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17 years of Working Practice of the WNTI HEXT Industry Working Group

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Abstract

The World Nuclear Transport Institute (WNTI) was founded in 1998 to represent the collective interests of the radioactive materials transport sector. The WNTI has grown substantially since, with member companies representing a wide range of the industry sectors.

Within WNTI, the HEXT WG (Uranium **HEX**afluoride **T**ransport Industry **W**orking **G**roup) was established in end 1999, to investigate the consequences of the new requirements for uranium hexafluoride (UF_6) in the 1996 Edition of the International Atomic Energy Agency Regulations for the Safe Transport of Radioactive Material (IAEA ST-1).

From this initial cooperation, the HEXT WG developed into a forum that exchanges industry experience on the handling and transport of UF_6 and cooperates and collaborates on the implementation of regulatory requirements. Where necessary topical technical meetings are held and task forces are formed. Industry consortia have been established to not only share experience and expertise, but also to allow for sharing of cost for research and development.

This paper reviews 17 years of working practice, describing several issues that have been addressed and the communications involved with regulators and competent authorities, including the challenges from the complex structure of the transport regulations for radioactive material and other dangerous goods.

Introduction

The WNTI was founded in 1998 by British Nuclear Fuels plc (BNFL), now International Nuclear Services (INS), of the United Kingdom, COGEMA, now AREVA, of France and the Federation of Electric Power Companies (FEPC) of Japan to represent the collective interests of the radioactive

materials transport sector. Over the past decade, WNTI has grown substantially with members participating from a wide range of industry sectors, including major utilities, fuel producers and fabricators, transport companies, package producers and the production and supply of large radiation sources.

End of 1999 the HEXT WG was established within WNTI with the purpose to exchange industry experience on the handling and transport of UF_6, to cooperate and collaborate on the implementation of regulatory requirements, to communicate with competent authorities and to develop and present the industry view. Beside conversion, enrichment and fabrication facilities also transportation companies, package manufacturers and service suppliers participate in the HEXT WG.

Working Practice

Initially, the HEXT WG was meeting very frequently to evaluate the implementation of the new regulatory requirements for UF_6 packages. Nowadays, the HEXT WG normally meets twice per year, as part of the WNTI Semi Annual Members Meeting. However, if required, specific topics are addressed in task groups or technical meetings. Also industry consortia are established to share costs on specific work packages

More than 25 companies from the UF_6 supply chain are contributing to the HEXT WG activities.

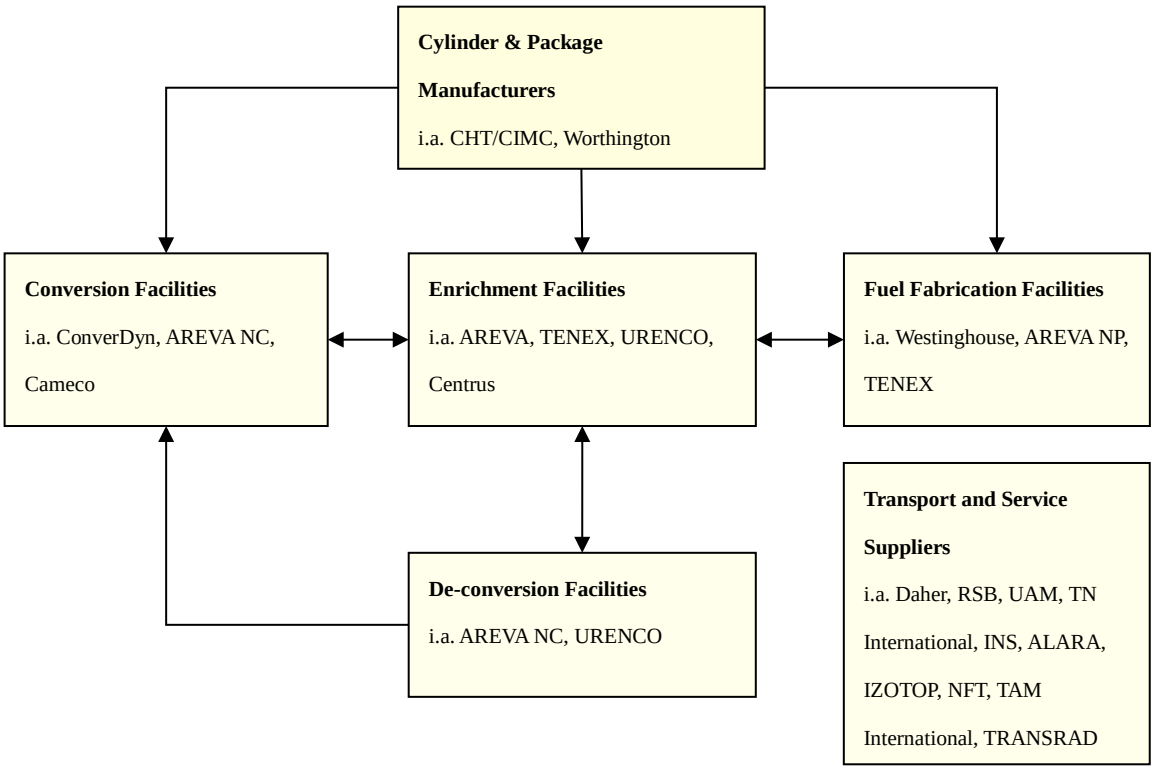


Fig. 1 UF_6 Cylinder Supply Chain

Working Timeline

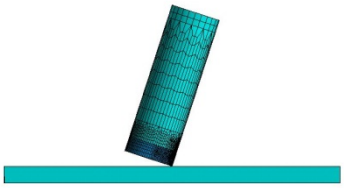
The following timeline shows the most important work packages of the HEXT WG until today.

1998 * WNTI founded

1999 * HEXT Industry WG established

2000 * Industry Consortium for H(M) approval for 48Y/X formed

2001 * Industry Consortium developed VPA for 48Y/X to fulfill new drop test



2001 * H(M) approval for 48Y/X by the US DOT with limited validation in Europe

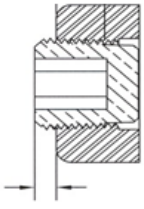
2002 * Development of Thermal Protection for 48Y Cylinder by Industry


2004 * H(U) approvals by the UK ONR and H(M) approvals in USA, Canada and Russia

2005 * Thermal protection for 48Y/X under H(U) approvals in use

2005 * Second edition of ISO 7195 published

2006 * Development of new design of 48Y cylinder plug (Socket Head Plug)

2007 * 1 year extensions of H(U) approvals for 48Y/X applied for (issued in 2008)

* Review of thermal protection requirement project

2009 * New H(U) approvals & validations for 48Y/X applied for and issued by UK, USA and Russia (valid for 5 years)

2010 * Preventive measures developed and implemented for issues reported on Protective Shipping Packages and Flat Racks

2011 * UX-30 Users Group re-established to share experience and support application process

2012 * Seventh edition of ANSI N14.1 issued (including new Socket Head Plug)

* IAEA SSR-6 Edition 2012 issued (new UN number for small quantity of UF_6)

2014 * WNTI issued 3 papers regarding a detached lifting lug on a 48Y cylinder

* New H(U) approvals & validations for 48Y/X applied for and issued by UK, USA and Russia (valid for 1 year)

* UF_6 Cylinder Identification Working Group formed

2015 * New H(U) approvals & validations for 48Y/X applied for and issued by UK, USA and Russia (valid for 5 years)

* UF_6 Fact Sheet and Good Practice Guide for UF_6 sample shipments published by WNTI

2016 * New B(U)F approval and validations applied for by the UX-30 consortium in 2014/15 and issued by USA, UK, Germany, France, Netherlands, Belgium, Sweden, Russia, Canada, Brazil, S. Korea, China in 2015/16

* Good Practice Guide for Installation of Socket Head Plugs published by WNTI

Working History

Some examples of several projects which were managed and coordinated by the HEXT WG are presented below:

Introduction of H(M) and H(U) approval concept for UF_6 packages

Since TS-R-1 [1] was published as ST-1 in 1996, the IAEA Regulations for the Safe Transport of Radioactive Material included specific requirements for uranium hexafluoride (UF_6). These requirements for UF_6 are the first and only substance specific requirements in the IAEA regulations. Industry did evaluate the new IAEA regulations in a coordinated manner and the HEXT WG specifically focused on the impact on the transport of natural and depleted UF_6.

The new requirements for UF_6 in 48 inch cylinders included a structural test, a free drop test from a height of 0.6 m and a thermal test.

It was concluded by the HEXT WG that 48Y and 48X cylinders manufactured and tested in accordance with ANSI N14.1 and/or ISO 7195 did comply with the structural test requirements due to the hydraulic test at manufacturing and recertification. However, to comply with the new drop and thermal test requirements, specific test and development work had to be done. For that reason an Industry Consortium, consisting out of 7 HEXT WG members was established to share the costs for the design, development and testing work needed.

The Industry Consortium developed:

a) A Valve Protector Assembly (VPA) that is bolted to the skirt and prevents the skirt from contacting the valve in the regulatory drop test,

b) A Blanket Thermal Protector (BTP) and a Composite Thermal Protector (CTP) to provide evidence for exceeding the 30 min survival time in the regulatory thermal test,

c) A Socket Head Plug that cannot be damaged by the skirt in the regulatory drop test.

Once the VPA had been developed and had been incorporated in ANSI N14.1, the Industry Consortium applied successfully for an H(M) package approval in the USA. This package approval was validated in other countries, but in Europe with limited duration.

Once BTPs and CTPs came available, the Industry Consortium applied for package approvals in the UK.

They were issued as GB/3570/H(U) and GB/3571/H(U) respectively.

The introduction of the socket head plug follows gradually at new manufacture and recertification of cylinders. A good practice guide has been prepared to support users of the new plugs [2].

Review of thermal protection requirements for 48X and 48Y cylinders

The new 1996 requirements for UF_6, and specifically the thermal test requirement, have been subject of investigation and discussion for many years. The IAEA even did initiate a Coordinated Research Project (CRP) for this issue. The six scientific experts involved in the CRP did not reach a common

conclusion on survival or failure and the CRP report [3] has not been finalized so far. More history can be found in a PATRAM 2007 paper [3].
Since the interpretations of the experimental results of the TENERIFE project and the numerical simulations used for the analytical formulas for the physical properties of UF_6 clearly indicate possible inaccuracies [4], a project was initiated by the Industry Consortium in 2007 to review the earlier work done and prepare a more accurate modelling of the thermal behavior of a full 48Y cylinder in the regulatory thermal test, supported by physical testing. During PATRAM 2010, papers have been presented on this work [6], [7].
However, the project was stopped in 2011, due to uncertainty about the final acceptance by the competent authorities and the high project costs foreseen.

New classification for small UF_6 quantities

The new requirements for UF_6 in the 1996 IAEA Regulations were for quantities of more than 0.1 kg per package. Smaller quantities were continued to be transported as excepted packages or as chemical packages, as practised safely and successfully for decades.
Following long lasting discussions that started in 2002, the IAEA - SSR-6 Edition 2012 introduced a new classification for UF6 in quantities of less than 0.1 kg per package:
UN3507, URANIUM HEXAFLUORIDE, RADIACTIVE MATERIAL, EXCEPTED PACKAGE, less than 0.1 kg per package, non-fissile or fissile-excepted.
This new UN number came into force first in the 56th Edition of the International Air Transport Association (IATA) Dangerous Good Regulations (DGR), ADR/RID 2015 and the IMDG Code 2014 Edition.
The HEXT WG developed a good practice guide for the packing, marking and labelling of UF_6 sample packages in accordance with the new classification [8].
The HEXT WG also reviewed the new fissile exceptions in SSR-6 and issued a WNTI Information Paper [9].

UF_6 Fact Sheet

The HEXT WG developed a UF_6 Fact Sheet which includes information about the chemical and physical properties, the application and transportation of UF_6 [10].

UF_6 Cylinder Identification

In May 2014, the HEXT WG formed a working group on the identification of UF_6 cylinders. The scope of the working group is to establish an industry-wide identification format that provides uniquely identification UF_6 cylinders and to investigate methods for making the unique identifier (UID) machine-readable and independently verifiable by IAEA Safeguards. A status report has been presented at PATRAM 2013 [11].

ANSI N14.1 and ISO 7195 development

The HEXT WG members are working collaboratively on the development, improvement and alignment of the standards for packaging's used for transport of UF_6. The ANSI N14.1 and ISO 7195 standards include specific information on design and fabrication requirements for the procurement of new UF_6 cylinders. These standards also define the requirements for in-service inspections, cleanliness and maintenance for cylinders in service.

End of 2012 the latest revision of ANSI N14.1 was issued and for 2017 a new revision of ISO 7195 is expected.

Revision of H(U) package approvals for 48X and 48Y cylinders with BTP or CTP

The H(U) package approvals for 48X and 48Y cylinders with BTP or CTP were due to expire by end of March 2014. Therefore a new Industry Consortium was formed within the HEXT WG in 2011 to prepare and apply for a renewal of these package approvals in the UK. The application was submitted by the Industry Consortium in March 2013. However, due to a 48Y cylinder lifting lug issue in France, the new certificates were issued with one year validity only.

Thereafter several questions from UK-ONR on the lifting lug issue were answered by the Industry Consortium and subsequently certificates valid for 5 years were issued on 27th July 2016.

Lifting Lug Issue on a 48Y cylinder

In December 2013 AREVA NC discovered in the storage area at their Tricastin site that one of four lifting lugs of a 48Y cylinder had been detached. The 48Y cylinder was not involved in a transport incident, but it is assumed that the lifting lug detached during an onsite movement with a forklift truck grappling the cylinder around the shell and not using the lifting lugs.

The HEXT Industry WG prepared three papers [12], [13], [14] to identify the root cause and to define preventive measures. To reassure the continued acceptable performance of the existing 48Y cylinder fleet an inspection program was developed and executed. In total 26,032 lifting lugs on 6,508 48Y cylinders were initially inspected.

As an added safety measure a non-destructive examination was introduced on the lifting lug welds on 48Y and 48X cylinders at the time of fabrication and during 5 year recertification. The additional examination will be included in the next revision of the relevant industry standards for UF_6 packages.

PSP operational experience

Operational experience and issues regarding handling, operation, maintenance and transport of protective shipping packages for 30B cylinders have been shared and discussed on a regular basis within the HEXT WG. Several issues were resolved and standards and good practices for the safe and efficient operation and maintenance were agreed.

Sometimes, commercial aspects may play a role, in which case the participation in discussion and sharing of information may be limited. The UX-30 Users Group is a specific example of this.

Conclusions

The HEXT WG members are WNTI members who have a specific interest in the safe handling and international transport of UF_6.

The HEXT WG developed into an industry forum where regulatory requirements are reviewed and implemented consistently and where practical experience is shared and good practices for the handling and transport of UF_6 are developed and agreed.

The interface with the competent authorities in IAEA TRANSSC Meetings and on a national level is essential for the HEXT WG to discuss regulatory requirements and for providing industry experience.

The HEXT WG will continue its activities in the years to come, as it remains committed to safe, efficient and reliable transport of UF_6.

Acknowledgments

The authors thank the HEXT WG members for their contributions and commitments during the meetings and specific working activities in the past several years.

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