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**“SUCCESS STORIES THROUGH
TRANSPORT RISK MANAGEMENT (TRM®)”**

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ABSTRACT

AREVA is involved in all sectors of the nuclear industry and has strategically organized its assets in order to provide nuclear power reactors with integrated services. As such, AREVA has recognized that the transport activity must be fully integrated into the offer for delivered products and services.

Consequently, stringent quality requirements applying to products, services and management equally apply to transport activities.

Transport and logistics are considered to be vital links between the various steps in the nuclear fuel cycle serving the nuclear power fleet, i.e. from mining, conversion, enrichment, fuel fabrication, fuel management and recycling to ultimate waste management. Yet, transport -- being an international activity, media sensitive, including multi-disciplinary operations and expertise, and performed within the public domain -- is also considered to be one of the industry's most sensitive activities.

In this context, AREVA has developed, deployed and promoted Transport Risk Management (TRM®) practices since 2006.

After a first deployment phase at the European level, TRM® has been extended to all AREVA transport activities since 2010. Currently, it is fully deployed not only in Europe, but also worldwide from the USA to Africa and Asia.

This paper will begin with a reminder of the subject presented at PATRAM 2010, presenting briefly the pillars of the AREVA TRM® Initiative and showing how it is used on a daily basis to conduct operational and strategic transport-related decisions.

Then, this paper will review the experience gained over the last three years and will highlight success stories AREVA has achieved worldwide through TRM® implementation.

It will demonstrate, relying on quantitative figures and several examples, how TRM® has increased safety, security and overall performance in transport activities.

Based on feedback from recent exchanges within the nuclear industry regarding TRM®, it will also demonstrate how TRM® practices benefit not only AREVA, but also the nuclear industry as a whole.

TRM® Initiative leads to the identification and support of best practices which are of interest for developing industrial standards that can be promoted worldwide for the benefit of all nuclear transport activities and stakeholders.

INTRODUCTION

Deployment of the TRM® initiative illustrates one of the AREVA credos: beyond the strict implementation of applicable standards, safety inevitably relies on an operator's ability to remain proactive and constantly vigilant.

The essential condition for ensuring real transport risk management is the adoption of a global vision, covering all stages of transport operations, right from shipment preparation. Hence, deployment of the TRM® Initiative concerns several fields:

- before transport - constant action to identify, evaluate and minimize risks during operational stages, implementing logistics and regulatory expertise, as well as deploying global acceptance actions to keep routes open or to open new ones,
- coordination of all stakeholders involved in the shipments,
- emergency response capabilities and know-how if an incident or an accident should occur.

On a day to day basis, it is performed by the TRM® team, which gathers more than 30 experienced people, who deal with the abovementioned topics sharing the objective to ensure safe transportation.

TRM team is part of AREVA TN, world leader in package design and licensing, and worldwide transportation of nuclear materials.

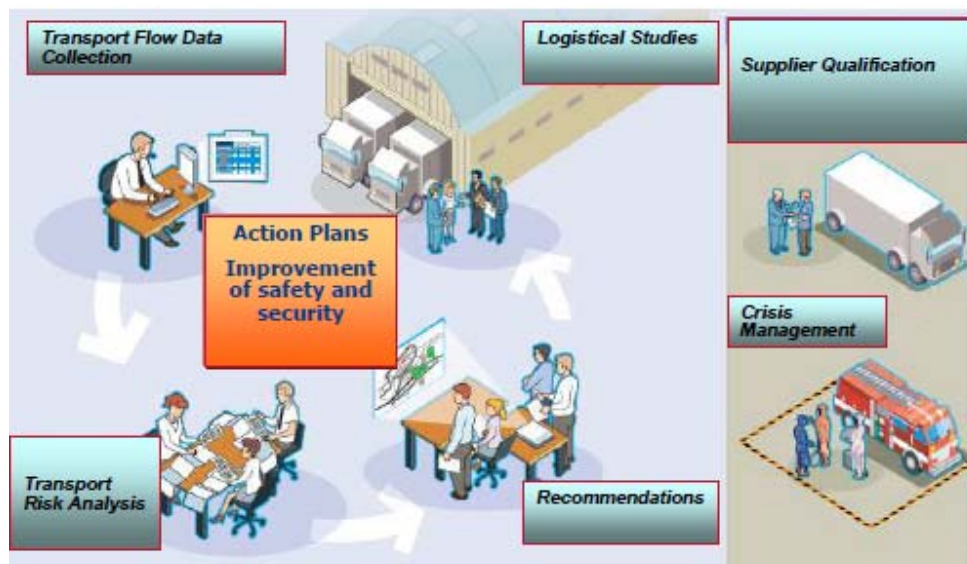


Figure 1. AREVA Transport Risk Management® Initiative

EVALUATE AND MINIMIZE RISKS: THE FIRST STEP TOWARDS TRANSPORT SAFETY

Risk analysis, regulatory and logistics expertise

As a first step, the TRM® Initiative consists of identifying and analyzing all transport flows that might put AREVA at risk. Thus, around 1,300 transport flows corresponding to approximately 12,000 shipments are evaluated each year concerning 33 AREVA industrial sites and many customers sites worldwide.

For all transport flows in which AREVA is involved, all relevant data are collected in order to evaluate the risk level, operation by operation. When a flow or a specific transport topic requires a more detailed analysis, the TRM® team undertakes a thorough technical study. Such studies may address specific requests from AREVA entities wanting to open new transport routes or needing to evaluate a transport mode (maritime for example). In some other cases, such studies can focus on a specific issue. They can then become a guide for operators concerned with the implementation of measures to ensure the strict application of technical and regulatory transport specifications.

These studies cover a wide range of subjects and require several fields of expertise: transport organization, regulatory watch, safety, security, loading and tie-down, even public relations. In 2012, the TRM® team carried out more than 50 of these studies.

Two essential criteria determine the risk level:

- the hazard level of the transport itself, determined by comparing the gravity of a possible incident to the probability of its occurrence
- the management level of the operator, which is based on the evaluation of the operator's organization and processes as well as its contribution to ensure proper transport risk management.

After the risk analysis, improvement measures are implemented and followed jointly by the TRM® team and the concerned AREVA site.

The below risk evaluation matrix shows the evolution of the rating for transport flows taking into account safety, security, industrial risks, and media risks. This matrix, updated every three months, also indicates which flows, operators or transport means to optimize when the evaluation shows a risk level which is too high.

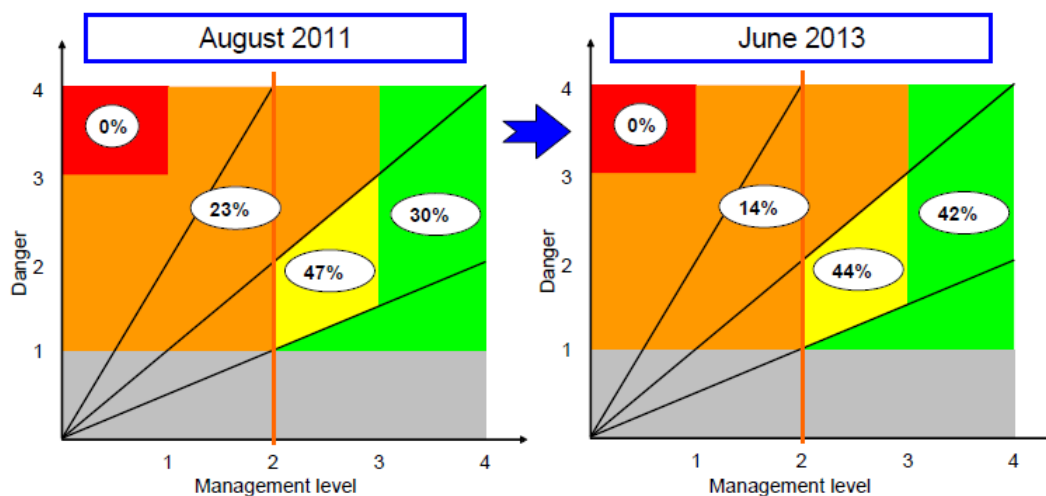


Figure 2. Risk evaluation matrix: example of evolution of rating for transport flows between August 2011 and June 2013

In August 2011, 77% of the shipments were evaluated with an acceptable (yellow) or good (green) management level. 86% had already been executed by June 2013 showing the efficiency of the improvement measures implemented.

The evolution of the above risk evaluation matrix is reviewed quarterly at the top management level to evaluate the efficiency of the improvement measures that are implemented following the risk analysis.

Package compliance

Proper management of transport operations is needed to minimize risks during transport operations. Yet this element is only one of the pillars to guarantee transport safety, as AREVA has understood.

Thus, end 2011, with AREVA's credo in mind (that beyond the strict implementation of applicable standards, safety inevitably relies on an operator's ability to remain proactive and constantly vigilant), the transport risk analysis method described above was extended to the management of package compliance for all AREVA Class 7 shipments.

Package supply, loading and preparation are the very first steps to be performed before the transport operations themselves, making them key for transport safety. To ensure the excellence of their management, an initiative has been set up dedicated to making proper evaluations of package compliance. A package compliance directive has been issued and implemented, first for French sites.

Consequently, since 2012, French AREVA sites have been evaluated on their package compliance management level for each kind of package used for Class 7 shipments. This has been performed by implementing an audit- and inspection-based surveillance

program prioritizing packages for which non compliance would most likely put the AREVA group and the customer at risk.

A mapping has been set up which gives the rating of the priority level for assessing management of package compliance for the packages shipped from AREVA sites. Priority is evaluated considering the potential impact of compliance non-conformity and the annual frequency of the shipments.

Improvement actions were recommended to consignor sites after the abovementioned package compliance reviews.

Good practices that were observed during site reviews have already been shared within all French AREVA entities to help them better improve package compliance.

Global acceptance: support transport routes while identifying and minimizing risks

Beyond managing risks for transport operations or package compliance, other actions have significantly added value in the support of transport operations so that they are executed more smoothly.

Global acceptance is a good example of how collaborative effort can drive actors to implement ultimate actions which allow a shipment to depart from the consignor or arrive at its destination, bringing significant added value to the minimization of risks.

As an example, major global acceptance actions were implemented in 2012 to open an alternative route between Kazakhstan and China for shipments of uranium ore concentrates after the border was closed to freight containing dangerous goods between these two countries.

The below Figure illustrates the new route that was opened.



Figure 3. New route opened in 2012 due to global acceptance actions

This route was successfully opened and made operational within 2 months due to several missions from the global acceptance team that were paramount in convincing all the Competent Authorities (port authorities, customs, firemen...) of the transit countries along the targeted new route to permit the transport.

Thus, canal and port terminals were opened, most of them for the first time, for transit of Class 7 material in:

- Malta – Marsaxlokk terminal
- Suez Canal
- United Arab Emirates – Jebel Ali and Khor Al Fakhan harbors
- China – Ningbo and Shanghai harbors

Close common work with the operational transport department from AREVA TN led to the validation of the route with the maritime company, also taking into account recommendations from the AREVA group and the Competent Authorities to ensure transport security (among others, during the Aden Gulf crossing).

Within 2 months, this new alternative route for uranium ore concentrate shipments was successfully opened once the risks and associated countermeasures had been identified.

SECOND STEP TOWARDS TRANSPORT SAFETY: IN-FIELD AUDITS AND INSPECTIONS FOR THE SURVEILLANCE OF OPERATIONS

Supplier qualification and transportation flow surveillance

During the transport itself, the TRM® Initiative is implemented through the in-field deployment of an auditor's and inspector's team qualified for intervening on all flows and for all associated suppliers on consignor and consignee sites, among others. Hence, all auditors and inspectors have perfect knowledge of national and international regulations of Class 7 material transport as well as thorough technical knowledge (knowledge in mechanics, for instance) that enable them to evaluate logistics operations.

Since its creation in 2007, more than 1,200 detailed control operations on all transport modes used by AREVA have been performed. Beyond the 250 inspections of transportation flows and suppliers carried out yearly worldwide, approximately 40 audits of suppliers involved in the logistics chain are carried out annually. Between 2007 and 2012, the percentage of "non satisfactory" inspections dropped from nearly 20% to less than 5%. AREVA acknowledges this decrease as proof that operators are more proactive in terms of safety because the AREVA requirements are now widespread and well-known.

Whenever a situation requires more specific support, the inspector's team can be dispatched to a consignor's site to support in situ experts by assisting and helping during transport preparation. For example, in 2012:

- In Namibia, one inspector was sent for a 20-day mission to help the consignor site implement all required actions before the very first uranium ore shipment was sent from the mine. The support provided by the inspector to the consignor site focused on transport documentation, drum and container labeling, and tie-down training. This first shipment arrived safely at the destination in France with no non-conformity found upon arrival.
- In China, one team of auditors and inspectors was sent for a 10-day mission to evaluate the ports of Zhuhai and Yangjiang and to audit road carriers in preparation of the first delivery of fresh fuel assemblies for the Taishan EPR.
- In Niger, one inspector was sent for a 10-day mission to train and support the consignor site on the implementation of the stacking of uranium ore concentrate drums (48 drums) in containers.

In 2013, as in the past years, audits and inspections have been carried out worldwide. An annual audit and inspection program has been set up for North America with a target of 10 audits and 15 inspections. Audits and inspections are carried out in other countries depending on the transportation flows: for instance, audits and inspections were carried out in Brazil in the Spring of 2013 for shipments of contaminated equipment, in Finland in the Summer of 2013; further audits and inspections are coming in South Africa, Kazakhstan, and Niger in the Fall of 2013.

A panel of the 185 most experienced referenced transport suppliers (rail, road, sea, air, others) has been built by compiling information from audits and inspections.



Figure 4. TRM® inspectors during a supplier inspection at Fos-Marseille harbor on a shipment of uranium ore concentrates

Inspections during transport preparation

Since 2012, deployment of in-field inspections of package preparations and shipment activities carried out within the framework of the TRM® Initiative has been extended to a fully integrated annual worldwide program covering not only transportation flows and suppliers but also consignor sites. The purpose of the extension of this scope was to

evaluate and improve the management level of the transport operations themselves, and also of all activities performed during the transport preparation.

Even more recently, in early 2013, the scope of inspections and audits was extended once again to include one step before the transport preparation, focusing on package suppliers (fabrication, maintenance...).

Hence, the overall surveillance program for 2013 has focused on carrying out the most suitable audits and inspections adapted to needs while taking into account possible mutualization to optimize financial costs for the AREVA group. Figure 5 gives an overview of the TRM® surveillance program for 2013:

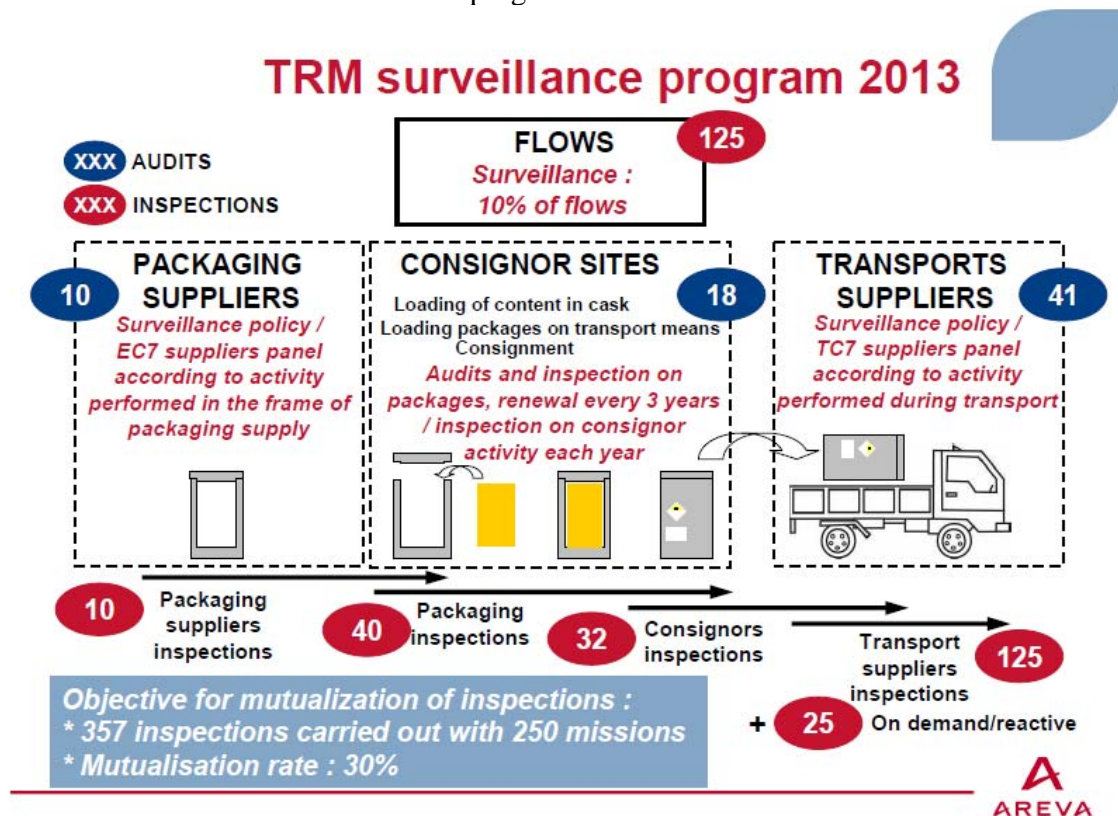


Figure 5. TRM®, 2013 surveillance program

EMERGENCY PREPAREDNESS AND RESPONSE: READY TO PROVIDE APPROPRIATE SUPPORT FOR CRISIS MITIGATION

For AREVA, the TRM® Initiative also concerns crisis prevention and crisis management in addition to normal activity. During an emergency situation, it would be inconsistent to not take advantage of and to not rely on specific resources which are usually in charge of dealing with sensitive technical information. From this perspective, to prevent potential emergency situations, the teams in charge of the TRM® Initiative provide, if necessary, technical recommendations based on information gathered within the framework of risk analyses, inspections and audits. Transport operators and AREVA sites must address these recommendations by implementing improvement measures in order to be qualified or remain qualified, or to improve their management level. Nearly 250 recommendations have been issued since 2007.

Emergency Response capabilities

In case of a transport emergency, the TRM® team at AREVA TN leads and coordinates the deployment of a Transport Emergency Response Plan (PUI-T, Plan d'Urgence et d'Intervention Transport). This plan gathers a Command and Decision team, a technical expertise team, a communications team, as well as a mobile team with specialists sent in the field to the emergency site. If the event occurs in France, staff is also deployed to the concerned local authority, usually the regional Prefecture.



Figure 6. Command and Decision Team gathered during a drill at the AREVA TN Emergency Response Center

Within the framework of an international deployment of the TRM® Initiative, this ability to be reactive is now reinforced by the Transport Safety Advisors and the Transport Advisors Network, which are present in all AREVA industrial sites. Thus, readily available resources, as well as reliable information about the transport, are mobilized immediately in the field.

Emergency Response Drills

The emergency plan and resources mentioned above are tested during internal or external emergency response drills, some of which simulate incidents occurring outside of France.

These drills are organized by the TRM® team according to an AREVA internal drill policy defining several types of exercises depending on their scope, from desktop exercises to full scale drills. The table hereafter summarizes the types of exercises:

| Exercise Level | Description | Who participates |
|-----------------------|---|--|
| LEVEL 1 | Targetted paper and desk AREVA internal exercise | Part of the local AREVA ER structure (site level) |
| LEVEL 2 | Small scale AREVA internal exercise | Whole local AREVA ER structure |
| LEVEL 3 | Full scale AREVA internal exercise | - Whole AREVA local ER structure, - Part of or whole AREVA ER structure at country level and headquarters level |
| LEVEL 4 | Full scale national or international exercise | - Public authorities of the country concerned - Whole AREVA structure (local+national+Hdqts) |

Figure 7. AREVA transport exercises according to level and scope

Each year, 5 to 6 exercises are carried out in accordance with an annual internal drill program. Level 4 drills are organized under request and approval of the Competent Authorities, as they gather all stakeholders at the national or international level for an entire day.

Usually, exercises are carried out during the second half of the year, first semester being devoted to scenario writing and exercise organization.

In 2012, 5 exercises were held as follows:

- 1 “Level 4” exercise: full day exercise for back-end transport at French national level focusing on physical protection
- 1 “Level 3” exercise: full day exercise for front-end UF4 shipment
- 1 “Level 2” exercise at French level: half-day exercise with EDF on spent fuel transportation
- 1 “Level 2” exercise at European level: half-day exercise with Lingen fuel fabrication facility based on the hypothesis of an accident occurring on a fresh fuel shipment
- 1 “Level 2” exercise at international level: half-day tripartite exercise gathering AREVA TN (France), INS (UK), and NFT (Japan) where an incident occurring during harbor handling operations was simulated for a shipment of vitrified residues going from France to Japan in a UK vessel

Each of these occasions provides opportunities to test and evaluate AREVA’s TRM® system.

A recognized Emergency Response organization and expertise

AREVA TN experience in emergency response is now fully recognized at the AREVA group level. Thus, AREVA TN is in charge of leading emergency mitigation for any Class 7 transport incident that would involve any AREVA site.

Since 2012, the AREVA TN Emergency Response Center has been designated as the back-up emergency response center for one of the AREVA group headquarters.

Our expertise in emergency response preparedness is now recognized by the French Competent Authorities. For instance, in 2013 the AREVA TN TRM® team was requested to provide support to the French INHESJ “Institut National des Hautes Etudes de la Sécurité et de la Justice” in developing exercises to train future representative of the French local authorities in dealing with emergency situations having an impact on population and environmental protection. The very first drill will be held in September 2013 based on a scenario developed by the TRM® team which includes all elements simulating an accident during a shipment of radioactive material. Due to its excellent knowledge of French emergency organizations, the TRM® team will also participate in the exercise by simulating some stakeholders who would take part in emergency mitigation in a live situation.

In July 2013 the French Safety Authority (ASN) audited the existing transport emergency response organization set up at AREVA TN within the framework of TRM®. No deviation was found during this audit, the ASN found the organization to be well trained and experienced. Some improvement actions were nevertheless proposed by the ASN that will be addressed by the TRM® team so that the Emergency Response organization becomes even more efficient.

Future development is planned for 2014. The TRM® team has been requested for support by the French Competent Authorities (ASN and IRSN) to take part in the first European drill for a shipment of radioactive material. This drill will gather French, UK and Belgium Competent Safety Authorities; the purpose is to have a specific drill to evaluate the interfaces between the countries.

CONCLUSION

The transport of radioactive material is vital to AREVA: it is not only the link between all of AREVA's facilities, but also between the group and its customers as well as its suppliers throughout the world.

As the transported materials are hazardous, the shipments themselves must be safe. The perpetuation of AREVA's industrial model, built around the nuclear fuel cycle, requires the perfect management of all radioactive material transport flows, whether they are arriving at or departing from an AREVA site.

AREVA has made the commitment to reach the highest level of risk prevention at each step of the logistics chain. This commitment applies to all AREVA logistics activities, may they be performed by the group itself or subcontracted. The corollary of this has been the deployment of the TRM® Initiative over the past 6 years which, while maximizing transport safety, has provided AREVA TN with a real competitive advantage.

TRM® Initiative leads to the identification and support of best practices which are of interest for developing industrial standards that can be promoted worldwide for the benefit of all nuclear transport activities and stakeholders.