NPP KRŠKO
TO.VZISI

TECHNICAL SPECIFICATION
No. ISI 05/26

for

FOSAR and Visual Re-examination of Reactor Vessel Internal Components W15, TSSB, and UGW per MRP-227 and TB-19-5, Rev.2 in NPP Krsko During Refueling Outage 2027

Revision 1

Safety Related

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1.0 ACTIVITIES

This Technical specification defines requirements for following activities:

- foreign object search and retrieval (**FOSAR) activity**: Basic and Additional (if relevant conditions; "damage" occur on fuel elements) as defined in section 2.1a and 2.1b respectively),
- reinspection and trending of linear indications detected during outage 2021 on alignment and interfacing components (**W15 in accordance with MRP-227, Rev. 2A**) activities as defined in section 2.2, and
- inspection of Thermal Shield Support Block (TSSB) cap screws in accordance with **TB-19-5, Rev. 2, Westinghouse NSSS PWR Thermal Shield Degradation**
- Proactive EVT-1 inspection of Upper Girth Weld (UGW) from inner side of Lower internal

NPP Krško reactor vessel internals are Westinghouse designed

For these activities, Bidder is expected to prepare a technical proposal that addresses the following: personnel, inspection and retrieval equipment, qualified examination procedures, as well as foreign material exclusion (FME) procedure.

1.1 FOSAR Activity

During each outage, before loading the new fuel into RV, it is necessary to inspect a reactor vessel for foreign objects that could damage the new fuel in RV and spread contamination within plant systems. Detail scope of activity is defined in section 2.1.

1.2 Reinspection and trending of linear indications detected during outage 2021, 2022, 2024 and 2025 and inspection of TSSB Cap Screws as defined by TB-19-5, Rev. 2

Visual examination of Reactor pressure vessel (RPV) internals at NPP KRSKO according to MRP 227, Rev. 2A and MRP-228, Rev. 5 were performed during the Outage 2021, 2022, 2024 and 2025. During visual examination of Upper Internals (UI) in 2021 **one crack on the upper core plate (UCP) guide (270°)** was detected and trended during 2022 and 2024. During visual examination of Upper Internals (UI) in 2025 **one crack on the upper core plate (UCP) guide (90°)** was detected, indication from 2025 was visible 2021. On Lower Internals (LI) guide pins, five (5) indications were detected during outage 2021, addition one (1) was detected during outage 2022 which was visible in 2021 but was not reported and addition one (1) was detected during outage 2024. Indication from 2024 was not visible 2021 but was visible in 2022. **Total of seven (7) indications on LI guide pins shall be reinspected and trended.**

Based on provisions from TB-19-5, Rev. 2, Westinghouse NSSS PWR Thermal Shield Degradation and results from previously inspections documented in report number D02-ARV-01-208-894, NPP Krško shall perform a visual examination (VT-3 / VT-1) on locations defined in 2.2.

2.0 SCOPE

Bidder shall offer the technical proposal for the 1) FOSAR scope (Basic FOSAR scope and Additional FOSAR scope if relevant conditions (damages) occur on fuel elements or if there is occur additional FME problem in Reactor Vessel including Reactor Internals, and 2) for reinspection and trending of linear indications detected during outage 2021 on UCP guides (inserts) on RPVUI, UCP guide pins on RPVLI and inspection of Thermal Shield Support Block Cap Screws as defined by TB-19-5, Rev. 2. EVT-1 inspection of Upper Girth Weld (UGW) from inner side of Lower internal.

2.1 FOSAR scope

a) Detailed basic scope of FOSAR services covers visual inspection and retrieval of a foreign object of:

- lower internals lower core plate,
- VT support by remote-controlled submarine during the pull out of the Upper and Lower internals from reactor vessel and return Lower internals to reactor vessel

b) Additional FOSAR scope activity shall be executed if relevant conditions (damages) result in broken fuel rods. Additional FOSAR scope applies to the inspection of the reactor internal and FHB refueling channel as well as retrieval of foreign parts.

- (FHB) refueling channel.

2.2 Scope of reinspection and trending of linear indications detected during outages 2021-2025 and inspection of Thermal Shield Support Block Cap Screws as defined by TB-19-5, Rev. 2. is defined in the table below:

Existing components	*Method*	*Examination coverage*
W15. Alignment and interfacing components Upper Core Plate alignment pins.	VT-3 / VT-1	Four (4) locations on the RVUI – UCP guide (inserts) and four (4) locations on the RVLI – UCP guide pins four (4) locations and accessible interior. This includes re-examination and trending of seven (7) reported indications from 2021, 2022, 2024 and 2025 on LI UCP guide pins and one (2) indication on UI UCP guide (insert)
TB-19-5, Rev. 2; Thermal Shield Flexures and Support Block Cap Screws	VT-3 (General condition visual inspection)	TSSB Cap Screws Minimum Inspection Recommendation 1
W.3a EVT-1 inspection of Upper Girth Weld (UGW) from inner and outer side of Lower internal	EVT-1	100% of the accessible weld length of ID surfaces of the UGW and 0.75 in. (1.91 cm) of adjacent base metal shall be examined.

Visual examination (VT-3) of reactor vessel internals accessible locations as defined in Program TD-2O and MRP-227, Rev, 2A, Existing components: W15. Alignment and interfacing components (Upper Core Plate alignment pins).

Bidder shall be capable to perform length measurement of detected indications.

3.0 SAFETY CLASSIFICATION

FOSAR and Reactor Vessel Internals Inspection activities in accordance with MRP-227, Rev. 2A and MRP-228, Rev. 5 requirements are considered as Safety Related (SR) activities.

4.0 TYPE OF SERVICE

According to the internal NPP Krško classification, Basic FOSAR activity, reinspection and trending of linear indications detected during outages 2021 - 2025, and inspection of TSSB cap screws and UGW are considered activities which includes inspection performance based on a fixed price and in compliance with Supplier's QA program approved by NPP Krško and include Supplier's QA/QC.

Potentially additional FOSAR activity of (FHB) transfer channel is considered as a type of service with hourly rate price for defined scope.

5.0 APPLICABLE CODES, STANDARDS AND PROCEDURES

5.1 Code of Federal Regulations 10 CFR 50.55a; 10 CFR 50 Appendix B, 10 CFR Part 21
5.2 ANSI/ASNT CP-189; 2006
5.3 ASME Section XI, Edition 2017
5.4 TD-2O; Program Nadzora Notranjih Delov Reaktorske posode; Rev. 5
5.5 MRP 227, Rev. 2A Pressurizer Water Reactor Internals Inspection and Evaulation Guidelines
5.6 MRP-228, Rev. 5; Inspection Standard for Pressurized Water Reactor Internals - 2023 Update
5.7 WCAP-17096 – NP Rev. 3; Reactor Internals Acceptance Criteria Methodology and Data Requirements
5.8 MRP-2024-004; License Renewal PWR Interim Guidance for Inspections of Core Barrel Welds in Supplement to MRP-227 Revision 1-A Inspection and Evaluation Guidelines
5.9 Rules ensuring safety and health in manual handling of loads (Official Gazette of the Republic of Slovenia, no. 73/05 and 43/11 – ZVZD-1)

6.0 IDENTIFICATION OF AFFECTED EQUIPMENT

- Reactor Pressure Vessel: RCPCRV01,
- Reactor Pressure Vessel Upper Internal: RPVUI,
- Reactor Pressure Vessel Lower Internal: RPVLI,
- Refueling cavity in the containment,
- Refueling canal in the FHB.

7.0 TECHNICAL REQUIREMENTS / EQUIPMENT

Basic FOSAR and Visual Examination of Reactor Vessel Interior activities shall be performed by standard FOSAR/VISUAL equipment (remote-controlled submarine equipped with cameras that fulfill requirements from IWA–2213 of ASME Section XI; Table: IWA-2211-1 and MRP 227 rev. 2A and MRP-228 rev. 5).

- **VT-3 examination**

The VT-3 examination shall be in accordance with the examination criteria set forth in ASME Section XI, IWB-3520.2 and MRP-227, Rev. 2A. The VT shall be performed at distance, for the verification of the structural integrity of the component. Natural or artificial lighting has to be sufficient (min 50 fc) to allow the reading of a letter with a height of 2,7 mm (Table IWA-2211-1). The level of natural or artificial illumination shall be verified before and after each examination or series of examinations without passing the time limit of 4 hours between each verification (IWA-2213). Each indication shall be registered by photograph or recorded by video and stored on external discs that will be submitted to NPP Krsko representative at the end of examination.

VT-3 shall be used to determine the general mechanical and structural condition of components and their supports and to detect discontinuities (cracking) and imperfections, such as loss of integrity at bolted and welded connections, lose or missing parts, distortion, debris, corrosion, wear, or erosion.

The VT examination shall be performed using remote controlled equipment such as compact submarine equipped with high resolution radiation resistant cameras.

- **EVT-1/VT-1 examination**

The EVT-1 and VT-1 examination shall be in accordance examination criteria set forth in ASME Section XI, IWB-3520.1 and MRP-227, Rev 1A. The VT shall be done by distance for the verification of the structural integrity of the component. Natural or artificial lighting has to be sufficient (min. 50 fc) to allow the reading of a letter with a height of 1,1 mm from a distance of 0,6 m (Table IWA-2211-1). The level of natural or artificial illumination shall be verified before and after each examination or series of examinations without passing the time limit of 4 hours between each verification (IWA-2210). Each indication shall be registered by photograph or recorded by video and stored on external hard discs that will be submitted to NPP Krško representative at the end of examination.

EVT-1 and VT-1 techniques shall be used for detecting surface imperfections and flaws, such as cracks, wear, erosion, and corrosion.

For remote visual examinations, the technique resolution requirements are described in MRP-228, Rev.5 for Enhanced Visual Examination (EVT-1), VT-1, and VT-3 examinations and shall be fulfilled.

- **FOSAR**

Activity on the reactor bottom shall be performed by a tube camera mounted on refueling bridge and remotely operated with adequate radiation tolerance. Camera shall have appropriate zoom capabilities (zoom > 35-times) and adjustable focus to avoid unnecessary close contact with the component surface. Tube camera shall have a fixed side view (45° mirror) or panel tilt and rotation movement, lightening integrated or separated from the camera, (dimension of tube camera shall be diameter ≤ 41mm).

A suction device for foreign objects removal shall be **integrated (mounted)** into the FOSAR submarine equipped with collection filters of a precise size due to the NPP Krško specific Filter disposal - Cask design. The diameter of the filter shall be smaller than 80mm. The filter shall have an adequate filtration range to avoid excessive contamination of the suction device. An additional suction device for small foreign objects removal shall be a standalone device with a diameter dimension ≤ 100mm and shall be mounted on sticks. The bidder shall provide a technical specification of a suction device in the technical proposal.

The suction device for fuel debris shall be a standalone device. Filter shall be with the finest filtration range and remote rejection of filter from the suction device. The filter shall have an adequate filtration range to avoid excessive contamination of the suction device.

Suction device parts shall be assembled before lowering into the Reactor cavity. The lowering and lifting of a standalone suction device into the reactor cavity **shall be by hand** (without a polar crane, because a polar crane will be unavailable at that time).
The weight of the standalone suction device shall be max. 55 kg, which is the limit for lowering and lifting by hands into the reactor cavity.

Cleaning of the RPV flange seal surfaces (FOSAR scope) must be done without damaging seal surfaces.

A suction device or griper shall be able to remove foreign objects from the reactor vessel bottom through holes on a lower internal lower core plate (the dimension of that tool shall be ≤ 41mm in diameter).

All equipment **shall be hand carried** (equipment unit max. weight 55kg) into the containment through the personnel hatch and shall be transported through the containment by hand (without the use of a polar crane).
All limitations for lifting, lowering, and transportation of equipment by hand are defined in ref. 5.4.

Available space for acquisition and analyzing in the reactor building is 4m^2 and an additional 1,5m^2 on the edge of a cavity for preparation work.

8.0 QUALIFICATION REQUIREMENTS

8.1 Examination system requirements

Examinations systems requirements of MRP-228, Rev.5 shall be implemented for all examinations as follows:

- All examination personnel, equipment, examinations, classification and measurement of indications, and documentation associated with visual examinations shall meet the requirements of MRP-228, Rev.5; Sections 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, and 3.10.

8.2 Qualification requirement for personnel

Non-destructive examination personnel shall be trained, qualified and certified in accordance with ANSI/ASNT CP-189, ASNT Standard for Qualification and Certification of Nondestructive Personnel. VT examination personnel shall be additionally qualified in accordance with ASME Sec. XI, Mandatory Appendix VI and requirements from MRP-228, Rev.5 respectively.

In addition to that, Suppliers shall provide a person who possesses a valid American Society for Nondestructive Testing (ASNT) Level III certificate for VT method.

9.0 DETAIL SCHEDULE

DETAIL SCHEDULE

- Equipment defined in 7.0 shall be on-site on the 29th of March 2027.
- Transportation of equipment to the FHB – building will be organized on the 5th of April 2027 at 08:00.
- Transportation of equipment to the RB – building will be organized on the 5th of April 2027 at 12:00.
- Equipment Setup will be organized on 5th of the April 2027 at 14:00.
- VT support by remote-controlled submarine during the pull out of the Upper internals from reactor vessel is scheduled for the 6th of April 2027 at 4:00.
- Visual Examination of Reactor Vessel Internals (**W15. Alignment and interfacing components;** UCP guide on RVUI) is scheduled for 6th of April 2027 at 04:00 and shall be completed on 6th April 2027 at 05:00.

- VT support by remote-controlled submarine during the pull out of the Lower internals from reactor vessel is scheduled for the 9th of April 2027 at 23:00
- **Visual examination of TSSB and W15. Alignment and interfacing components UCP guide pin on RVLI and UGW** (with Lower Internals on stand) is scheduled for the 12th of April 2027 at 09:00 and shall be completed on the 12th of April 2027 at 18:00 (exact date will be determined based on daily activities).
- VT support by remote-controlled submarine during the return the Lower internals to reactor vessel is scheduled for the 22nd of April 2027 at 15:00
- FOSAR activity on Lower Core Plate is scheduled for 25th April 2027 at 12:00 and shall be completed on 25th April 2027 at 16:00.
- After completion of the inspection, NPP Krško will organize transportation back to the container or decontamination area if is needed extra decontamination.

Transportation of equipment in FHB and RB	5th of April 2027 at 08:00
Setup equipment	5th of April 2027 at 14:00
VT support by remote-controlled submarine during the pull out of the Upper internals from reactor vessel	6th of April 2027 at 4:00
Visual Examination of Reactor Vessel Internals (Upper Internal)	6th of April 2027 at 5:00
VT support by remote-controlled submarine during the pull out of the Lower internals from reactor vessel	9th of April 2027 at 23:00
Visual examination of TSSB and W15. Alignment and interfacing components UCP guide pin on RVLI and UGW	12th of April 2027 from 9:00 to 18:00
VT support by remote-controlled submarine during the return of the Lower internals to reactor vessel	22nd of April 2027 at 15:00
Lower Core Plate of the lower internals	25th April 2027 from 12:00 to 16:00
Transportation of equipment from RB and decontamination	25th of April 2027 at 18:00 to 27th of April 2027 at 18:00

The actual start of FOSAR and visual examination activities will be notified by NPP Krško representative 14 days in advance before actual start of the outage and confirmed at actual start of the Outage 2027.

10.0 SUPPLIER RESPONSIBILITIES

Supplier shall provide to NPP Krško:

- Equipment, capable to fulfill requirements listed in chapter 7.0.
- Trained, qualified and certified inspection personnel for specified activities.
- All working procedures shall be handed over to the NPP Krško for approval before starting activities.
- Completion of required scope within the available time.
- Reports of performed FOSAR activities (Preliminary and Final report). All reports shall be handed over to the NPP Krško representative for review and comments.
- Proposal shall address FME procedure.
- The Bidder shall provide at least two (2) confirmed references of FOSAR and Visual Examination of Reactor Vessel Internals activities on PWR NPP-s with the same equipment that will be used in NPP Krško.

Equipment and procedures on-site qualification shall be performed and carried out during equipment set up and functionality test as mentioned in 2.0. Scope of service.

The proposal shall include:

- System/equipment documentation shall be contained within a proposal too. A detailed description of the system is required (dimensions: length, width, height).
- Organization chart for the activity to be performed including responsibilities of personnel.
- Working procedures, FME procedures.
- At least two (2) confirmed references of FOSAR and MRP-227 Visual Examination of Reactor Vessel Internals activities on PWR NPP-s with the same equipment that will be used in NPP Krško.
- Evidence of trained, qualified and certified inspection personnel for specified activities.

30 days before the start of the work, the Supplier shall submit the following documentation as a minimum:

a) Organization chart for the activity to be performed including responsibilities of personnel;
b) Inspection Plan where NPP Krško and authorized inspection organizations will define checkpoints (R, W, H, T);
c) List of applicable procedures (latest revision) and controlled copy of that procedures;
d) Personnel qualification certificates;
e) Equipment and material list with all calibration evidence and certificates.

After work is performed and the latest on the exit meeting Supplier shall prepare a Preliminary report about activities performed which includes as a minimum:
a) Overview of the scope performed;
b) List of non-conformities with their status;
c) Qualitatively judgment of the work performed

d) Inspection Plan with all checkpoints (R, W, H, T) signed

At least 30 days after the completed scope of work Supplier shall deliver Final Report (2 copies), which includes as a minimum:

a) Overview of the scope performed;
b) List of non-conformities with their status;
c) List of all applied work and control procedures;
d) List of all personnel and their certificates;
e) Equipment and material list with all calibration evidences and certificates;
f) Inspection Plan with all QA/QC reports;
g) All pages in the Final Report shall be numbered and total pages number shall be noted at the front page of the Final Report.
h) Video recordings stored on portable disk drive

11.0 NPP KRŠKO RESPONSIBILITIES

NPP Krško shall provide the following:

- All necessary applicable as-built drawings and technical details
- On-site transportation and lifting
- Site-specific training courses needed for entering the control area (2-3 days before the actual start of activity in the Reactor building)
- Supply of electric power, compressed air
- HP coverage and support for decontamination
- Radioactive waste due to a specific tool refurbishment if necessary and its decontamination will be processed and accepted by NPP Krško.

12.0 SPECIAL REQUIREMENTS

SI units shall be used throughout the project; other units shall be shown in brackets.
Each company bidding for this job shall deliver a copy of the current Written Practice in accordance with CP-189 and ASME XI, the list of NPP Krsko Outage 2025 potential VT examiners with CP-189 and ASME Sec. XI, Appendix VI VT certificates, supplier's team leader certificate (American Society for Nondestructive Testing (ASNT) Level III certificate for VT method), as defined in chapter 8.0, and the list of two (2) confirmed references of FOSAR and MRP-227 Visual Examination of Reactor Vessel Internals activities on PWR NPP-s with the same equipment that will be used in NPP Krsko.

Each company bidding for this job shall deliver a copy of the equipment and material list with all calibration evidence and certificates.

13.0 QA REQUIREMENTS

For the supply of Safety Related (SR) products and services, the Supplier shall establish a quality assurance (QA) Program that complies with the requirements of Title 10, *Code of Federal Regulations, Part 50, Appendix B (10CFR50, Appendix B), Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants*, the standard of *ANSI/ASME N45.2-1977, Quality Assurance Program Requirements for Nuclear Facilities* or *ASME NQA-1-2008, Addendum 2009/2011, Quality Assurance Requirements for Nuclear Facility Applications,* and the requirements of the enclosed specification *QS-610, Rev. 2, Generic Quality Assurance Program Requirements.*

Any noncompliance and defects shall be reported in compliance with the requirements of Title 10, *Code of Federal Regulations, Part 21 (10CFR21), Reporting of Defects and Noncompliance.*

The Supplier's bid shall be accompanied by the QA Manual of the latest revision, if not previously submitted to NEK. The relevance and effectiveness of the Supplier's QA Program shall be reviewed and approved by NEK prior to the contract award. The same shall apply to any subsequent changes proposed by the Supplier during the implementation of the purchase order.

All work shall be carried out in compliance with the Supplier's QA Program and with the previously approved Inspection Plan. In accordance with this specification, the Supplier shall also assume responsibility to require any Subcontractors to comply with the quality requirements, technical and commercial requirements, and schedules, in accordance with this specification.

Applicable Codes and Standards:

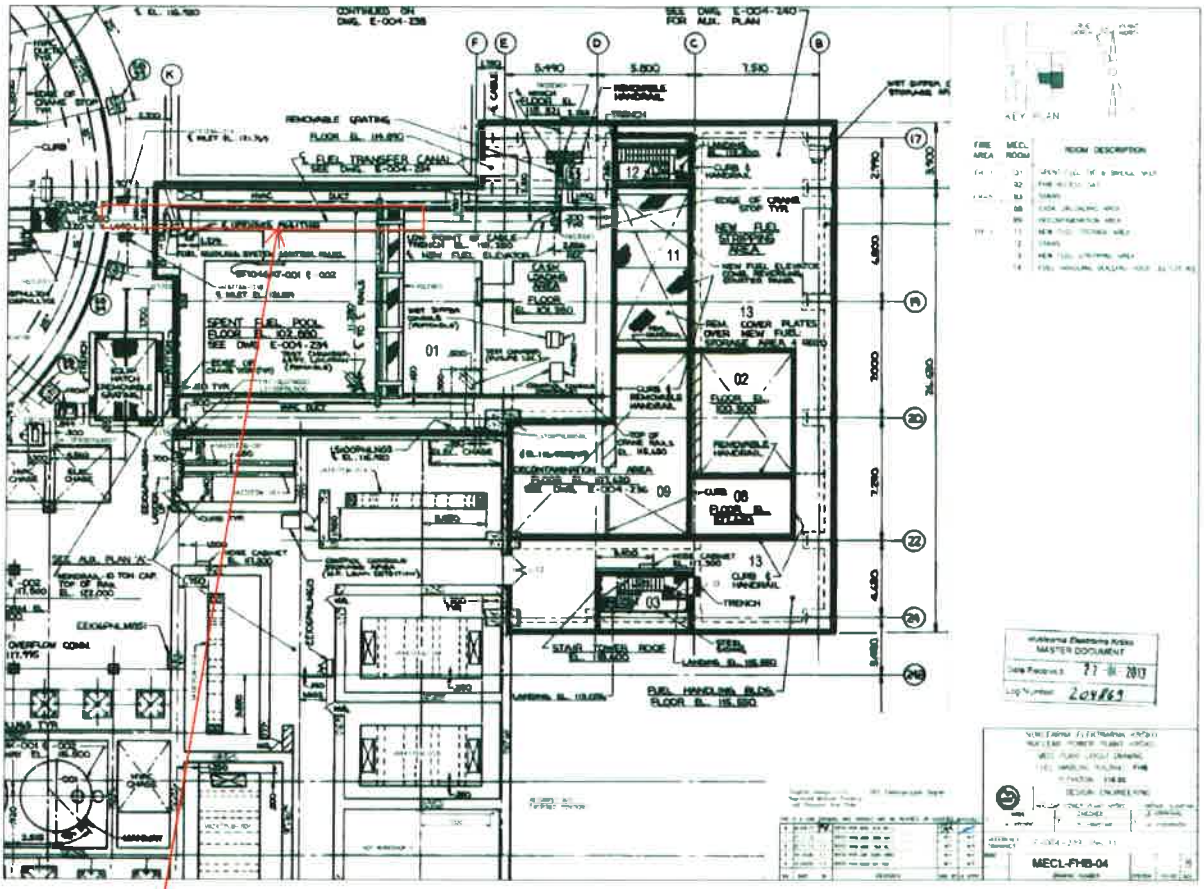
- 10 CFR 50 Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants
- 10 CFR 21, Reporting of Defects and Noncompliance
- ANSI/ASME NQA-1-2008, Addenda 2009/2011, Quality Assurance Requirements for Nuclear Facility Applications

14.0 APPENDICES

Attachments:

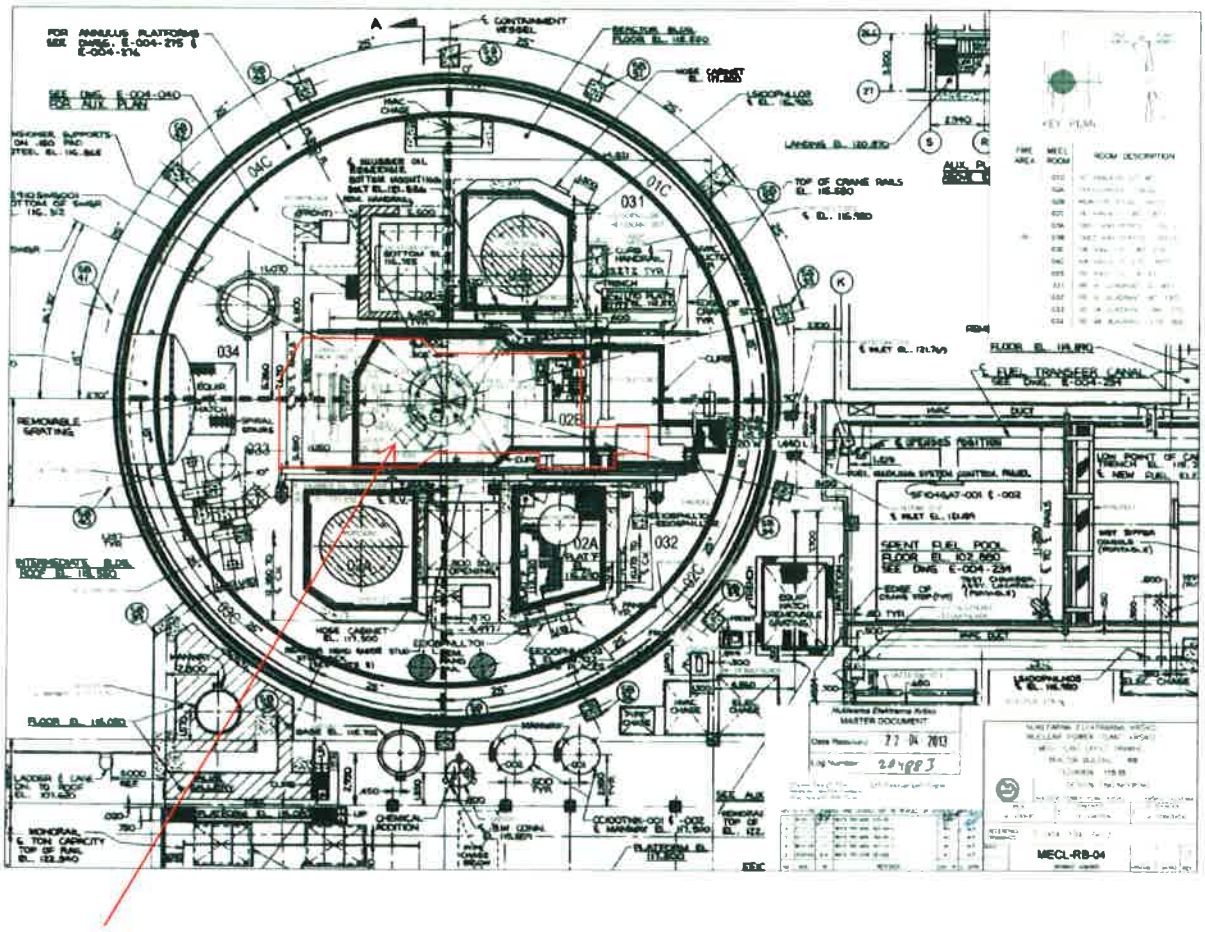
Att. 1: Fuel Transfer Chanel by the Spent Fuel Pit
Att. 2: Reactor Cavity and Reactor Vessel
Att. 3: Corel Barrel UGW

Att. 1: Fuel Transfer Canal by the Spent Fuel Pit



Fuel transfer channel

Att. 2: Reactor Cavity and Reactor Vessel



Reactor Cavity

Att. 3: Corel Barrel UGW

