

# Management of Spent Fuel Pool Criticality

## Pressurized Water Reactors

June 21, 2013 update

### Means to meet subcriticality requirements

PWR	Region 1 (fresher fuel)	Region 2 (older fuel)	License Amendment Reference	Date updated
Arkansas Nuclear One Unit 1	Storage patterns/burnup + 444 ppm [B]	Metamic inserts in "Region 3" + Storage patterns/burnup + 444 ppm [B]	LA #228 01/26/2007 ML070160038	June 21, 2013
Arkansas Nuclear One Unit 2	Metamic + 452 ppm [B]	Storage patterns/burnup + 452 ppm [B]	LA #273 09/28/2007 ML072620412	June 21, 2013
Beaver Valley Unit 1	Boral	Boral	LA #178 11/01/1993 ML003767816	June 21, 2013
Beaver Valley Unit 2	Storage patterns/burnup + 450 ppm [B] Currently installing Metamic	Storage patterns/burnup + 450 ppm [B] Currently installing Metamic	LA #165 03/27/2008 ML080730476 (storage patterns) LA #173 04/29/2011 ML110890844 (Metamic)	June 21, 2013
Braidwood Unit 1	Boral + burnup	Boral + storage patterns/burnup	LA #105 03/01/2000 ML003692088	June 21, 2013
Braidwood Unit 2	Boral + burnup	Boral + storage patterns/burnup	LA #105 03/01/2000 ML003692088	June 21, 2013
Byron Unit 1	Boral + burnup	Boral + storage patterns/burnup	LA #112 03/01/2000 ML003692088	June 21, 2013
Byron Unit 2	Boral + burnup	Boral + storage patterns/burnup	LA #112 03/01/2000 ML003692088	June 21, 2013
Callaway	Boral + storage patterns	Boral + storage patterns/burnup + IFBA	LA #129 01/19/1999 ML021640249	June 21, 2013
Calvert Cliffs Unit 1	Carboundum + 350 ppm [B]	Carborundum + 350 ppm [B]	LA # 267 06/03/2004 ML041040129	June 21, 2013
Calvert Cliffs Unit 2	Storage patterns/burnup + 350 ppm [B]	Storage patterns/burnup + 350 ppm [B]	LA # 246 01/27/2005 ML050140262	June 21, 2013
Catawba Unit 1	Flux trap racks + 200 ppm [B]	Flux trap racks + 200 ppm [B]	LA #233 09/27/2006 ML062540237	June 21, 2013
Catawba Unit 2	Flux trap racks + 200 ppm [B]	flux trap racks + 200 ppm [B]	LA #229 09/27/2006 ML062540237	June 21, 2013
Comanche Peak Unit 1	Boral + 700 ppm [B]	9" spacing and storage patterns/burnup + 800 ppm [B]	LA #87 10/02/2001 ML012560143	June 21, 2013

<b>Comanche Peak Unit 2</b>	Boral + 700 ppm [B]	9" spacing and storage patterns/burnup + 800 ppm [B]	LA #87 10/02/2001 ML012560143	June 21, 2013
<b>Crystal River Unit 3 Pool A</b>	Carborundum +storage patterns/burnup	Carborundum +storage patterns/burnup	LA #193 09/13/2000 ML003752886 (storage patterns/burnup) LA #227 10/25/2007 ML072910317 (revise storage patterns/burnup)	June 21, 2013
<b>Crystal River Unit 3 Pool B</b>	Boral + storage patterns	Boral + burnup	LA #193 09/13/2000 ML003752886 (Boral) La #227 10/25/2007 ML072910317 (revise storage patterns/burnup)	June 21, 2013
<b>Davis Besse</b>	Boral + storage patterns/burnup + flux trap	Boral + storage patterns/burnup	LA #247 10/19/2001 ML012910442	June 21, 2013
<b>Diablo Canyon Unit 1</b>	Storage Patterns/burnup + IFBA rods + 806 ppm [B]	Storage Patterns/burnup + IFBA rods	LA #154 09/25/2002 ML022610080 LA #183 11/21/2005 ML052970270 (Cask pit)	June 21, 2013
<b>Diablo Canyon Unit 2</b>	Storage Patterns/burnup + IFBA rods + 806 ppm [B]	Storage Patterns/burnup + IFBA rods	LA #154 09/25/2002 ML022610080 LA #185 11/21/2005 ML052970270 (Cask pit)	June 21, 2013
<b>Donald C. Cook Units 1 + 2 (shared pool)</b>	Boral + storage patterns/burnup	Boral + storage patterns/burnup	LA #169 and #152 01/14/1993 ML021060153 (Boral) LA #311 and #293 10/08/2009 ML092540310 (storage patterns)	June 21, 2013
<b>Fort Calhoun</b>	Boral	Boral + control element assemblies	LA #155 08/12/1993 NUDOCS #9308240229	June 21, 2013
<b>H.B. Robinson Unit 2</b>	Storage patterns/burnup + 200 ppm [B]	Storage patterns/burnup + 200 ppm [B]	LA #198 12/22/2003 ML033560622	June 21, 2013
<b>Indian Point Unit 2</b>	Region 1-1: Storage patterns + IFBA rods + 714 ppm [B] Region 1-2: 50% Boraflex + 786 ppm [B]	Region 2-1: 770 ppm [B] Region 2-2: 70% Boraflex + 725 ppm [B]	LA #227 05/29/2002 ML021230367	June 21, 2013
<b>Indian Point Unit 3</b>	Boral	Boral + burnup	LA #90 10/12/1989 ML003778816	June 21, 2013
<b>Joseph M. Farley Unit 1</b>	Storage patterns/burnup + IFBA rods + 400 ppm [B]	Storage patterns/burnup + IFBA rods + 400 ppm [B]	LA #133 01/23/1998 ML013130226	June 21, 2013
<b>Joseph M. Farley Unit 2</b>	Storage patterns/burnup + 400 ppm [B]	Storage patterns/burnup + 400 ppm [B]	LA #125 01/23/1998 ML013130226	June 21, 2013
<b>Kewaunee</b>	Boron Carbide plates (ESK Tetrabor: see NUDOCS #7812080188 12/01/1978)	Boral in the Canal Pool	LA #26 03/06/1979 NUDOCS#7904060101 (Tetrabor) LA #150 01/23/2001 ML010240051 (Boral)	June 21, 2013
<b>McGuire Unit 1</b>	Boral + 800 ppm [B]	Storage patterns/burnup + 800 ppm [B]	LA#225 03/17/2005 ML050280409	June 21, 2013
<b>McGuire Unit 2</b>	Boral + 800 ppm [B]	Storage patterns/burnup + 800 ppm [B]	LA#207 03/17/2005 ML050280409	June 21, 2013

<b>Millstone Unit 2</b>	Regions A and B: 75% Boraflex + Storage patterns/burnup + 600 ppm [B]	Region C: Storage patterns + RODLETS + 600 ppm [B]	LA #274 04/01/2003 ML030910485 Response to RAI for Rodlet LAR ML13155A140 05/28/2013	June 21, 2013
<b>Millstone Unit 3</b>	Boral + Storage patterns/burnup in Region 1 and 2	Region 3: Storage patterns/burnup	LA #189 11/28/2000 ML003744387	June 21, 2013
<b>North Anna Units 1 + 2 (shared pool)</b>	Storage patterns/burnup + 350 [B]	Storage patterns/burnup + 350 [B]	LA #227 and #208 06/15/2001 ML011700557	June 21, 2013
<b>Oconee Units 1 + 2 (shared pool)</b>	Storage patterns/burnup + 430 ppm [B]	Storage patterns/burnup + 430 ppm [B]	LA #323 and #323 04/22/02 ML020930470	June 21, 2013
<b>Oconee Unit 3</b>	Storage patterns/burnup + 430 ppm [B]	Storage patterns/burnup + 430 ppm [B]	LA #324 04/22/02 ML020930470	June 21, 2013
<b>Palisades</b>	Storage patterns/burnup + 850 ppm [B]	Storage patterns/burnup + 850 ppm [B]	LA #236 02/06/2009 ML090160238 (ppm [B]) LA #246 01/27/2012 ML11362A468 (storage patterns) LA #250 2/28/2013 ML13056A514 (Metamic Inserts)	June 21, 2013
<b>Palo Verde Unit 1</b>	Storage patterns/burnup + 500 ppm [B]	Storage patterns/burnup + 500 ppm [B]	LA #125 03/02/2000 ML003689038	June 21, 2013
<b>Palo Verde Unit 2</b>	Storage patterns/burnup + 500 ppm [B]	Storage patterns/burnup + 500 ppm [B]	LA #125 03/02/2000 ML003689038	June 21, 2013
<b>Palo Verde Unit 3</b>	Storage patterns/burnup + 500 ppm [B]	Storage patterns/burnup + 500 ppm [B]	LA #125 03/02/2000 ML003689038	June 21, 2013
<b>Point Beach Units 1 + 2 (Shared pool)</b>	Storage patterns/burnup + 402 ppm [B] +IFBA	Storage patterns/burnup + 402 ppm [B] + IFBA	LA #236 #240 03/05/2010 ML100400106	June 21, 2013
<b>Prairie Island Unit 1</b>	Storage patterns/burnup + 730 ppm [B] + Gd burnable absorbers	Storage patterns/burnup + 730 ppm [B] + Gd burnable absorbers	LA#129 06/12/1997 ML022260190	June 21, 2013
<b>Prairie Island Unit 2</b>	Storage patterns/burnup + 730 ppm [B] + Gd burnable absorbers	Storage patterns/burnup + 730 ppm [B] + Gd burnable absorbers	LA#129 06/12/1997 ML022260190	June 21, 2013
<b>R.E. Ginna</b>	Storage patterns/burnup + borated stainless steel + 584 ppm [B]	Storage patterns/burnup + borated stainless steel + 584 ppm [B]	LA #79 12/07/2000 ML003761578	June 21, 2013
<b>Salem Unit 1</b>	Boral + Storage patterns/burnup	Boral + storage patterns/burnup	LA #151 05/04/1994 ML011710291 (Boral) LA # 262 02/06/2004 ML033650405 (revise ppm [B])	June 21, 2013
<b>Salem Unit 2</b>	Boral + storage patterns/burnup	Boral + storage patterns/burnup	LA #131 05/04/1994 ML011710291 (Boral) LA # 244 02/06/2004 ML033650405 (revise ppm [B])	June 21, 2013
<b>San Onofre Unit 2</b>	CEA rods + Borated Stainless Steel GT inserts in assemblies + Erbium rods + storage patterns/burnup + 970 ppm [B]	CEA rods + Borated Stainless Steel GT inserts in assemblies + Erbium rods + storage patterns/burnup + 970 ppm [B]	LA #213 09/27/2007 ML072550175	June 21, 2013
<b>San Onofre Unit 3</b>	CEA rods + Borated Stainless Steel GT inserts in assemblies + Erbium rods + storage patterns/burnup + 970 ppm [B]	CEA rods + Borated Stainless Steel GT inserts in assemblies + Erbium rods + storage patterns/burnup + 970 ppm [B]	LA #205 09/27/2007 ML072550175	June 21, 2013
<b>Seabrook Unit 1</b>	Boral + Storage patterns/burnup	Storage Patterns/burnup	<b>No license amendment found in ADAMS for installation of Boral. License Amendment request to remove Boraflex credit is under review. See ML12038A036 01/30/2012.</b>	June 21, 2013
<b>Sequoyah Units 1 + 2 (shared pool)</b>	Boral + storage patterns/burnup +300 ppm [B]	Boral + storage patterns/burnup + 300 [B]	LA #167 and #157 04/28/1993 ML013310493 (Boral and cask pit) LA # 265 #256 12/19/2000 ML003779981 (300 ppm [B])	June 21, 2013
<b>Shearon Harris Unit 1 Pools A and B</b>	PWR racks: Storage patterns/burnup + 500 ppm [B]	BWR racks: Boraflex	LA #121 03/10/2006 ML060600349	June 21, 2013

<b>Shearon Harris Unit 1 Pools C and D</b>	Boral + Metamic + storage patterns/burnup	Boral + Metamic + storage patterns/burnup	LA #103 12/21/2000 ML003779362 (original racking) LA #129 01/29/2009 ML090270022 (Metamic)	June 21, 2013
<b>South Texas Project Unit 1</b>	Storage patterns/burnup + IFBA + 500 ppm [B]	Storage patterns/burnup + 700 ppm [B]	LA # 104 03/03/1999 ML021330578	June 21, 2013
<b>South Texas Project Unit 2</b>	Storage patterns/burnup + IFBA + 500 ppm [B]	Storage patterns/burnup + 700 ppm [B]	LA # 91 03/03/1999 ML021330578	June 21, 2013
<b>St. Lucie Unit 1</b>	Storage patterns/burnup + 500 ppm [B] + Metamic inserts	Storage patterns/burnup + 500 ppm [B] + Metamic inserts	LA #193 09/23/2004 ML042670562 (storage patterns and [B]) LA#213 7/09/2012 ML12181A019 p60,83 (extended power uprate and Metamic)	June 21, 2013
<b>St. Lucie Unit 2</b>	Checkerboarding + CEA + Gadolinium + burnable absorbers 500 ppm [B] +Metamic inserts	Checkerboarding + CEA + Gadolinium + burnable absorbers 500 ppm [B] +Metamic inserts	LA#101 05/06/1999 ML013610012 LA #163 9/24/2012, p 64 ML12235A463 (extended power uprate and Metamic inserts) LA #162 9/19/2012 ML12263A224, p10, ([B])	June 21, 2013
<b>Surry Units 1 + 2 (shared pool)</b>	burnup + 14" center-center	14" center-center	LA # 214 06/19/1998 ML012710055	June 21, 2013
<b>Three Mile Island Unit 1 Pool A</b>	Boral + Storage patterns/burnup + Metamic	Boral + Storage patterns/burnup + Metamic	LA #164 04/27/1992 ML003766347 (Boral) 50.59 report 04/16/12 ML12109A235 (Metamic)	June 21, 2013
<b>Three Mile Island Unit 1 Pool B</b>	burnup + 13 5/8" distance	burnup + 13 5/8" distance	LA #164 04/27/1992 ML003766347	June 21, 2013
<b>Turkey Point Unit 3</b>	RCCA + storage patterns/burnup + 500 ppm [B]	Metamic inserts + RCCA + storage patterns/burnup + 500 ppm [B]	LA #234 07/17/2007 ML071800198 (Metamic) LA #246 10/31/2011 ML11216A057 (storage patterns) LA #249 6/15/2012 6/15/2012, p79 ML11293A365 (extended power uprate)	June 21, 2013
<b>Turkey Point Unit 4</b>	RCCA Storage pattern/burnup +500 ppm [B]	Metamic inserts + RCCA Storage pattern/burnup +500 ppm [B]	LA #229 07/17/2007 ML071800198 (Metamic) LA #242 10/31/2011 ML11216A057 (storage patterns) LA #245 6/15/2012 ML11293A365, p79, (extended power uprate)	June 21, 2013
<b>V.C. Summer</b>	Boral	Boral + burnup	LA #160 08/30/2002 ML022330203 Corrected LA #160 10/15/2007 ML072490017	June 21, 2013
<b>Vogtle Unit 1</b>	Boral + stoarge patterns/burnup + IFBA + 511 ppm [B]	Boral + stoarge patterns/burnup + IFBA + 511 ppm [B]	LA #102 06/29/1998 ML102410127 (Boral racks) LA #139 09/22/2005 ML052420110 (storage patterns/burnup and ppm [B])	June 21, 2013
<b>Vogtle Unit 2</b>	Storage patterns/burnup + IFBA + 394 ppm [B]	Storage patterns/burnup + IFBA + 394 ppm [B]	LA #118 09/22/2005 ML052420110	June 21, 2013
<b>Waterford Unit 3</b>	Boral (Region I located in cask storage pit)	Boral + storage patterns/burnup (located in spent fuel pool)	LA #144 07/10/1998 ML021790559	June 21, 2013
<b>Watts Bar Unit 1</b>	Boral + storage patterns/burnup	Boral + storage patterns/burnup	LA #6 07/28/1997 ML020780158	June 21, 2013
<b>Wolf Creek Unit 1</b>	Boral + Storage patterns + IFBA	Boral + Storage patterns/burnup + IFBA	LA #120 03/22/1999 ML022050079	June 21, 2013

# Management of Spent Fuel Pool Criticality

## Boiling Water Reactors

June 21, 2013 update

BWR	Current Subcriticality Credit	License Amendment Reference	Date updated
Browns Ferry Unit 1	Boral	LA #42 09/21/1978 ML020040269	June 21, 2013
Browns Ferry Unit 2	Boral	LA #39 09/21/1978 ML020040269	June 21, 2013
Browns Ferry Unit 3	Boral	LA #16 09/21/1978 ML020040269	June 21, 2013
Brunswick Unit 1	Boral (BWR Fuel) 8.95 inch distance for low-density PWR fuel 8.625 in distance for low-density BWR fuel	LA #8 08/26/1977 ML020370382 (low-density racks) LA #61 12/15/1983 ML020380374 (Boral racks)	June 21, 2013
Brunswick Unit 2	Boral (BWR Fuel) 8.95 inch distance for low-density PWR fuel 8.625 inch distance for low-density BWR fuel	LA #30 08/26/1977 ML020370382 (low-density racks) LA #87 12/15/1983 ML020380374 (Boral racks)	June 21, 2013
Clinton	Boral + Metamic + low-density racks + burnup	LA #170 10/31/2005 ML053070593	June 21, 2013
Columbia Generating Station	B4C granule in phenolic resin	<b>B4C is original to plant; therefore there is no license amendment for installation.</b> See LR RAI response ML102440342 p5, 08/19/2010	June 21, 2013
Cooper	Boral + 2 Metamic racks + burnup + Gd in Metamic racks	LA #52 09/29/1978 ML021350079 (Boral) LA #227 09/06/2007 ML072130023 (Metamic + burnup) Holtec Licensing Report 10/07/2006 ML062990432 p48 (Gd credit)	June 21, 2013
Dresden Unit 2	Boral	LA #74 08/27/1982 ML021150164	June 21, 2013
Dresden Unit 3	Boral	LA #66 08/27/1982 ML021150164	June 21, 2013
Duane Arnold	Boral + Gd burnable absorbers	LA #195 02/02/1994 ML021910481 (Boral) LA #226 06/08/1999 ML021920201 (add GE 10x10 fuel)	June 21, 2013
Edwin I. Hatch Unit 1	Boral	LA #74 04/21/80 ML012950485 (Boral) LA #220 03/23/00 ML003711959 (168 rack cells)	June 21, 2013
Edwin I. Hatch Unit 2	Boral	LA #15 04/21/80 ML012950485 (Boral) LA #161 03/23/00 ML003711959 (168 rack cells)	June 21, 2013
Fermi Unit 2	Boraflex + Boral + Gd burnable absorber	LA #141 01/25/2001 ML011150103	June 21, 2013
Grand Gulf Unit 1	Boraflex + storage patterns	LA #17 08/18/1986 ML021420285	June 21, 2013
Hope Creek Unit 1	Boral	<b>No Amendment for Boral Installation.</b> Boral monitoring in place; see SER for LR ML110690244 p314, 03/09/2011	June 21, 2013
James A. Fitzpatrick	Boral + Gd burnable absorbers	SER for LA #256 11/10/1999 ML993260026	June 21, 2013
La Salle County Unit 1	Boral + storage patterns/burnup + Gadolinia rods	LA #90 02/24/1993 ML021120427	June 21, 2013

La Salle County Unit 2	Rio Tinto Alcan NETCO Snap-In Inserts	LA #186 01/28/2011 ML 110250051 Withdrawal of LAR and notification of completion, 01/06/2012, ML120060432	June 21, 2013
Limerick Unit 1	Boral	LA #82 11/29/1994 ML011560690	June 21, 2013
Limerick Unit 2	Boral	LA #82 11/29/1994 ML011560690	June 21, 2013
Monticello	Boral	LA #34 04/14/1978 ML020880176	June 21, 2013
Nine Mile Point Unit 1	Boraflex + Boral	LA #54 02/01/1984 ML010990385 (Boraflex) LA #167 06/17/1999 ML011030037 (Boral)	June 21, 2013
Nine Mile Point Unit 2	Boral	<b>No amendment found in ADAMS for Boral Installation</b> See Holtec criticality analysis ML103500365 12/13/2010	June 21, 2013
Oyster Creek Unit 1	Boraflex (2645 cells) + Boral (390 cells) + Gd burnable absorbers	LA #76 09/17/08 ML011160078 (Boraflex) LA #179 04/10/1995 ML011220244 (Gd) LA #215 09/15/2000 ML003730135 (Boral)	June 21, 2013
Peach Bottom Unit 2	Boraflex, storage patterns, burnup during installation of NETCO Snap-in inserts	LA #116 02/19/1986 ML021570574 LA#287 5/21/2013 ML13114A929	June 21, 2013
Peach Bottom Unit 3	Boraflex, storage patterns, burnup during installation of NETCO Snap-in inserts	LA #120 02/19/1986 ML021570574 LA#290 5/21/2013 ML13114A929	June 21, 2013
Perry Unit 1	<b>No public reference to neutron absorber or subcriticality credit found</b>	<b>No amendment found in ADAMS</b>	June 21, 2013
Pilgrim Unit 1	Boraflex + Boral + Metamic	LA #33 08/17/1978 ML011910005 (Install Boral) LA#155 06/22/1994 ML011940178 (Install more Boral) <b>No LA found for installation of Boraflex or Metamic</b> LR SER on 6/28/2007 ML071410455 (Boraflex) LR Supp. SER on 6/30/2011 ML11147A036 (Metamic)	June 21, 2013
Quad Cities Unit 1	Boraflex + storage patterns	LA #79 06/09/1982 ML020940141	June 21, 2013
Quad Cities Unit 2	Boraflex + storage patterns	LA #79 06/09/1982 ML020940141	June 21, 2013
River Bend Unit 1	Boraflex II	See Licence Amendment Request ML102630247 09/09/10	June 21, 2013
Susquehanna Unit 1	Boral	<b>Boral is original to plant; therefore there is no license amendment for installation;</b> see SER for License Renewal ML093170792 p249, 11/30/2009	June 21, 2013
Susquehanna Unit 2	Boral	<b>Boral is original to plant; therefore there is no license amendment for installation;</b> see SER for License Renewal ML093170792 p249, 11/30/2009	June 21, 2013
Vermont Yankee	Boral	LA #104 05/20/88 ML011640093	June 21, 2013

## Management of Spent Fuel Pool Criticality

Decommissioned Plants which still hold fuel in either wet or dry storage

Plant	Plant type	Total spent fuel bundles	Bundle status	Pool status	Current Subcriticality Credit	Sources	Date Updated	NOTE
LaCrosse	BWR	0	ISFSI	Empty	---	Correspondance 10/31/2012 ML12264A384	June 21, 2013	
Millstone Unit 1	BWR					No public sources found in ADAMS	June 21, 2013	
Zion Units 1+2 Shared pool	PWR					No public sources found in ADAMS	June 21, 2013	