cover is shown at fig. 2.

Fig.2. The ICC-20 open top container with a dismountable top cover (20’x8’x8’6” (6096 x 2438 x 2591mm) HARD TOP IP2 type).

This implementation based on the UKTN-24000 operation experience will:

- make waste loading operations easier and more fast with reduced delays and increased containers turnover;
- provide large-sized equipment loading without fragmentation;
- increase containers filling rate.

Finally the open top containers operations will provide transport cost component reduction in the whole radioactive waste treatment cost.

"ECOMET-S" JSC also works for tank containers certification and implementing. These tank containers are intended for LSA-II liquid LLW transportation. Tank container basic characteristics are given in Table VI.

Table VI. Tank container basic characteristics.

No.	Name	Unit	Value
1.	Requirements:	IMO ISO ASME CODE RID/ADR	IMO1 type Article VIII, section 1. 3, 6, 8
2.	Maximum gross weight	kg	36 000
3.	Dimensions: -length -width -height	 mm mm mm	 6 058 2 438 2 591
4.	Liquid LLW typical characteristics: -form		 water solutions with

	-salts content -PH level -solid particles -oil products content	mg/l - mg/l mg/l	solid impurities 10 000 7 1 000 100
5.	Volume	l	24 000
6.	LLW combustibility LLW toxity LLW explosiveness	- - -	non combustible, non toxic, non explosive
7.	Transportation	-	By railways, autos and vessels
8.	dangerous cargoes transportation class & category	-	class 7 category III YELLOW
9.	shell and bottom material	-	stainless steel

The tank container appearance is presented on fig. 3.

Fig. 3. Tank container appearance.

After certification these tanks-containers are to be used for transport service to third-party organizations.

FINAL STATEMENT

Waste management experience in general and metal LLW treatment experience in particular confirmed the centralized facilities concept effectiveness. Metal LLW treatment technology and containers' effectiveness were confirmed also.
Containers safety and reliability were approved by all certification and licensing bodies. Containers provide full radiation safety to personnel and population.
In fact regular federal LLW transportation system was created.
Insignificant transportation cost (in comparison with total treatment and disposal costs) makes deliveries from all the regions affordable.
State waste management system needs (NPP decommission campaign starting in 2015 in particular), own company's development plans and operational experience require further containers' fleet enlargement and new containers' types implementing.

REFERENCES

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