

Technical Consulting Service on Human Factors Analysis Methodology and Experience related to Multiple Module NPP Control Room Operation

2023. 06.



1. OBJECTIVES

The objective of this consulting service is to provide KEPCO E&C with the following scope of services related to research and training on human factors engineering processes. The purpose of this technical consulting services is Idaho National Laboratory (Contractor) to share researcher's experiences related with human factors considerations and carry out a research on the advanced HFE process for the multi-unit control room operation concept in Small Modular Reactor (SMR). Results of consulting service could be provided to KHNP.

2. SCOPE OF SERVICES

To achieve the above objective, the Contractor shall provide KEPCO E&C with the technical consulting services in the following tasks:

Task 1. Functional Requirements Analysis and Function Allocation

Consultation on allocating a function to human or system, or both. Contractor efforts consist of:

- Sharing Contractor's experience of functional allocation processes for multi-unit operations including the higher level of automation or the lower number of staff members compared to conventional NPPs; and
- Suggestion of functional allocation methodologies specific for the multi-unit operations.

Task 2. Task Analysis

Consultation on task analysis methodology. Contractor efforts consist of:

- Introduction to the commonly used task analysis methods in the U.S. (e.g., hierarchical task analysis based on procedures);
- Sharing experience with modeling factors that affect task analysis such as time required, time estimated, or time available, and workload analysis methodology; and
- Suggestion of specific task analysis methods for multi-unit operations including the higher level of automation or the lower number of staff members compared to conventional NPPs.

Task 3. HSI Tests and Evaluations and Human Factors Verification and Validation

Consultation on “HSI tests and evaluations” and “human factors verification and validation (V&V)” methodology. Contractor efforts consist of:

- Introduction to HSI test and evaluation cases performed by Contractor, and commonly used in U.S.;
- Introduction of V&V methodologies developed by Contractor, and commonly used in U.S., including relevant topics such as operational conditions sampling, integrated system validation, and the testbed fidelity;
- Suggesting a way to determine types of relevant performance measures based on design experiences in U.S.; and
- Suggestion of evaluation methodology by performance measures (e.g., participant questionnaires, post-scenario debriefing, observation by subject-matter experts, simulator-archived data).

Task 4. Technical Meetings & Training

KEPCO E&C engineers and Contractor shall take part in technical meetings for the discussion of consulting service tasks and the review of the consultation report, and a training for educational instruction of technical details. In case that these face-to-face meetings are available, Interim meeting shall be held at KEPCO E&C after submission of a Preliminary Report for Task 1 and Final meeting shall be held at Contractor’s office after submission of a Draft Report for Task 1 to Task 3. The Contractor (1 major expert to perform the Services)) shall participate in the meetings.

- Interim meeting after submission of Preliminary a Report for Task 1 (2~3 days): The Contractor will visit to KEPCO E&C to take part in Interim meeting for educational seminar about explanation of technical details about consultation works. Also, KEPCO E&C engineers and Contractor will review and discuss the Preliminary Report for Task 1
- Final meeting after submission of a Draft Report for Task 1 to Task 3 (4~5 days): KEPCO E&C engineers will visit to the Contractor to take part in meeting for review, discussion, and modification (if any) of the Draft Report for Task 1 to Task 3. Also, Contractor instruct technical details for the whole procedure about human factors analysis (related to multi-unit operations, etc.) to the KEPCO E&C engineers.

Task 5. Preparation of Consultation Task Reports

A Preliminary Report for Task 1 shall be submitted to KEPCO E&C 10 weeks after the Execution Date.

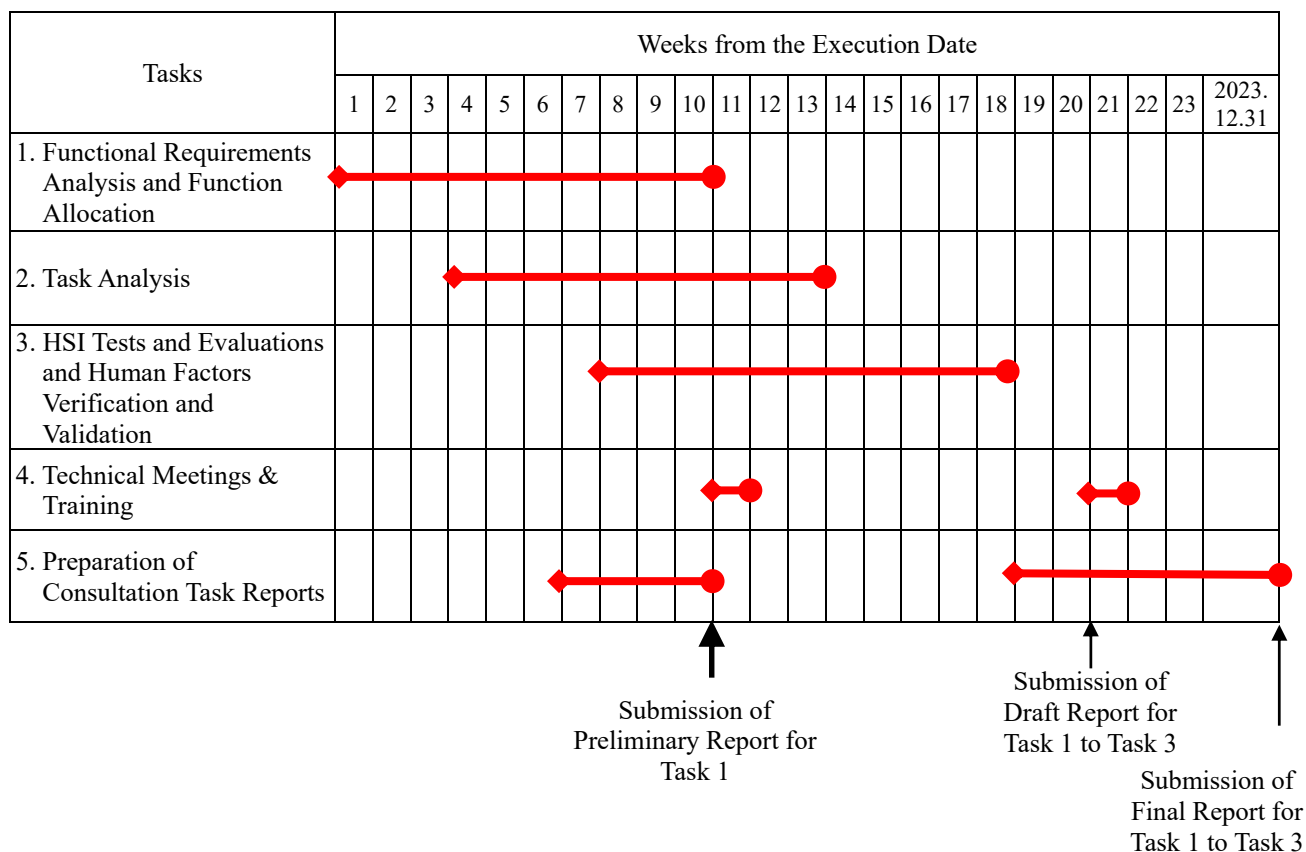
A Draft Report for Task 1 to Task 3 shall be submitted to KEPCO E&C 20 weeks after the Execution Date. All comments issued by KEPCO E&C shall be resolved and incorporated into the Final Consultation Task Report which shall be submitted at the end of consultation. In addition, all of the analysis input, output files and digital data shall be submitted with the Final Consultation Task Report.

- Submittal of Preliminary Report for Task 1: within 10 weeks from the Execution Date
 - Submittal of Draft Report for Task 1, Task 2 and Task 3: within 20 weeks from the Execution Date
 - Submittal of Final Consultation Task Report*, in-house programs developed (if any) including digital data: Before Contract Completion Date(December 31, 2023).
- *All the comments issued by KEPCO E&C shall be resolved and incorporated into the Final Consultation Task Report.

3. METHODS OF PERFORMANCE

Consultation Schedule

The contract period shall be about 24 weeks from the Contract signing date (Execution Date), and Contract Completion Date is December 31, 2023.



Method of Performance

The Contractor shall start the consultation service in accordance with the schedule shown as the above table, immediately after the Execution Date.

Based on technically acceptable and sound basis, all the tasks above should be performed by Contractor researchers' who can 't be replaced. The Contractor shall keep confidential all the results and information obtained from this consultation, and shall not divulge them to any third parties. KEPCO E&C will provide information and guidance. KEPCO E&C will review the results of each task and Draft Report which shall be prepared by the Contractor. KEPCO E&C will discuss the problems and issues encountered during the execution of Task 1 to Task 3.

Also, detailed technologies related to consultation shall be transferred to KEPCO E&C. If an additional discussion is needed for the tasks, the Contractor or KEPCO E&C contacts with each other by e-mail or requests a conference call to the other party.

Deliverables

The deliverables are a Preliminary Report for Task 1, Draft Report for Task 1 to Task 3 and Final Consultation Task Report for Task 1 to Task 3 which shall incorporate all KEPCO E&C's comments, and all of the analysis input and output files including digital data produced through performing the tasks.

Miscellaneous

After the consulting tasks, the Contractor must discard all of the documents, data, etc. provided by KEPCO E&C.