붙임2.

국외 하도급 발주내역서

Technical Consulting on the CLP design method improvement and repair method for corroded CLP of NPPs

2019. 11

한국전력기술주식회사

APPENDIX A - SCOPE OF SERVICES AND METHOD OF PERFORMANCE

1. GENERAL INFORMATION OF THE SERVICE

1.1 Name of the Service

Technical Consulting on the CLP design method improvement and repair method for corroded CLP of NPPs

1.2 General Descriptions

ASME Section III, Division 2, Subsection CC, table CC-3720-1 in [Table 1] shows the allowable strains of membrane and combined membrane and bending, and the calculated strains for the liner shall not exceed the values given in Table CC-3720-1. ASME CC does not provide specific requirements for liner strain calculation method, but the liner plate membrane strain can be estimated by summing the strains due to the effects of dead load, prestress, concrete creep and shrinkage, temperature, earthquake, etc. If a panel of the liner plate should have an inward curvature resulting from fabrication and construction such as [Figure 1], then this panel will deform inward since it has low stiffness relative to a panel with outward curvature when concrete vessel undergoes compressive deformation due to a prestress and etc.

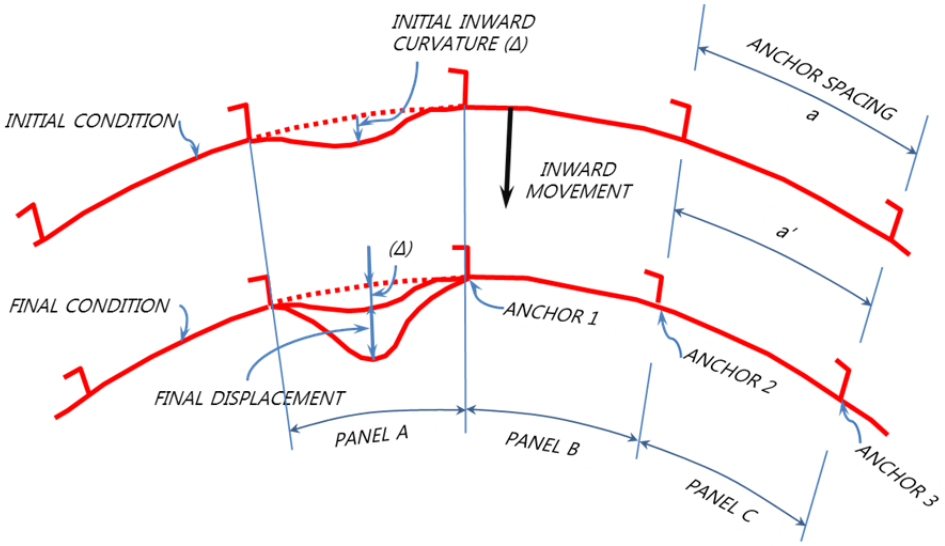
[Table 1] ASME CC TABLE CC-3720-1 "LINER PLATE ALLOWABLES"

Category	Stress-Strain Allowable [Notes (1), (2)]	
	Membrane	Combined Membrane and Bending
Construction	$f_{st} = f_{sc} = 2/3\ f_{py}$	$f_{st} = f_{sc} = 2/3\ f_{py}$
Service	$\varepsilon_{st} = \varepsilon_{sc} = 0.002$	$\varepsilon_{st} = \varepsilon_{sc} = 0.004$
Factored	$\varepsilon_{sc} = 0.005$	$\varepsilon_{sc} = 0.014$
	$\varepsilon_{st} = 0.003$	$\varepsilon_{st} = 0.010$

NOTES:

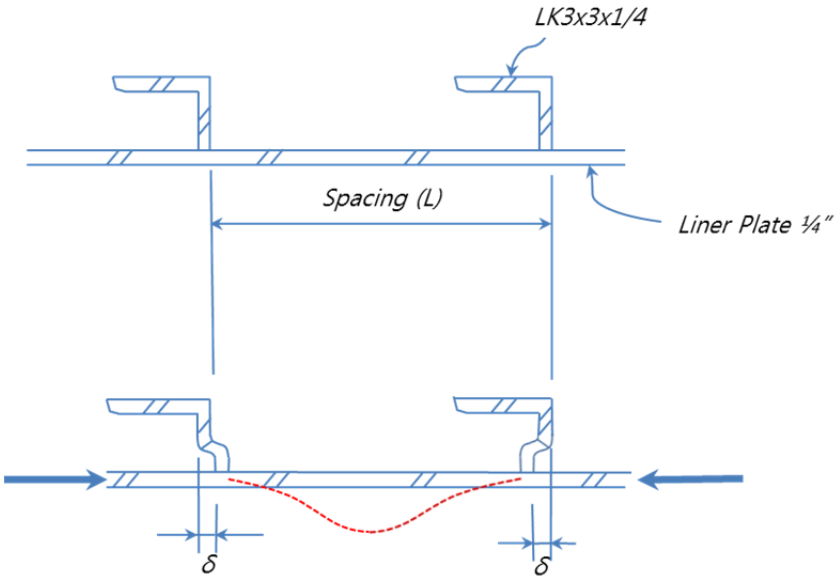
(1) The types of strains limited by this Table are strains induced by other than construction-related liner deformations.

(2) Strain in in./in. or mm/mm.



[Figure 1] Inward Displacement of Liner Plate (Plan View)

In such a deformed shape, the liner plate is subjected to bending, and a bending strain is caused thereby. The bending strain for this deformed shape can be derived according to the beam theory of Euler-Bernoulli and the elastic stability theory of Timoshenko.



[Figure 2] Idealized Liner Local Bending Deformation

In such a deformed shape, the liner plate is subjected to bending, and a bending strain is caused thereby. The bending strain for this deformed shape can be derived according to the beam theory of Euler-Bernoulli and the elastic stability theory of Timoshenko.

Assuming that the liner plate thickness is 0.25 inch and the liner anchor spacing is 15 inch as like in APR1400, the allowable stresses for the combined membrane and bending strain for the idealized liner local bending deformation is deemed to be very conservative.

So, it is necessary to review and confirm the best approaches and procedures for the liner strain calculation of combined membrane and bending based on the engineering experiences and previous OTS reports.

In addition, there were found some corroded CLP in OPR1000 NPPs and very severe evaluation and investigation were carried out to find reason of CLP corrosion and CLP repair work were performed after investigation. The cut CLP to inspect the concrete void behind CLP also should be repaired after covering the concrete with mortar and other CLP.

However only one method to repair corroded CLP or cut CLP is known to us as follows:

Step 1: Cut the corroded CLP
Step 2: Concrete Chipping behind CLP up to sufficient space
Step 3: Welding Backup Bar inside CLP
Step 4: Grouting the Chipping area
Step 5: Welding CLP Cover
Step 6: Non-Destructive Examination on the Weld

So, it is necessary to investigate examples of CLP repair performed for US or international operating nuclear units.

1.3 Objectives

The purpose of the service is to investigate the optimized design calculation method for CLP based on the design experience and previous Overseas Technical Service results and to investigate examples of CLP repair performed for US or international operating nuclear units.

2. SCOPE OF THE SERVICE & METHODS OF PERFORMANCE

With this regard, KEPCO E&C requests the service and the methods of performance.

2.1 Task 1 : Suggestion of optimized CLP design procedure.

- Contract shall provide optimized CLP design procedure suitable for APR1400 based on Contractor's practice for CLP design. Information on CLP design for APR1400 will be provided. If the information is not available, Contractor can assume by discussion with KEPCO E&C. Contract shall compare current KEPCO E&C's design procedure with the optimized CLP design procedure and provide technical discussions.
- Contractor shall propose optimized CLP thickness by investigation of CLP used in US and consideration of corrosion

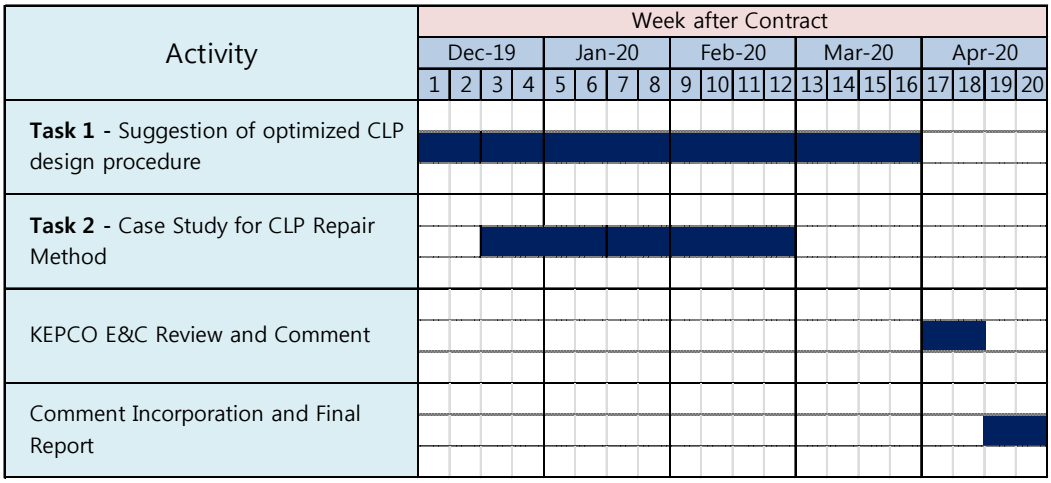
2.2 Task 2 : Case Study for CLP Repair Method:

Contract shall investigate examples of CLP repair performed for USA or international operating nuclear units.

3. SCHEDULE AND SUBMITTAL REQUIREMENTS

3.1 Schedule

1st December, 2019 ~ 30th April, 2020



3.2 Submittal Requirements

The Contractor shall submit report of the services by the date of delivery. The date of delivery may be changed by project schedule.

Description	After Contract Date
Final Report reflected Review & Comment	5 months