



DEVELOPMENT OF THE STRATEGY OF LARGE COMPONENTS FRAGMENTATION OF V1 NPP PRIMARY CIRCUITS

Seminar
KP-JAVYS-003

 **javys**
jadrová
a vyrad'ovacia
spoločnosť, a.s.



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FOREWORD

In 2021, the European Commission (EC) adopted a new proposal for a Council Regulation establishing a dedicated financial programme for decommissioning nuclear facilities and managing radioactive waste. This instrument covers the co-funding of the decommissioning programmes of Bulgaria, Slovakia, and the decommissioning of the Joint Research Centre (JRC). A separate Council Regulation was adopted for the decommissioning programme of Lithuania.

The EC JRC is mandated to foster the spread of decommissioning knowledge across all the European Union Member States and facilitate knowledge sharing arising from implementing the abovementioned decommissioning programmes, funded by the Nuclear Decommissioning Assistance Programme (NDAP).

The decommissioning operators from the NDAP (NDAP Operators) implemented and tested a knowledge management methodology in 2021 through Project ENER/D2/2020-273. Using this methodology, the NDAP Operators can develop Knowledge Products that are currently available to share with other European stakeholders. In addition, this methodology is under implementation in the JRC Nuclear Decommissioning and Waste Management Directorate (NDWMD), which becomes a knowledge generator extracting the knowledge from the ongoing decommissioning activities at the different sites (Geel, Ispra, Karlsruhe, and Petten).

The JRC NDWMD aims to become a Centre of Excellence in nuclear decommissioning knowledge management and develop a decommissioning knowledge platform which allows exchanging information and building on the best practices in the EU inside the multi-annual financial framework (2021 – 2027) strategy. The operational phase of the project is expected to start in 2024 to develop ties and exchanges among EU stakeholders and document explicit knowledge and make it available through multi-lateral knowledge transfers on decommissioning and waste management governance issues, managerial best practices, technological challenges, and decommissioning processes at both operational and organisational level, to develop potential EU synergies.

This is a Knowledge Product prepared by JAVYS, a.s., Slovakia, for the JRC NDWMD.

1. Council Regulation (Euratom) 2021/100 of 25 January 2021 establishing a dedicated financial programme for the decommissioning of nuclear facilities and the management of radioactive waste, and repealing Regulation (EURATOM) No. 1368/2013
2. Council Regulation (EU) 2021/101 of 25 January 2021 establishing the nuclear decommissioning assistance programme of the Ignalina nuclear power plant in Lithuania and repealing Regulation (EU) No. 1369/2013

PRODUCT DESCRIPTION

The seminar on "*Development of the Strategy of Large Components Fragmentation of V1 NPP Primary Circuits*" was prepared by a team of experts from company JAVYS, a.s. at V1 Nuclear Power Plant (Jaslovské Bohunice site) in Slovakia. The guidance and recommendations of this product are collected from the experience gained during the implementation of the D4.2 Project – "*Dismantling of Reactor Coolant System Large Components*", co-financed by the European Commission via the Nuclear Decommissioning Assistance Program (NDAP) between years 2017-2024.

This seminar aims to assist the D&WM operators in determining or assessing the strategy of large components fragmentation.

This product was developed as part of an effort to disseminate and share the knowledge acquired during the decommissioning and radioactive waste management activities performed with NDAP funding under the EU Council Regulation (EURATOM) No. 1368/2013 repealed by Council Regulation (EURATOM) 2021/100 of 25 January 2021 with all EU State Members.

KEYWORDS

V1NPP, BOHUNICE, WWER REACTOR, PRIMARY CIRCUIT, LARGE COMPONENTS, FRAGMENTATION STRATEGY, WET-CUTTING, DRY-CUTTING, DECOMMISSIONING, DISMANTLING, DECONTAMINATION.

ABSTRACT

Fragmentation of activated and contaminated large components of the primary circuits requires a properly defined fragmentation strategy. This seminar provides a demonstration of the feasibility and flexibility of the changes in fragmentation strategy and knowledge, tips and recommendations from the successfully implemented fragmentation strategy of the V1 NPP primary circuit large components.

OBJECTIVES

The main objectives of this seminar are:

- To provide an example (V1 NPP) of fragmentation strategy development for activated and contaminated large components of primary circuits (basic design / final design).
- To become familiar with the initiative for modification of the fragmentation strategy.
- To help the target user define (their own) fragmentation strategy for activated and contaminated large components of primary circuits.

APPROACH

This seminar was developed by a team of experts from the company JAVYS, a.s. responsible for planning and implementation of large components fragmentation of primary circuits.

Lessons learned in this seminar arose from the modification of the original fragmentation strategy due to the limited area and limited time for the implementation, are included.

RESULTS, FINDINGS, AND INSIGHTS

This document provides tips to consider when establishing the fragmentation strategy of large components of primary circuits and the answers to specific questions:

- Procurement method – to allow or not to allow strategy assessment by potential tenderers?
- Shall the strategy of large-component fragmentation be flexible even if the re-licensing is necessary?
- Is establishing the fragmentation workshops only in containment or elsewhere possible?

TARGET USERS

1. New NPP Decommissioning Operators (limited by space-controlled area) currently **developing the large components fragmentation strategy** of primary circuits in the early planning phase.
2. Existing NPP Decommissioning Operators (limited by space-controlled area) **re-assessing the fragmentation strategy** before starting the implementation.

APPLICATION, VALUE, AND USE

- This seminar primarily targets the planning personnel (D&WM operators) developing the fragmentation strategy.
- Lessons learned and tips from successfully implemented fragmentation strategy (V1 NPP) may be considered at early stages for other D&WM operators.
- D&WM operators with existing fragmentation strategy may re-consider the strategy and compare it with an existing benchmark (provided information).
- Example of V1 NNP is customised, however, it may be used as a benchmark for similar types of NPPs.
- Specific tips (e.g., erection of the fragmentation workshops outside the containment).



TABLE OF CONTENTS

1. V1 NPP General Information
2. V1 NPP's Large Components Dismantling and Fragmentation Scope
3. V1 NPP's Original Fragmentation Strategy
4. Modification of Fragmentation Strategy
5. V1 NPP's Final Fragmentation Strategy
6. Conclusions & Lessons Learned
7. Bibliography

1. V1 NPP General Information

LOCATION:	Jaslovské Bohunice (Slovakia)
D&WM OPERATOR:	JAVYS, a.s.
UNITS:	two
REACTOR TYPE:	WWER 440-V230
THERMAL OUTPUT:	1,375 MW _T
FUEL:	UO ₂ (1.8 / 2.4 / 3.6 % U-235) (modified 3.82 % U-235)
MODERATOR AND COOLANT:	H ₂ O
NO. OF LOOPS:	6



2. V1 NPP's Large Components Dismantling & Fragmentation Scope

PRIMARY CIRCUITS:

- Steam generators (6 pcs/Unit)
- Main circulation pumps (6 pcs/Unit)
- Main isolation valves (12 pcs/Unit)
- Primary piping
- Pressurizers (1 pcs/Unit)
- Bubble tanks (1 pcs/Unit)

REACTOR VESSELS AND INTERNALS

AUXILIARY EQUIPMENT

PLANT SYSTEMS

ANNULAR WATER TANKS

ACTIVATED OPERATIONAL WASTE

ACTIVATED CONCRETE

Most of the material used in the primary circuit is austenitic steel.

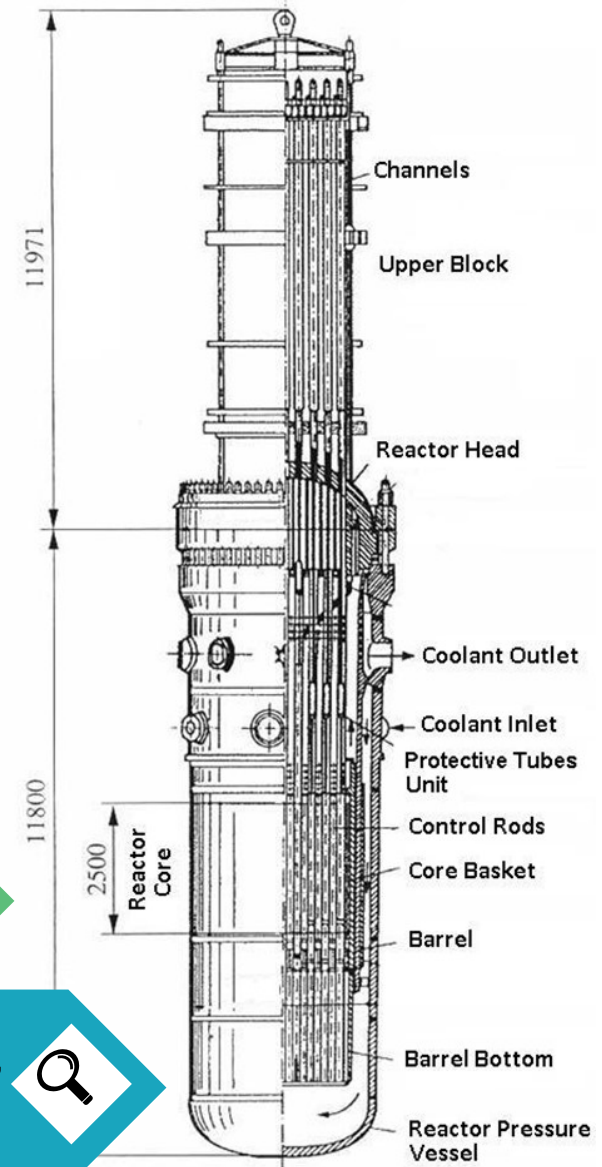


The dimensions of the components are proportional to the reactor type and power (1,375 MW_T)



E.g., RPV (Reactor Pressure Vessel):

RPV mass: 215,150 kg, RPV body material: 15Ch2MFA steel (low alloy steel), Height: 11,805 mm, External diameter (splitting surface area): 4,270mm, External diameter (smooth cylindrical part): 3,840mm, Average wall thickness: 149 ± 2 mm



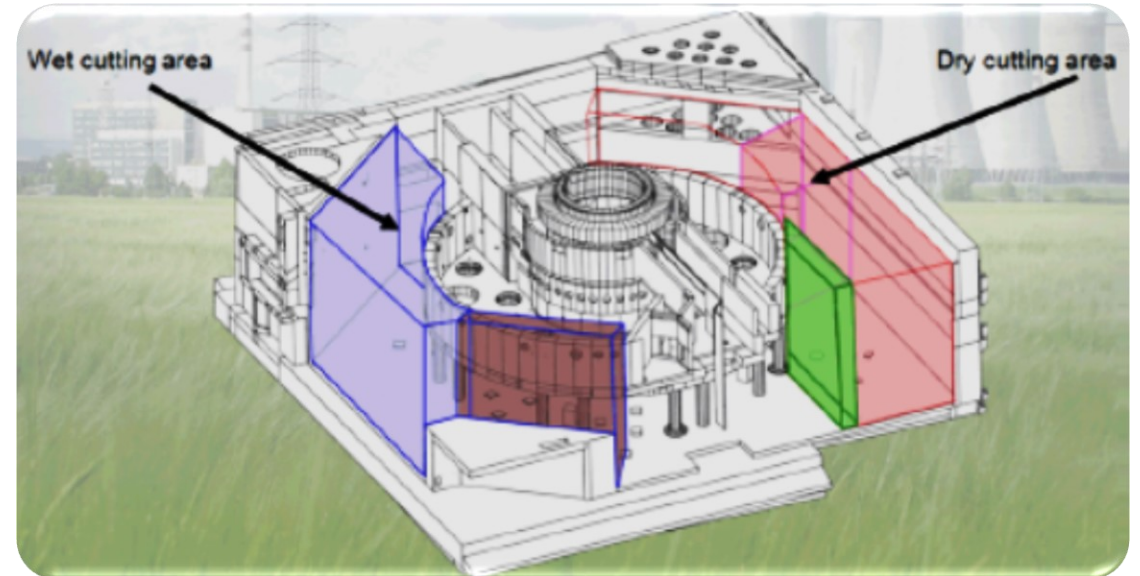
3. V1 NPP's Original Fragmentation Strategy



Check any relevant information from other D&WM operators, which may be considered a benchmark when establishing your fragmentation strategy (basic design).

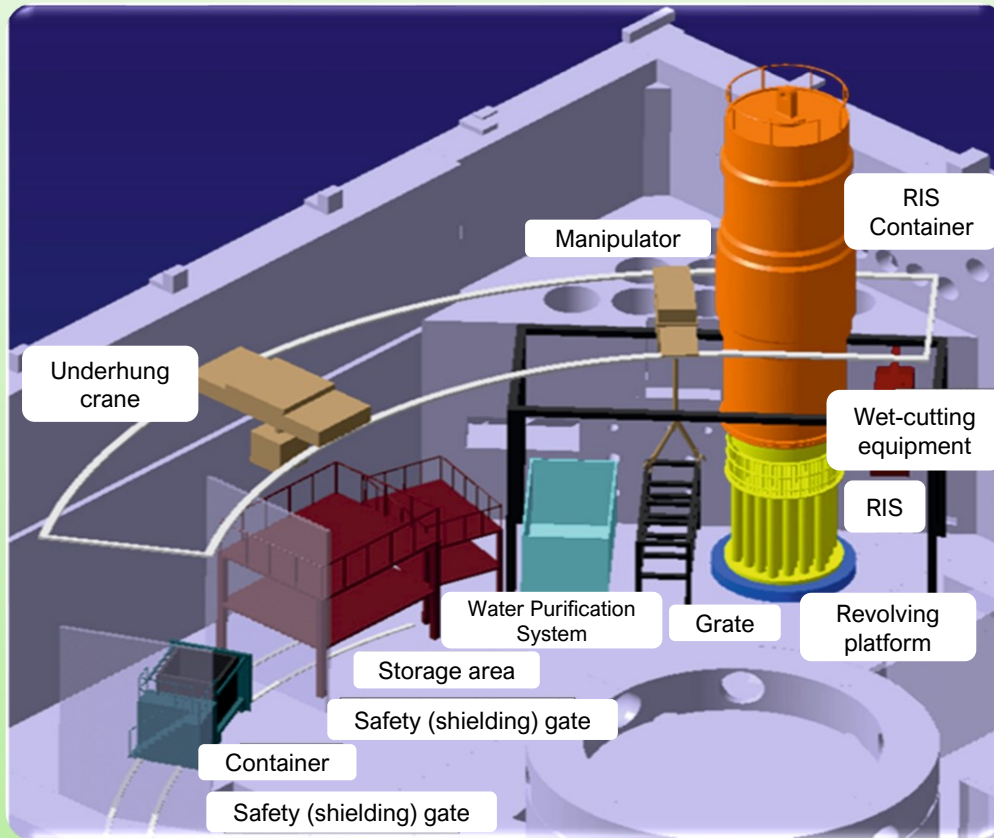
Original Scope – Large Components Fragmentation Workplaces

- ❑ Only in one of two containments (steam generator boxes) in the reactor hall (Unit 1)
- ❑ One WCW - Wet-Cutting Workshop
- ❑ One DCW - Dry-Cutting Workshop
- ❑ Steam generators fragmentation planned in steam generator boxes



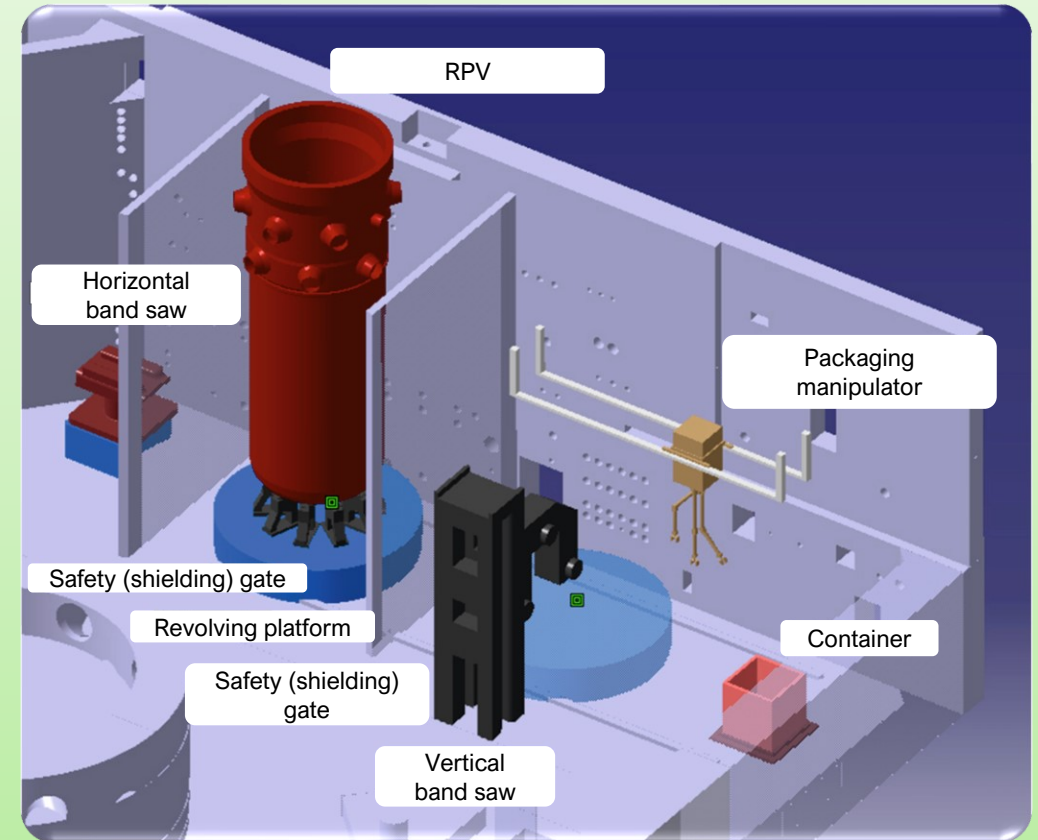
3. V1 NPP's Original Fragmentation Strategy

One Wet-Cutting Workshop (WCW)



WCW with only one fragmentation facility.

One Dry-Cutting Workshop (DCW)



RPVs of Unit 1 and Unit 2 were planned initially to be fragmented one after another in DCW.

4. Modification of Fragmentation Strategy

Lesson Learned 1: Appropriate procurement method is essential for successful implementation of the project.

- ❑ Appropriate procurement method allows the tenderers to assess and provide comments to the technical specification (TS)
- ❑ V1 NPP: applied open two-stage tender process

First stage

- Assessment of the fulfilment of the qualification requirements
- Assessment of original strategy by tenderers and submitting of their comments/proposals for modification
- Assessment of obtained comments/proposals for modification
- Incorporation of accepted comments/proposals into the TS (addendum to tender documents)

RESULT: Updated TS

Second stage

- Submitting the updated TS to tenderers (addendum to tender documents)
- Technical and financial proposals of tenderers (to updated TS)
- Technical and financial evaluation

RESULT: Contract Award



Added value of Open Two-Stage Tender process – knowledge and actual experience of Tenderers may be incorporated into strategy!

4. Modification of Fragmentation Strategy

Lesson Learned 2:

Flexibility for optimization of large components fragmentation strategy should be welcomed and strongly encouraged.

- ❑ Market response to the original tender documents (technical specification) had shown that the expectations to complete the fragmentation activity within the scheduled time were not feasible - either an extension of duration or a change of strategy!

- ❑ Without the insight of the tenderers as experts in the given area, having knowledge and experience in specialised services, the original strategy would not have led to meeting the project goal (scheduled fragmentation completion).

- ❑ The strategy was modified with the main changes:
 - Number and type of fragmentation workshops.
 - Properly estimated cutting plans considering radiological and volume capacity of existing licensed package forms.
 - Establishment of the fragmentation workplaces also outside the reactor hall.



Flexibility for optimization of Cutting Plans of Reactor Pressure Vessel (RPV) or Reactor Internals should be welcomed and strongly encouraged.

5. V1 NPP's Final Fragmentation Strategy

Original Strategy

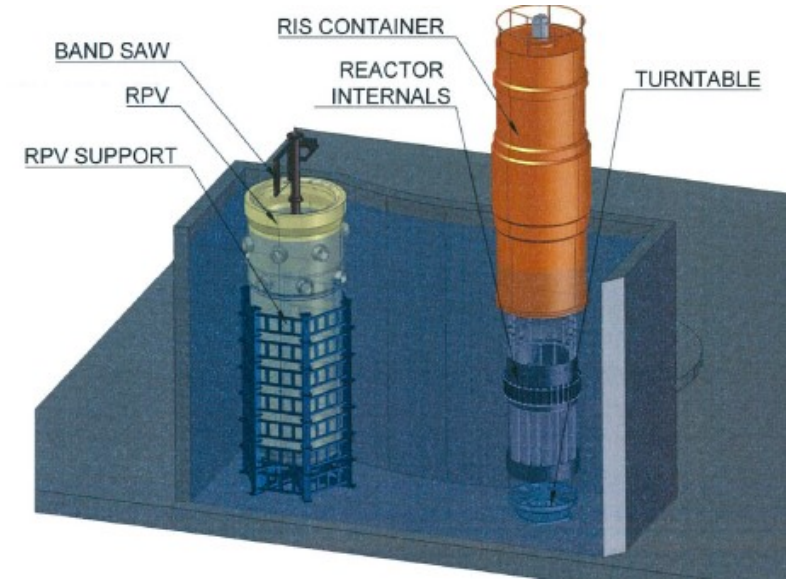
- 1 Wet-Cutting Workshop (WCW)
- WCW includes one fragmentation facility
- Dry-cutting of Reactor Pressure Vessels (RPVs)

Successive fragmentation

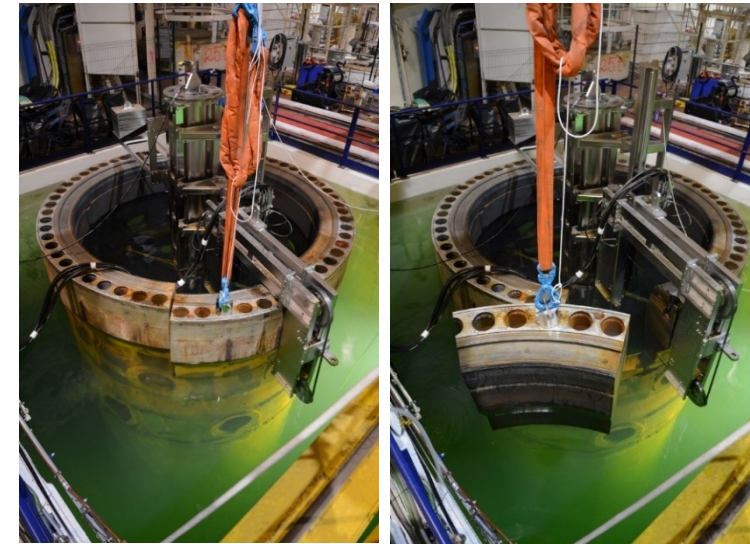
Modified strategy

- 2 Wet-Cutting Workshops (WCWs)
- WCW includes two fragmentation facilities
- Wet-cutting of Reactor Pressure Vessels (RPVs)

Parallel fragmentation



WCW with 2 fragmentation facilities: Underwater segmentation of RPV and RIS



First piece cut off the RPV 1 (9/2020), WCW1B

5. V1 NPP's Final Fragmentation Strategy

Lesson Learned 3: The establishment of the fragmentation workplaces also outside the reactor hall is a benefit (if the radiological situation of components allows it).

- ❑ V1 NPP: fragmentation of steam generators outside the containment (DCW in the turbine hall).
- ❑ Transportation of steam generators outside the reactor hall allowed the emptied areas to be used to establish fragmentation workplaces in their original position.
- ❑ Simultaneous fragmentation of steam generators in the turbine hall and other large components in fragmentation workshops in the reactor hall.



Turbine Hall – temporary storage & fragmentation in Dry-Cutting Workshop (DCW) in Turbine Hall

5. V1 NPP's Final Fragmentation Strategy



Appropriate plan for transportation of steam generators (SGs) with preparatory modification activities in implementation in parallel.



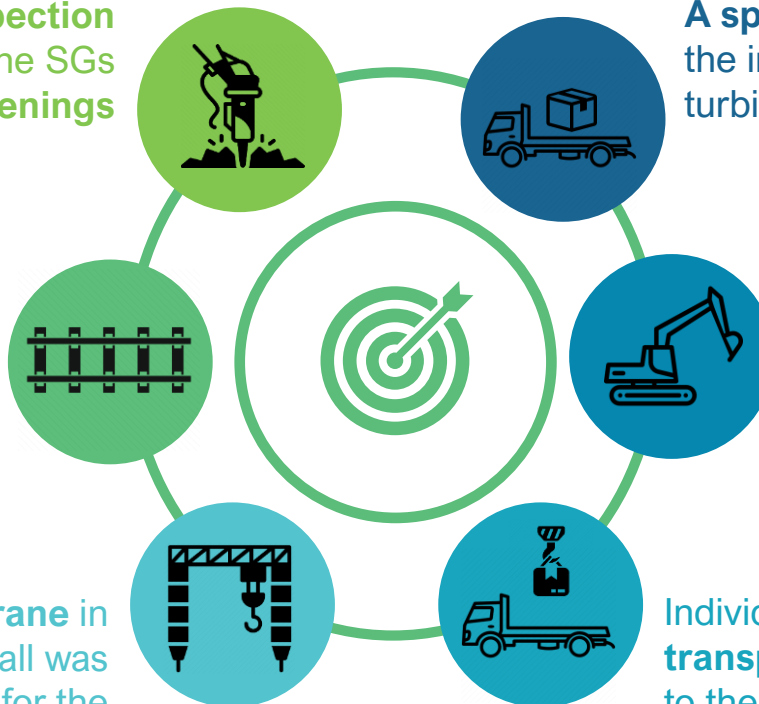
Adjustment of **inspection openings** above the SGs to transport openings



Special railway for transporting the SGs within SG boxes



The existing crane in the reactor hall was **modified** for also for the transport needs of SGs



A **special truck** transported the individual SGs into the turbine hall



The turbine hall was modified for **storage** and **fragmentation** of SGs

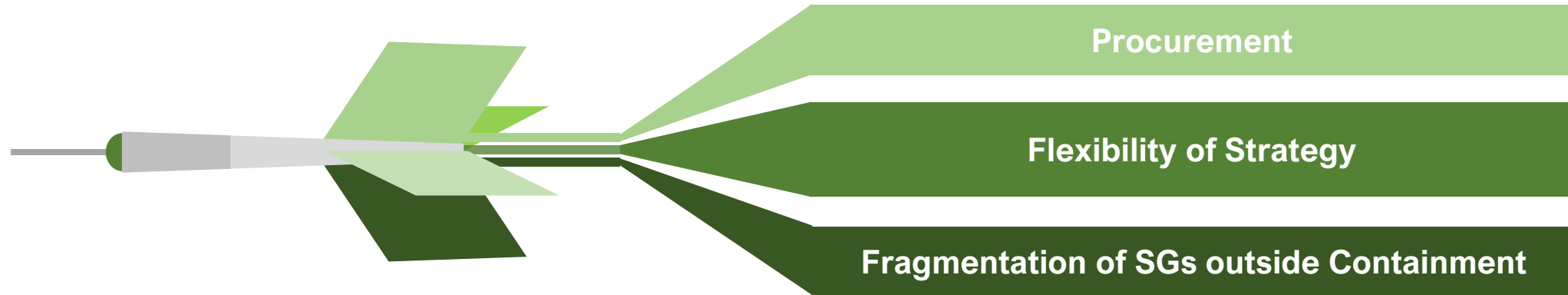


Individual SGs were **transported** from SG boxes to the **siding corridor** of the reactor building (loaded onto a **special truck**)



6. Conclusions & Lessons Learned

Dismantling and fragmentation of primary circuit large components of the V1 NPP (Bohunice, Slovakia) is the first completed activity of such kind related to WWER-440 NPP.



Key Lessons Learned:

- An appropriate procurement method is essential for the successful implementation of the project**
 - ✓ Contractor ensuring proven techniques and experience
 - ✓ Review of strategy by specialists
- Flexibility for optimisation of fragmentation strategy should be welcomed and strongly encouraged**
 - ✓ Parallel fragmentation of both Units → V1 NPP Decommissioning Project Schedule was not impacted
- Fragmentation of the steam generators outside the Containment – DCW in the turbine hall**

7. Bibliography

JAVYS internal documentation:

- Technical Specification of the D4.2 Project, rev. 2, Doc. ID: D42-TS-PMU-07004 (issued 20/04/2016)
- Photo documentation of the D4.2 Project

Thank you