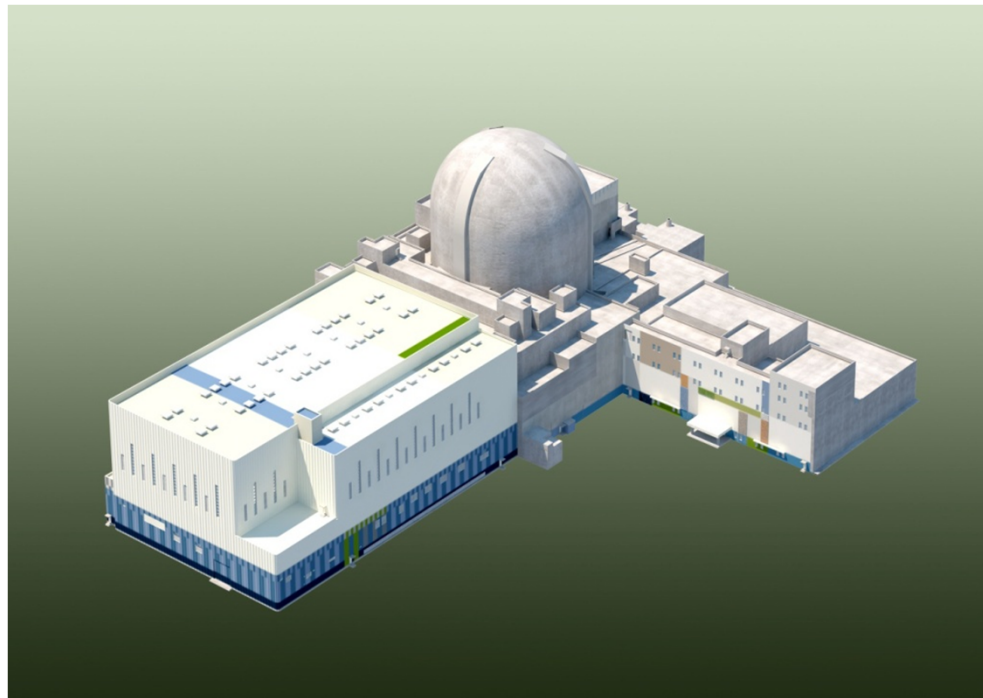


# Loop Seal Reformation for APR1400



**KEPCO/KHNP**  
**OCTOBER 12, 2016**

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# Introduction

# Introduction

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- **Background and Relevant RAI**

- ✓ Loop Seal Reformation due to ECCS injection during the long term cooling phase of a LOCA can cause suppression of the two-phase mixture level in the reactor core.
- ✓ If this level drops below the top of the active fuel, cladding heatup and oxidation can occur.
- ✓ NRC RAI 8092 requires the PCT caused by Loop Seal Reformation should be below 800°F in the APR1400 plants.
- ✓ In the previous NRC Public meeting, NRC asked for the results of Loop Seal Reformation calculation using CENPD SBLOCA methodology.
- ✓ KHNP performed the sensitivity study and break spectrum calculation using CENPD SBLOCA methodology.

# Introduction

## ● Loop Seal Reformation Calculation Procedure

### 1. CEFLASH-4AS Conservative Base Input Preparation

➤ Calculation End Time: [ ]<sup>TS,(a,c)</sup> sec

➤ [ ]<sup>TS,(a,c)</sup>

### 2. Break Spectrum Analyses (CEFLASH-4AS)

➤ [ ]<sup>TS</sup>

### 3. Input Preparation for the fuel rod heat-up code (PARCH/EM)

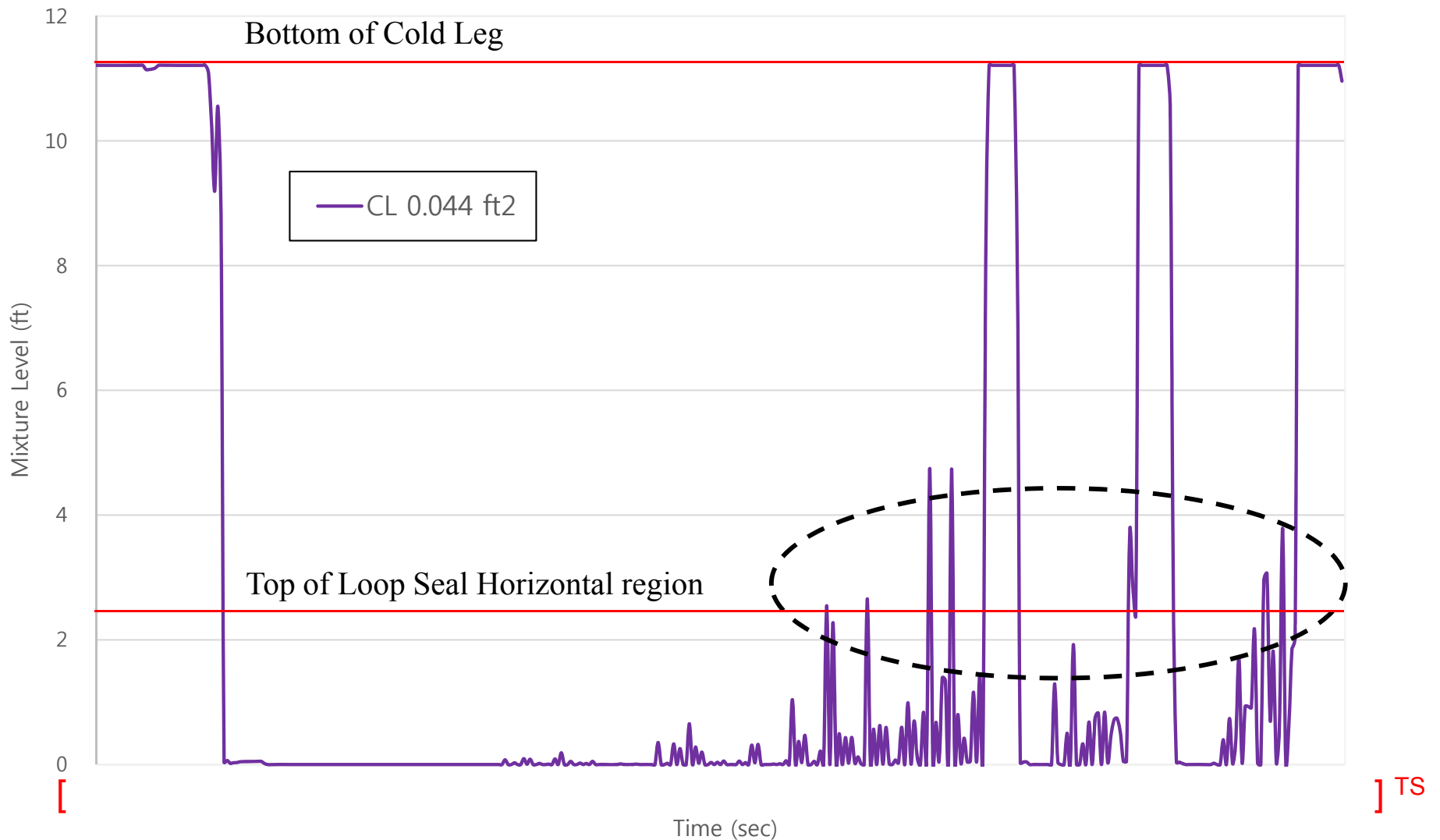
➤ Data transfer of CEFLASH-4AS result for each limiting case

▪ [ ]<sup>TS,(a,c)</sup>

### 4. Evaluate the PCT caused by Loop Seal Reformation (PARCH/EM)

# CEFLASH-4AS Calculation

- Loop Seal Mixture Level for Broken Loop



# CEFLASH-4AS Calculation

- **Break Spectrum Summary**

- ✓ Break location: pump discharge leg
- ✓ Range of break size occurring Loop Seal Reformation are below

\* No sustained uncovering but cycling of reformation and clearing

TS

# CEFLASH-4AS Calculation

- Limiting Case Selection

- ✓ [ ]<sup>TS</sup> loop seal clearing cases for conservative core recovery
- ✓ [ ]<sup>TS</sup> for conservative PCT

TS



# CEFLASH-4AS Calculation

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- Core Mixture Level

TS

# PARCH/EM Evaluation

# PARCH/EM Evaluation

- **Input Preparation for PARCH/EM Calculation**

- ✓ Each PARCH/EM input for the selected cases in CEFLASH-4AS is prepared with the following three modifications applied to PARCH/EM base deck;
- ✓ Prepare the  $[ ]^{TS,(a,c)}$  based on CEFLASH-4AS result.

# PARCH/EM Evaluation

TS,(a,c)

Public Meeting

# PARCH/EM Evaluation

TS,(a,c)

Public Meeting

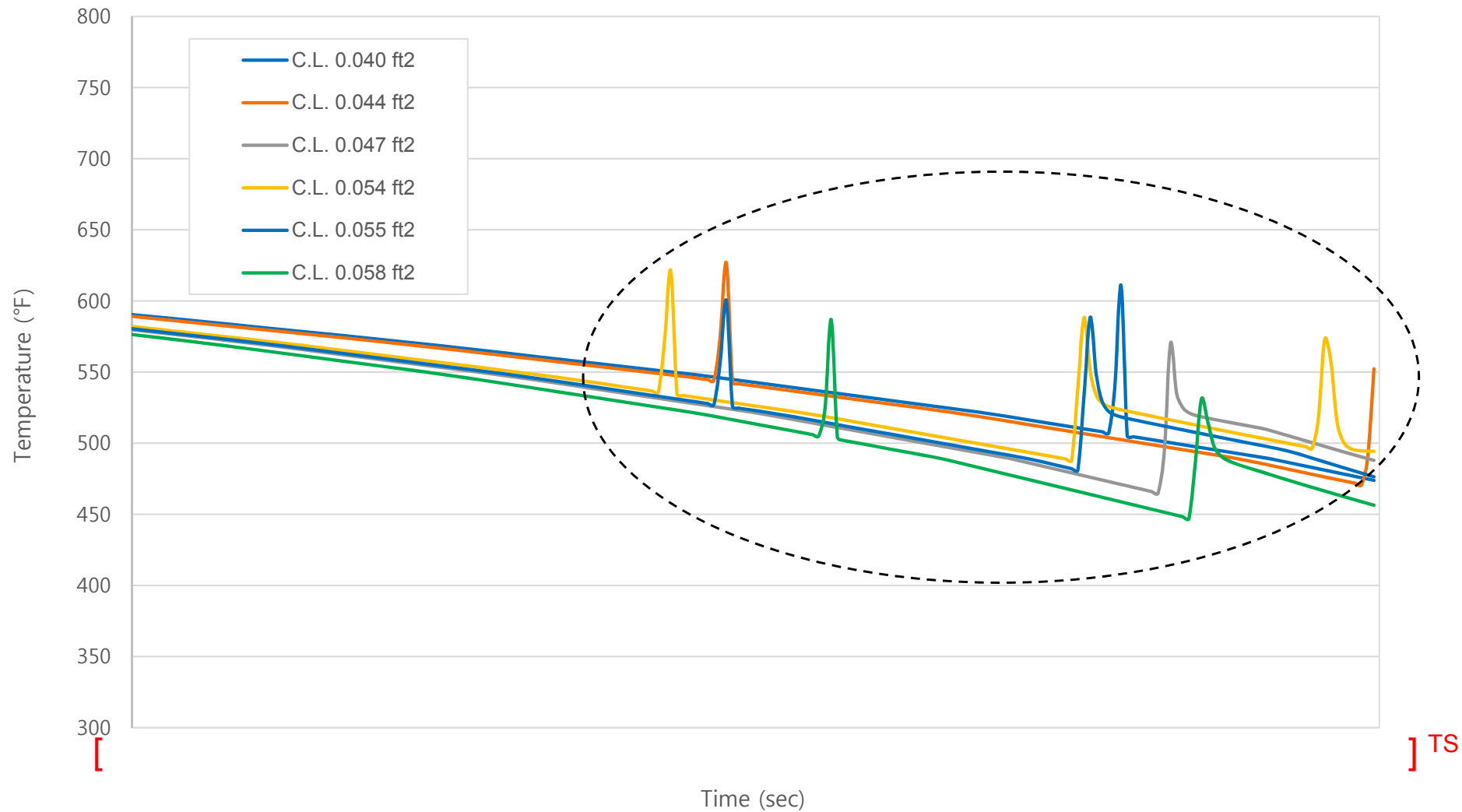
# PARCH/EM Evaluation

TS,(a,c)

Public Meeting

# PARCH/EM Evaluation

## ● Cladding Surface Temperature



# Differences

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- Deep Core Location

TS,(a,c)



# Conclusion

# Conclusion

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- **Findings and Results**
  - ✓ Loop seal reformation cause core reheat while core is uncovered.
  - ✓ However, the PCTs of limiting cases for loop seal reformation are below 650°F for the APR1400 and meet the NRC requirement.