

Technical Information

Technical Support for APR1000 Standard Design

September, 2020



한국전력기술주식회사
KEPCO ENGINEERING & CONSTRUCTION COMPANY, INC

1.0 PURPOSE

KEPCO E&C has developed a new NPP design of APR1000 to comply with the safety requirements of recent IAEA, WENRA and EUR Rev. E to provide the most competitive NPP in the overseas market including Europe. KEPCO E&C is responsible for the design of the APR1000 which also applies for the EUR design assessment.

Although most of the design concepts of the APR1000 have already been completed, there are still several areas that need further development and/or independent peer review by a third party because those areas include new evolutionary design concepts or European region-specific design requirements.

The purpose of this framework contract is to assist KEPCO E&C to complete the APR1000 standard design which is planned to finish by Dec. 31, 2023.

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: Load following operation

Contractor shall provide experiences (design modifications, licensing issues, etc.) on load following operation in Europe countries (Belgium, France, etc.)

- Daily load cycle
- Primary frequency control
- Secondary control
- Extended low power operation
- Island operation
- Reviews of load following operation for APR1000

Task 2: Low Temperature Overpressure Protection(LTOP) design

Contractor shall provide the following technical supports;

- Review on the design status for LTOP valve in Europe.
- Review on the safety analyses bases for LTOP protection in Europe
- Explain the licensing experiences for LTOP protection design in EUR.

Task 3: Mid-loop operation

Contractor shall provide the review and comments on the following items;

- design application to avoid mid-loop operation of European NPP
- design application of a RCS level control system during mid-loop operation in European NPP

- evaluation methodology for how to ensure the functionality of residual heat removal systems during mid-loop operation
- those licensing experiences.

Task 4: Redundancy of Pressurizer Spray

Contractor shall provide the review and comments on the following items:

- A requirement of spray system per EUR, Rev.D, Vol. 2.7, Sec. 2.8.2.2 is “The auxiliary spray system shall be totally separate from the spray system used in normal operation.” This requirement is deleted in the same section of EUR, Rev.E.
- But, redundancy shall be employed for improving the reliability and to meet the single failure criterion per EUR, Rev.E, Vol. 2.1, Sec. 6.3.1.1. Also, the spray system shall be designed to prevent or minimize thermal stratification per EUR, Rev.E, Vol. 2.8, Sec. 3.3.1.2.2.
- It will be supposed that two spray nozzles on the closure head of the pressurizer and two separated spray lines should be provided.
- Review on the following items:
 - 1) the present states or examples of separation of main spray line and auxiliary spray line of European NPP
 - 2) design requirements of main spray line and auxiliary spray line in current European guidelines,
 - 3) design recommendation to meet EU guidelines

Task 5: Inclined surge line

Contractor shall provide the following items;

- Review of the structural integrities of the inclined surge line including nozzle having a dissimilar weld
- Review of the design and layout of the inclined surge line
- Methodology to check the magnitude of thermal stratification

Task 6: Practical Elimination of ATWS

Contractor shall provide the following items;

- Technical Background for PE of ATWS (CEDM mechanical failure)
- Review and evaluation on CEDM mechanical failure of CE-type plant

Task 7: Practical elimination of early or large radioactive releases

Contractor shall provide the following items;

- Assist to select the severe accident conditions that have to be practically eliminated
- Provide methods to demonstrate PE using physical impossibility
- Provide methods to demonstrate PE using extremely unlikeliness
- Provide the methods for design of SSCs used for PE

Task 8: Design for DEC without core melt

Contractor shall provide the following items;

- Provide list of DEC without core melt events
- Select the list of events to be considered in the containment pressure and temperature analysis for DEC without core melt conditions
- Provide methods for safety analysis and radiological consequence analysis in the events of DEC without core melt
- Provide the methods for design of systems (fluid, electrical, I&C) used to mitigate DEC without core melt events
- Provide the methods of system design to ensure diversity

Task 9: Verification of structure design based on European code

Contractor shall provide the following items;

- Provide the containment structure design methods to comply with requirements of European Code & Standards
- Provide draft engineering calculations for design of exterior structure of containment building
- Provide draft engineering calculations for post-tensioning system

Task10: Design to withstand rare and severe external hazards

Contractor shall provide the following items;

- Provide design methodology of RSEH
- Provide the design criteria and methods for evaluation of biological hazards
- Provide design methods for cooling water system structures in potential NPP sites
- Provide responses to questions during the design process
- Provide the methods for evaluation of external natural hazards based on EUR Rev.E European practice

- Provide the procedures for site evaluation against external natural hazards
- Provide responses to questions on site evaluation that will be performed by the designer
- Provide the design criteria and procedures for safety systems and cooling systems that are to withstand RSEH conditions
- Provide the design methods for HVAC systems that are to be designed to withstand RSEH conditions
- Review of system design performed by the designer
- Provide responses to questions on site evaluation that will be performed by the designer

Task 11: Application of IEC 61660-1 for calculation of short circuit current for DC system

Contractor shall provide the following items;

- Provide the methods for calculation of short circuit current for DC system based on IEC 61660-1
- Provide responses to questions during the selection of short circuit current for DC system that will be performed by the designer
- Review of results of the selection of short circuit current for DC system that will be performed by the designer

Task 12: Application of equipment qualification methods based on EUR Rev.E

Contractor shall provide the following items;

- Provide the methods for seismic qualification to comply with IEC 60980
- Provide the methods for equipment qualification to comply with IEC 60780
- Review of seismic and equipment qualification program that will be prepared by the designer

Task 13: PSA methodology to comply with EUR

Contractor shall provide the following items;

- Provide the PSA methodology for evaluating software reliability and inter-system common cause failure based on European best practice
- Provide the PSA methodology for evaluating the fire, flooding and external hazards based on European best practice

Task 14: EIA methodology for EUR Rev.E

Contractor shall provide the following items;

- Provide standard or generic environmental conditions to be applied to the standard EIA

- ### 3.0 METHOD OF PERFORMANCE

The consulting schedule for the basic tasks (Task 1 to 14) shall be until Dec. 31,2023 from the Execution Date of the Contract, as follows:

[illegible]

Method of Performance

Contractor shall start the consulting service in accordance with each of the Task Orders(TOs) and perform the activities specified in the TOs. The methods to issue the TOs and to perform activities are described as follows:

A. Preparation and Issuance of Task Orders

KEPCO E&C is responsible for preparation of a draft TO. However, if it is considered more efficient, KEPCO E&C may request Contractor to prepare the draft TO on behalf of KEPCO E&C. It is recommended to use the template given in this Contract. The draft TO shall include the following information:

- (a) Title of the task order
- (b) Schedule
- (c) Scope of work
- (d) Methods of performance
- (e) Deliverables
- (f) Price information (including man-hours, indirect expenses, if any)
- (g) Others

The draft TO shall be reviewed, agreed and approved by the project managers of the both parties. Then, the signed (approved by the project managers of both parties) final TO is officially issued by the project manager of KEPCO E&C.

B. Task Orders

The Task Order forms are provided in Attachment 1.

Contractor shall keep confidential all the data and information from this Contract, and shall not divulge them to any third parties.

Deliverables

Deliverables issued by the TOs shall be provided in accordance with the above article (method of performance) mentioned.

4.0 SCHEDULE

The framework contract shall be effective until December 31, 2023.
The time schedule of each TO shall be specified in each of the TOs.