

## ENCLOSURE 2

M190012

### 2018 Technology Update Presentation

#### Non-Proprietary Information

#### INFORMATION NOTICE

Enclosure 2 is a non-proprietary version of the 2018 Technology Update Presentations from Enclosure 1, which has the proprietary information removed. Portions that have been removed are indicated by open and closed double brackets as shown here [[ ]].

# Technology Update for the US NRC

## August 2018

2018 Annual Report to NRC  
M180156

August 28, 2018

## Control Rods

Scott Nelson



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# Product Line Overview

## Marathon (1991 – 2014)

- NEDE-31758P-A, 1991
- Lifetime reduction in 2011 due to observed cracks ([
- Continue to perform visual inspections to confirm lifetime limits.

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## Ultra MD (2009 – present)

- NEDE-33284P-A Rev. 2, 2009
- Perform visual inspections of lead depletion control rods.
- Zero cracks observed to date.

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## Ultra HD (2012 – present)

- NEDE-33284 Suppl. 1P-A Rev. 1, 2012
- Perform visual inspections of lead depletion control rods.
- Zero cracks observed to date.

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# New Marathon Inspection Data

Plant	Absorber Tube Type	Tube Geom	Date	$\frac{1}{4}$ - Segment B-10 Depletion (%)	Nuclear End of Life (% B-10 Depletion)	Peak Local Depletion (%)	Results
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# Plant J Marathon Inspection

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# Plant P Marathon Inspection

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# Plant P Marathon Inspection

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# Ultra Surveillance Requirements

## Ultra MD: NEDE-33284P-A Rev. 2 Safety Evaluation

- Inspect 2 lead depletion control rods.
- Inspect 2 lead depletion control rods of opposite lattice, once they have exceeded 75% of NEOL.
- Inspect 12 control rods of each lattice type upon end of life discharge.

## Ultra HD: NEDE-33284 Suppl. 1P-A Rev. 1 Safety Evaluation

- Inspect 2 lead depletion control rods once they have exceeded 75% of NEOL.
- Inspect 2 lead depletion control rods of opposite lattice, once they have exceeded 90% of NEOL.
- Inspect 12 control rods of each lattice type upon end of life discharge.



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NEOL = Nuclear End of Life



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# New Ultra Inspection Data

Plant	Absorber Tube Type	Control Rod Type	Date	# of CRB's Inspected	<sup>1</sup> / <sub>4</sub> - Segment B-10 Depletion (%)	Nuclear End of Life (% B-10 Depletion)	Peak Local Depletion (%)	Results
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# Ultra MD Visual Inspection Data

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# Ultra HD Visual Inspection Data

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# Plant P Ultra HD Inspection

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Control Rods  
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# Plant P Ultra HD Inspection

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# Ultra MD Surveillance Summary

Ref: NEDE-33284P-A Rev. 2 Safety Evaluation

- Inspect 2 lead depletion control rods.
  - ✓ Plant M will likely be the lead depletion Ultra MD at inspection in fall 2019.
- Inspect 2 lead depletion control rods of opposite lattice, once they have exceeded 75% of NEOL.
  - ✓ Performed opposite lattice inspection at [[                      ]] of NEOL, ahead of 75% NEOL requirement.
- Inspect 12 control rods of each lattice type upon end-of-life discharge.
  - ✓ No Ultra MD control rods discharged to date.

No observed cracks to date  
on Ultra MD control rods.



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# Ultra HD Surveillance Summary

Ref: NEDE-33284 Suppl. 1P-A Rev. 1 Safety Evaluation

- Inspect 2 lead depletion control rods once they have exceeded 75% of NEOL.
  - ✓ Lead depletion control rods are being inspected at multiple plants, far earlier than 75% NEOL requirement.
- Inspect 2 lead depletion control rods of opposite lattice, once they have exceeded 90% of NEOL.
  - ✓ Opposite lattice Ultra HD control rods are far below 90% of NEOL.
- Inspect 12 control rods of each lattice type upon end-of-life discharge.
  - ✓ No Ultra HD control rods discharged to date.

No observed cracks to date  
on Ultra HD control rods.



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# TRACG LOCA

2018 NRC Technology Update

August 28, 2018

Guangjun Li





# Outline

1. TRACG LOCA LTR Status
2. TRACG LOCA Applications
3. 10 CFR 50.46c



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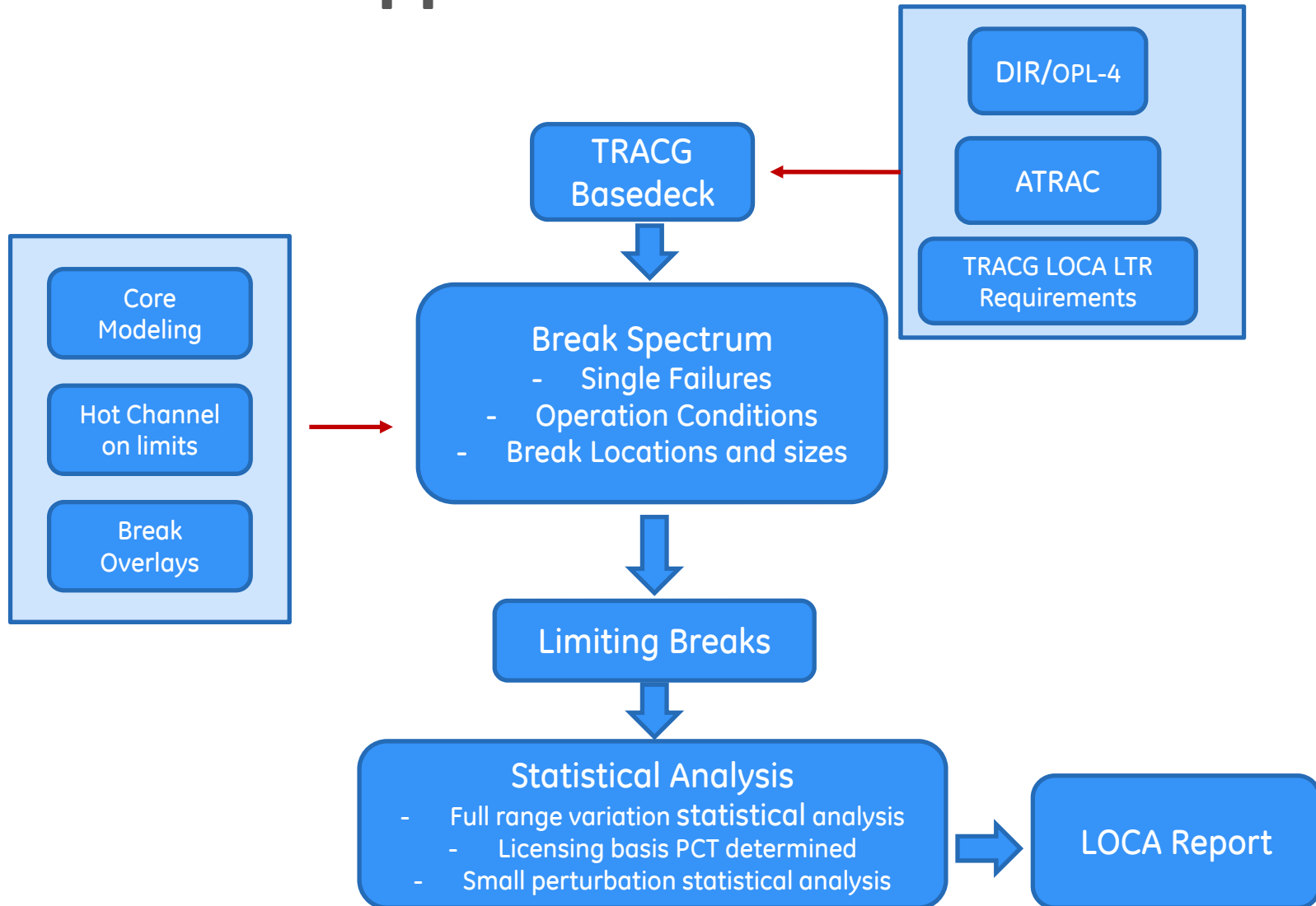
## TRACG LOCA LTR Status

- MFN 11-001, NEDE-33005P was submitted in 2011
  - 104 RAIs in 5 sets (2012~2016)
  - Final SE: February 2017
  - GESTAR SE: March 2017 with Revision 1 LTR
  - Satisfaction of Limitation 10.7 Submittal: July 2017
  - Final SE for Satisfaction of Limitation 10.7: May 2018
  - GESTAR SE: August 2018 with Revision 2 LTR
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- First non-US Application: KKM, February 2015
  - First US Application: NMP1, March 2017



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# TRACG LOCA Application



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# TRACG LOCA Applications

- Oyster Creek GNF2 TRACG LOCA (suspended)
- SNC Hatch TRACG LOCA for GNF3
  - Basedeck completed
  - Break Spectrum – on going
  - LOCA report expected in November to support Unit 2 C26 reload
- DTE Fermi Unit 2 TRACG LOCA for GNF3
  - Basedeck – on going
  - LOCA report expected at end of 2018 or early 2019



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# 10 CFR 50.46c Rule



## 50.46c Rulemaking Goals

- Revise emergency core cooling system (ECCS) acceptance criteria to reflect recent research findings
- Expand applicability to all fuel designs and cladding materials
- Replace prescriptive analytical requirements with performance-based requirements
- Address concerns raised in two petitions for rulemaking (PRMs): PRM-50-71 and PRM-50-84
- Allow an alternative risk-informed approach to evaluate the effects of debris on long-term cooling

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# 10 CFR 50.46c Rule



## **50.46c Requirements - Unchanged**

- Peak cladding temperature criterion, 2200 °F
- Core wide oxidation criterion, 1.0%
- Requirement to address debris effects

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## 10 CFR 50.46c Rule



### **50.46c Requirements - New**

- Hydrogen-dependent cladding embrittlement criteria, integral time-at-temperature and peak cladding temperature
- Breakaway oxidation test and analytical requirement
- Cladding ID oxygen ingress analytical requirement
- Crud thermal conductivity analytical requirement
- LTC fuel performance requirement
- Alternative risk-informed approach for treatment of debris

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# 10 CFR 50.46c

## 10 CFR 50.46c Rulemaking

- Final Draft Rule to ACRS: 3 Dec 2015
- ACRS Recommends issuance of the Rule: 23 Feb 2016
- Rule to Commission: 16 March 2016 (SECY-16-0033)
- Expected adoption and publication: ???

## Implementation Plan

- Licensee to submit implementation plan within 6 months of rule issuance.
- Plan requires NRC approval: extensive delay will need justification.
- Over 84 month period, execute the plan.
- Submit report to show compliance under revised rule.



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# Adaption of 50.46c in GEH EMs

- LOCA Evaluation Model (EM) updates:
  - SAFER/PRIME – supplement
  - TRACG/PRIME – supplement
- “Acceptable Fuel Cladding Hydrogen Uptake Model” (ML15133A306) issued by NRC will be used as an interim strategy until the proprietary model is separately submitted/reviewed/approved in the future. EMs will not be hardwired to H-model.



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# SAFER/PRIME

- A supplement to the SAFER/PRIME methodology will provide necessary evaluations demonstrating the 50.46c compliance of GNF-fueled BWR fleet. A common LAR template will be made available to streamline licensee submittals.
- Once updated, all future analyses will adapt the new limits, ahead of 'termination date for compliance'.

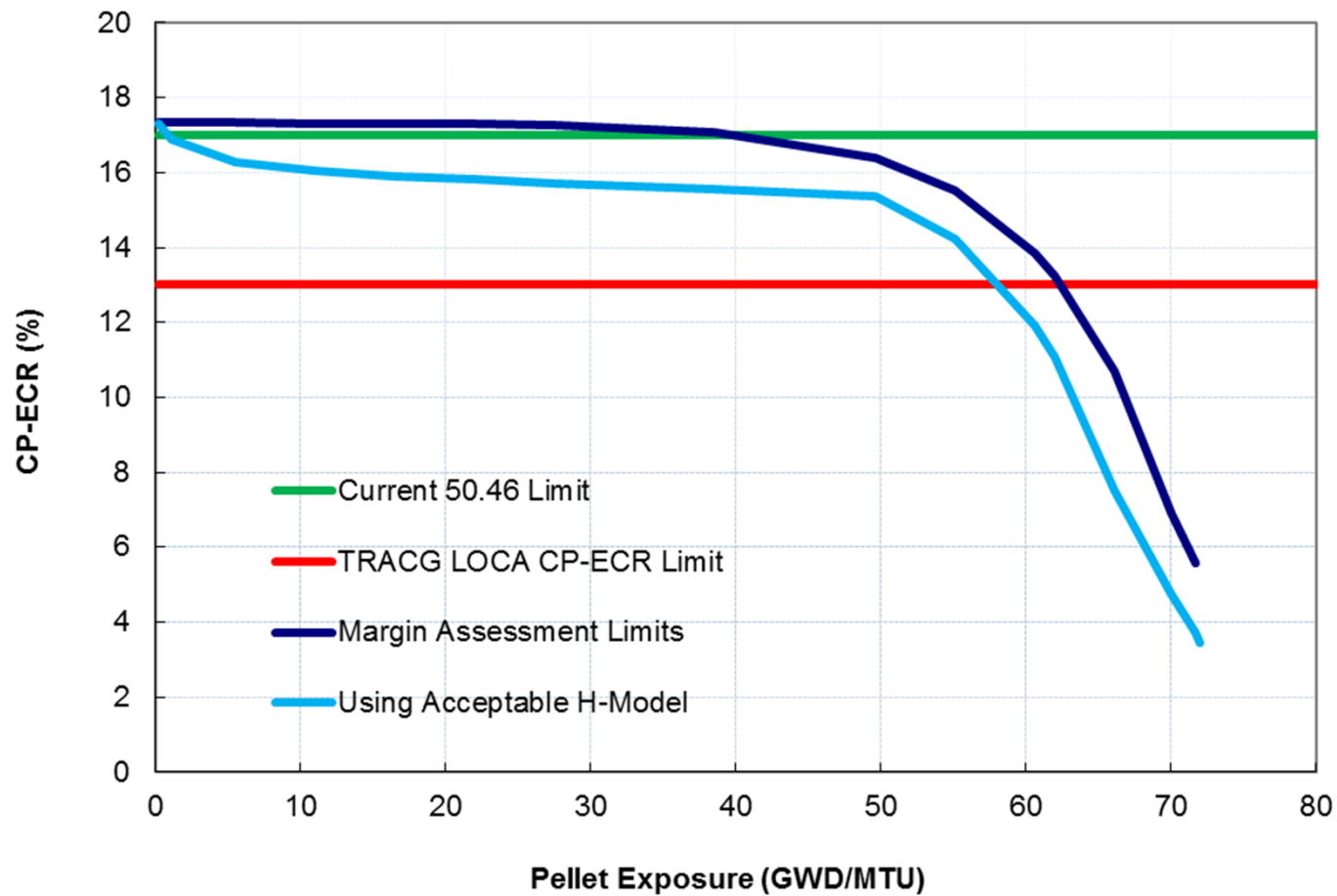
# TRACG/PRIME

- An infrastructure is already incorporated into the current TRACG LOCA methodology so that elements necessary for 50.46c compliance can be readily analyzed.
- The supplement for 50.46c [[  
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- The new rule removes the 13% CP-ECR limitation.



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# TRACG LOCA/PRIME



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## 50.46c Projected Timeline / Discussion

- EM Updates:
  - TRACG LOCA supplement [[ ]]
  - SAFER EM supplement [[ ]]
- Opportunities for streamlining the implementation and significantly simplifying the paperwork for compliance will be explored.
- Active engagement to reduce uncertainties in the implementation process by various means (RIS, review standard, etc.) will be sought.

Non-Proprietary Information



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# 2018 Technology Update

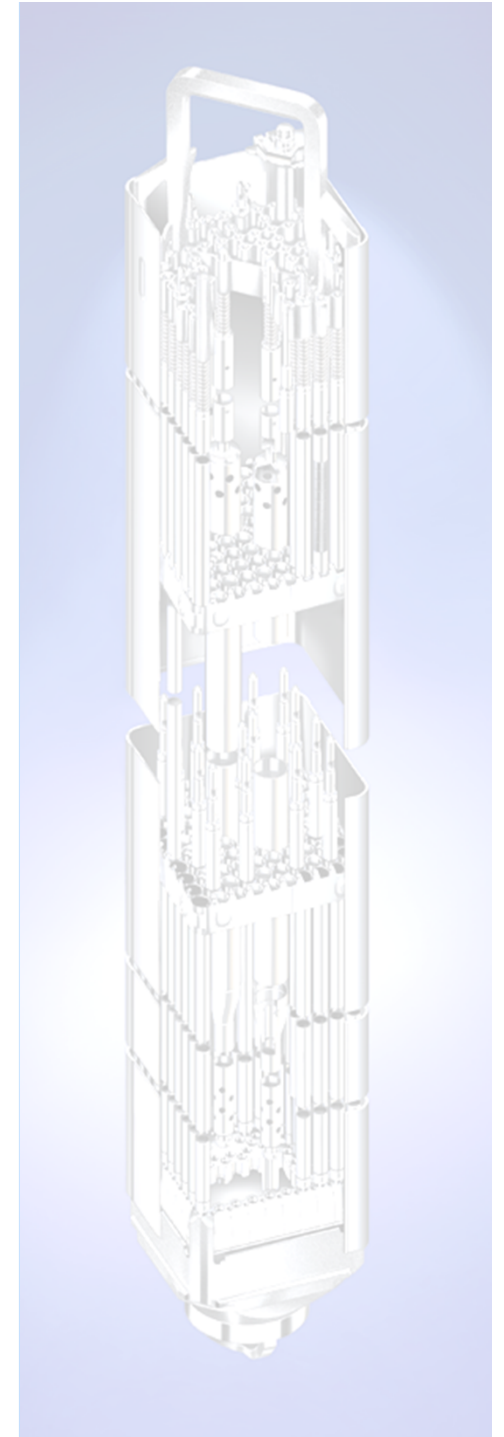
## Completed, In-Process, and Planned Submittals

Jim Harrison

August 28, 2018



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# GESTAR II Submittals

- NEDE-24011P – Revision 25  
Clarified Refueling Accident  
Clarified M+ Above 120%  
August 2017
- NEDE-24011P – Revision 26  
PRIME Transient  
January 2018
- NEDE-24011P – Revision 27  
Clarified Final Loading Pattern Process  
Updated TRACG-LOCA to Rev 2 Satisfy L&C 10.7  
August 2018





# GESTAR II Submittals - Continued

- Amendment 46

Submitted Feb 2018

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- Amendment 48

Submitted June 2018

SRLR Template Cleanup



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# Methods LTR

- NEDC-33173P Sup 5                      Submitted June 2017  
GNF3 Supplement for Interim Methods  
RAIs In-Process
- NEDC-33173P Sup 6    Submitted September 2017  
Removal of M+ SLMCPR Penalties  
RAIs In-Process



# Stability Solutions and Methods

(Just for Fun History)

- NEDE-33147 Rev 4 -A Version Submitted  
TRACG04 for DSS-CD Application Aug 2013
- NEDC-33075 Rev 8 -A Version Submitted  
DSS-CD Revision using TRACG04 Nov 2013
- TRACG04 Supplement for NEDO-32465  
-A Version Submitted Oct 2014
- GEH Simplified Stability Solution (GS3)  
-A Version Submitted Mar 2015



# Fuel Technology & Methods

- Ziron Cladding Draft SE Last Week
  - PRIME Transient TR -A August 18, 2017
  - TRACG-LOCA Application -A Revision 2 May 2018
  - Control Rod Drop Accident Methodology February 2018
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