

Technical Information

**Technical Support for The Probability of Ex-vessel  
Core Debris Coolability and Basemat Melt-Through  
for Kori 3&4 and Hanbit 3&4**

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## **[Appendix A - SCOPE OF SERVICES AND METHOD OF PERFORMANCE]**

### **1.0 PURPOSE**

KEPCO E&C is responsible for the Periodic Safety Review – Probabilistic Safety Assessment (PSR – PSA) of Kori Nuclear Power Plant Unit 3&4 and Hanbit Nuclear Power Plant Unit 3&4 services (Service Specification: 22-S-X-0020). The purpose of this work scope is to promote the safety issue regarding the Molten Core – Concrete Interaction (MCCI) phenomena. The goal of this work is to ensure the reliability of the analysis result on the ex-vessel debris coolability by the up-to-date plant specific analysis with a parametric uncertainty study.

Therefore, in order to perform the enhanced safety assessment for the MCCI phenomena, KEPCO E&C aims to get technical support from the Contractor to accomplish the following goals:

- Review the up-to-date plant specific design condition affecting the MCCI phenomena
- Evaluate and review the probability of the core debris cool-down in the reactor cavity during At-Power operation.

### **2.0 TECHNICAL SCOPE OF WORK**

Contractor shall provide the following engineering services to KEPCO E&C as described in the following tasks:

#### **Task 1. Probability and Uncertainty analysis of the MCCI phenomena for The Kori 3&4**

In this task, the Contractor shall provide consulting service for the probability and the uncertainty analysis regarding the MCCI phenomena for the Kori nuclear power plant unit 3&4.

- Probability of ex-vessel core debris coolability & basemat melt-through with the uncertainty analysis: The Contractor shall provide for ex-vessel debris coolability and basemat melt-through, and address its uncertainty. To do this, the Contractor shall perform the analysis in the following manner.
  - (1) Shake down of KN3&4 parameter file
    - Steady state and null transient analysis will be performed.
  - (2) Uncertainty analysis for estimating probability of the ex-vessel debris coolability and basemat melt-through
    - Select important MAAP parameters affecting the ex-vessel debris coolability and basemat melt-through.
    - For each parameter, define probability distribution between the minimum and the maximum values.
    - Uncertainty analysis for given MAAP parameters and probability distribution using Latin Hypercube Sampling (LHS).
    - Create MAAP input decks for uncertainty analysis.

- Determine the probability of debris cooling-down and basemat melt-through from the results of uncertainty.

(3) Results

- Run all the MAAP cases, check results, and debugging.
- Final report summarizing inputs and results.
- Perform QA review of results.

**Task 2. Probability and Uncertainty analysis of the MCCI phenomena for The Hanbit 3&4**

In this task, the Contractor shall provide consulting service for the probability and the uncertainty analysis regarding the MCCI phenomena for the Hanbit nuclear power plant unit 3&4.

- Probability of ex-vessel core debris coolability & basemat melt-through with the uncertainty analysis: The Contractor shall provide for ex-vessel debris coolability and basemat melt-through, and address its uncertainty. To do this, the Contractor shall perform the analysis in the following manner.

(1) Shake down of HN3&4 parameter file

- Steady state and null transient analysis will be performed.

(2) Uncertainty analysis for estimating probability of the ex-vessel debris coolability and basemat melt-through

- Select important MAAP parameters affecting the ex-vessel debris coolability and basemat melt-through.
- For each parameter, define probability distribution between the minimum and the maximum values.
- Uncertainty analysis for given MAAP parameters and probability distribution using Latin Hypercube Sampling (LHS).
- Create MAAP input decks for uncertainty analysis.
- Determine the probability of debris cooling-down and basemat melt-through from the results of uncertainty.

(3) Results

- Run all the MAAP cases, check results, and debugging.
- Final report summarizing inputs and results.
- Perform QA review of results.

**Task 3. Kickoff, Progress, and Final Technical Meetings**

In this task, all scopes of work are addressing the technical meetings with the Contractor and KEPCO E&C.

- Kickoff Meeting: The Contractor shall prepare/host one kickoff meeting with KEPCO E&C. The meeting shall be held as a virtual meeting such as video conference.
- Progress Meeting: The Contractor shall host one virtual progress meeting with KEPCO E&C. The meeting shall be held as a virtual meeting such as video conference.
- Final Meeting: After the end of Task 2, the face-to-face meeting will be held at the Contractor's office. The meeting shall be 3 days long
- Time schedule or manner of meeting can be adjusted due to COVID19.

#### **Task 4. Documentation and Review**

In this task, the Contractor shall provide two (2) final report to incorporate the review comments from the KEPCO E&C. QA review shall be performed on the electric files and the report based on the Contractor's QA procedure.

### **4.0 METHOD OF PERFORMANCE**

#### **Consulting Schedule**

The contract period shall be 12 months from the Execution Date.

Action Items	1	2	3	4	5	6	7	8	9	10	11	12
Task 1 <sup>1)</sup>												
Task 2 <sup>1)</sup>												
Task 3 <sup>1), 2)</sup>												
Task 4 <sup>1)</sup>												

1) The detailed time schedule for each task can be adjusted according to the agreement with the Contractor and KEPCO E&C.

2) The detailed time schedule for the Task 3 (Progress meetings) can be adjusted according to progress.

#### **Method of Performance**

KEPCO E&C will provide the information and the necessary documents after signing of the Contract, and will communicate and have discussions to expedite the progress of each task.

The Contractor shall submit each deliverable of each Task within Date of Submittal. The Contractor shall finalize each deliverable to incorporate KEPCO E&C's review comments and their resolutions.

KEPCO E&C will visit Contractor's office to discuss the major agenda, and conduct the face-to-face review on each Task.

The Contractor shall keep confidential all the data and information in connection with this Contract, and shall not divulge them to any third parties. Also, the Contractor shall destroy all documents, data, information, etc. provided by KEPCO E&C immediately after completion of the service.

### Deliverables

The final deliverables are fully verified technical report which incorporates the KEPCO E&C's comments and all of the analysis input and output files in the tasks.

KEPCO E&C will provide the deliverables to the Korea Hydro & Nuclear Power Co. (KHNP), the prime client of this Contract, also KHNP would use the results.

No.	Activities/Deliverables	Date of Submittal
1	Presentation materials for each meeting of Task 3 - Two (2) virtual meeting - One (1) face to face meeting	Within 2 weeks after each meeting
2	Draft report, electronic files for the uncertainty study of MCCI for Kori 3&4 - One (1) draft report (The report or an memo involve the detail contents of Task 1)	T0* + 6 months
3	Draft report, electronic files for the uncertainty study of MCCI for Hanbit 3&4 - One (1) draft report (The report or an memo involve the detail contents of Task 2)	T0 + 8 months
5	Final reports: Final reports shall incorporate all KEPCO E&C's comments and Contractor's resolutions - Two (2) final reports for all tasks**	T0 + 12 months

\* T0: Execution Date

\*\* Two final reports for Task 1 and Task 2