

TUS-Safety and Environmental & Engineering Laboratory' cross sections considerations of one <Safety and SF&RAW matrix> and review of the SF&RAW management in Bulgaria

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Main points of the contents

Introduction

- 1) TUS' brief profile
- 2) Safety and Environmental Engineering Laboratory' expertise
- 3) Atomic Energy Security Unit of MEE' functions
- 4) Considerations for <Safety and SF&RAW matrix>
- 5) Review of SF&RAW management in Bulgaria
- 6) TUS' idea for collaboration within IGD-TP

Conclusions

Introduction

At least two main views are important to be underlined if we like to consider the SF&RAW problem in Europe:

- To Oct. 1, 2014 there are 155 nuclear reactors operable (without 33 in Russia that's 35 % of the all in the world), 4 under construction and 21 planed (until 8-10 years), with about 20 kT Uranium required in 2014. The relevant **great quantity SF&RAW** has to be stored in the European nuclear countries which have very different opportunities for safety storage, and
- The operation of 19 reactors in the NMS' and 15 in Ukraine (more than one-fifth or 22 % of all in Europe) still relies to return the spent fuel and high RAW in Russia but that increasingly becomes uncertain in the current difficult political situation in East Europe,

When we consider and and talk about NPPs, as a necessary presence in our lives, regardless of their great environmental advantage of "zero" CO2 emissions we still have to think about the back-end of the nuclear fuel cycle.

1) *TUS' brief profile*

- ▣ **TUS is the oldest (69 years) and biggest Bulgarian technical higher school with more than 12000 students.**
- ▣ **TUS provides Bach, Master and PhD degrees in the fields of electrical power engineering, thermal- and nuclear power engineering, computer sciences, communications, electronic, machine building, transport, etc.**
- ▣ **TUS has very important national role for the distribution of electrical and power engineering, transport and other knowledge, and for development of the Energy, RES and Industrial Research Area in Bulgaria, incl. in collaboration with MES, MEE, MEW.**



2) *TUS - Safety and Environmental Engineering Laboratory' expertise*

The Safety and Environmental Engineering Laboratory (SEEL)
of the Electrical Faculty – Electrical Power Department



is specialized in research surveys, and consulting services in the field of:

- *Nuclear- , Technical- and Fire Safety.*
- *Risk Analysis and Nuclear and Technical Safety Studies*
- *NPPs' Severe Accidents phenomena investigations with ASTEC computer code modeling and calculations.*
- *Environmental Impact Assessment of NPPs, incl. SF&RAW' accent and opportunities for mitigation of the problems with them.*
- *RAW and industrial waste management.*
- *Labour and Environmental Monitoring and Protection, etc.*

3-1) Atomic Energy Security Unit of MEE' general functions

The Atomic Energy Security Unit supports the minister of the Ministry of Economy and Energy in implementing:

- **Management of policy development in the energy field;**
- **Definition of the energy' strategic objectives and priorities and approval of programs for restructuring the energy sector;**
- **Development and monitoring of the implementation of the national energy strategy;**
- **Implementation of the state policy on RAW management;**
- **Development and monitoring of the implementation of the strategy for the management of SF&RAW.**

3-2) Atomic Energy Security Unit of MEE' functions concerning SF&RAW

The main functions concerning SF&RAW off the Unit are:

- Supports the implementation of the state policy in the nuclear infrastructure development, SF&RAW management and decommissioning of nuclear facilities;
- Coordination and control activities concerning the construction and operation of a National facility for disposal and/or storage of RAW;
- Organizes and coordinates a review and update of the National Strategy for SF&RAW management and monitors the implementation of the strategy;
- Coordination of implementation the obligations under international treaties and initiatives in the Nuclear Energy and RAW management' areas, etc.

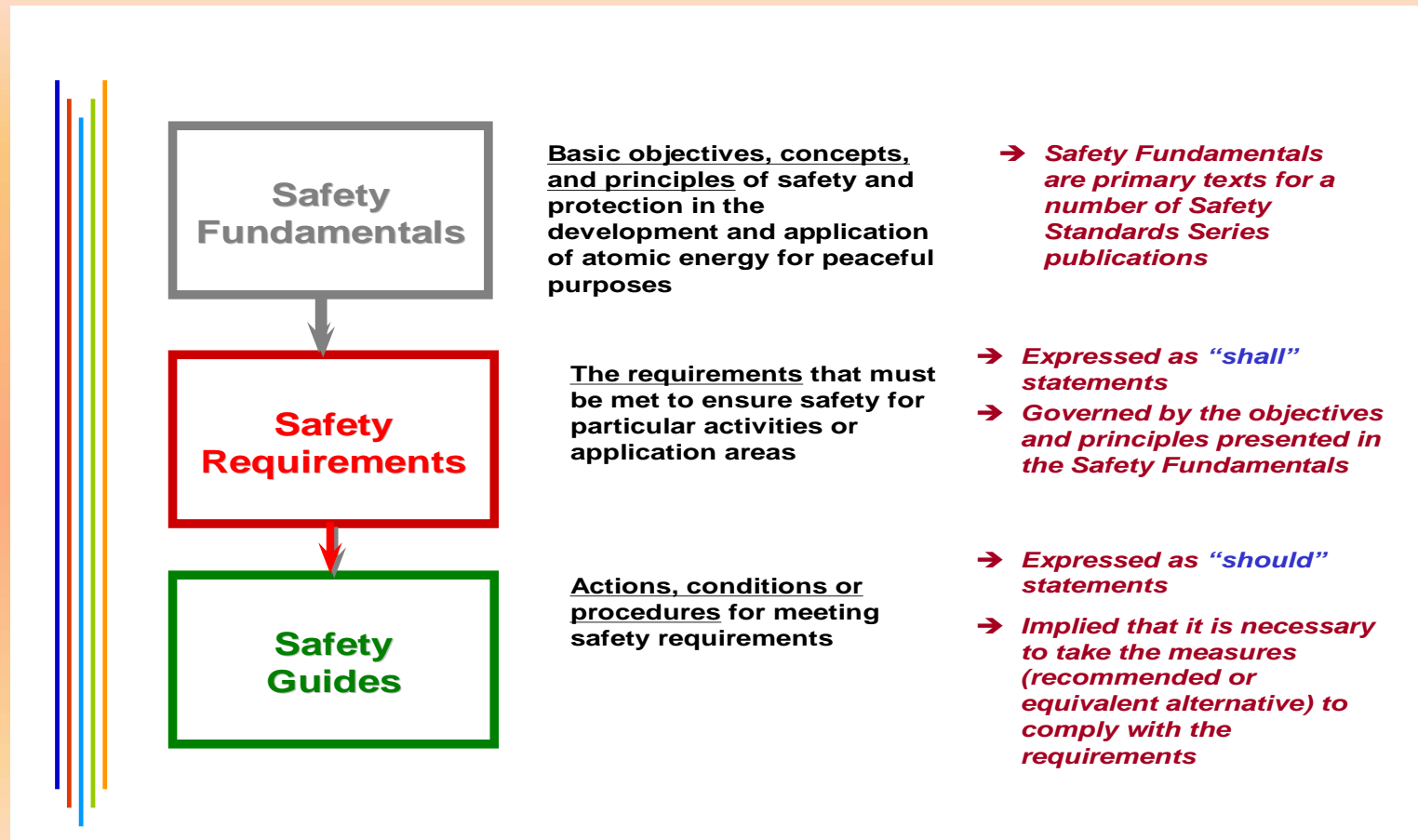
4-1) Cross sections considerations of one < Safety and SF&RAW matrix >

Matrix of some important documents

	<i>SF & RAW</i>	Spent Fuel	Radioactive Waste
<i>Safety</i>	<ul style="list-style-type: none"> • General overview of IAEA safety standards • Directive 2003/122/Euratom 	❖ Joint Convention on the Safety of Spent Fuel Management	on the Safety of Radioactive Waste Management ' 1998
National Safety Requirements	<ul style="list-style-type: none"> • Bulgarian Safe Use of Nuclear Energy Act' 2002 • Regulation on ensuring the safety of NPP' 2004 	❖ Strategy for management of spent nuclear fuel and radioactive waste'2011 – <i>until 2030</i>	❖ Regulation for safe management of the radioactive waste' 2004

4-2) Cross sections considerations of one < Safety and SF&RAW matrix >

- General overview of IAEA safety standards



4-3) *Cross sections considerations of one < Safety and SF&RAW matrix >*

❖ **Examples as results of some considerations and implementations:**

1) **Concerning the IAEA safety standards and Fulfillment of the Obligations of the IAEA Joint Convention on the Safety of SF&RAW management in Bulgaria:**

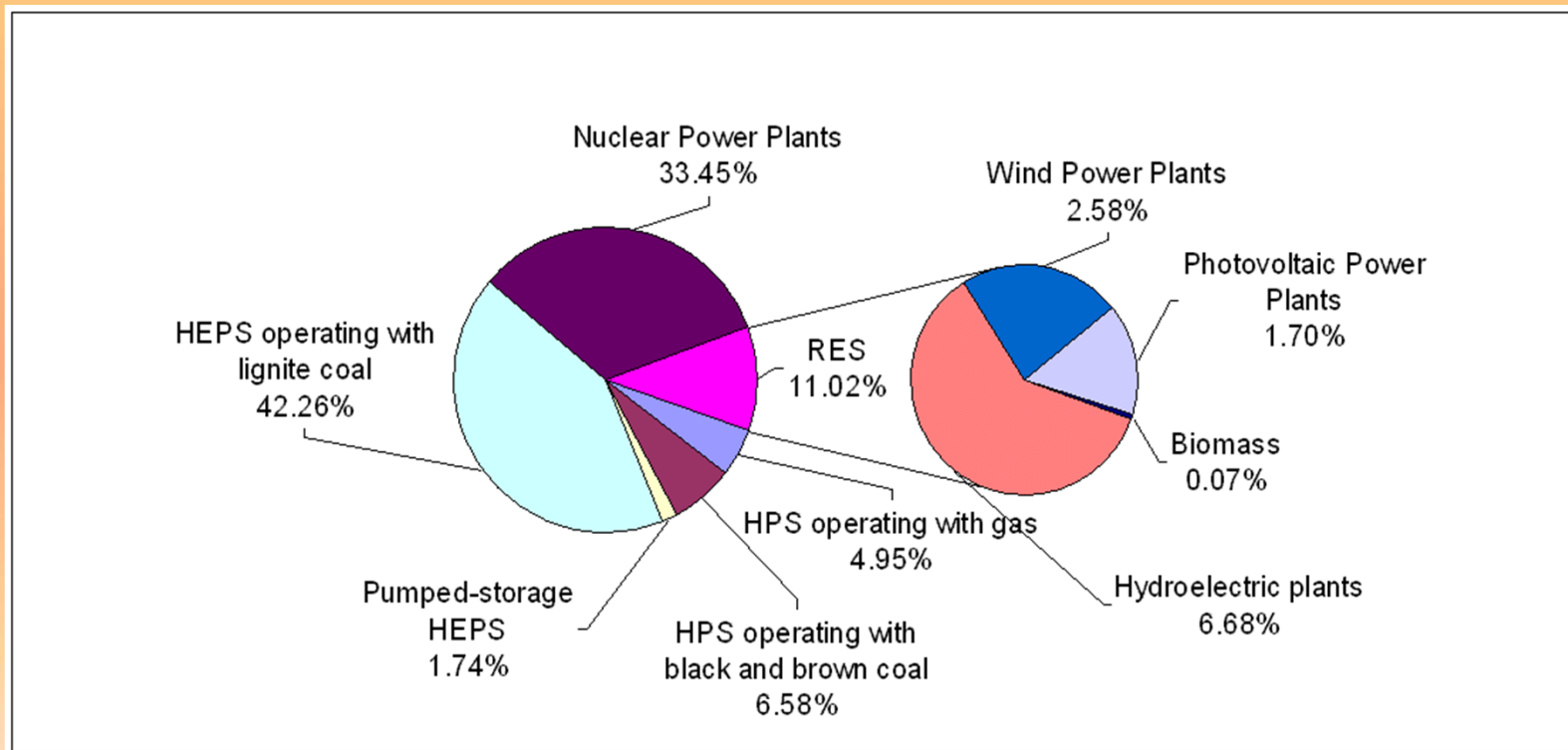
- ✓ Are explicitly introduced the basic principles of Nuclear Safety and Radiation Protection in accordance with the underlying document of IAEA “SF-1 Safety Fundamentals”
- ✓ Review and update of the documents of the Bulgarian policy of SF and RAW management, and the relevant practices, incl. for **limitation SF management to be carried out only by entities with a license for a nuclear facility**; ban on RAW import to the country; **Acceptance of the deep geological repository as a most suitable option** for durable guaranteed safety in the isolation of highly active and long-life RAW.
- ✓ Overhaul of the opportunities for further transports of SF&RAW for processing in Russia and searching of decisions for construction of storages in the country, etc.

2) **Concerning implementation of the Directive 2003/122/Euratom on the control of high-activity sealed radioactive sources and orphan sources in Bulgaria:**

- ✓ Introduction of an integrated computer information system and the National Register of sources of ionizing radiation; Creating of Cadastre of radioactive sources.
- ✓ Implementation of projects **to enhance the physical protection and safety of risk sites** with highly active sources.
- ✓ Introduction of measures to ensure more stringent requirements of **Directive 2003/122/Euratom** for safety and storage of high level sources **from all categories 1 to 5**, compared to the requirements of **IAEA for categories 1 to 3**.

5-1) Brief review of SF&RAW management in Bulgaria

State of the Bulgarian electrical power system & Electricity generation in 2012



5-2) *Brief review of SF&RAW management in Bulgaria*

Main sources of SF and/or RAW:

- ❖ **Two** reactors - type **VVER 1000/320** - currently in operation;
- ❖ **Four** reactors - type **VVER 440/ 230** – being **shutdown** in the period **2002-2006** and prepared for decommissioning;
- ❖ **One** research reactor shutdown in **1989** and modified later;
- ❖ The activities regarding the new nuclear build at **Belene** site are suspended and at **Kozloduy** site are under negotiation;
- ❖ In addition there are waste disposal facilities, medical units, industrial radioactive sources, and transportation of radioactive material.

The management of radioactive waste in Bulgaria outside the place of their generation is carried out by the **State Enterprise Radioactive Waste (SE RAW)**, which is established pursuant to art. 78 (1) of the Safe Use of Nuclear Energy Act.

5-3) *Brief review of SF&RAW management in Bulgaria*

Specialized divisions (SD) of SE RAW are:

1. **SD on Novi Han storage facility site (close to Sofia) for low- and intermediate level RAW generated in industry, medicine and science.**
2. **SD responsible for the implementation of the project for National disposal facility for low- and intermediate RAW from nuclear facilities and nuclear applications. The site selection process is completed and the facility is in its design stage.**
3. **SD on Kozloduy NPP site responsible for conditioning and storage of low- and medium-level RAW generated as a result of the operation of the units.**
4. **SD on Kozloduy NPP site established responsible for decommissioned units of the plant.**

In 2008-2012 Units 1-4 of Kozloduy NPP (under a Council of Ministers' Decree) have been announced as RAW management facilities and have been transferred to SE RAW.

In 2013 the Bulgarian Nuclear Regulatory Agency (BNRA) issued licenses to SE RAW for decommissioning those units of Kozloduy NPP.

5-4) Brief review of SF&RAW management in Bulgaria

The only facility, which generates spent nuclear fuel in Bulgaria, is the Kozloduy NPP. The SF is stored in the reactor pools and later removed to the Wet Spent Fuel Storage Facility (WSFSF) in a separate building, located at the Kozloduy NPP site.

Apart from the storing of SF on site of the Kozloduy NPP, part of it is shipped annually to Russia for reprocessing and storage.

A Dry Spent Fuel Storage Facility (DSFSF) is designed for long-term storage of SF from VVER-440 reactors and situated within the Kozloduy NPP site. It is equipped with systems for receiving, storage and shipment of casks/containers with SF. In 2011 the construction of the DSFSF has finished and is in a process of commissioning.

In Bulgaria there are regulated three major categories of solid RAW correlated with the three main ways of disposal:

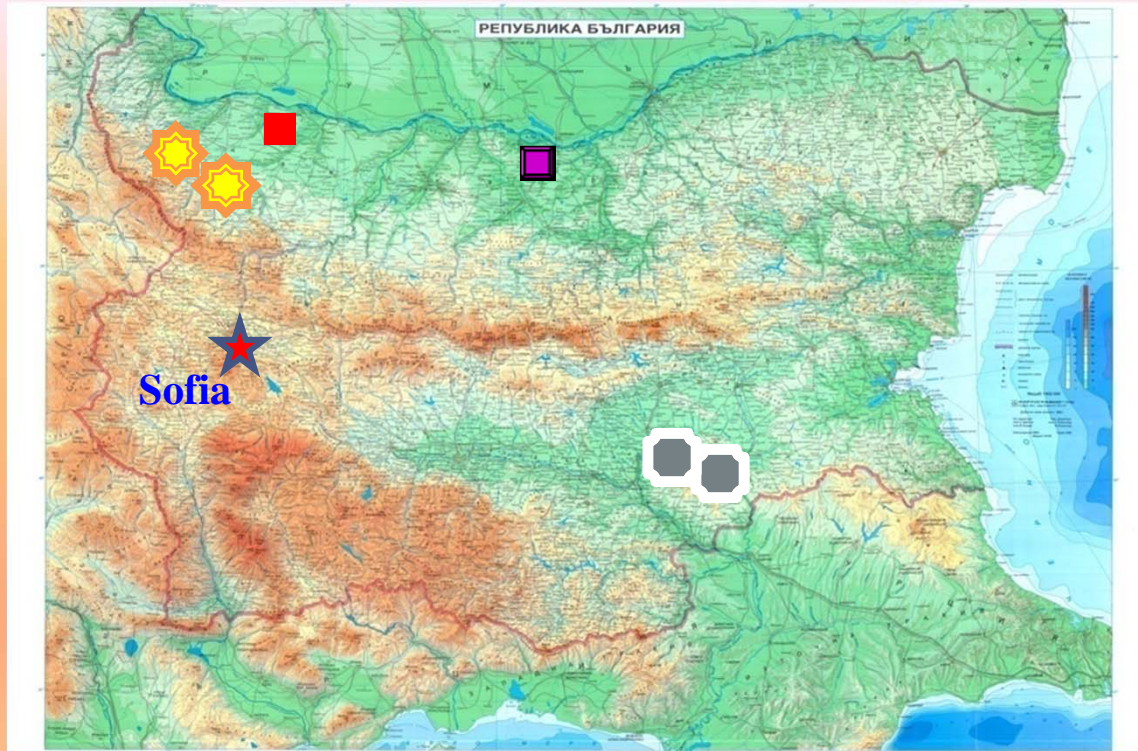
- i. storage in compliance with the natural decay time;**
- ii. surface or undersurface disposal of short-lived radioactive waste;**
- iii. disposal of long lived radioactive waste in appropriate geological formations.**

5-5) Brief review of SF&RAW management in Bulgaria

There are different study activities in Bulgaria last 10-15 years concerning geological disposal of SF and RAW, for instance:

- ❖ **In SE RAW has started a project for feasibility study for construction of geological disposal.**
- ❖ **Determining the main concept for disposal - research into several options and selection of an option, assessment of the main concept using the available research results as basis information and development of a national programme incl. the initial assessment of prospective geological conditions for disposal.**
- ❖ **Determining the main requirements for selection of site and development of a programme for selection.**

5-6) Brief review of SF&RAW management in Bulgaria



■ Kozloduy NPP in operation

■ Belene NPP under stopped construction

★ Lower cretaceous clayey marls sites

■ Granite sites

A comparison of different sites for potential geological disposal was made and **4 sites** were chosen as more appropriate in Bulgaria - two lower cretaceous clayey marls sites in NW part and two granite sites in SE part of Bulgaria.

The investigation and selection process is continuing.

6) TUS' idea for collaboration within IGD-TP

If there is interest within the present 5EF and IGD-TP, **SE&EL of TUS** proposes on your attention one idea for discussion and development:

Research and engineering and management potential strengthening for identification of rational safe and environmental ways of geological disposal in Bulgaria,
relevant to SF and solid RAW,
as part of subject and joint activities in a new project for collaboration within IGD-TP.

Conclusions

On our attention as researchers and experts are:

- from the one side the present reasonable very strong safety and environmental requirements in global and national level,
and

- from other side our obligations to be find rational and applicable decision for SF&RAW' problem,

thinking for our planet, for the present and future generations...

and we hope the above brief presented considerations are useful for that.



**Thank you
for
your attention**

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