

**Technical Consultation on HBN 3,4 and HUN 3,4 SC/SI  
System Replaced Valve Weld Leak-Before-Break  
(LBB) Evaluation**

*November 2019*



**한국전력기술주식회사**  
KEPCO ENGINEERING & CONSTRUCTION COMPANY, INC

## 1.0 PURPOSE

Leak-Before-Break (LBB) evaluation should be performed for replaced valve weld in HBN 3,4 and HUN 3,4 SC/SI System that LBB applied. For this evaluation, technical issues proposed by regulatory agency should be investigated. So, these technical issues will be resolved by this consultation.

## 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: Selection of archival material for material testing

All 'Heat Number' within the LBB line are not tested. One 'Heat Number' is selected for testing which provides the lowest value base on the below equation.

$$(S_y + S_u) \times L\% \quad (S_y: \text{Yield stress}, S_u: \text{Ultimate stress}, L\%: \text{Elongation})$$

NUREG-1061 Vol. 3 requires 3 specimens per Heat Number. However, there are several tens of heats within SI/SC piping.

Contractor shall look into technical basis and provide a recommendation and write up on this item. Contractor shall use material properties (tensile properties and J-R curve data) in the PIFRAC database to investigate the adequacy of the method used by KEPCO E&C.

Applicability of the method to various materials shall be also investigated.

### Task 2: Consideration of long-term aging effects in material testing

Currently, KEPCO E&C does not consider the long-term aging effect in material testing. Creep/creep-fatigue can be considered for thermal aging, but per SRP 3.6.3, creep can be excluded from the active degradation mechanism since the operating temperature is lower than the creep temperature. In SRP 3.6.3 III.11.A.i, it is stated to consider material properties for long-term effect such as thermal aging.

Contractor shall provide a recommendation and write up on this item. Long term aging affects some specific materials such as cast austenitic stainless steels and to a lesser extent stainless steel weld metals. Contractor shall list all the materials considered in the LBB evaluation.

### Task 3: Consideration of material temperature dependency in material testing

In SRP 3.6.3 III.11.B.iv, it is stated that the temperature dependency of the material should be considered. Material properties tend to decrease as the temperature increases.

Contractor shall investigate temperature behavior from both stress-strain and toughness viewpoint and provide a write up with recommendation on this item.

### Task 4: Specimen orientation

As per ASTM E399, material testing is conducted as shown in the table below. For fracture toughness testing, the specimens are in the L-C orientation (both for base and weld materials). For tensile testing, the base material and weld material are in the L orientation and C orientation, respectively. The weld material tensile specimens are in the C orientation to avoid having both base and weld material within the specimen.

The weld material fracture toughness specimen in the L-C orientation includes both base and weld metal.

Contractor shall perform a literature search to find examples where the weld tensile specimens were machined in the C orientation. In addition, Contractor shall search for data that might demonstrate the negligible anisotropy effect in the weld material. Contractor shall perform a literature search to find examples where the C(T) specimens in the L-C orientation included both base and weld materials.

#### Task 5: Meetings

Contractor shall hold a kick-off meeting (1-day). Contractor shall hold a project closing meeting (2-day).

#### Task 6: Letter report

Contractor shall prepare a draft letter report and submit to KEPCO E&C summarizing the findings and recommendations on Tasks 1 through 4 prior to the closing meeting for one round of review. The final letter report will be submitted to KEPCO E&C after addressing all comments from the closing meeting.

### 3.0 METHOD OF PERFORMANCE

#### Consulting Schedule

The consulting schedule for the basic tasks (Task 1 to 6) shall be until 31<sup>st</sup> March, 2020 from the Execution Date of the Contract, as follow:

Tasks	Schedule																								
	2019.11					2019.12					2020.01					2020.02					2020.03				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
Task 1 – Selection of archival material for material testing																									
Task 2 – Consideration of long-term aging effects in material testing																									
Task 3 – Consideration of material temperature dependency in material testing																									
Task 4 – Specimen orientation																									
Task 5 – Meetings																									
Task 6 – Letter Report																									

#### Method of Performance

- Contractor shall start the consulting service in accordance with the schedule shown as the above schedule, immediately after signing of the Contract.
- Technical issues should be resolved by technical meeting and the Contractor shall provide final report by 24<sup>th</sup> March 2020.
- Contractor shall keep confidential all the data and information from this Contract, and shall not divulge them to any third parties.

#### Deliverables

- Preliminary Report shall be provided by 14<sup>th</sup> February 2020.
- Final Report shall be provided by 24<sup>th</sup> March 2020