



# Implementation Plan Template

50.46c Workshop  
January 2016

Paul M. Clifford  
Division of Safety Systems  
Nuclear Reactor Regulation



# Workshop Goals

- Develop a standardized format and scope for 50.46c implementation plans.



# Implementation Plan

- Based on industry comments, 50.46c implementation requirements revised as follows:
  - Each licensee submits an implementation plan (regulatory commitment) within **6 months** of rule.
    - Implementation plan must identify key aspects of the compliance demonstration
      - LOCA EM, along with approval status and/or review schedule
      - Fuel design (cladding alloy)
      - Analytical limits for PQD and breakaway
      - Relative level of effort
      - Updated annually
  - Upon receipt, the NRC would negotiate with licensees to **prioritize and balance workload**, ultimately agreeing to a plant-specific implementation plan.
    - Resources would be allocated to ensure NRC is not critical path.

# Level of Effort

Level of Effort	Scope of Performance Demonstration
Level I	<ul style="list-style-type: none"> <li>• Maintain existing LOCA evaluation model(s)<sup>9</sup></li> <li>• Minimal calculations (e.g., post-processing, integrate time-at-temperature with Cathcart-Pawel correlation)</li> </ul>
Level II	<ul style="list-style-type: none"> <li>• Maintain existing LOCA evaluation model(s)<sup>10</sup></li> <li>• Partial reanalysis with limited number of new LOCA simulations (e.g., burnup/rod power-dependent cases)</li> </ul>
Level III	<ul style="list-style-type: none"> <li>• New LOCA evaluation model(s)</li> <li>• Complete reanalysis with new break spectrum               <ul style="list-style-type: none"> <li>- or -</li> </ul> </li> <li>• New PQD testing to develop alloy-specific or PCT-specific analytical limits.</li> </ul>

9 As modified to comply with new § 50.46c requirements.

10 As modified to comply with new § 50.46c requirements.



## Rule Language

- (2)(i) Each holder of an operating license issued under this part as of **[INSERT DATE THAT IS 30 DAYS AFTER THE DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**, and each holder of an operating license issued under this part which is based upon a construction permit in effect as of **[INSERT DATE THAT IS 30 DAYS AFTER THE DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]** (including deferred and reinstated construction permits), must submit an implementation plan and schedule for achieving compliance with the provisions of this regulation with the exception of the consideration of debris effects under paragraph (d)(2)(iii) of this section. The implementation plan must identify the evaluation model(s), fuel design(s) and cladding alloy(s), and analytical limits to be used in the ECCS performance demonstration, along with the relative level of effort needed to complete the performance demonstration. The schedule must identify, for each element of the ECCS performance demonstration required to be submitted to the NRC for review (e.g., evaluation model, hydrogen uptake model, cladding alloy), the earliest possible date for submission and the expected date of submission. The implementation plan and schedule must be submitted within 6 months of **[INSERT DATE THAT IS 30 DAYS AFTER THE DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**, and updated by the licensee every 12 months until the license amendment request has been submitted and docketed by the NRC for review.
- (ii) The licensee's request for NRC approval under paragraph (d)(2) of this section must be in the form of license amendment application under § 50.90. The application must be submitted by no later than 60 months after **[INSERT DATE THAT IS 30 DAYS AFTER THE DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**.
- (iii) Licensees must be in compliance with the requirements of this section no later than 84 months after **[INSERT DATE THAT IS 30 DAYS AFTER THE DATE OF PUBLICATION IN THE *FEDERAL REGISTER*]**. Until such compliance is achieved, the requirements of § 50.46 continue to apply for purposes of ECCS design and fuel design.



## Sample Template

### 50.46c Implementation Plan

Plant Name: Calvert Cliffs Unit 1  
 LAR Level of Effort Category: Level III  
 LAR Submittal Date: November 1, 2020

#### Reactor Fuel Design:

	<u>Primary</u>	<u>Re-Inserts</u>
Manufacturer(s)	AREVA	Westinghouse
Design(s)	CE14HTP	CE14NGF
Cladding Alloy(s)	M5	ZIRLO

#### ECCS Performance Analytical Limits:

		<u>Status</u>
PQD Analytical Limits	RG 1.224 Figure 2	Available for Use
Breakaway Analytical Limits	M5: 4000 seconds, ZIRLO: 4000 seconds	Available for Use

#### ECCS Performance Evaluation Models:

		<u>Status</u>
Hydrogen Model	M5, ZIRLO models in RG 1.224	Available for Use
SBLOCA	EMF-2328, Rev.1	Under Review, Dec. 2016
LBLOCA	EMF-2103, Rev.4	Under Review, June 2017

#### ECCS Performance Demonstration:

##### *SBLOCA*

No new accident simulations will be performed. Existing EM and break spectrum sufficient to identify most limiting breakaway oxidation condition. Integral time-at-temperature will be re-baselined using CP correlation for comparison to RG 1.224 analytical limits.

##### *LBLOCA*

Complete break spectrum will be performed using new EM.

#### License Amendment Request:

50.46c LAR will be aligned with Cycle 27 to allow 3rd batch of AREVA CE14HTP with M5 cladding. Also, awaiting NRC approval of EMF-2103 Rev.4 and new LBLOCA analysis. Based upon schedule for new analysis, earliest possible date of submittal is February 2020.



## 50.46c Implementation Plan

Plant Name: Calvert Cliffs Unit 1  
 LAR Level of Effort Category: Level III  
 LAR Submittal Date: November 1, 2020

Level I, II, or III

### Reactor Fuel Design:

	Primary	Re-Inserts
Manufacturer(s)	AREVA	Westinghouse
Design(s)	CE14HTP	CE14NGF
Cladding Alloy(s)	M5	ZIRLO

Identify LOCA EMs and approval status/schedule

### ECCS Performance Analytical Limits:

		Status
PQD Analytical Limits	RG 1.224 Figure 2	Available for Use
Breakaway Analytical Limits	M5: 4000 seconds, ZIRLO: 4000 seconds	Available for Use

Details of LOCA calculations and LAR submittal

### ECCS Performance Evaluation Models:

		Status
Hydrogen Model	M5, ZIRLO models in RG 1.224	Available for Use
SBLOCA	EMF-2328, Rev.1	Under Review, Dec. 2016
LBLOCA	EMF-2103, Rev.4	Under Review, June 2017

Basis for LAR schedule including any unique situations

### ECCS Performance Demonstration:

#### SBLOCA

No new accident simulations will be performed. Existing EM and break spectrum sufficient to identify most limiting breakaway oxidation condition. Integral time-at-temperature will be re-baselined using CP correlation for comparison to RG 1.224 analytical limits.

#### LBLOCA

Complete break spectrum will be performed using new EM.

Earliest possible date for LAR submittal

### License Amendment Request:

50.46c LAR will be aligned with Cycle 27 to allow 3rd batch of AREVA CE14HTP with M5 cladding. Also, awaiting NRC approval of EMF-2103 Rev.4 and new LBLOCA analysis. Based upon schedule for new analysis, earliest possible date of submittal is February 2020.



# Legacy Fuel

- RG 1.224 provides guidance related to legacy fuel.
- PQD Analytical Limit
  - Fuel that is **manufactured prior** to the effective date of the rule and comprised of either **currently available** commercial cladding alloys (e.g., Zry-2, Zry-4) or **legacy zirconium alloys** no longer commercially available can be evaluated using Figure 2 of RG 1.224 to show compliance with 50.46c(g)(1)(ii)
- Breakaway Oxidation
  - Fuel that is **manufactured prior** to the effective date of the rule and comprised of **currently available** commercial cladding alloys (e.g., Zry-2, Zry-4) can be evaluated using the breakaway oxidation analytical time limit established for the current versions of those commercial alloys should be applied to show compliance with 50.46c(g)(1)(iii)
  - Fuel that is **manufactured prior** to the effective date of the rule and comprised of **legacy zirconium alloys** no longer commercially available can be evaluated using an analytical time limit of 3,500 seconds to show compliance with 50.46c(g)(1)(iii)





## Future Actions

- Industry (NEI) controls final implementation plan template
- Schedule next workshop to develop Level I, II, and III LAR templates