



TECHNICAL SPECIFICATION

NPP Krško FIRE PSA Update

(PSR3-SNSA-FPSA-1)

Augmented Quality

Specification Number

SP-ES1447

Rev.1

KRŠKO NUCLEAR POWER PLANT

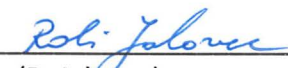
January 2024

Written by:


(dr. R. Prosen)

Date: 31 / 1 / 2024

Reviewed by:


(R. Jalovec)

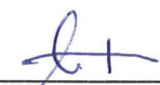
Date: 31 / 01 / 2024

Reviewed by:


(A. Antolovič)

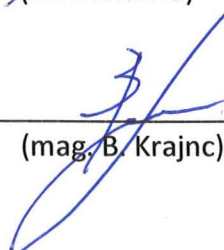
Date: 1 / 2 / 2024

Reviewed by:


(M. Mihalina)

Date: 1 / 2 / 2024

Approved by:


(mag. B. Krajnc)

Date: 1 / 2 / 2024

1. BACKGROUND

The NEK Fire PSA analysis, which was examined within the framework of the IAEA review, concludes that NEK Fire PSA is not in accordance with the latest methodological guidelines and standards for Fire PSA, which were developed after the Fire PSA was completed. The NEK Fire PSA was initially developed at the end of the 1990s and was a major input for the safety improvements with regards to fire risk. At NEK, both the PSA and Fire PSA models are generally subject to updates reflecting plant changes (plant design modifications).

New methodological guidelines, pointed out in the conclusions of the IAEA review, consists of the US NRC/EPRI methodological framework documented in NUREG/CR-6850 and other NUREG and EPRI documents.

The update related to NEK FIRE PSA model, as described in references (4.1 to 4.7, 4.11 to 4.13), will address existing discrepancies (i.e., gaps) with international standards for nuclear safety assessment (ASME PRA and IAEA standards), methodology (see 6.4 to 6.37) and domestic regulation (6.1 to 6.3). The technical scope of the update is described below. The scope is divided according to Fire PSA elements as described in reference (4.8). Further details can be found in IAEA NEK Fire PSA review report (4.8).

In view of this, the Fire PSA update is assigned a S.N. of 4 (corresponding to DOD significance, as of PSR3 issues evaluation, and was marked as PSR3 SNSA-FPSA-1 (*Named: Fire PSA Update*) (4.9). It is noted that, since the previous PSR, the NEK implemented the extensive Safety Upgrade Program (SUP) under which an independent line of defense was installed in the form of alternative systems including the Emergency Control Room.

This additional line of defense further reduced the risk, including fire risk. NEK fire safety is based on the deterministic principles which include the extensive Fire Hazard Analysis (FHA), and Post-Fire Safe Shutdown Analysis (SSA) with a principle of protected train. Fire hazard assessment is also part of any plant design modification package, according to the plant administrative procedures. It is expected that the Fire PSA update will focus on incorporating the FHA and Post-Fire SSA principles that were implemented at SUP, and that the new DEC systems, with regards to fire hazard, have high degree of independency from the existing design systems resulting in an appropriate margin of safety with regards to the fire events.

In summary, this PSR3 issue - PSR3-SNSA.FPSA-1 (4.9), describes a request for updating the NEK's Fire PSA according to the state-of-the-art methodology guidelines and standards which have been issued since the completion of the Fire PSA. The technical gaps in the existing Fire PSA are described in the *URSJV/RP-114/2020, Report of the Expert Mission on State-of-the-Art Approaches on Fire PSA* (4.8). In this document, technical gaps are divided according to the various Fire PSA elements and specific comments are provided indicating areas where updates are recommended.

A detailed scope of work is provided in the following specification section - 2. SCOPE OF WORK.

2. SCOPE OF WORK

The PSR3 SNSA-FPSA-1 Issue relates to the need for update of the NEK's Fire PSA according to the latest state-of-the-art methodological guidelines and standards. The scope of work is divided by Fire PSA elements. Technical basis for the update are available in reference (4.8).

2.1 Human Reliability Analysis

It can be concluded that the Krško NPP's HRA for the Fire PSA is outdated and not in compliance with the newest standards. These require more in-depth analysis of the needed operator fire response actions, possible undesired actions, instrumentation required for the actions, etc. Practice shows that by utilizing state-of-the-art Fire PSA HRA beneficial changes to the procedures (EOPs, AOPs, FRPs) can be identified and implemented. These improvements can eliminate detrimental actions that could increase risk, such as actions to disable operating equipment. The safety of the plant can be increased as the procedures become symptom based and risk informed.

In particular, the following aspects are to be addressed in updated NEK fire PSA study:

- Perform in-depth analysis of the needed operator fire response actions, possible undesired actions, instrumentation required for the actions, and others in both Level 1 and Level 2 Fire PSA.

Reference: (4.8), Section 3.1, on HRA Comments / Section 4. Conclusion.

2.2 MCR Abandonment Scenario

The documentation related to the establishment of the new Emergency Control Room (ECR) is to be analyzed, and if necessary is to be visited during the plant walkdown. Also, a revised HRA for the actions required for the abandonment of the MCR, and transfer to ECR is to be assessed in all details, necessary for NEK fire PSA model modeling, to be implemented in a way to reflect all the latest methodology (e.g., timelines, feasibility analysis, etc.) contained in NUREG-1921 Supplements 1&2 (6.35, 6.36).

In particular, the following aspects are to be addressed in updated fire PSA study:

- Utilizing the state-of-the-art methodology for the MCR abandonment modeling.

Reference: (4.8), Section 3.2, Conclusions on MCRA Comments / Section 4. Conclusion.

2.3 Multiple Spurious Operations Scenarios and Hot Short Probabilities

The evaluations of Multiple Spurious Operations scenarios (MSOs) should be performed for both the safe shutdown analysis and the NEK Fire PSA. The guidance for performing this analysis is provided in NEI 00-01 rev. 2 (endorsed by NRC; (6.9)) and rev. 3 (6.10). In addition, FAQ 07-0038 (6.11) provides Lessons learned on MSOs and should be used in the update modeling process. Performing the MSO expert panel can provide insights on the availability of one or more safe shutdown paths, which is valuable information for finalizing the design and procedure associated with the ECR.

In relation to hot short probabilities, the latest methodology available in NUREG-7150 (6.14) should be incorporated in the NEK Fire PSA update.

In particular, the following aspects are to be addressed in updated NEK fire PSA study:

- Perform analysis of MSOs for the NEK Fire PSA in accordance with current practice;
- Update hot short probabilities.

Reference: (4.8), Section 3.3, Conclusions on (Multiple) Spurious Operations and Hot Shorts Comments / Section 4. Conclusion.

2.4 Ignition Frequencies Determination

During the plant Fire PSA review mission, Krško NPP provided the “NPP Krško Analysis of Combination of Fire and Other Postulated Initiating Events” (documented in NEK ESD-TR-26/16 rev. 1; (4.11)), which uses methodology for calculating the fire initiating events frequencies given in the NUREG-2169 (6.18). This document still includes inconsistencies with the newest standards, such as aggressive qualitative screening of fire areas, simplified determination of the severity factors, simplified modeling of fire suppression. It can be concluded that this study represents a good starting point for updating the Krško Fire PSA.

In particular, the following aspects are to be addressed in updated NEK fire PSA study:

- Review and update as appropriate the ignition sources and ignition frequency calculations.

Reference: (4.8), Section 3.4, Conclusions on Ignition Frequency Determination Comments / Section 4. Conclusion.

2.5 Quantification and Interpretation of Results

In the original Fire PSA study, the quantification and interpretation of results are not presented in a way that meets the latest standard.

In particular, the following information is to be presented in future NEK Fire PSA update (4.14):

- Analysis of the dominant risk contributors and interpretation of results to support decision making;
- Importance measures of parameters, components fire frequencies, fire compartments, buildings, ignition sources and human errors;
- Sensitivity analysis of parameters and used assumptions;
- Uncertainty analysis.

Reference: (4.8), Section 3.5, Conclusions on the Comments Related to the Quantification and Interpretation of Results. All modelling (4.14) and analyses shall be performed by the contractor. Old full power Fire PSA model shall be upgraded or replaced, depending on the approach.

2.6 Cable Selection and Circuit Analysis

Circuit analysis is required by the latest standards. Industry experience has demonstrated that circuit analysis should be performed for all “electrically supported” basic events. The analysis of only certain basic events may be inefficient due to the routine need of justifying why the selected cables fail the equipment represented by the basic events.

During the plant review process, the cable routing database was described. The database does not have the fire area field populated for any of the cables in the plant. This information will be essential when updating the Fire PSA and safe shutdown analysis, and to meet the requirements of the latest standard. It is also noted that the existing database PC-CKS (i.e., Program Controlled Cables and Raceway Management Program) is a good starting point for the expansion of the information about the cables needed for the Fire PSA update, such as tracking cables through the raceways and compartments and performing circuit analysis.

Similar to the case of cable routing analysis, the existing Safe Shutdown Analysis and the Fire PSA are not supported by circuit analysis packages developed for the components credited in those analyses. The latest standards require detailed circuit analysis to be performed for such components.

In particular, the following aspects are to be addressed in updated NEK fire PSA study update:

- Perform circuit analysis for all electrically supported basic events.

Reference: (4.8), Section 3.6, Conclusions on Cable Selection and Circuit Analysis Comments / Section 4. Conclusion. All cable data base formatting and analyses shall be performed by the contractor. If needed, cable database shall be updated and fulfilled with missing data by the contractor. NEK will provide the Fire Hazard Analyses (4.10) (with Safe Shutdown analyses) and PC-CKS export.

2.7 Fire Modelling

The fire modelling supporting the existing Krško Fire PSA will need to be fully updated to reflect the latest methodology, fire models and applicable verification and validation (e.g., NUREG-1824 (6.19, 6.20)). This will include implementing the available special models developed for addressing specific nuclear power plant scenarios (e.g., cable fires, high energy arcing faults, etc.). It is noted that the level of detail necessary in the fire modelling analysis should support appropriate calculations of severity factors and non-suppression probabilities consistent with the treatment required by the standard. For example, very few fire scenarios (if any) require detailed fire modelling using advanced tools such as FDS. Simpler approaches can be used (e.g., FDT, CFAST) as long as the severity factors and non-suppression probabilities can be calculated in a manner commensurate with the need to understand the impact of the scenario.

In particular, the following aspects are to be addressed in updated NEK fire PSA study:

- Update the fire modeling analysis to include the latest methodology including V&V.

Reference: (4.8), Section 3.7, Conclusions to the Comments Related to Fire Modelling / Section 4. Conclusion. All modelling (4.14) and analyses shall be performed by the contractor. Old full power Fire PSA model shall be upgraded or replaced, depending on the approach.

2.8 Fire PSA Update – Level 2

The NEK Fire PSA update should account for dependence of human error probability associated to isolation of the containment as a function of the fire location. That is, depending on where the fire occurs the containment isolation could be prevented by the fire. On the other hand, if the fire does not affect the isolation function, it may cause loss of instrumentation, which would create a human error dependency. Even considering the ECR, the timeline for operator actions should be assessed considering that some time has elapsed due to the failed instrumentation, which could delay the decision to abandon the MCR.

Reference: (4.8), Section 3.8, Conclusions on the Level 2 Comments. All modelling (4.14) and analyses shall be performed by the contractor. Old full power Fire PSA model shall be upgraded or replaced, depending on the approach.

2.9 General Requirements regarding Fire PSA Update – Level 1 and Level 2

- Technical reference for Fire PSA update is provided in the latest ASME/ANS PRA standard (6.4).
- All cable data base analyses and modelling (4.10 and PC-CKS database) and all baseline model (4.14) analyses, modelling and quantification shall be performed by the contractor.
- All elements of Fire PSA (refer to Table 23.1 in Attachment) including Fire and Seismic interactions (combinations of events), uncertainties in fire analyses shall be addressed, fulfilled and updated in this Fire PSA update.
- Level 1 and Level 2 PSA shall be updated with this Fire PSA update. All in NEK documents defined Level 2 release categories (4.12, 4.13) shall be considered, analyzed, and modelled in (4.14) for all Level 1 core damage sequences.
- The Table 23.1 in addendum to this specification (Appendix C of the reference (4.8)), contains the cross-reference matrix of year 2020 methodologies for the various elements of Fire PSA, which are intended to be used in achieving the current state of practice, for the intended methodological update of the NEK FIRE PSA update. Latest standards and guides must be considered.
- Note: with this Fire PSA update/upgrade it is not planned to update the general Level 1 and Level 2 PSA methodology, but to use the current PSA model methodology for the Level 1 and Level 2 approach. For example, NEK evaluates all Level 2 release categories not only LERF categories and the existing Level 2 methodology documented in NEK technical reports shall be used for modeling. Methodology update is not planned with the Fire PSA update.

2.10 Plant Walkdown

Plant walkdown is available at any time, except inside containment. Walkdown inside containment is available only during shutdowns, that are planned in April 2024 and in October 2025.

2.11 Preparation of USAR Changes and presentation for the SNSA

Contractor shall provide a licensing documentation (Safety Evaluation Screening (SES), Safety Evaluation (SE) and USAR Change Package (UCP)). In addition, contractor shall provide presentation to the Slovenian Nuclear Safety Agency (SNSA) in the process of analysis and model approval. Contractor shall resolve all comments during licensing process.

3. SAFETY CLASSIFICATION OF WORK

This work is classified as non-safety related.

4. INPUT DATA

The following documents provide the reference information for the requested update:

- 4.1 PSA of NPP Krško Internal Fire Analysis, Rev. 1, LTA Inc., August 1999
- 4.2 Level 2 Internal Fire Analysis of NPP Krško, Rev. 0; LTA Inc.; August 1999
- 4.3 ESD-TR-07/99, Rev. 0, Integration of Level 1 and Level 2 Fire PSA into NEK Risk Spectrum PSA Model and Process Validation; NEK; November 1999

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- 4.4 ESD-TR-08/99 Rev. 0, Evolution of the Impact of FPAP4 Modifications on the Integrated NEK Risk Spectrum PSA Model; NEK; December 1999
 - 4.5 ESD-TR-23-09 Rev. 0, NE Krško FPAP Update; LTA Inc.; April 2010
 - 4.6 ESD-TR-02/19 Rev. 0 Update of PSA Model based on the Plant Changes in Cycle 29 and Updated PSA Parameters up to the end of 2018; NEK; May 2019
 - 4.7 ESD-TR-03/23 Rev. 0, Update of PSA Model based on the Plant Changes in Cycles 31 and 32; NEK; 2023
 - 4.8 URSJV/RP-114/2020 Rev. 0, Report of the Expert Mission on State-of-the-Art Approaches on Fire PSA; SNSA(URSJV); April 2020
 - 4.9 PSR3-NEK-9.2 Rev. 0, Implementation Action Plan; NEK; 27.06.2023.
 - 4.10 Fire Hazard Analysis, Rev. 10; NEK; September 2023
 - 4.11 ESD-TR-26/16 Rev. 1, Analysis of Combination of Fire and Other Postulated Initiating Events; NEK; December 2018
 - 4.12 ESD-TR-01/22 Rev. 0, Krško NPP Level 2 PSA Containment Event Tree Notebook Part 4 Quantification and Risk Assembly; NEK; 2022
 - 4.13 ESD-TR-01/23 Rev. 0, Level 2 CET update; NEK; 2023
 - 4.14 Latest available RiskSpectrum PSA baseline model
 - 4.15 ESP-2.302 Rev.6, Administration of Changes to the Updated Safety Analysis Report (USAR)
 - 4.16 ESP-2.303 Rev.7, Evaluation of Changes in NEK

Additionally, the Contractor shall define the list of all necessary inputs (NEK procedures, calcnotes, plant drawings and other documents) needed for performing the described scope of work. NEK will inform the Contractor on the availability of the requested information sources and terms in which the information can be delivered. NEK may decide that to some of the information will only be available at the NEK site.

5. APPLICABLE WORK CONTROL PROGRAM

- 5.1 A formal work control program is not applicable.

6. APPLICABLE CODES, STANDARDS, AND CRITERIA FOR THE WORK

The following codes, regulations and standards shall be used as current methodologies for the various elements of Fire PSA:

- 6.1 ZVISJV-1 "Ionising Radiation Protection and Nuclear Safety Act (ZVISJV-1)"; Official Gazette of the Republic of Slovenia; No. 76/17, 26/19, 172/21 in 18/23 – ZDU-10
- 6.2 "Rules on Radiation and Nuclear Safety Factors (JV5)"; Official Gazette of the Republic of Slovenia; No. 74/16 and 76/17 – ZVISJV-1
- 6.3 "Rules on ensuring safety after the start of operation of radiation or nuclear facilities (JV9)"; Official Gazette of the Republic of Slovenia, no. 81/16 and 76/17 – ZVISJV-1

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- 6.4 RA-S-1.1-2022 Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications; ASME; 2022
 - 6.5 NUREG-1921 EPRI/NRC-RES Fire Human Reliability Analysis Guidelines; EPRI/NRC; July 2012
 - 6.6 SSG-3 Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants; IAEA; 2010
 - 6.7 IAEA SSG-77 Protection Against Internal and External Hazards in the Operation of Nuclear Power Plants; IAEA; 2022
 - 6.8 IAEA-TECDOC-1944 Fire Protection in Nuclear Power Plants; IAEA; 2021
 - 6.9 NEI 00-01 Rev. 2, Guidance for post fire safe shutdown circuit analysis; NEI; May 2009
 - 6.10 NEI 00-01 Rev. 3, Guidance for post fire safe shutdown circuit analysis; NEI; October 2011
 - 6.11 FAQ 07-0038 Rev. 3, Lessons learned on multiple spurious operations; NRC; 2011
 - 6.12 NEI 04-02 Rev. 2, Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10CFR50.48(c); NEI; 2008
 - 6.13 NEI 04-02 Rev. 3, Guidance for Implementing a Risk-Informed, Performance-Based Fire Protection Program Under 10CFR50.48(c); NEI; 2016
 - 6.14 NUREG/CR-7150, Joint Assessment of Cable Damage and Quantification of Effects from Fire; US NRC; 2012
 - 6.15 NUREG/CR-6850, EPRI/NRC-RES Fire PRA Methodology for Nuclear Power Facilities; US NRC/EPRI; 2005
 - 6.16 NUREG/CR-6850, EPRI TR 1011989 Errata Sheet; US NRC/EPRI; May 1, 2006
 - 6.17 NUREG/CR-6850 Supplement 1(EPRI 1019259), Fire Probabilistic Risk Assessment Methods Enhancements; US NRC/EPRI; September 2010
 - 6.18 NUREG-2169, Nuclear power plant fire ignition frequency and non-suppression probability estimation using the updated fire events database; US NRC/EPRI; 2015
 - 6.19 NUREG-1824, Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications; US NRC/EPRI; May 2007
 - 6.20 NUREG-1824 Supplement 1, Verification and Validation of Selected Fire Models for Nuclear Power Plant Applications – Final Report; US NRC/EPRI; November 2016
 - 6.21 NUREG-1805, Fire Dynamics Tools (FDT) – Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program; US NRC; December 2004
 - 6.22 NUREG-1805 Supplement 1, Fire Dynamics Tools (FDTs) Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program; US NRC; July 2013
 - 6.23 NUREG/CR-7244, Response of Nuclear Power Plant Instrumentation Cables Exposed to Fire Conditions; US NRC; January 2019
 - 6.24 EPRI 3002016053, Methodology for Modeling Plant Trip Probabilities in Nuclear Power Plant Fire Probabilistic Risk Assessment; EPRI; 2019
 - 6.25 EPRI 302584, Updated Fire Events Database: Description of Content and Fire Event Classification Scheme; EPRI; 2013
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- 6.26 NUREG-2178, Refining and Characterizing Heat Release Rates from Electrical Enclosures During a Fire; US NRC; April 2016
 - 6.27 EPRI 3002000830, FIVE Rev. 2; EPRI; 2014
 - 6.28 NUREG-1934, Nuclear Power Plant Fire Modeling Analysis Guidelines; US NRC/EPRI; November 2012
 - 6.29 NUREG/CR-6931 Vol. 3, THIEF Model for cable heating; US NRC; April 2008
 - 6.30 NUREG-2180, Determining the Effectiveness, Limitations, and Operator Response for Very Early Warning Fire Detection Systems in Nuclear Facilities (DELORES-VEWFIRE) - Incipient detection; US NRC; December 2016
 - 6.31 NUREG/CR-7102, Kerite Analysis in Thermal Environment of FIRE (KATE-Fire): Test Results – Final Report; US NRC; December 2011
 - 6.32 NUREG-2230, Methodology for Modeling Fire Growth and Suppression Response of Electrical Cabinet Fires in NPPs; US NRC/EPRI; June 2020
 - 6.33 NUREG-2233, Methodology for Modeling Transient Fires in Nuclear Power Plant Fire Probabilistic Risk Assessment; US NRC; October 2020
 - 6.34 NUREG-1921, EPRI/NRC-RES Fire Human Reliability Analysis Guidelines; US NRC/EPRI; July 2012
 - 6.35 NUREG-1921 Supplement 1, EPRI/NRC-RES Fire Human Reliability Analysis Guidelines - Qualitative Analysis for Main Control Room Abandonment Scenarios; US NRC/EPRI; January 2020
 - 6.36 NUREG-1921, Supplement 2, EPRI/NRC-RES Fire Human Reliability Analysis Guidelines - Quantification Guidance for Main Control Room Abandonment Scenarios; EPRI; Draft Report, March 2018
 - 6.37 NUREG-1855, Rev. 1, Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-informed Decision Making; US NRC; March 2017

7. AFFECTED SYSTEM

Not applicable.

8. IDENTIFICATION OF AFFECTED EQUIPMENT

Not applicable.

9. REVIEW AND/OR VERIFICATION OF THE WORK

- 9.1 The Contractor is required to provide first drafts of each Fire PSA notebook (i.e., report deliverable), which will be reviewed by the NEK. NEK will review the documents and prove comments to the Contractor, who will issue a final version of the reports after comments have been resolved to NEK satisfaction. There could be more than one iteration to finalize the report.
- 9.2 The Contractor shall provide all reference documents, calculations and other documents to complete work package. This will be needed for more expedient NEK review process.

10. SCHEDULE REQUIREMENTS

10.1 Overall Schedule Requirements for project deliverables (milestone dates) are following:

<i>Description</i>	<i>Milestone</i>
Final report(s): NEK Outside Containment Walkdown Report(s)	November 1st, 2024
Final report(s): NEK Inside Containment Walkdown Report(s)	(July 1st, 2024) December 1st, 2025
Preliminary Fire PSA Notebooks: NEK FIRE PSA Level 1	February 1st, 2026
Final Fire PSA Notebooks: NEK FIRE PSA Level 1	June 1st, 2026
Preliminary Fire PSA Notebooks: NEK FIRE PSA Level 2	September 1st, 2026
Final Fire PSA Notebooks: NEK FIRE PSA Level 2	November 1st, 2026
USAR change package, SES and SE	December 1st, 2026
USAR change package, SES and SE approved by SNSA	April 1st, 2027

11. STATUS REPORTING REQUIREMENTS

- 11.1 The Contractor shall provide written status reports on a monthly basis including schedule updates to NEK.
- 11.2 Details of contents of monthly status reports should be proposed in Contractor's PMM (Project Management Manual), but at least the following should be included: general work status report, a four week look ahead activities, technical and schedule challenges and proposed corrective actions to ensure milestone schedule dates are achieved.
- 11.3 Due to the tight time schedule the progress of required task shall be communicated via e-mails, MS Teams, with presentations of partial results, preliminary reports etc.
- 11.4 Pro-active approach to problem solution is requested.

12. WORK TO BE PERFORMED OR INFORMATION TO BE PROVIDED BY NEK

- 12.1 The NEK Project Manager will provide the overall project coordination from NEK side. In the first phase, NEK will perform detailed review of bidder documents, which is the subject of coordination before contract assignment.

- 12.2 During the initial project phase, NEK will provide all available plant documentation and plant design reference documents which will be needed.
- 12.3 NEK will also coordinate and perform review of all generated documents developed as an interim or final product.
- 12.4 NEK will support contractor experts with technical specialists on area where needed to describe, support, or clarify opened technical issues.

13. CHANGES OF WORK SCOPE

The Contractor shall identify any scope changes that could cause an impact the Contractor's cost or schedule of the project by the issuance of a Contractor Change of Work Scope Request. The Contractor shall not proceed with a change in the scope of the Work until written approval has been authorized by NEK. It is the Contractor's obligation to notify the NEK Responsible Commercial Person, writing of the noted scope change and it is the responsibility of the NEK Responsible Commercial Person to attempt to respond within 15 working days of the acceptability of the Contractors scope change request. Unauthorized Work will not be reimbursed by NEK.

14. DELIVERABLES TO BE PROVIDED BY THE CONTRACTOR

14.1 BID PROPOSAL DELIVERABLES

With the Bid Proposal the following deliverables are required:

14.1.1 Technical Approach Plan (TAP)

For details see Section 17.

14.1.2 References

The Contractor's and Subcontractor's relevant references, in the area of PSA and Fire PSA Analyses, shall be submitted to NEK.

The Contractor shall submit personal certificates with referent jobs and qualifications of all responsible (key) personnel.

14.1.3 Project Management Manual (PMM),

PMM should among others include project scope and schedule, an organization chart for this project with names of the responsible persons, communication protocol, co-ordination meetings (also see Item 11.2)

14.1.4 Project Quality Plan (PQP)

14.2 PROJECT DELIVERABLES

14.2.1 The Contractor shall prepare and hand over the following deliverables:

Deliverable Item	Number of Copies
Preliminary report: NEK FIRE PSA Level 1 including updated PSA model	1 (Adobe pdf) RS model

Deliverable Item	Number of Copies
Preliminary report: NEK FIRE PSA Level 2 including updated PSA model	1 (Adobe pdf) RS model
Final report: NEK Outside Containment Walkdown report	2 (Hard Copies) 1 (Adobe pdf)
Final report: NEK Inside Containment Walkdown report	2 (Hard Copies) 1 (Adobe pdf)
Final report: NEK FIRE PSA Level 1 including updated PSA model	2 (Hard Copies) 1 (Adobe pdf) RS model
Final report: NEK FIRE PSA Level 2 including updated PSA model	2 (Hard Copies) 1 (Adobe pdf) RS model
Licensing documentation (SES, SE, UCP) including presentation for SNSA	1 (MS Word docx) 1 (Adobe pdf) 1 (MS PowerPoint)

14.2.2 Documents to be provided by the Contractor:

- a. Copy of all used references, calculations, detailed evaluation worksheets and other documents essential for review, verification or approval of work been performed. Deliverables should be sent to the NEK Project Manager according to the schedule.
- b. Updated NEK PSA baseline model.
- c. Additional versions of NEK PSA models that were used for sensitivity studies if applicable.

14.2.3 All deliverables will be reviewed and approved by NEK. NEK will formally review and comment any of deliverables within two months.

14.2.4 Contractor shall resolve all open items based on NEK and SNSA comments prior to seeking NEK approval.

14.2.5 Electronic versions shall be provided in MS Word (.docx) format, MS Excel (.xlsx) as well as searchable Adobe Acrobat (.pdf) format and PSA model in RS format.

14.2.6 All documentation shall be written in English.

15. DOCUMENTS AND RECORDS

- 16.1 All the final and interim documents in connection with the work implementation shall be delivered to NEK in the prescribed format in time.
- 16.2 Verification and validation records shall be in accordance with applicable Contractor procedures (QA manual).

16. ORGANIZATIONAL CONTACT

- 16.1 The Contractor shall coordinate all technical and schedule matters with PM / PEs.

NEK representatives:

NEK Project Manager (PM):

dr. Rudolf Prosen
Phone: +386 7 480 2533
E-mail: rudolf.prosen@nek.si

NEK Project Engineers (PE):

Robi Jalovec
Phone: +386 7 480 2529
E-mail: robi.jalovec@nek.si

Barbara Grobelnik
Phone: +386 7 480 2512
E-mail: barbara.grobelnik@nek.si

The Contractor shall coordinate all technical and schedule matters with the NEK Responsible PM, PEs and REs.

- 16.2 NEK Responsible Engineers (RE):

For fire hazard	Damir Kopinč Phone: +386 7 480 2324 E-mail: damir.kopinc@nek.si
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For PC-CKS	Boris Pisanski Phone: +386 7 480 2622 E-mail: boris.pisanski@nek.si
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- 16.3 Commercial items are to be addressed with the NEK Commercial Department representative defined in contract.

17. CONTRACTOR TECHNICAL APPROACH TO WORK

The Contractor is fully responsible for organization and performance of work in the scope and requirements of the given specification. The Contractor shall prepare a Technical Approach Plan which will outline how the work is going to be performed (documentation review, interviews, walkdowns, etc.). It should also contain Contractor's interpretation of scope of work, as described by this specification.

The project is to be performed in close cooperation between NEK and the Contractor. The project team members will work in their own offices, with regular contacts via e-mails and co-ordination meeting as needed (refer also to 11.3).

The Contractor will conduct a Fire PSA upgrade according to Chapter 2 of this specification.

18. ACCESS TO CONTRACTOR FACILITY AND DOCUMENTS

For the purpose of reviewing the quality and the amount of the work being performed, a Contractor will provide access to Contractor's or to its Authorized Sub-contractor's working process to NEK. A Contractor will introduce to NEK Contractor's/Sub-contractor's personnel assigned to contracted work.

19. SUBCONTRACTED WORK

The Contractor could subcontract any portion of the Work. The subcontracted work could not be subcontracted without the written approval of the NEK Responsible Manager. Subcontractors will be required to be technically qualified to the satisfaction of NEK criteria.

20. SUPPORT OF APPROVAL PROCESS AT SLOVENIAN NUCLEAR SAFETY ADMINISTRATION

The Contractor shall be responsible to provide NEK all necessary support for approval process (meetings, presentations, additional justification) as requested by Slovenian Nuclear Safety Administration (SNSA).

21. QUALITY ASSURANCE REQUIREMENTS

- 21.1 Contractor's Quality Manual review and acceptance by the Purchaser shall be a prerequisite for selection of Bidder as a Contractor. The Contractor shall implement and maintain this program while carrying out the requirements of this specification. All proposed changes to the program shall be submitted and approved by the Purchaser prior to the implementation. The Contractor has the responsibility for QA activities for all work pursuant to this Specification. All technical and quality requirements shall be met. All work performed by Subcontractor(s) shall be subject to the technical and quality requirements of this Specification as well. The Contractor shall be responsible for all subcontracted activities.
- 21.2 The work shall be performed in accordance with Contractor's QA Program, which complies with ISO 9001 or a comparable standard, and applicable requirements of NEK QS 610 rev.2.
- 21.3 A record system shall be established and maintained by the Contractor to provide a documentary evidence of the quality of performed activities. Records shall, as a minimum,

identify the Purchaser's name, Purchaser's order number, inspector or data recorder, inspection date, type of observation, procedures used, results, acceptability, and action taken with any deficiencies noted. Records of inspection shall also include identity of drawings and procedures utilized, along with the revision level. All quality verification records, procedures, and qualifications shall be identifiable to the activity involved.

- 21.4 If the Contractor's QA Program Manual has not been previously accepted by NEK, it shall be submitted to NEK as part of Proposal.

22. NEK PROPRIETARY DATA

NEK has a proprietary interest in all of the drawings, designs, specifications, documents, information or know-how that may be furnished pursuant contract execution. Also, NEK has a proprietary interest in any know-how, improvement, discovery or invention which may be made, developed, or conceived in the performance of work hereunder or which may arise or result there from (hereinafter collectively referred to as the "Information"). All such information shall be considered to be proprietary to the NEK. The right to use of all such Information shall be transmitted to the Contractor only for its personnel use and shall be entirely restricted to the performance of the Contract and subject to the confidentiality provision.

23. ATTACHMENTS

Table 23.1

The Appendix C, of the reference (4.8) contains the cross-reference matrix of year 2020 methodologies for the various elements of Fire PSA, which will aid in achieving the current state of practice, for the intended methodological update of the NEK FIRE PSA update. Latest standards and guides have to be considered.

Table 23.1 APPENDIX C: THE MATRIX

NUREG/CR-6850 Tasks	Related Documentation	Description of Documentation	Disposition	ADAMS Reference(s)
<u>Task 1: Plant Boundary Definition and Partitioning</u>	None		Active	N/A
<u>Task 2: Fire PRA Component Selection</u>	<i>NEI 00-01, Rev. 3</i>	Guidance for Post-Fire Safe Shutdown Circuit Analysis	Active, use for generic MSO list only	ML112910147
<u>Task 3: Fire PRA Cable Selection</u>	<i>NEI 00-01, Rev. 2</i>	Guidance for Post-Fire Safe Shutdown Circuit Analysis	Active and endorsed	ML091770265
	<i>NEI 00-01, Rev. 3</i>	Guidance for Post-Fire Safe Shutdown Circuit Analysis	Draft, use for generic MSO list only	ML112910147
	<i>NEI 00-01, Rev. 4</i>	Guidance for Post-Fire Safe Shutdown Circuit Analysis	Draft, under review by NRC	ML16312A019
	<i>NUREG/CR-7150, Vol. 1</i>	Joint Assessment of Cable Damage and Quantifications of Effects from Fire (JACQUE-FIRE)	Active	ML12313A105
	<i>NUREG/CR-7150, Vol. 3</i>	Joint Assessment of Cable Damage and Quantification of Effects from Fire (JACQUE-FIRE).	Active	ML17331B098
	<i>NUREG/CR-7244</i>	Response of Nuclear Power Plant Instrumentation Cables Exposed to Fire Conditions	Active	ML19022A293
<u>Task 4: Qualitative Screening</u>	None		Active	N/A
<u>Task 5: Fire-Induced Risk Model</u>	<i>NEI 00-01, Rev. 2</i>	Guidance for Post-Fire Safe Shutdown Circuit Analysis	Active and endorsed	ML091770265
	<i>NEI 00-01, Rev. 3</i>	Guidance for Post-Fire Safe Shutdown Circuit Analysis	Draft, use for generic MSO list only	ML112910147
	<i>NUREG-1921, Supplement 1</i>	Qualitative Guidance for Main Control Room Abandonment Scenarios, Chapter 3 provides guidance on modeling requirements for main control room abandonment	Active	ML16110A413
	<i>EPRI 3002016053</i>	Methodology for Modeling Plant Trip Probabilities in Nuclear Power Plant Fire Probabilistic Risk Assessment	Active	N/A
<u>Task 6: Fire Ignition Frequencies</u>	<i>EPRI 302584</i>	Updated Fire Events Database: Description of Content and Fire Event Classification Scheme	Active	N/A
	<i>FAQ 06-0016 (NUREG/CR-6850 Supp 1), Ch.3</i>	Clarification & enhancement of ignition source counting guidance for electrical cabinets	Active	ML103090242

NUREG/CR-6850 Tasks	Related Documentation	Description of Documentation	Disposition	ADAMS Reference(s)
	<i>FAQ 06-0017 (NUREG/CR-6850 Supp 1), Ch. 4</i>	Clarification & enhancement of ignition source counting guidance for high energy arcing faults	Active	ML103090242
	<i>FAQ 06-0018 (NUREG/CR-6850 Supp 1), Ch. 5</i>	Clarification & enhancement of ignition source counting guidance for main control boards	Active	ML103090242
	<i>FAQ 07-0031 (NUREG/CR-6850 Supp 1), Ch. 6</i>	Counting for miscellaneous ignition sources bins by NFPA 805 transition applicants. Clarification of miscellaneous ignition source binning	Active	ML103090242
	<i>FAQ 07-0035 (NUREG/CR-6850 Supp 1), Ch. 7</i>	Bus duct counting guidance for high energy arcing faults	Active	ML103090242
	<i>FAQ 08-0042 (NUREG/CR-6850 Supp 1), Ch. 8</i>	Clarification to guidance for fire propagation from electrical cabinets	Active	ML103090242
	<i>FAQ 12-0064</i>	Influence factors for transient and hotwork fires	Active - available treatment refinement if supported by plant procedures - otherwise, same as pre-existing guidance	ML12346A488 ML122580425 ML122550050
	<i>FAQ 13-0005</i>	Counting and modeling of Self Ignited Cable Fire and Cable Fires due to Welding and Cutting	Active	ML13319B181
	<i>FAQ 13-0006</i>	Junction Box modeling in Fire PRA	Active	ML13331B213
	<i>FAQ 14-0008</i>	Main Control Board Treatment, Clarification on counting the main control board	Active	ML14190B307
	<i>FAQ 14-0007</i>	Floor Area Based Transient Apportionment	Active - available treatment refinement if supported by plant procedures - otherwise, same as pre-existing guidance	ML18088B020 ML18088B096
	<i>FAQ 16-0010</i>	Alternative Methods for FPRA Ignition Frequency Weighting Factors	Active	ML17258A638 ML17258A686
	<i>ML12171A583</i>	Recent Fire PRA Methods Review Panel Decisions and EPRI 1022993	Active	ML12171A583

NUREG/CR-6850 Tasks	Related Documentation	Description of Documentation	Disposition	ADAMS Reference(s)
	NUREG-2169	Nuclear power plant fire ignition frequency and non-suppression probability estimation using the updated fire events database	Active, replaces FAQ 08-0048 (NUREG/CR-6850 Supp 1)	ML15016A069
<u>Task 7: Quantitative Screening</u>	None		Active	N/A
<u>Task 8: Scoping Fire Modeling</u>	FAQ 08-0043 (NUREG/CR-6850 Supp 1), Ch. 12	Provide additional guidance on the location of Fires caused by electrical cabinets	Active	ML103090242
	FAQ 08-0044 (NUREG/CR-6850 Supp 1), Ch. 9	Expand on the existing guidance for the treatment of oil leaks and fires	Active	ML103090242
	FAQ 14-0009	Provides clarification for the treatment of fire propagation from well-sealed MCC electrical cabinets with voltage levels at 440V or greater	Active	ML15114A441 ML15118A810
	ML12171A583	Recent Fire PRA Methods Review Panel Decisions and EPRI 1022993	Active	ML12171A583
	NUREG-2178, Vol 1	Refining and Characterizing Heat Release Rates from Electrical Enclosures During a Fire	Active, alters Appendix G, captures NUREG/CR-4527, NUREG/CR-7010 Vol 1, NUREG/CR-7197	ML16110A140 ML16117A300
<u>Task 9: Detailed Circuit Failure Analysis</u>	NEI 00-01, Rev. 2	Guidance for Post-Fire Safe Shutdown Circuit Analysis	Active and endorsed	ML091770265
	NEI 00-01, Rev. 3	Guidance for Post-Fire Safe Shutdown Circuit Analysis	Draft, use for generic MSO list only	ML112910147
	NEI 00-01, Rev. 4	Guidance for Post-Fire Safe Shutdown Circuit Analysis	Draft, under review by NRC	ML16312A019
	NUREG/CR-7150, Vol. 1	Joint Assessment of Cable Damage and Quantifications of Effects from Fire (JACQUE-FIRE)	Active	ML12313A105
	NUREG/CR-7150, Vol. 3	Joint Assessment of Cable Damage and Quantification of Effects from Fire (JACQUE-FIRE).	Active	ML17331B098
<u>Task 10: Circuit Failure Mode Likelihood Analysis</u>	FAQ 08-0047 (NUREG/CR-6850 Supp 1), Ch. 15	Additional guidance on the determination of circuit failure probabilities for components with multiple electrical cables within a fire area or compartment (Spurious Operation Probability)	Active	ML103090242
	NUREG/CR-7150, Vol. 1	Joint Assessment of Cable Damage and Quantifications of Effects from Fire (JACQUE-FIRE)	Active	ML12313A105

NUREG/CR-6850 Tasks	Related Documentation	Description of Documentation	Disposition	ADAMS Reference(s)
	<i>NUREG/CR-7150, Vol. 2</i>	Joint Assessment of Cable Damage and Quantifications of Effects from Fire (JACQUE-FIRE)	Active	ML14141A129
	<i>NUREG/CR-7150, Vol. 3</i>	Joint Assessment of Cable Damage and Quantification of Effects from Fire (JACQUE-FIRE).	Active	ML17331B098
Task 11: Detailed Fire Modeling	EPRI 3002000830	FIVE Rev 2	Active	N/A
	<i>FAQ 07-0035 (NUREG/CR-6850 Supp 1), Ch. 7</i>	Bus duct counting guidance for high energy arcing faults	Active	ML103090242
	<i>FAQ 08-0042 (NUREG/CR-6850 Supp 1), Ch. 8</i>	Clarification to guidance for fire propagation from electrical cabinets	Active	ML103090242
	<i>FAQ 08-0043 (NUREG/CR-6850 Supp 1), Ch. 12</i>	Provide additional guidance on the location of Fires caused by electrical cabinets	Active	ML103090242
	<i>FAQ 08-0052 (NUREG/CR-6850 Supp 1), Ch. 17</i>	Provide additional guidance on the fire growth rate for transient fires within the plant and the treatment of transient fires within the control room	Active, alters Appendix G	ML103090242
	<i>FAQ 13-0004</i>	Modeling treatment for sensitive electronics	Active, alters Appendix S	ML13322A085
	<i>FAQ 13-0005</i>	Counting and modeling of Self Ignited Cable Fire and Cable Fires due to Welding and Cutting	Active	ML13319B181
	<i>FAQ 13-0006</i>	Junction Box modeling in Fire PRA	Active	ML13331B213
	<i>FAQ 14-0008</i>	Main Control Board Treatment	Active, alters Appendix L	ML14190B307
	<i>FAQ 14-0009</i>	Provides clarification for the treatment of fire propagation from well-sealed MCC electrical cabinets with voltage levels at 440V or greater	Active	ML15114A441 ML15118A810
	<i>ML12171A583</i>	Recent Fire PRA Methods Review Panel Decisions and EPRI 1022993	Active	ML12171A583
	<i>NUREG-1805</i>	Fire Dynamics Tools, Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program	Active	ML043290075
	<i>NUREG-1805 (Supplement 1)</i>	Fire Dynamics Tools, Quantitative Fire Hazard Analysis Methods for the U.S. Nuclear Regulatory Commission Fire Protection Inspection Program (Supplement 1)	Active	ML13211A097 ML13211A098

NUREG/CR-6850 Tasks	Related Documentation	Description of Documentation	Disposition	ADAMS Reference(s)
	<i>NUREG-1824</i>	Fire Modeling Verification and Validation	Active	ML071650546 ML071730305 ML071730493 ML071730499 ML071730527 ML071730504 ML071730543
	<i>NUREG-1824 (Supplement 1)</i>	Fire Modeling Verification and Validation	Active	ML16309A011 ML16132A545 ML16132A547 ML16132A549 ML16132A560
	<i>NUREG-1934</i>	Nuclear Power Plant Fire Modeling Analysis Guidelines	Active	ML12314A165
	<i>NUREG-2169</i>	Nuclear power plant fire ignition frequency and non-suppression probability estimation using the updated fire events database	replaces FAQs 08-0048 and 08-0050 (NUREG/CR-6850 Supp 1)	ML15016A069
	<i>NUREG-2178, Vol. 1</i>	Refining and Characterizing Heat Release Rates from Electrical Enclosures During a Fire	Active, alters Appendix G, captures NUREG/CR-4527, NUREG/CR-7010 Vol 1, NUREG/CR-7197	ML16110A140 ML16117A300
	<i>NUREG-2178, Vol. 2</i>	Refining and Characterizing Heat Release Rates from Electrical Enclosures During Fire Fire modeling guidance for electrical cabinets, electric motors, indoor dry transformers, and the main control board	EPRI Document Issued awaiting NUREG	ML19087A210
	<i>NUREG/CR-6931 Vol 3</i>	THIEF Model for cable heating	Active	ML081190261
	<i>NUREG-2180</i>	Incipient detection	Active, replaces FAQ 08-0046 (NUREG/CR-6850 Supp 1)	ML16343A058

NUREG/CR-6850 Tasks	Related Documentation	Description of Documentation	Disposition	ADAMS Reference(s)
	FAQ 16-0011	Cable tray ignition	Active, alters Appendix R, used instead of FAQ 08-0049 (NUREG/CR-6850 Supp 1)	ML18074A020 ML18074A021
	FAQ 17-0013	HEAF non suppression probabilities	Active, replaces FAQ 08-0050	ML18075A071 ML18075A083
	FAQ 08-0053	Kerite-FR Cable Failure Thresholds	Active	ML121440155 ML120580405 ML120580635 ML120060267 ML082660021
	NUREG/CR-7102	Kerite Analysis in Thermal Environment of FIRE (KATE-Fire): Test Results	Active	ML11333A033
	NUREG-2230	Methodology for Modeling Fire Growth and Suppression Response of Electrical Cabinet Fires in NPPs	Active	ML19087A215
	NUREG-2233	Methodology for Modeling Transient Fires in Nuclear Power Plant Fire Probabilistic Risk Assessment	Active	ML19345F683
	NUREG-2262	High Energy Arcing Fault Frequency and Consequence Modeling	Active	ML23108A113
<u>Task 12: Post-Fire Human Reliability Analysis</u>	NUREG-1921	Fire Human Reliability Analysis Guidelines	Active	ML12216A104
	NUREG-1921, Supplement 1	Qualitative Guidance for Main Control Room Abandonment Scenarios	Active	ML20035E043
	NUREG-1921, Supplement 2	Main control room abandonment guidelines for quantitative HRA	EPRI Document Issued awaiting NUREG	ML19162A376 ML19162A377 ML19162A376
<u>Task 13: Seismic-Fire Interactions Assessment</u>	None		Note - in PRA Std but in process of being removed from Part 4.	N/A
<u>Task 14: Fire Risk Quantification</u>	None			N/A

NUREG/CR-6850 Tasks	Related Documentation	Description of Documentation	Disposition	ADAMS Reference(s)
<u>Task 15: Uncertainty and Sensitivity Analyses</u>	<i>NUREG-1855, Revision 1</i>	Guidance on the Treatment of Uncertainties Associated with PRAs in Risk-informed Decision Making	Active	ML17062A466
<u>Task 16: Fire PRA Documentation</u>	None			
<u>Support Task A: Plant Walkdowns</u>	None			
<u>Support Task B: Fire PRA database system</u>	None			
<u>Primary Reference Documents</u>	NUREG/CR-6850, Volume 1	Fire PRA Methodology for Nuclear Power Facilities, Summary and Overview	Active	ML15167A401
	NUREG/CR-6850, Volume 2	Fire PRA Methodology for Nuclear Power Facilities, Detailed Methodology	Active	ML15167A411
	NUREG/CR-6850, Supplement 1	Fire PRA Methods Enhancements	Active	ML103090242
	NUREG/CR-6850 Errata	Errata from May 1, 2006	Active	ML061630360