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VOLUME 5 of 6

UC-70, -71, and -85

Office of Civilian Radioactive Waste Management

**CHARACTERISTICS OF SPENT FUEL,
HIGH-LEVEL WASTE, AND OTHER
RADIOACTIVE WASTES WHICH MAY
REQUIRE LONG-TERM ISOLATION**

DECEMBER 1987

U.S. Department of Energy
Office of Civilian Radioactive Waste Management
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APPENDIX 2E

PHYSICAL DESCRIPTIONS OF LWR NONFUEL ASSEMBLY HARDWARE

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INTRODUCTION

This appendix includes a two to three page Physical Description report for each Non-fuel Assembly (NFA) Hardware item identified from the current data. Information was obtained via subcontracts with these NFA hardware vendors: Babcock & Wilcox, Combustion Engineering and Westinghouse. Data for some NFA hardware are not available. For such hardware, the information shown in this report was obtained from the open literature. Efforts to obtain additional information are continuing.

NFA hardware can be grouped into six categories: BWR Channels, Control Elements, Guide Tube Plugs/Orifice Rods, Instrumentation, Neutron Poisons, and Neutron Sources. This appendix lists Physical Description reports alphabetically by vendor within each category.

Individual Physical Description reports can be generated interactively through the menu-driven LWR Non-Fuel Assembly Hardware Data Base system. These reports can be viewed on the screen, directed to a printer, or saved in a text file for later use. Special reports and compilations of specific data items can be produced on request.

Comments and requests are welcome. Please contact:

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2E-7/8

BWR CHANNELS

Physical Description Report

Page: 1

General Electric Dresden, 60 Mil BWR Channel

Designed for:

Fuel Assembly with array size: 6x6
Boiling Water Reactor

Dimensions:

Total Length:	120	inches
Total Weight:	30	pounds
Average Width:	4.410	inches

Channel Material: Zircaloy-2

Life Expectancy: 3 cycles

Physical Description Report

Page: 2

General Electric Dresden, 60 Mil BWR Channel

Composition:

Material	Total Weight (kg)	Zone
Zircaloy-2	13.600	In Core

Used at the Following Reactors:

Reactor	Number in Core
Dresden 1	488

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	6x6	GE	(assumed)
General Electric	6x6	DRES-1	

Comment:

Length is an estimate based on drawing D-8; Docket 50-10, September 3, 1957. Weight is estimated.

Physical Description Report

Page: 1

General Electric Humboldt Bay BWR Channel

Designed for:

Fuel Assembly with array size: 7x7
Boiling Water Reactor

Dimensions:

Total Length:	88.6	inches
Total Weight:	23.4	pounds
Average Width:	4.662	inches

Channel Material: Zircaloy-2

Life Expectancy: 3 cycles

Physical Description Report

Page: 2

General Electric Humboldt Bay BWR Channel

Composition:

Material	Total Weight (kg)	Zone
Zircaloy-2	10.600	In Core

Used at the Following Reactors:

Reactor	Number in Core
Humboldt Bay	172

Used with Following Fuel Assembly Types:

Vendor	Array Version
--------	---------------

Comment:

Weight is estimated.

Physical Description Report

Page: 1

General Electric BWR/2,3;80 Mil Thick BWR Channel

Designed for:

Fuel Assembly with array size: 7x7
Boiling Water Reactor

Dimensions:

Total Length:	162.125	inches
Total Weight:	67	pounds
Average Width:	5.438	inches

Channel Material: Zircaloy-4

Life Expectancy: 3 cycles

Physical Description Report

Page: 2

General Electric BWR/2,3;80 Mil Thick BWR Channel

Composition:

Material	Total Weight (kg)	Zone
Zircaloy-4	30.000	In Core

Used at the Following Reactors:

Reactor	Number in Core
Dresden 2	724
Dresden 3	724
Quad Cities 1	724
Quad Cities 2	724
Oyster Creek	560
Nine Mile Point 1	532
Millstone 1	580
Monticello	484

Used with Following Fuel Assembly Types:

Vendor	Array	Version
--------	-------	---------

Comment:

Weight is estimated.

Physical Description Report

Page: 1

General Electric BWR/3, Long 80 Mil BWR Channel

Designed for:

Fuel Assembly with array size: 7x7
Boiling Water Reactor

Dimensions:

Total Length:	171.125	inches
Total Weight:	70	pounds
Average Width:	5.438	inches

Channel Material: Zircaloy-4

Life Expectancy: 3 cycles

Physical Description Report

Page: 2

General Electric BWR/3, Long 80 Mil BWR Channel

Composition:

Material	Total Weight (kg)	Zone
Zircaloy-4	32.000	In Core

Used at the Following Reactors:

Reactor	Number in Core
Pilgrim	580

Used with Following Fuel Assembly Types:

Vendor	Array	Version
--------	-------	---------

Comment:

Weight is estimated.

Physical Description Report

Page: 1

General Electric BWR/4; 80 Mil Thick BWR Channel

Designed for:

Fuel Assembly with array size: 7x7
Boiling Water Reactor

Dimensions:

Total Length:	166.9	inches
Total Weight:	69	pounds
Average Width:	5.438	inches

Channel Material: Zircaloy-4

Life Expectancy: 3 cycles

Physical Description Report

Page: 2

General Electric BWR/4; 80 Mil Thick BWR Channel

Composition:

Material	Total Weight (kg)	Zone
Zircaloy-4	31.000	In Core

Used at the Following Reactors:

Reactor	Number in Core	
Brunswick 1	560	
Brunswick 2	560	
Enrico Fermi 2	764	(assumed)
Hatch 1	560	
Hatch 2	560	
Duane Arnold	368	
Shoreham	560	
Cooper Station	548	
Susquehanna 1	764	(assumed)
Susquehanna 2	764	(assumed)
Limerick 1	764	(assumed)
Limerick 2	764	(assumed)
Peach Bottom 2	764	
Peach Bottom 3	764	
Fitzpatrick	560	
Hope Creek	764	
Browns Ferry 1	764	
Browns Ferry 2	764	
Browns Ferry 3	764	
Vermont Yankee	368	

Used with Following Fuel Assembly Types:

Vendor	Array Version
--------	---------------

Comment:

Weight is estimated.

Physical Description Report

Page: 1

General Electric BWR/4,5,100 Mil Thic BWR Channel

Designed for:

Fuel Assembly with array size: 7x7
Boiling Water Reactor

Dimensions:

Total Length:	166.9	inches
Total Weight:	86	pounds
Average Width:	5.438	inches

Channel Material: Zircaloy-4

Life Expectancy: 3 cycles

Physical Description Report

Page: 2

General Electric BWR/4,5,100 Mil Thic BWR Channel

Composition:

Material	Total Weight (kg)	Zone
Zircaloy-4	39.000	In Core

Used at the Following Reactors:

Reactor	Number in Core	
Brunswick 1	560	
Brunswick 2	560	
LaSalle 1	764	
LaSalle 2	764	
Enrico Fermi 2	764	(assumed)
Hatch 1	560	
Hatch 2	560	
Duane Arnold	368	
Shoreham	560	
Cooper Station	548	
Nine Mile Point 2	764	
Susquehanna 1	764	(assumed)
Susquehanna 2	764	(assumed)
Limerick 1	764	(assumed)
Limerick 2	764	(assumed)
Peach Bottom 2	760	
Peach Bottom 3	760	
Fitzpatrick	560	
Hope Creek	764	
Browns Ferry 1	764	
Browns Ferry 2	764	
Browns Ferry 3	764	
Washington Nuclear 2	764	(assumed)
Vermont Yankee	368	

Used with Following Fuel Assembly Types:

Vendor	Array Version
--------	---------------

Comment:

Weight is estimated.

Physical Description Report

Page: 1

General Electric BWR/6; 120 Mil Thick BWR Channel

Designed for:

Fuel Assembly with array size: 8x8
Boiling Water Reactor

Dimensions:

Total Length:	167.4	inches
Total Weight:	104	pounds
Average Width:	5.455	inches

Channel Material: Zircaloy-4

Life Expectancy: 3-6 cycles

Physical Description Report

Page: 2

General Electric BWR/6; 120 Mil Thick BWR Channel

Composition:

Material	Total Weight (kg)	Zone
Zircaloy-4	46.000	In Core

Used at the Following Reactors:

Reactor	Number in Core	
Perry 1	784	(assumed)
Perry 2	784	(assumed)
River Bend 1	592	
Clinton	592	
Grand Gulf 1	784	
Grand Gulf 2	784	

Used with Following Fuel Assembly Types:

Vendor	Array	Version
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Comment:

Weight is estimated.

2E-23/24

CONTROL ELEMENTS

Physical Description Report

Page: 1

Babcock & Wilcox Standard Control Element

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length: 160 inches
Total Weight: 130 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.440 inches
Wall Thickness:
Diametral Gap:

Poison:

Primary Material: Ag-In-Cd
Poison Length:
Pellet Diameter:

Plenum Spring Material: St. Steel 302

Spider Material: St. Steel CF3M

Number of Control Rods: 16

Life Expectancy:

Design Variations:

Roddy, et. al., report a "Long Life" CRA from B&W. It is
pressurized to 465 PSIG and uses Inc-625 cladding. B&W made
no mention of this in their submittal.

Physical Description Report

Page: 2

Babcock & Wilcox Standard Control Element

Composition:

Material	Total Weight (kg)	Zone
St.Steel CF3M	3.200	Top
St.Steel 304	0.070	Top
Ag-In-Cd	43.120	In Core
St.Steel 304	10.820	In Core
St.Steel 302	0.850	In Core

Used at the Following Reactors:

Reactor	Number in Core
Arkansas 1	61
Oconee 1	61
Oconee 2	61
Oconee 3	61
Crystal River 3	61
Three Mile Island 1	61
Rancho Seco	53
Davis-Besse	61

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	15x15	Mark B
Babcock & Wilcox	15x15	Mark BZ

Physical Description Report

Page: 1

Combustion Engineering SYS80 4 Rod Part Len Control Element

Designed for:

Fuel Assembly with array size: 16x16
Pressurized Water Reactor

Dimensions:

Total Length: 253 inches
Total Weight: 95.0 pounds

Cladding:

Material: Inconel 625
Outer Diameter: 0.816 inches
Wall Thickness: 0.035 inches
Diametral Gap: 0.009 inches

Poison:

Primary Material: Inconel 625
Poison Length: 91 inches
Pellet Diameter: 0.737 inches

Plenum Spring Material: St.Steel 302

Spider Material: St.Steel 304

Number of Control Rods: 4

Life Expectancy: 4000 EFPD

Physical Description Report

Page: 2

Combustion Engineering SYS80 4 Rod Part Len Control Element

Composition:

Material	Total Weight (kg)	Zone
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Used at the Following Reactors:

Reactor	Number in Core
Palo Verde 1	13
Palo Verde 2	13
Palo Verde 3	13

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	16x16	SYS80

Comment:

Control Elements are 75" of Inconel 625 and 16" of B4C

Physical Description Report

Page: 1

Combustion Engineering SYS80 12Rod Full Len Control Element

Designed for:

Fuel Assembly with array size: 16x16
Pressurized Water Reactor

Dimensions:

Total Length: 253 inches
Total Weight: 192.2 pounds

Cladding:

Material: Inconel 625
Outer Diameter: 0.816 inches
Wall Thickness: 0.035 inches
Diametral Gap: 0.009 inches

Poison:

Primary Material: B4C (CE)
Poison Length: 148 inches
Pellet Diameter: 0.737 inches

Plenum Spring Material: St.Steel 302

Spider Material: St.Steel 304

Number of Control Rods: 12

Life Expectancy: 4000 EFPD

Physical Description Report

Page: 2

Combustion Engineering SYS80 12Rod Full Len Control Element

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	8.170	Top
Inconel 625	53.620	Top
B4C (CE)	20.900	Top
St.Steel 304	0.680	Gas Plenum
Inconel 625	2.200	Gas Plenum
B4C (CE)	1.600	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Palo Verde 1	48
Palo Verde 2	48
Palo Verde 3	48

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	16x16	SYS80

Physical Description Report

Page: 1

Combustion Engineering San Onofre Part Len Control Element

Designed for:

Fuel Assembly with array size: 16x16
Pressurized Water Reactor

Dimensions:

Total Length: 181 inches
Total Weight: 92.0 pounds

Cladding:

Material: Inconel 625
Outer Diameter: 0.816 inches
Wall Thickness: 0.035 inches
Diametral Gap: 0.009 inches

Poison:

Primary Material: Inconel 625
Poison Length: 91.0 inches
Pellet Diameter: 0.737 inches

Plenum Spring Material: St. Steel 302

Spider Material: St. Steel 304

Number of Control Rods: 5

Life Expectancy: 4000 EFPD

Physical Description Report

Page: 2

Combustion Engineering San Onofre Part Len Control Element

Composition:

Material	Total Weight (kg)	Zone
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Used at the Following Reactors:

Reactor	Number in Core
Waterford 3	8
San Onofre 2	8
San Onofre 3	8

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	16x16	Onofre
Combustion Engineering	16x16	ANO2

Comment:

Control Elements are 16.0" of B4C and 75.0" of Inconel 625.
Very similar to Part Length CEA'S used at ANO2.

Physical Description Report

Page: 1

Combustion Engineering San Onofre Full Len Control Element

Designed for:

Fuel Assembly with array size: 16x16
Pressurized Water Reactor

Dimensions:

Total Length: 181 inches
Total Weight: 72 pounds

Cladding:

Material: Inconel 625
Outer Diameter: 0.816 inches
Wall Thickness: 0.035 inches
Diametral Gap: 0.009 inches

Poison:

Primary Material: B4C (CE)
Poison Length: 148.5 inches
Pellet Diameter: 0.737 inches

Plenum Spring Material: St. Steel 302

Spider Material: St. Steel 304

Number of Control Rods: 5

Life Expectancy: 4000 EFPD

Design Variations:

Four CEA'S have only four elements (no center element).

Physical Description Report

Page: 2

Combustion Engineering San Onofre Full Len Control Element

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	3.400	Top
Inconel 625	15.500	Top
B4C (CE)	8.710	Top
Ag-In-Cd (CE)	1.100	Top
St. Steel 304	0.230	Gas Plenum
Inconel 625	0.910	Gas Plenum
Ag-In-Cd (CE)	2.800	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Waterford 3	83
San Onofre 2	83
San Onofre 3	83

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	16x16	Onofre
Combustion Engineering	16x16	ANO2

Comment:

Control Elements are 136.0" of B4C and 12.5" of Ag-In-Cd.

Physical Description Report

Page: 1

Combustion Engineering ANO2 Part Length Control Element

Designed for:

Fuel Assembly with array size: 16x16
Pressurized Water Reactor

Dimensions:

Total Length: 180.8 inches
Total Weight: 91.1 pounds

Cladding:

Material: Inconel 625
Outer Diameter: 0.816 inches
Wall Thickness: 0.035 inches
Diametral Gap: 0.009 inches

Poison:

Primary Material: Inconel 625
Poison Length: 91 inches
Pellet Diameter: 0.737 inches

Plenum Spring Material: St. Steel 302

Spider Material: St. Steel 304

Number of Control Rods: 5

Life Expectancy: 4000 EFPD

Physical Description Report

Page: 2

Combustion Engineering ANO2 Part Length Control Element

Composition:

Material	Total Weight (kg)	Zone
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Used at the Following Reactors:

Reactor	Number in Core
Arkansas 2	8

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	16x16	ANO2

Comment:

Poison elements are 16.0" of B4C and 75.0" of Inconel 625. Very similar to Part Length CEA'S used at Waterford 3 and San Onofre.

Physical Description Report

Page: 1

Combustion Engineering ANO2 Full Length Control Element

Designed for:

Fuel Assembly with array size: 16x16
Pressurized Water Reactor

Dimensions:

Total Length: 180.8 inches
Total Weight: 71.3 pounds

Cladding:

Material: Inconel 625
Outer Diameter: 0.816 inches
Wall Thickness: 0.035 inches
Diametral Gap: 0.009 inches

Poison:

Primary Material: B4C (CE)
Poison Length: 149.2 inches
Pellet Diameter: 0.737 inches

Plenum Spring Material: St.Steel 302

Spider Material: St.Steel 304

Number of Control Rods: 5

Life Expectancy: 4000 EFPD

Physical Description Report

Page: 2

Combustion Engineering ANO2 Full Length Control Element

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	3.400	Top
Inconel 625	15.400	Top
B4C (CE)	8.710	Top
Ag-In-Cd (CE)	0.860	Top
St.Steel 304	0.230	Gas Plenum
Inconel 625	1.400	Gas Plenum
B4C (CE)	0.050	Gas Plenum
Ag-In-Cd (CE)	2.300	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Arkansas 2	73

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	16x16	ANO2

Comment:

Center Element is 140" of B4C and 9.2" of Inconel 625.
 Outside elements are 135.5" of B4C and 12.5" of Ag-In-Cd.

Physical Description Report

Page: 1

Combustion Engineering St. Lucie 2 Part Len Control Element

Designed for:

Fuel Assembly with array size: 16x16
Pressurized Water Reactor

Dimensions:

Total Length: 162.8 inches
Total Weight: 83.0 pounds

Cladding:

Material: Inconel 625
Outer Diameter: 0.816 inches
Wall Thickness: 0.035 inches
Diametral Gap: 0.009 inches

Poison:

Primary Material: Inconel 625
Poison Length: 82.5 inches
Pellet Diameter: 0.737 inches

Plenum Spring Material: St. Steel 302

Spider Material: St. Steel 304

Number of Control Rods: 5

Life Expectancy: 4000 EFPD

Physical Description Report

Page: 2

Combustion Engineering St. Lucie 2 Part Len Control Element

Composition:

Material	Total Weight (kg)	Zone
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Used at the Following Reactors:

Reactor	Number in Core
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St. Lucie 2	8
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Used with Following Fuel Assembly Types:

Vendor	Array	Version
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Combustion Engineering	16x16	Lucie 2
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Comment:

Poison Elements are 14.0" of B4C and 68.5" of Inconel 625.

Physical Description Report

Page: 1

Combustion Engineering St. Lucie 2 Full Len Control Element

Designed for:

Fuel Assembly with array size: 16x16
Pressurized Water Reactor

Dimensions:

Total Length: 162.8 inches
Total Weight: 65.8 pounds

Cladding:

Material: Inconel 625
Outer Diameter: 0.816 inches
Wall Thickness: 0.035 inches
Diametral Gap: 0.009 inches

Poison:

Primary Material: B4C (CE)
Poison Length: 135.5 inches
Pellet Diameter: 0.737 inches

Plenum Spring Material: St. Steel 302

Spider Material: St. Steel 304

Number of Control Rods: 5

Life Expectancy: 4000 EFPD

Physical Description Report

Page: 2

Combustion Engineering St. Lucie 2 Full Len Control Element

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	3.400	Top
Inconel 625	13.600	Top
B4C (CE)	7.890	Top
Ag-In-Cd (CE)	1.100	Top
St. Steel 304	0.230	Gas Plenum
Inconel 625	0.820	Gas Plenum
Ag-In-Cd (CE)	2.800	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
St. Lucie 2	83

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	16x16	Lucie 2

Comment:

Poison Elements are 123" of B4C and 12.5" of Ag-In-Cd.

Physical Description Report

Page: 1

Combustion Engineering Part Length, Ver. 3 Control Element

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 161.3 inches
Total Weight: 104.5 pounds

Cladding:

Material: Inconel 625
Outer Diameter: 0.948 inches
Wall Thickness: 0.040 inches
Diametral Gap: 0.008 inches

Poison:

Primary Material: B4C (CE)
Poison Length: 134 inches
Pellet Diameter: 0.860 inches

Plenum Spring Material: St.Steel 302

Spider Material: St.Steel 304

Number of Control Rods: 5

Life Expectancy: 4000 EFPD

Elemental Geometry:

Outside Elements use 134" of St.Steel 304 as Poison.

Design Variations:

Six CEA'S have 3 all SS elements and 2 elements with 8" of Ag-In-Cd and 124" of B4C.

Physical Description Report

Page: 2

Combustion Engineering Part Length, Ver. 3 Control Element

Composition:

Material	Total Weight (kg)	Zone
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Used at the Following Reactors:

Reactor	Number in Core
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Maine Yankee	12
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Used with Following Fuel Assembly Types:

Vendor	Array	Version
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Combustion Engineering	14x14	Std
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Physical Description Report

Page: 1

Combustion Engineering Part Length, Ver. 2 Control Element

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 161.3 inches
Total Weight: 82.4 pounds

Cladding:

Material: Inconel 625
Outer Diameter: 0.948 inches
Wall Thickness: 0.040 inches
Diametral Gap: 0.008 inches

Poison:

Primary Material: B4C (CE)
Poison Length: 132 inches
Pellet Diameter: 0.860 inches

Plenum Spring Material: St.Steel 302

Spider Material: St.Steel 304

Number of Control Rods: 5

Life Expectancy: 4000 EFPD

Elemental Geometry:

Center Element is 134" of B4C. Outside Elements are 124" of
and 8" of Ag-In-Cd.

Design Variations:

Four CEA'S have one all Al2O3 element (center). Four CEA's
have 10" of SS and 124" of Al2O3 in 2 corner fingers.

Physical Description Report

Page: 2

Combustion Engineering Part Length, Ver. 2 Control Element

Composition:

Material	Total Weight (kg)	Zone
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Used at the Following Reactors:

Reactor	Number in Core
St. Lucie 1	8
Millstone 2	8

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	14x14	Std

Physical Description Report

Page: 1

Combustion Engineering Part Length, Ver. 1 Control Element

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 161.3 inches
Total Weight: 63.0 pounds

Cladding:

Material: Inconel 625
Outer Diameter: 0.948 inches
Wall Thickness: 0.040 inches
Diametral Gap: 0.008 inches

Poison:

Primary Material: B4C (CE)
Poison Length: 132 inches
Pellet Diameter: 0.860 inches

Plenum Spring Material: St. Steel 302

Spider Material: St. Steel 304

Number of Control Rods: 5

Life Expectancy: 4000 EFPD

Elemental Geometry:

Central element is 134" of Al2O3. Two Outside Elements are 124" of B4C and 8" of Ag-In-Cd. Two Outside Elements are 124" of Al2O3 and 8" of SS304.

Physical Description Report

Page: 2

Combustion Engineering Part Length, Ver. 1 Control Element

Composition:

Material	Total Weight (kg)	Zone
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Used at the Following Reactors:

Reactor	Number in Core
Calvert Cliffs 1	12
Calvert Cliffs 2	12

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	14x14	Std

Physical Description Report

Page: 1

Combustion Engineering Full Length Control Element

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 161.3 inches
Total Weight: 76.8 pounds

Cladding:

Material: Inconel 625
Outer Diameter: 0.948 inches
Wall Thickness: 0.040 inches
Diametral Gap: 0.008 inches

Poison:

Primary Material: B4C (CE)
Poison Length: 134 inches
Pellet Diameter: 0.860 inches

Plenum Spring Material: St. Steel 302

Spider Material: St. Steel 304

Number of Control Rods: 5

Life Expectancy: 4000 EFPD

Design Variations:

Four CEA'S have 1 all SS element (center). Four CEA's have three all SS elements (center and 2 corner).

Physical Description Report

Page: 2

Combustion Engineering Full Length Control Element

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	3.200	Top
Inconel 625	15.400	Top
B4C (CE)	10.500	Top
St. Steel 304	0.230	Gas Plenum
Inconel 625	2.300	Gas Plenum
B4C (CE)	0.500	Gas Plenum
Ag-In-Cd (CE)	2.800	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Calvert Cliffs 1	65
Calvert Cliffs 2	65
St. Lucie 1	65
Maine Yankee	65
Millstone 2	65

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	14x14	Std

Comment:

Central Poison Element is 134" of B4C. Outside Poison Elements are 124" of B4C, 8" of Ag-In-Cd, & 2.6" of Inconel.

Physical Description Report

Page: 1

Combustion Engineering Part Length Control Element

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 152 inches
Total Weight: 63.0 pounds

Cladding:

Material: Inconel 625
Outer Diameter: 0.948 inches
Wall Thickness: 0.040 inches
Diametral Gap: 0.008 inches

Poison:

Primary Material: B4C (CE)
Poison Length: 32.0 inches
Pellet Diameter: 0.860 inches

Plenum Spring Material: St. Steel 302

Spider Material: St. Steel 304

Number of Control Rods: 5

Life Expectancy: 4000 EFPD

Physical Description Report

Page: 2

Combustion Engineering Part Length Control Element

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304		Top
Inconel 625		Top
B4C (CE)		Top
St.Steel 304		Gas Plenum
Inconel 625		Gas Plenum
B4C (CE)		Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Fort Calhoun	4

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	14x14	Ft.Cal.

Comment:

The Central Element has 128" of B4C Poison; Outside Elements have 32" of B4C Poison.

Physical Description Report

Page: 1

Combustion Engineering Full Length Control Element

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 152 inches
Total Weight: 66.5 pounds

Cladding:

Material: Inconel 625
Outer Diameter: 0.948 inches
Wall Thickness: 0.040 inches
Diametral Gap: 0.008 inches

Poison:

Primary Material: B4C (CE)
Poison Length: 128 inches
Pellet Diameter: 0.860 inches

Plenum Spring Material: St. Steel 302

Spider Material: St. Steel 304

Number of Control Rods: 5

Life Expectancy: 4000 EFPD

Physical Description Report

Page: 2

Combustion Engineering Full Length Control Element

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	3.200	Top
Inconel 625	13.600	Top
B4C (CE)	10.800	Top
St. Steel 304	0.230	Gas Plenum
Inconel 625	1.800	Gas Plenum
B4C (CE)	0.540	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
---------	----------------

Fort Calhoun	45
--------------	----

Used with Following Fuel Assembly Types:

Vendor	Array	Version
--------	-------	---------

Combustion Engineering	14x14	Ft. Cal.
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Physical Description Report

Page: 1

Combustion Engineering Cruciform Blade Control Element

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length: 151 inches
Total Weight: 214 pounds

Cladding:

Material: St. Steel 304
Outer Diameter:
Wall Thickness:
Diametral Gap:

Poison:

Primary Material: Ag-In-Cd (CE)
Poison Length: 133 inches
Pellet Diameter:

Plenum Spring Material:

Spider Material: St. Steel 304

Number of Control Rods:

Life Expectancy: 20 cycles

Physical Description Report

Page: 2

Combustion Engineering Cruciform Blade Control Element

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	26.300	Top
Ag-In-Cd (CE)	64.320	Top
St. Steel 304	1.900	Gas Plenum
Ag-In-Cd (CE)	4.540	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
---------	----------------

Palisades	45
-----------	----

Used with Following Fuel Assembly Types:

Vendor	Array	Version
--------	-------	---------

Combustion Engineering	15x15	Palis.
Exxon / ANF	15x15	CE

Physical Description Report

Page: 1

Westinghouse Standard Control Element

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 158.454 inches
Total Weight: 128.00 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.435 inches
Wall Thickness: 0.0185 inches
Diametral Gap:

Poison:

Primary Material: Ag-In-Cd (WE)
Poison Length: 142.00 inches
Pellet Diameter:

Plenum Spring Material: Carbon Steel

Spider Material: St.Steel 304

Number of Control Rods: 16

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Standard Control Element

Composition:

Material	Total Weight (kg)	Zone
Carbon Steel	0.120	Top
Inconel X-750	0.730	Top
St.Steel 308M	1.900	Gas Plenum
St.Steel 304	10.500	Gas Plenum
Ag-In-Cd (WE)	45.400	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
Ginna	(assumed)
San Onofre 1	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)
Westinghouse	14x14	Std/SC (assumed)

Comment:

Drawing number is 108D134.

Physical Description Report

Page: 1

Westinghouse Short, Ver. 1 Control Element

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 156.636 inches
Total Weight: 128.00 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.435 inches
Wall Thickness: 0.0185 inches
Diametral Gap:

Poison:

Primary Material: Ag-In-Cd (WE)
Poison Length: 118.00 inches
Pellet Diameter:

Plenum Spring Material: Carbon Steel

Spider Material: St. Steel 304

Number of Control Rods: 16

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Short, Ver. 1 Control Element

Composition:

Material	Total Weight (kg)	Zone
Carbon Steel	0.120	Top
Inconel X-750	0.731	Top
St.Steel 308M	2.100	Gas Plenum
St.Steel 304	9.000	Gas Plenum
Ag-In-Cd (WE)	37.700	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
Ginna	(assumed)
San Onofre 1	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)
Westinghouse	14x14	Std/SC (assumed)

Comment:

Drawing number is 108D419.
 Correct total weight appears to be 109.2 pounds.

Physical Description Report

Page: 1

Westinghouse Short, Ver. 2 Control Element

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 133.70 inches
Total Weight: 109.00 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.435 inches
Wall Thickness: 0.0185 inches
Diametral Gap:

Poison:

Primary Material: Ag-In-Cd (WE)
Poison Length: 118.37 inches
Pellet Diameter:

Plenum Spring Material: Inconel X-750

Spider Material: St. Steel 304

Number of Control Rods: 16

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Short, Ver. 2 Control Element

Composition:

Material	Total Weight (kg)	Zone
Inconel X-750	0.910	Top
St. Steel 304	9.480	Top
Ag-In-Cd (WE)	37.800	Gas Plenum
St. Steel 308M	1.300	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
Ginna	(assumed)
San Onofre 1	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)
Westinghouse	14x14	Std/SC (assumed)

Physical Description Report

Page: 1

Westinghouse Standard Control Element

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length: 156.6 inches
Total Weight: 165.00 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.443 inches
Wall Thickness: 0.020 inches
Diametral Gap:

Poison:

Primary Material: Ag-In-Cd (WE)
Poison Length: 142.00 inches
Pellet Diameter:

Plenum Spring Material: Carbon Steel

Spider Material: St.Steel 304

Number of Control Rods: 20

Life Expectancy:

Design Variations:

Length ranges from 156.6 to 158.5 inches.

Physical Description Report

Page: 2

Westinghouse Standard Control Element

Composition:

Material	Total Weight (kg)	Zone
Carbon Steel	0.150	Top
Inconel X-750	0.730	Top
St.Steel 308M	2.500	Gas Plenum
St.Steel 304	13.800	Gas Plenum
Ag-In-Cd (WE)	58.700	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Robinson 2	(assumed)
Zion 1	(assumed)
Zion 2	(assumed)
Indian Point 2	(assumed)
Turkey Point 3	(assumed)
Turkey Point 4	(assumed)
Indian Point 3	(assumed)
Surry 1	(assumed)
Surry 2	(assumed)
Haddam Neck	(assumed)
Cook 1	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	15x15	St.Stl. (assumed)
Exxon / ANF	15x15	WE (assumed)
Westinghouse	15x15	Std/ZC (assumed)
Westinghouse	15x15	OFA (assumed)
Westinghouse	15x15	Std/SC (assumed)

Comment:

Drawing numbers are 5655D54 and 8823D53.

Physical Description Report

Page: 1

Westinghouse Full Length, Ver. 1 Control Element

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length: 160.949 inches
Total Weight: 149.00 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.385 inches
Wall Thickness: 0.0185 inches
Diametral Gap:

Poison:

Primary Material: Ag-In-Cd (WE)
Poison Length: 142.00 inches
Pellet Diameter:

Plenum Spring Material: St.Steel 302

Spider Material: St.Steel 304

Number of Control Rods: 24

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Full Length, Ver. 1 Control Element

Composition:

Material	Total Weight (kg)	Zone
St.Steel 302	0.520	Top
St.Steel 308M	1.600	Top
St.Steel 304	13.000	Gas Plenum
Ag-In-Cd (WE)	51.800	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)
Seabrook 1	(assumed)
Seabrook 2	(assumed)

Physical Description Report

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Westinghouse Full Length, Ver. 1 Control Element

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

Drawing number is 1186F66.

Physical Description Report

Page: 1

Westinghouse Full Length, Ver. 2 Control Element

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length: 160.949 inches
Total Weight: 180.00 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.385 inches
Wall Thickness: 0.0185 inches
Diametral Gap:

Poison:

Primary Material: Hafnium
Poison Length: 142.00 inches
Pellet Diameter:

Plenum Spring Material: St. Steel 302

Spider Material: St. Steel 304

Number of Control Rods: 24

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Full Length, Ver. 2 Control Element

Composition:

Material	Total Weight (kg)	Zone
St.Steel 302	0.520	Top
St.Steel 308M	1.100	Top
Inconel-718	0.750	Top
St.Steel 304	13.000	Gas Plenum
Hafnium	65.300	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)
Seabrook 1	(assumed)
Seabrook 2	(assumed)

Physical Description Report

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Westinghouse Full Length, Ver. 2 Control Element

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

Drawing number is 1549E40G02/G06.
Clad thickness assumed from clad weight and thickness of other versions.

Physical Description Report

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Westinghouse Full Length, Ver. 3 Control Element

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length: 160.949 inches
Total Weight: 149.00 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.385 inches
Wall Thickness: 0.0185 inches
Diametral Gap:

Poison:

Primary Material: Ag-In-Cd (WE)
Poison Length: 142.00 inches
Pellet Diameter:

Plenum Spring Material: St. Steel 302

Spider Material: St. Steel 304

Number of Control Rods: 24

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Full Length, Ver. 3 Control Element

Composition:

Material	Total Weight (kg)	Zone
St. Steel 302	0.520	Top
St. Steel 308M	1.100	Top
Inconel-718	0.750	Top
St. Steel 304	13.000	Gas Plenum
Ag-In-Cd (WE)	51.800	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)
Seabrook 1	(assumed)
Seabrook 2	(assumed)

Physical Description Report

Page: 3

Westinghouse Full Length, Ver. 3 Control Element

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

Clad thickness assumed from weight and clad thickness of other versions.

Physical Description Report

Page: 1

Westinghouse Hybrid Control Element

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length: 160.960 inches
Total Weight: 92.7 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.385 inches
Wall Thickness: 0.038 inches
Diametral Gap:

Poison:

Primary Material: B4C (WE)
Poison Length: 142.00 inches
Pellet Diameter:

Plenum Spring Material: Inconel-718

Spider Material: St.Steel 304

Number of Control Rods: 24

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Hybrid Control Element

Composition:

Material	Total Weight (kg)	Zone
Inconel-718	1.040	Top
B4C (WE)	4.060	Top
St.Steel 304	22.500	Gas Plenum
St.Steel	1.100	Gas Plenum
Ag-In-Cd (WE)	11.400	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)
Seabrook 1	(assumed)
Seabrook 2	(assumed)

Physical Description Report

Page: 3

Westinghouse Hybrid Control Element

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

Control rods are 102.00" of B4C and 40" of Ag-In-Cd. Drawing number is 1187F30.

Physical Description Report

Page: 1

Westinghouse Part Length Control Element

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length: 160.949 inches
Total Weight: 100 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.385 inches
Wall Thickness: 0.0185 inches
Diametral Gap:

Poison:

Primary Material: Ag-In-Cd (WE)
Poison Length: 36.00 inches
Pellet Diameter:

Plenum Spring Material: St.Steel 302

Spider Material: St.Steel 304

Number of Control Rods: 24

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Part Length Control Element

Composition:

Material	Total Weight (kg)	Zone
St.Steel 302	0.520	Top
St.Steel 308M	1.600	Top
St.Steel 304	12.000	Top
Inconel-718	0.750	Top
Ag-In-Cd (WE)	13.200	Gas Plenum
Alum. Oxide	16.400	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)
Seabrook 1	(assumed)

Physical Description Report

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Westinghouse Part Length Control Element

Used at the Following Reactors: (continued)

Reactor	Number in Core
Seabrook 2	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

Control Rod has 106.00" of Al₂O₃ and 36.00" of B₄C. Drawing number is 1182F87.

2E-81/82

GUIDE TUBE PLUGS / ORIFICE RODS

Physical Description Report

Page: 1

Babcock & Wilcox Standard Guide Tube Plug

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length: 16 inches
Total Weight: 15.8 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.524 inches

Spider Material: St. Steel CF3M

Number of Orifice Rods: 16

Life Expectancy:

Physical Description Report

Page: 2

Babcock & Wilcox Standard Guide Tube Plug

Composition:

Material	Total Weight (kg)	Zone
St.Steel CF3M	3.500	Top
St.Steel 304	0.070	Top
St.Steel 304	3.400	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Arkansas 1	108
Oconee 1	108
Oconee 2	108
Oconee 3	108
Crystal River 3	72
Three Mile Island 1	108
Rancho Seco	108
Davis-Besse	57

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	15x15	Mark B
Babcock & Wilcox	15x15	Mark BZ

Comment:

Number used per core are the number shipped to the reactor,
not the number actually used at a given moment.

Physical Description Report

Page: 1

Westinghouse Water Displacement Guide Tube Plug

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 156 inches
Total Weight: 20.5 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.437 inches

Spider Material: St.Steel 304

Number of Orifice Rods: 16

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Water Displacement Guide Tube Plug

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	1.700	Top
Inconel-718	0.420	Top
St.Steel 304	0.530	Gas Plenum
St.Steel 304	6.500	In Core

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
Ginna	(assumed)
San Onofre 1	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)
Westinghouse	14x14	Std/SC (assumed)

Comment:

This version has 12 Water Displacement Rods and 4 Thimble Plugs. Another version has 4 Water Displacement Rods and 12 Thimble Plugs. It weighs 13 pounds.

Physical Description Report

Page: 1

Westinghouse Standard Guide Tube Plug

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 12.1 inches
Total Weight: 9.5 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.491 inches

Spider Material: St.Steel 304

Number of Orifice Rods: 16

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Standard Guide Tube Plug

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	1.700	Top
Inconel-718	0.420	Top
St.Steel 304	2.200	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
Ginna	(assumed)
San Onofre 1	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)
Westinghouse	14x14	Std/SC (assumed)

Comment:

This Thimble Plug Assembly not specifically described by Westinghouse. It is described based on the commonly used parts for other 14x14 NFA hardware.

Physical Description Report

Page: 1

Westinghouse Standard Guide Tube Plug

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length: 10.2 inches
Total Weight: 10.8 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.498 inches

Spider Material: St. Steel 304

Number of Orifice Rods: 20

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Standard Guide Tube Plug

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	1.800	Top
Inconel-718	0.420	Top
St. Steel 304	2.700	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Robinson 2	(assumed)
Zion 1	(assumed)
Zion 2	(assumed)
Indian Point 2	(assumed)
Turkey Point 3	(assumed)
Turkey Point 4	(assumed)
Indian Point 3	(assumed)
Surry 1	(assumed)
Surry 2	(assumed)
Haddam Neck	(assumed)
Cook 1	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	15x15	St.Stl. (assumed)
Exxon / ANF	15x15	WE (assumed)
Westinghouse	15x15	Std/ZC (assumed)
Westinghouse	15x15	OFA (assumed)
Westinghouse	15x15	Std/SC (assumed)

Comment:

This Thimble Plug Assembly not specifically described by Westinghouse. It is described based on the commonly used parts for 15x15 NFA hardware.

Physical Description Report

Page: 1

Westinghouse Standard Guide Tube Plug

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length: 11.8 inches
Total Weight: 13.0 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.434 inches

Spider Material: St. Steel 304

Number of Orifice Rods: 24

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Standard Guide Tube Plug

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	2.300	Top
Inconel-718	0.420	Top
St. Steel 304	3.200	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)
Seabrook 1	(assumed)
Seabrook 2	(assumed)

Westinghouse Standard Guide Tube Plug

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

This Thimble Plug assembly not specifically described by Westinghouse. It is described based on commonly used parts for 17x17 NFA hardware.

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INSTRUMENTATION

Physical Description Report

Page: 1

Combustion Engineering System 80 Instrumentation

Designed for:

Fuel Assembly with array size: 10x10
Pressurized Water Reactor

Dimensions:

Total Length: 116 feet
Total Weight: 34.3 pounds

Number of Emitters or Detectors: 5

Emitter/Detector Material: Rhodium

Housing:

Material: Inconel 600
Outer Diameter: 0.450 inches

Seal Plug:

Material: St. Steel 347
Diameter: 1.747 inches

Lead Wire Material:

Sheathing: Inconel 600
Insulation: Alum. Oxide

Life Expectancy: 1200 EFPD

Physical Description Report

Page: 2

Combustion Engineering System 80 Instrumentation

Composition:

Material	Total Weight (kg)	Zone
Inconel 600	0.200	Gas Plenum
Alum. Oxide	0.100	In Core
Inconel 600	1.400	In Core
Rhodium	0.005	In Core
Alum. Oxide	0.950	Bottom
Inconel 600	11.300	Bottom
St.Steel 347	1.600	Bottom

Used at the Following Reactors:

Reactor	Number in Core
Palo Verde 1	61
Palo Verde 2	61
Palo Verde 3	61

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	16x16	SYS80

Physical Description Report

Page: 1

Combustion Engineering Waterford Instrumentation

Designed for:

Fuel Assembly with array size: 16x16
Pressurized Water Reactor

Dimensions:

Total Length: 38 feet
Total Weight: 7.3 pounds

Number of Emitters or Detectors: 5

Emitter/Detector Material: Rhodium

Housing:

Material: Inconel 600
Outer Diameter: 0.350 inches

Seal Plug:

Material: St. Steel 347
Diameter: 1.383 inches

Lead Wire Material:

Sheathing: Inconel 600
Insulation: Alum. Oxide

Life Expectancy: 1200 EFPD

Physical Description Report

Page: 2

Combustion Engineering Waterford Instrumentation

Composition:

Material	Total Weight (kg)	Zone
Alum. Oxide	0.230	Top
Inconel 600	1.400	Top
St.Steel 347	0.640	Top
Inconel 600	0.050	Gas Plenum
Alum. Oxide	0.150	In Core
Inconel 600	0.910	In Core
Rhodium	0.005	In Core

Used at the Following Reactors:

Reactor	Number in Core
Waterford 3	56

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	16x16	ANO2

Physical Description Report

Page: 1

Combustion Engineering San Onofre Instrumentation

Designed for:

Fuel Assembly with array size: 16x16
Pressurized Water Reactor

Dimensions:

Total Length: 37.0 inches
Total Weight: 6.4 pounds

Number of Emitters or Detectors: 5

Emitter/Detector Material: Rhodium

Housing:

Material: Inconel 600
Outer Diameter: 0.350 inches

Seal Plug:

Material: St. Steel 347
Diameter: 1.250 inches

Lead Wire Material:

Sheathing: Inconel 600
Insulation: Alum. Oxide

Life Expectancy: 1200 EFPD

Physical Description Report

Page: 2

Combustion Engineering San Onofre Instrumentation

Composition:

Material	Total Weight (kg)	Zone
Alum. Oxide	0.230	Top
Inconel 600	1.300	Top
St.Steel 347	0.500	Top
Inconel 600	0.050	Gas Plenum
Alum. Oxide	0.100	In Core
Inconel 600	0.820	In Core
Rhodium	0.005	In Core

Used at the Following Reactors:

Reactor	Number in Core
San Onofre 2	56
San Onofre 3	56

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	16x16	Onofre

Physical Description Report

Page: 1

Combustion Engineering ANO2 Instrumentation

Designed for:

Fuel Assembly with array size: 16x16
Pressurized Water Reactor

Dimensions:

Total Length: 37.0 inches
Total Weight: 7.0 pounds

Number of Emitters or Detectors: 5

Emitter/Detector Material: Rhodium

Housing:

Material: Inconel 600
Outer Diameter: 0.350 inches

Seal Plug:

Material: St. Steel 347
Diameter: 1.250 inches

Lead Wire Material:

Sheathing: Inconel 600
Insulation: Alum. Oxide

Life Expectancy: 1200 EFPD

Physical Description Report

Page: 2

Combustion Engineering ANO2 Instrumentation

Composition:

Material	Total Weight (kg)	Zone
Alum. Oxide	0.230	Top
Inconel 600	1.400	Top
St.Steel 347	0.450	Top
Inconel 600	0.050	Gas Plenum
Alum. Oxide	0.150	In Core
Inconel 600	0.860	In Core
Rhodium	0.005	In Core

Used at the Following Reactors:

Reactor	Number in Core
Arkansas 2	44

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	16x16	ANO2

Physical Description Report

Page: 1

Combustion Engineering St. Lucie 2 Instrumentation

Designed for:

Fuel Assembly with array size: 16x16
Pressurized Water Reactor

Dimensions:

Total Length: 35 feet
Total Weight: 7.0 pounds

Number of Emitters or Detectors: 4

Emitter/Detector Material: Rhodium

Housing:

Material: Inconel 600
Outer Diameter: 0.350 inches

Seal Plug:

Material: St. Steel 347
Diameter: 1.383 inches

Lead Wire Material:

Sheathing: Inconel 600
Insulation: Alum. Oxide

Life Expectancy: 1200 EFPD

Physical Description Report

Page: 2

Combustion Engineering St. Lucie 2 Instrumentation

Composition:

Material	Total Weight (kg)	Zone
St. Steel 347	0.640	Top
Alum. Oxide	0.140	Top
Inconel 600	1.500	Top
Inconel 600	0.050	Gas Plenum
Alum. Oxide	0.050	In Core
Inconel 600	0.770	In Core
Rhodium	0.005	In Core

Used at the Following Reactors:

Reactor	Number in Core
St. Lucie 2	56

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	16x16	Lucie 2

Physical Description Report

Page: 1

Combustion Engineering Calvert Cliffs Instrumentation

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 41 feet
Total Weight: 11.7 pounds

Number of Emitters or Detectors: 4

Emitter/Detector Material: Rhodium

Housing:

Material: St. Steel 304
Outer Diameter: 0.350 inches

Seal Plug:

Material: St. Steel 347
Diameter: 1.515 inches

Lead Wire Material:

Sheathing: Inconel 600
Insulation: Alum. Oxide

Life Expectancy: 1200 EFPD

Physical Description Report

Page: 2

Combustion Engineering Calvert Cliffs Instrumentation

Composition:

Material	Total Weight (kg)	Zone
St.Steel 347	3.200	Top
Inconel 600	0.500	Top
Alum. Oxide	0.200	Top
St.Steel 304	0.090	Gas Plenum
Alum. Oxide	0.050	In Core
Inconel 600	0.200	In Core
St.Steel 304	1.100	In Core
Rhodium	0.005	In Core

Used at the Following Reactors:

Reactor	Number in Core
Calvert Cliffs 1	45
Calvert Cliffs 2	45

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	14x14	Std

Physical Description Report

Page: 1

Combustion Engineering Millstone 2 Instrumentation

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 38 feet
Total Weight: 12.7 pounds

Number of Emitters or Detectors: 4

Emitter/Detector Material: Rhodium

Housing:

Material: St. Steel 304
Outer Diameter: 0.350 inches

Seal Plug:

Material: St. Steel 347
Diameter: 1.383 inches

Lead Wire Material:

Sheathing: Inconel 600
Insulation: Alum. Oxide

Life Expectancy: 1200 EFPD

Physical Description Report

Page: 2

Combustion Engineering Millstone 2 Instrumentation

Composition:

Material	Total Weight (kg)	Zone
St. Steel 347	3.400	Top
Inconel 600	0.450	Top
Alum. Oxide	0.200	Top
St. Steel 304	0.140	Gas Plenum
Alum. Oxide	0.095	In Core
Inconel 600	0.200	In Core
St. Steel 304	1.300	In Core
Rhodium	0.005	In Core

Used at the Following Reactors:

Reactor	Number in Core
St. Lucie 1	45
Millstone 2	45

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Combustion Engineering	14x14	Std	
Exxon / ANF	14x14	CE	(assumed)
Westinghouse	14x14	Model C	

Physical Description Report

Page: 1

Combustion Engineering Ft. Calhoun Instrumentation

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 39 feet
Total Weight: 11.6 pounds

Number of Emitters or Detectors: 4

Emitter/Detector Material: Rhodium

Housing:

Material: St. Steel 304
Outer Diameter: 0.350 inches

Seal Plug:

Material: St. Steel 347
Diameter: 1.383 inches

Lead Wire Material:

Sheathing: Inconel 600
Insulation: Alum. Oxide

Life Expectancy: 1200 EFPD

Physical Description Report

Page: 2

Combustion Engineering Ft. Calhoun Instrumentation

Composition:

Material	Total Weight (kg)	Zone
Alum. Oxide	0.200	Top
Inconel 600	0.500	Top
St.Steel 347	3.300	Top
St.Steel 304	0.090	Gas Plenum
Alum. Oxide	0.050	In Core
Inconel 600	0.150	In Core
St.Steel 304	1.000	In Core
Rhodium	0.005	In Core

Used at the Following Reactors:

Reactor	Number in Core
Fort Calhoun	28

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	14x14	Ft.Cal.

Physical Description Report

Page: 1

Combustion Engineering Palisades Instrumentation

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length: 37.0 feet
Total Weight: 9.3 pounds

Number of Emitters or Detectors: 5

Emitter/Detector Material: Rhodium

Housing:

Material: St. Steel 304
Outer Diameter: 0.350 inches

Seal Plug:

Material: St. Steel 347
Diameter: 1.500 inches

Lead Wire Material:

Sheathing: Inconel 600
Insulation: Alum. Oxide

Life Expectancy: 1200 EFPD

Physical Description Report

Page: 2

Combustion Engineering Palisades Instrumentation

Composition:

Material	Total Weight (kg)	Zone
St.Steel 347	2.500	Top
Inconel 600	0.400	Top
Alum. Oxide	0.200	Top
St.Steel 304	0.091	Gas Plenum
Rhodium	0.005	In Core
St.Steel 304	0.910	In Core
Alum. Oxide	0.050	In Core
Inconel 600	0.150	In Core

Used at the Following Reactors:

Reactor	Number in Core
Palisades	43

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	15x15	Palis.
Exxon / ANF	15x15	CE

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NEUTRON POISONS

Physical Description Report

Page: 1

Babcock & Wilcox Gray Ax. Power Shap. Neutron Poison

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length:	159.75	inches
Rod Length:	155.56	inches
Total Weight:	71	pounds

Poison:

Material:	Inconel 600
Length:	63.00 inches

Cladding:

Material:	St.Steel 304
Outer Diameter:	0.440 inches
Wall Thickness:	
Diametral Gap:	

Spider Material:	St.Steel CF3M
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Number of Burnable Poison Rods:	0
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Number of Orifice Rods:	0
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Life Expectancy:

Physical Description Report

Page: 2

Babcock & Wilcox Gray Ax. Power Shap. Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St.Steel CF3M	3.400	Top
St.Steel 304	0.070	Top
St.Steel 304	13.500	In Core
Inconel 600	15.300	In Core

Used at the Following Reactors:

Reactor	Number in Core
Arkansas 1	(assumed)
Oconee 1	(assumed)
Oconee 2	(assumed)
Oconee 3	(assumed)
Crystal River 3	(assumed)
Three Mile Island 1	(assumed)
Rancho Seco	(assumed)
Davis-Besse	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	15x15	Mark B (assumed)
Babcock & Wilcox	15x15	Mark BZ (assumed)

Physical Description Report

Page: 1

Babcock & Wilcox Burnable Poison Neutron Poison

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length:	154	inches
Rod Length:	148.375	inches
Total Weight:	57	pounds

Poison:

Material:	Al203 - B4C
Length:	

Cladding:

Material:	Zircaloy-4
Outer Diameter:	0.43 inches
Wall Thickness:	
Diametral Gap:	

Spider Material:	St.Steel CF3M
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Number of Burnable Poison Rods:	16
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Number of Orifice Rods:	0
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Life Expectancy:

Physical Description Report

Page: 2

Babcock & Wilcox Burnable Poison Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St.Steel CF3M	3.500	Top
St.Steel 304	0.060	Top
Zircaloy-4	11.380	In Core
St.Steel 304	0.940	In Core
Al203 - B4C	9.440	In Core

Used at the Following Reactors:

Reactor	Number in Core
Arkansas 1	64
Oconee 1	60
Oconee 2	60
Oconee 3	60
Crystal River 3	60
Three Mile Island 1	68
Rancho Seco	64
Davis-Besse	56

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	15x15	Mark B
Babcock & Wilcox	15x15	Mark BZ

Physical Description Report

Page: 1

Babcock & Wilcox Axial Power Shap. Neutron Poison

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length:	160	inches
Rod Length:	156	inches
Total Weight:	57	pounds

Poison:

Material:	Ag-In-Cd	
Length:	36	inches

Cladding:

Material:	St. Steel 304	
Outer Diameter:	0.476	inches
Wall Thickness:		
Diametral Gap:		

Spider Material:	St. Steel CF3M
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Number of Burnable Poison Rods:	16
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Number of Orifice Rods:	0
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Life Expectancy:

Physical Description Report

Page: 2

Babcock & Wilcox Axial Power Shap. Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St.Steel CF3M	3.500	Top
St.Steel 304	0.073	Top
St.Steel 304	11.100	In Core
Ag-In-Cd	10.610	In Core

Used at the Following Reactors:

Reactor	Number in Core
Arkansas 1	(assumed)
Oconee 1	(assumed)
Oconee 2	(assumed)
Oconee 3	(assumed)
Crystal River 3	(assumed)
Three Mile Island 1	
Rancho Seco	
Davis-Besse	

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	15x15	Mark B
Babcock & Wilcox	15x15	Mark BZ

Physical Description Report

Page: 1

Westinghouse (4-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length:	156.1	inches
Rod Length:	150.6	inches
Total Weight:	17	pounds

Poison:

Material:	Borosil.Glass
Length:	142.7 inches

Cladding:

Material:	St.Steel 304
Outer Diameter:	0.437 inches
Wall Thickness:	0.018 inches
Diametral Gap:	

Spider Material:	St.Steel 304
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Number of Burnable Poison Rods:	4
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Number of Orifice Rods:	12
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Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 1-16 Burnable Poison Rods. The weight of a version can be expressed as $9.27 + (1.92 * \text{the number of Burnable Poison Rods})$. Radiological Characterizations are available for 4, 12, and 16 Rod versions.

Physical Description Report

Page: 2

Westinghouse (4-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	1.700	Top
Inconel-718	0.420	Top
St.Steel 304	1.600	Gas Plenum
St.Steel 304	2.500	In Core
Borosil.Glass	1.500	In Core

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
Ginna	(assumed)
San Onofre 1	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)
Westinghouse	14x14	Std/SC (assumed)

Comment:

Reference: BPA01, G01; page B-19 of WTSD-TME-148

Physical Description Report

Page: 1

Westinghouse (12-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length:	156.1	inches
Rod Length:	150.6	inches
Total Weight:	32	pounds

Poison:

Material:	Borosil.Glass
Length:	142.7 inches

Cladding:

Material:	St.Steel 304
Outer Diameter:	0.437 inches
Wall Thickness:	0.018 inches
Diametral Gap:	

Spider Material: St.Steel 304

Number of Burnable Poison Rods: 12

Number of Orifice Rods: 4

Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 1-16 Burnable Poison Rods. The weight of a version can be expressed as $9.27 + (1.92 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations available for 4, 12, and 16 Rod versions.

Physical Description Report

Page: 2

Westinghouse (12-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	1.700	Top
Inconel-718	0.420	Top
St.Steel 304	0.540	Gas Plenum
Borosil.Glass	4.500	In Core
St.Steel 304	7.500	In Core

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
Ginna	(assumed)
San Onofre 1	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)
Westinghouse	14x14	Std/SC (assumed)

Comment:

Reference: BPA01, G03; page B-19 of WTSD-TME-148.

Physical Description Report

Page: 1

Westinghouse BPA (16-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length:	156.1	inches
Rod Length:	150.6	inches
Total Weight:	40	pounds

Poison:

Material:	Borosil.Glass	
Length:	142.7	inches

Cladding:

Material:	St.Steel 304	
Outer Diameter:	0.437	inches
Wall Thickness:	0.018	inches
Diametral Gap:		

Spider Material:	St.Steel 304
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Number of Burnable Poison Rods:	16
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Number of Orifice Rods:	0
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Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 1-16 Burnable Poison Rods. The weight of a version can be expressed as $9.27 + (1.92 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations available for 4, 12 and 16 Rod versions.

Physical Description Report

Page: 2

Westinghouse BPA (16-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	1.700	Top
Inconel-718	0.420	Top
St.Steel 304	9.900	In Core
Borosil.Glass	6.000	In Core

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
Ginna	(assumed)
San Onofre 1	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)
Westinghouse	14x14	Std/SC (assumed)

Comment:

Reference: BPA01-G04; page B-19 of WTSD-TME-148

Physical Description Report

Page: 1

Westinghouse WABA (4-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 153.6 inches
Rod Length: 150.1 inches
Total Weight: 15.6 pounds

Poison:

Material: B4C (WE)
Length: 134.0 inches

Cladding:

Material: Zircaloy-4
Outer Diameter: 0.381 inches
Wall Thickness: 0.026 inches
Diametral Gap:

Spider Material: St.Steel 304

Number of Burnable Poison Rods: 4

Number of Orifice Rods: 12

Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 4-16 Burnable Poison Rods. The weight of a version can be expressed as $9.56 + (1.54 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations available for 4, 12, and 16 Rod versions.

Physical Description Report

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Westinghouse WABA (4-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	1.700	Top
Inconel-718	0.420	Top
St.Steel 304	1.600	Gas Plenum
Zircaloy-4	2.900	In Core
B4C (WE)	0.420	In Core

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
GINNA	(assumed)
San Onofre 1	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)
Westinghouse	14x14	Std/SC (assumed)

Comment:

Reference: WABA-1, G01; page B-27 of WTSD-TME-148.

Physical Description Report

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Westinghouse WABA (12-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length:	153.6	inches
Rod Length:	150.1	inches
Total Weight:	27.7	pounds

Poison:

Material:	B4C (WE)	
Length:	134.0	inches

Cladding:

Material:	Zircaloy-4	
Outer Diameter:	0.381	inches
Wall Thickness:	0.026	inches
Diametral Gap:		

Spider Material:	St. Steel 304
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Number of Burnable Poison Rods:	12
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Number of Orifice Rods:	4
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Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 4-16 Burnable Poison Rods. The weight of a version can be expressed as $9.56 + (1.54 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations available for 4, 12, and 16 Rod versions.

Physical Description Report

Page: 2

Westinghouse WABA (12-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	1.700	Top
Inconel-718	0.420	Top
St.Steel 304	0.550	Gas Plenum
Zircaloy-4	8.820	In Core
B4C (WE)	1.250	In Core

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
Ginna	(assumed)
San Onofre 1	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)
Westinghouse	14x14	Std/SC (assumed)

Comment:

Reference: WABA-1, G03; page B-27 of WTSD-TME-148.

Physical Description Report

Page: 1

Westinghouse WABA (16-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length:	153.6	inches
Rod Length:	150.1	inches
Total Weight:	34.2	pounds

Poison:

Material:	B4C (WE)	
Length:	134.0	inches

Cladding:

Material:	Zircaloy-4	
Outer Diameter:	0.381	inches
Wall Thickness:	0.026	inches
Diametral Gap:		

Spider Material: St. Steel 304

Number of Burnable Poison Rods: 16

Number of Orifice Rods: 0

Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 4-16 Burnable Poison Rods. The weight of a version can be expressed as $9.56 + (1.54 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations available for 4, 12, and 16 Rod versions.

Physical Description Report

Page: 2

Westinghouse WABA (16-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	1.700	Top
Inconel-718	0.420	Top
Zircaloy-4	11.760	In Core
B4C (WE)	1.700	In Core

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
GINNA	(assumed)
San Onofre 1	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)
Westinghouse	14x14	Std/SC (assumed)

Comment:

Reference: WABA-1,G04; page B-27 of WTSD-TME-148.

Physical Description Report

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Westinghouse WABA (8-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length:	153.7	inches
Rod Length:	150.1	inches
Total Weight:	22.8	pounds

Poison:

Material:	B4C (WE)	
Length:	134.0	inches

Cladding:

Material:	Zircaloy-4	
Outer Diameter:	0.381	inches
Wall Thickness:	0.026	inches
Diametral Gap:		

Spider Material: St.Steel 304

Number of Burnable Poison Rods: 8

Number of Orifice Rods: 12

Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 4-20 Burnable Poison Rods. The weight of a version can be expressed as $10.84 + (1.55 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations are available for 8 and 20 Rod versions.

Physical Description Report

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Westinghouse WABA (8-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	1.800	Top
Inconel-718	0.420	Top
St. Steel 304	1.600	Gas Plenum
Zircaloy-4	5.900	In Core
B4C (WE)	0.840	In Core

Used at the Following Reactors:

Reactor	Number in Core
Robinson 2	(assumed)
Zion 1	(assumed)
Zion 2	(assumed)
Indian Point 2	(assumed)
Turkey Point 3	(assumed)
Turkey Point 4	(assumed)
Indian Point 3	(assumed)
Surry 1	(assumed)
Surry 2	(assumed)
Haddam Neck	(assumed)
Cook 1	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	15x15	St.Stl. (assumed)
Exxon / ANF	15x15	WE (assumed)
Westinghouse	15x15	Std/ZC (assumed)
Westinghouse	15x15	OFA (assumed)
Westinghouse	15x15	Std/SC (assumed)

Comment:

Reference: WABA2, G01; page B-27 of WTSD-TME-148.
Weights given in WTSD-TME-148 appear to be wrong.

Physical Description Report

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Westinghouse WABA (20-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length:	153.7	inches
Rod Length:	150.1	inches
Total Weight:	40.8	pounds

Poison:

Material:	B4C (WE)	
Length:	134.0	inches

Cladding:

Material:	Zircaloy-4	
Outer Diameter:	0.381	inches
Wall Thickness:	0.026	inches
Diametral Gap:		

Spider Material: St. Steel 304

Number of Burnable Poison Rods: 20

Number of Orifice Rods: 0

Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 4-20 Burnable Poison Rods. The weight of a version can be expressed as $10.84 + (1.55 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations available for the 8 and 20 Rod versions.

Physical Description Report

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Westinghouse WABA (20-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	1.800	Top
Inconel-718	0.420	Top
Zircaloy-4	14.700	In Core
B4C (WE)	2.090	In Core

Used at the Following Reactors:

Reactor	Number in Core
Robinson 2	(assumed)
Zion 1	(assumed)
Zion 2	(assumed)
Indian Point 2	(assumed)
Turkey Point 3	(assumed)
Turkey Point 4	(assumed)
Indian Point 3	(assumed)
Surry 1	(assumed)
Surry 2	(assumed)
Haddam Neck	(assumed)
Cook 1	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Babcock & Wilcox	15x15	St.Stl.	(assumed)
Exxon / ANF	15x15	WE	(assumed)
Westinghouse	15x15	Std/ZC	(assumed)
Westinghouse	15x15	OFA	(assumed)
Westinghouse	15x15	Std/SC	(assumed)

Comment:

Reference: WABA2, G09; page B-27 of WTSD-TME-148.
Weights given in WTSD-TME-148 appear to be wrong.

Physical Description Report

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Westinghouse Short WABA (4-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length:	146.6	inches
Rod Length:	143.1	inches
Total Weight:	16.5	pounds

Poison:

Material:	B4C (WE)	
Length:	114.0	inches

Cladding:

Material:	Zircaloy-4	
Outer Diameter:	0.381	inches
Wall Thickness:	0.026	inches
Diametral Gap:		

Spider Material: St. Steel 304

Number of Burnable Poison Rods: 4

Number of Orifice Rods: 16

Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 4-16 Burnable Poison Rods. The weight of a version can be expressed as $11.5 + (1.44 * \text{Number of Burnable Poison Rods.})$ Radiological Characterizations are available for 4 and 12 Rod versions.

Physical Description Report

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Westinghouse Short WABA (4-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	1.800	Top
Inconel-718	0.420	Top
St.Steel 304	2.200	Gas Plenum
Zircaloy-4	2.600	In Core
B4C (WE)	0.360	In Core

Used at the Following Reactors:

Reactor	Number in Core
Robinson 2	(assumed)
Zion 1	(assumed)
Zion 2	(assumed)
Indian Point 2	(assumed)
Turkey Point 3	(assumed)
Turkey Point 4	(assumed)
Indian Point 3	(assumed)
Surry 1	(assumed)
Surry 2	(assumed)
Haddam Neck	(assumed)
Cook 1	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Babcock & Wilcox	15x15	St.Stl.	(assumed)
Exxon / ANF	15x15	WE	(assumed)
Westinghouse	15x15	Std/ZC	(assumed)
Westinghouse	15x15	OFA	(assumed)
Westinghouse	15x15	Std/SC	(assumed)

Comment:

Reference: WABA-3, G04; page B-28 of WTSD-TME-148.

Physical Description Report

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Westinghouse Short WABA (12-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length:	146.6	inches
Rod Length:	143.1	inches
Total Weight:	28	pounds

Poison:

Material:	B4C (WE)	
Length:	114.0	inches

Cladding:

Material:	Zircaloy-4	
Outer Diameter:	0.381	inches
Wall Thickness:	0.026	inches
Diametral Gap:		

Spider Material:	St. Steel 304
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Number of Burnable Poison Rods:	12
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Number of Orifice Rods:	8
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Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 4-16 Burnable Poison Rods. The weight of a version can be expressed as $11.5 + (1.44 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations are available for 4 and 12 Rod versions.

Physical Description Report

Page: 2

Westinghouse Short WABA (12-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	1.800	Top
Inconel-718	0.420	Top
St.Steel 304	1.090	Gas Plenum
Zircaloy-4	7.900	In Core
B4C (WE)	1.090	In Core

Used at the Following Reactors:

Reactor	Number in Core
Robinson 2	(assumed)
Zion 1	(assumed)
Zion 2	(assumed)
Indian Point 2	(assumed)
Turkey Point 3	(assumed)
Turkey Point 4	(assumed)
Indian Point 3	(assumed)
Surry 1	(assumed)
Surry 2	(assumed)
Haddam Neck	(assumed)
Cook 1	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	15x15	St.Stl. (assumed)
Exxon / ANF	15x15	WE (assumed)
Westinghouse	15x15	Std/ZC (assumed)
Westinghouse	15x15	OFA (assumed)
Westinghouse	15x15	Std/SC (assumed)

Comment:

Reference: WABA3, G06; page B-28 of WTSD-TME-148.

Physical Description Report

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Westinghouse BPA (4-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length:	156.1	inches
Rod Length:	152.5	inches
Total Weight:	20.4	pounds

Poison:

Material:	Borosil.Glass	
Length:	142.7	inches

Cladding:

Material:	St.Steel 304	
Outer Diameter:	0.445	inches
Wall Thickness:	0.020	inches
Diametral Gap:		

Spider Material:	St.Steel 304
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Number of Burnable Poison Rods:	4
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Number of Orifice Rods:	16
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Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 4-20 Burnable Poison Rods. The weight of a version can be expressed as $12.35 + (2.07 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations available for 4, 12, and 20 Rod versions.

Physical Description Report

Page: 2

Westinghouse BPA (4-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	1.700	Top
Inconel-718	0.360	Top
St.Steel 304	2.600	Gas Plenum
St.Steel 304	2.600	In Core
Borosil.Glass	1.500	In Core

Used at the Following Reactors:

Reactor	Number in Core
Robinson 2	(assumed)
Zion 1	(assumed)
Zion 2	(assumed)
Indian Point 2	(assumed)
Turkey Point 3	(assumed)
Turkey Point 4	(assumed)
Indian Point 3	(assumed)
Surry 1	(assumed)
Surry 2	(assumed)
Haddam Neck	(assumed)
Cook 1	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	15x15	St.Stl. (assumed)
Exxon / ANF	15x15	WE (assumed)
Westinghouse	15x15	Std/ZC (assumed)
Westinghouse	15x15	OFA (assumed)
Westinghouse	15x15	Std/SC (assumed)

Comment:

Reference: BPA10, G06; page B-21 of WTSD-TME-148

Physical Description Report

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Westinghouse BPA (10-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length:	156.1	inches
Rod Length:	152.5	inches
Total Weight:	33.7	pounds

Poison:

Material:	Borosil.Glass	
Length:	142.7	inches

Cladding:

Material:	St.Steel 304	
Outer Diameter:	0.445	inches
Wall Thickness:	0.020	inches
Diametral Gap:		

Spider Material:	St.Steel 304
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Number of Burnable Poison Rods:	10
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Number of Orifice Rods:	10
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Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 4-20 Burnable Poison Rods. The weight of a version can be expressed as $12.35 + (2.07 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations available for 4, 10, and 20 Rod versions.

Physical Description Report

Page: 2

Westinghouse BPA (10-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	1.700	Top
Inconel-718	0.360	Top
St.Steel 304	1.600	Gas Plenum
St.Steel 304	6.600	In Core
Borosil.Glass	3.760	In Core

Used at the Following Reactors:

Reactor	Number in Core
Robinson 2	(assumed)
Zion 1	(assumed)
Zion 2	(assumed)
Indian Point 2	(assumed)
Turkey Point 3	(assumed)
Turkey Point 4	(assumed)
Indian Point 3	(assumed)
Surry 1	(assumed)
Surry 2	(assumed)
Haddam Neck	(assumed)
Cook 1	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	15x15	St.Stl. (assumed)
Exxon / ANF	15x15	WE (assumed)
Westinghouse	15x15	Std/ZC (assumed)
Westinghouse	15x15	OFA (assumed)
Westinghouse	15x15	Std/SC (assumed)

Comment:

Reference: BPA10, G09; page B-21 of WTSD-TME-148

Physical Description Report

Page: 1

Westinghouse BPA (20-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length:	156.1	inches
Rod Length:	152.5	inches
Total Weight:	53.6	pounds

Poison:

Material:	Borosil.Glass
Length:	142.7 inches

Cladding:

Material:	St.Steel 304
Outer Diameter:	0.445 inches
Wall Thickness:	0.020 inches
Diametral Gap:	

Spider Material: St.Steel 304

Number of Burnable Poison Rods: 20

Number of Orifice Rods: 0

Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 4-20 Burnable Poison Rods. The weight of a version can be expressed as $12.35 + (2.06 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations available for 4, 10, and 20 Rod versions.

Physical Description Report

Page: 2

Westinghouse BPA (20-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	1.700	Top
Inconel-718	0.360	Top
St.Steel 304	13.200	In Core
Borosil.Glass	7.500	In Core

Used at the Following Reactors:

Reactor	Number in Core
Robinson 2	(assumed)
Zion 1	(assumed)
Zion 2	(assumed)
Indian Point 2	(assumed)
Turkey Point 3	(assumed)
Turkey Point 4	(assumed)
Indian Point 3	(assumed)
Surry 1	(assumed)
Surry 2	(assumed)
Haddam Neck	(assumed)
Cook 1	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Babcock & Wilcox	15x15	St.Stl.	(assumed)
Exxon / ANF	15x15	WE	(assumed)
Westinghouse	15x15	Std/ZC	(assumed)
Westinghouse	15x15	OFA	(assumed)
Westinghouse	15x15	Std/SC	(assumed)

Comment:

Reference: BPA10, G03; page B-21 of WTSD-TME-148

Physical Description Report

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Westinghouse WABA (4-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length:	153.6	inches
Rod Length:	150.0	inches
Total Weight:	16.9	pounds

Poison:

Material:	B4C (WE)	
Length:	134.0	inches

Cladding:

Material:	Zircaloy-4	
Outer Diameter:	0.381	inches
Wall Thickness:	0.026	inches
Diametral Gap:		

Spider Material: St. Steel 304

Number of Burnable Poison Rods: 4

Number of Orifice Rods: 20

Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 3-24 Burnable Poison Rods. The weight of a version can be expressed as $10.14 + (1.68 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations available for 4, 16, and 24 Rod versions.

Physical Description Report

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Westinghouse WABA (4-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	2.300	Top
Inconel-718	0.420	Top
St.Steel 304	1.500	Gas Plenum
B4C (WE)	0.420	In Core
Zircaloy-4	2.900	In Core

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)
Seabrook 1	(assumed)
Seabrook 2	(assumed)

Westinghouse WABA (4-Rod) Neutron Poison

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

Reference: WABA-4, G16; page B-28 of WTSD-TME-148

Physical Description Report

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Westinghouse WABA (16-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length:	153.6	inches
Rod Length:	150.0	inches
Total Weight:	37.1	pounds

Poison:

Material:	B4C (WE)	
Length:	134.0	inches

Cladding:

Material:	Zircaloy-4	
Outer Diameter:	0.381	inches
Wall Thickness:	0.026	inches
Diametral Gap:		

Spider Material: St. Steel 304

Number of Burnable Poison Rods: 16

Number of Orifice Rods: 8

Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 3-24 Burnable Poison Rods. The weight of a version can be expressed as $10.14 + (1.86 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations available for 4, 16, and 24 Rod versions.

Physical Description Report

Page: 2

Westinghouse WABA (16-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	2.300	Top
Inconel-718	0.420	Top
St. Steel 304	0.580	Gas Plenum
B4C (WE)	1.700	In Core
Zircaloy-4	11.600	In Core

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)
Seabrook 1	(assumed)
Seabrook 2	(assumed)

Physical Description Report

Page: 3

Westinghouse WABA (16-Rod) Neutron Poison

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

Reference: WABA4, GO2; page B-28 of WTSD-TME-148

Physical Description Report

Page: 1

Westinghouse WABA (24-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length:	153.6	inches
Rod Length:	150.0	inches
Total Weight:	50.5	pounds

Poison:

Material:	B4C (WE)	
Length:	134.0	inches

Cladding:

Material:	Zircaloy-4	
Outer Diameter:	0.381	inches
Wall Thickness:	0.026	inches
Diametral Gap:		

Spider Material: St. Steel 304

Number of Burnable Poison Rods: 24

Number of Orifice Rods: 0

Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 3-24 Burnable Poison Rods. The weight of a version can be expressed as $10.14 + (1.86 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations available for 4, 16, and 24 Rod versions.

Physical Description Report

Page: 2

Westinghouse WABA (24-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	2.300	Top
Inconel-718	0.420	Top
B4C (WE)	2.500	In Core
Zircaloy-4	17.400	In Core

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)
Seabrook 1	(assumed)
Seabrook 2	(assumed)

Physical Description Report

Page: 3

Westinghouse WABA (24-Rod) Neutron Poison

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

Reference: WABA4, G43; page B-29 of WTSD-TME-148

Physical Description Report

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Westinghouse BPA (4-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length:	156.1	inches
Rod Length:	152.4	inches
Total Weight:	19.2	pounds

Poison:

Material:	Borosil.Glass	
Length:	142.0	inches

Cladding:

Material:	St.Steel 304	
Outer Diameter:	0.385	inches
Wall Thickness:	0.018	inches
Diametral Gap:		

Spider Material: St.Steel 304

Number of Burnable Poison Rods: 4

Number of Orifice Rods: 20

Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 2-24 Burnable Poison Rods. The weight of a version can be expressed as $13.09 + (1.52 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations available for 4, 10, 16 and 24 Rod versions.

Physical Description Report

Page: 2

Westinghouse BPA (4-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	2.300	Top
Inconel-718	0.420	Top
St. Steel 304	2.630	Gas Plenum
St. Steel 304	2.000	In Core
Borosil. Glass	1.300	In Core

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)
Seabrook 1	(assumed)
Seabrook 2	(assumed)

Physical Description Report

Page: 3

Westinghouse BPA (4-Rod) Neutron Poison

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

Reference: BPA16, G43; page B-23 of WTSD-TME-148

Physical Description Report

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Westinghouse BPA (10-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length:	156.1	inches
Rod Length:	152.4	inches
Total Weight:	28.4	pounds

Poison:

Material:	Borosil.Glass
Length:	142.0 inches

Cladding:

Material:	St.Steel 304
Outer Diameter:	0.385 inches
Wall Thickness:	0.018 inches
Diametral Gap:	

Spider Material: St.Steel 304

Number of Burnable Poison Rods: 10

Number of Orifice Rods: 14

Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 2-24 Burnable Poison Rods. The weight of a version can be expressed as $13.09 + (1.52 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations available for 4,10,16 and 24 Rod versions.

Physical Description Report

Page: 2

Westinghouse BPA (10-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	2.300	Top
Inconel-718	0.420	Top
St. Steel 304	1.800	Gas Plenum
St. Steel 304	5.000	In Core
Borosil. Glass	3.200	In Core

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)
Seabrook 1	(assumed)
Seabrook 2	(assumed)

Physical Description Report

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Westinghouse BPA (10-Rod) Neutron Poison

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

Reference: BPA-16, G06; page B-22 of WTSD-TME-148

Physical Description Report

Page: 1

Westinghouse BPA (16-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length:	156.1	inches
Rod Length:	152.4	inches
Total Weight:	37.5	pounds

Poison:

Material:	Borosil.Glass	
Length:	142.0	inches

Cladding:

Material:	St.Steel 304	
Outer Diameter:	0.385	inches
Wall Thickness:	0.018	inches
Diametral Gap:		

Spider Material: St.Steel 304

Number of Burnable Poison Rods: 16

Number of Orifice Rods: 8

Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 2-24 Burnable Poison Rods. The weight of a version can be expressed as $13.09 + (1.52 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations available for 4,10,16 and 24 Rod versions.

Physical Description Report

Page: 2

Westinghouse BPA (16-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	2.300	Top
Inconel-718	0.420	Top
St.Steel 304	1.000	Gas Plenum
St.Steel 304	8.100	In Core
Borosil.Glass	5.100	In Core

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)
Seabrook 1	(assumed)
Seabrook 2	(assumed)

Westinghouse BPA (16-Rod) Neutron Poison

Used with Following Fuel Assembly Types:
Vendor Array Version

Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

Reference: BPA-16, G01; page B-22 of WTSD-TME-148

Physical Description Report

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Westinghouse BPA (24-Rod) Neutron Poison

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length:	156.7	inches
Rod Length:	152.4	inches
Total Weight:	49.6	pounds

Poison:

Material:	Borosil.Glass	
Length:	142.0	inches

Cladding:

Material:	St.Steel 304	
Outer Diameter:	0.385	inches
Wall Thickness:	0.018	inches
Diametral Gap:		

Spider Material: St.Steel 304

Number of Burnable Poison Rods: 24

Number of Orifice Rods: 0

Life Expectancy:

Design Variations:

Westinghouse makes versions of this part with 2-24 Burnable Poison Rods. The weight of a version can be expressed as $13.09 + (1.52 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations available for 4,10,16 and 24 Rod versions.

Physical Description Report

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Westinghouse BPA (24-Rod) Neutron Poison

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	2.300	Top
Inconel-718	0.420	Top
St.Steel 304	12.100	In Core
Borosil.Glass	7.600	In Core

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)
Seabrook 1	(assumed)
Seabrook 2	(assumed)

Physical Description Report

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Westinghouse BPA (24-Rod) Neutron Poison

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

Reference: BPA-16, G14; page B-22 of WTSD-TME-148.

2E-171/172

NEUTRON SOURCE ASSEMBLIES

Physical Description Report

Page: 1

Babcock & Wilcox Primary Source Neutron Source

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length: 145.75 inches
Total Weight: 1 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.440 inches
Diametral Gap:

Poison Material: N/A

Spider/Plunger Material: N/A

Primary Source:

Material: Am-Be Copper
Length: 0.5 inches
Strength:

Secondary Source:

Material: N/A
Length:

Spacers:

Material: N/A
Length:

Number of Orifice Rods: 0

Number of Burnable Poison Rods: 0

Number of Source Rods,
primary and secondary: 1

Number of Primary Source Rods only: 1

Number of Secondary Source Rods only: 0

Life Expectancy:

Physical Description Report

Page: 2

Babcock & Wilcox Primary Source Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	0.440	In Core
Am-Be Copper	0.009	In Core

Used at the Following Reactors:

Reactor	Number in Core
Arkansas 1	
Oconee 1	(assumed)
Oconee 2	(assumed)
Oconee 3	(assumed)
Crystal River 3	
Three Mile Island 1	(assumed)
Rancho Seco	(assumed)
Davis-Besse	

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Babcock & Wilcox	15x15	Mark B	
Babcock & Wilcox	15x15	Mark BZ	(assumed)

Physical Description Report

Page: 1

Babcock & Wilcox Regenerative Neutron Source

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length: 144 inches
Total Weight: 46.3 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.440 inches
Diametral Gap:

Poison Material: N/A

Spider/Plunger Material: St. Steel CF3M

Primary Source:

Material: N/A
Length:
Strength:

Secondary Source:

Material: Antimony-Be
Length:

Spacers:

Material:
Length:

Number of Orifice Rods:

Number of Burnable Poison Rods:

Number of Source Rods,
primary and secondary: 8

Number of Primary Source Rods only:

Number of Secondary Source Rods only: 8

Life Expectancy:

Babcock & Wilcox Regenerative Neutron Source

Rod Configuration Feature:

Assumed Cladding and End Plug weight of 1.3 pounds per Rod.

Physical Description Report

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Babcock & Wilcox Regenerative Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St.Steel CF3M	3.500	Top
St.Steel 304	0.040	Top
St.Steel 304	4.700	In Core
Antimony-Be	12.700	In Core

Used at the Following Reactors:

Reactor	Number in Core
Arkansas 1	2-3
Oconee 1	2
Oconee 2	2
Oconee 3	2-3
Crystal River 3	2
Three Mile Island 1	2-3
Rancho Seco	2-3
Davis-Besse	2-3

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	15x15	Mark B
Babcock & Wilcox	15x15	Mark BZ

Physical Description Report

Page: 1

Combustion Engineering Standard Neutron Source

Designed for:

Fuel Assembly with array size: 16x16
Pressurized Water Reactor

Dimensions:

Total Length: 99.0 inches
Total Weight: 8.2 pounds

Cladding:

Material: St. Steel 316
Outer Diameter: 0.812 inches
Diametral Gap:

Poison Material: N/A

Spider/Plunger Material: St. Steel 316

Primary Source:

Material: Pu-Be
Length: 6 inches
Strength:

Secondary Source:

Material: Antimony-Be
Length: 15.65 inches

Spacers:

Material: St. Steel 316
Length: 5.95 inches

Number of Orifice Rods: 0

Number of Burnable Poison Rods: 0

Number of Source Rods,
primary and secondary: 1

Number of Primary Source Rods only: 0

Number of Secondary Source Rods only: 0

Life Expectancy: 3500 EFPD

Physical Description Report

Page: 2

Combustion Engineering Standard Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St.Steel 316	0.040	Top
Inconel 600	0.090	Top
St.Steel 316	0.090	Gas Plenum
St.Steel 316	3.600	In Core
Inconel 600	0.090	In Core
Plutonium	0.140	In Core
Antimony	0.140	In Core
Beryllium	0.230	In Core

Used at the Following Reactors:

Reactor	Number in Core
Palo Verde 1	2
Palo Verde 2	2
Palo Verde 3	2
Arkansas 2	2
St. Lucie 2	2
Waterford 3	2
San Onofre 2	2
San Onofre 3	2

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	16x16	Onofre
Combustion Engineering	16x16	Lucie 2
Combustion Engineering	16x16	ANO2
Combustion Engineering	16x16	SYS80

Comment:

Uncertainty as to how many Secondary Source and Spacer Pellets per Rod. One each per Rod assumed.

Physical Description Report

Page: 1

Combustion Engineering 128 Inch Core Neutron Source

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 100 inches
Total Weight: 10.6 pounds

Cladding:

Material: St. Steel 316
Outer Diameter: 0.875 inches
Diametral Gap:

Poison Material: N/A

Spider/Plunger Material: St. Steel 316

Primary Source:

Material: Pu-Be
Length: 10.75 inches
Strength:

Secondary Source:

Material: Antimony-Be
Length: 15.65 inches

Spacers:

Material: St. Steel 316
Length: 2.10 inches

Number of Orifice Rods: 0

Number of Burnable Poison Rods: 0

Number of Source Rods,
primary and secondary: 1

Number of Primary Source Rods only: 0

Number of Secondary Source Rods only: 0

Life Expectancy: 4000 EFPD

Physical Description Report

Page: 2

Combustion Engineering 128 Inch Core Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St. Steel 316	0.320	Top
CE Ni Alloy	0.050	Top
St. Steel 316	0.050	Gas Plenum
St. Steel 316	2.900	In Core
CE Ni Alloy	0.050	In Core
Plutonium	0.090	In Core
Antimony	0.090	In Core
Beryllium	0.200	In Core

Used at the Following Reactors:

Reactor	Number in Core
Fort Calhoun	2

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	14x14	Ft. Cal.
Exxon / ANF	14x14	Ft. Cal

Comment:

Uncertainty as to number of Secondary Source and Spacer Pellets per Rod. One per Rod assumed.

Physical Description Report

Page: 1

Combustion Engineering 137 Inch Core Neutron Source

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 106 inches
Total Weight: 10.9 pounds

Cladding:

Material: St. Steel 316
Outer Diameter: 0.875 inches
Diametral Gap: 0.035 inches

Poison Material: N/A

Spider/Plunger Material: St. Steel 316

Primary Source:

Material: Pu-Be
Length: 10.75 inches
Strength:

Secondary Source:

Material: Antimony-Be
Length: 15.65 inches

Spacers:

Material: St. Steel 316
Length: 2.10 inches

Number of Orifice Rods: 0

Number of Burnable Poison Rods: 0

Number of Source Rods,
primary and secondary: 1

Number of Primary Source Rods only: 0

Number of Secondary Source Rods only: 0

Life Expectancy: 4000 EFPD

Physical Description Report

Page: 2

Combustion Engineering 137 Inch Core Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St.Steel 316	0.400	Top
CE Ni Alloy	0.090	Top
St.Steel 316	0.090	Gas Plenum
St.Steel 348H	3.800	In Core
CE Ni Alloy	0.090	In Core
Plutonium	0.140	In Core
Antimony	0.140	In Core
Beryllium	0.230	In Core

Used at the Following Reactors:

Reactor	Number in Core
Calvert Cliffs 1	2
Calvert Cliffs 2	2
St. Lucie 1	2
Maine Yankee	2
Millstone 2	2

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	14x14	Std
Exxon / ANF	14x14	CE
Westinghouse	14x14	Model C

Comment:

Uncertainty as to number of Secondary Source and Spacer Pellets per Rod. One per Rod assumed.

Physical Description Report

Page: 1

Combustion Engineering Sustaining Neutron Source

Designed for:

Fuel Assembly with array size: 15x15
 Pressurized Water Reactor

Dimensions:

Total Length: 117 inches
 Total Weight: 4.5 pounds

Cladding:

Material: St. Steel 304
 Outer Diameter: 0.340 inches
 Diametral Gap:

Poison Material: N/A

Spider/Plunger Material: St. Steel 304

Primary Source:

Material: N/A
 Length:
 Strength:

Secondary Source:

Material: Antimony-Be
 Length: 72 inches

Spacers:

Material: N/A
 Length:

Number of Orifice Rods: 0
 Number of Burnable Poison Rods: 0
 Number of Source Rods,
 primary and secondary: 1
 Number of Primary Source Rods only: 0
 Number of Secondary Source Rods only: 1
 Life Expectancy: 4000 EFPD

Physical Description Report

Page: 2

Combustion Engineering Sustaining Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	0.680	Top
St.Steel 304	0.050	Gas Plenum
St.Steel 304	1.100	In Core
Antimony	0.090	In Core
Beryllium	0.090	In Core

Used at the Following Reactors:

Reactor	Number in Core
Palisades	2

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	15x15	Palis.
Exxon / ANF	15x15	CE

Physical Description Report

Page: 1

Combustion Engineering Start-up Neutron Source

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length: 117 inches
Total Weight: 4.5 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.340 inches
Diametral Gap:

Poison Material: N/A

Spider/Plunger Material: St.Steel 304

Primary Source:

Material: Pu-Be
Length: 12.0 inches
Strength:

Secondary Source:

Material: Antimony-Be
Length: 60.0 inches

Spacers:

Material: N/A
Length:

Number of Orifice Rods: 0
Number of Burnable Poison Rods: 0
Number of Source Rods,
primary and secondary: 1
Number of Primary Source Rods only: 0
Number of Secondary Source Rods only: 0
Life Expectancy: 4000 EFPD

Combustion Engineering Start-up Neutron Source

Rod Configuration Feature:

This Neutron Source has two 30" Sb-Be Pellets, separated by a 12" Po-Be Pellet.

Physical Description Report

Page: 3

Combustion Engineering Start-up Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	0.680	Top
St. Steel 304	0.050	Gas Plenum
St. Steel 304	1.100	In Core
Plutonium	0.050	In Core
Antimony	0.090	In Core
Beryllium	0.090	In Core

Used at the Following Reactors:

Reactor	Number in Core
Palisades	2

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Combustion Engineering	15x15	Palis.	
Exxon / ANF	15x15	CE	(assumed)

Physical Description Report

Page: 1

Westinghouse Primary, Version 1 Neutron Source

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 125.3 inches
Total Weight: 48 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.43 inches
Diametral Gap:

Poison Material: Borosil. Glass

Spider/Plunger Material: St. Steel 304

Primary Source:

Material: Californium
Length:
Strength: 2-6E+08 curies

Secondary Source:

Material: Antimony-Be
Length:

Spacers:

Material: N/A
Length:

Number of Orifice Rods: 0
Number of Burnable Poison Rods: 12
Number of Source Rods,
primary and secondary: 4
Number of Primary Source Rods only: 1
Number of Secondary Source Rods only: 3
Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Primary, Version 1 Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	3.520	Top
Inconel X-750	0.230	Top
St.Steel 304	10.100	In Core
Borosil.Glass	4.500	In Core
Californium		In Core
Antimony-Be		In Core

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
Ginna	(assumed)
San Onofre 1	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)
Westinghouse	14x14	Std/SC (assumed)

Comment:

Reference: SA-16, G06; page B-9 of WTSD-TME-148.

Physical Description Report

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Westinghouse Primary, Version 2 Neutron Source

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 158.3 inches
Total Weight: 48 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.43 inches
Diametral Gap:

Poison Material: Borosil.Glass

Spider/Plunger Material: St.Steel 304

Primary Source:

Material: Californium
Length: 1.65 inches
Strength: 2-6E+08 curies

Secondary Source:

Material: Antimony-Be
Length:

Spacers:

Material: Alum. Oxide
Length: 145.4 inches

Number of Orifice Rods: 0
Number of Burnable Poison Rods: 12
Number of Source Rods,
primary and secondary: 4
Number of Primary Source Rods only: 1
Number of Secondary Source Rods only: 3
Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Primary, Version 2 Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	3.520	Top
Inconel X-750	0.230	Top
St.Steel 304	10.200	In Core
Borosil.Glass	4.500	In Core
Antimony-Be	1.600	In Core

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
Ginna	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)

Comment:

Reference: SA-16, G08; page B-9 of WTSD-TME-148.

Physical Description Report

Page: 1

Westinghouse Primary, Version 3 Neutron Source

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 158.3 inches
Total Weight: 48 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.43 inches
Diametral Gap:

Poison Material: Borosil. Glass

Spider/Plunger Material: St. Steel 304

Primary Source:

Material: Pu-Be
Length:
Strength: 50 curies

Secondary Source:

Material: Antimony-Be
Length:

Spacers:

Material: N/A
Length:

Number of Orifice Rods: 0

Number of Burnable Poison Rods: 12

Number of Source Rods,
primary and secondary: 4

Number of Primary Source Rods only: 0

Number of Secondary Source Rods only: 3

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Primary, Version 3 Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	3.520	Top
Inconel X-750	0.230	Top
St.Steel 304	10.200	In Core
Borosil.Glass	4.500	In Core
Antimony-Be		In Core
Pu-Be		In Core

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
Ginna	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)

Comment:

Reference: SA-16, G07; page B-9 of WTSD-TME-148.

Physical Description Report

Page: 1

Westinghouse Secondary, 116 Inch Neutron Source

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 116.2 inches
Total Weight: 22.2 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.43 inches
Diametral Gap:

Poison Material: N/A

Spider/Plunger Material: St.Steel 304

Primary Source:

Material: N/A
Length:
Strength:

Secondary Source:

Material: Antimony-Be
Length: 65.0 inches

Spacers:

Material: St.Steel 304
Length: 1.19 inches

Number of Orifice Rods: 12

Number of Burnable Poison Rods: 0

Number of Source Rods,
primary and secondary: 4

Number of Primary Source Rods only: 0

Number of Secondary Source Rods only: 4

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Secondary, 116 Inch Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	3.520	Top
Inconel X-750	0.230	Top
St.Steel 304	2.300	Gas Plenum
St.Steel 304	1.600	In Core
Antimony-Be	1.900	In Core

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
Ginna	(assumed)
San Onofre 1	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)
Westinghouse	14x14	Std/SC (assumed)

Comment:

Reference: SA-07, G04; page B-7 of WTSD-TME-148.

Physical Description Report

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Westinghouse Secondary, 137 Inch Neutron Source

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 137.5 inches
Total Weight: 23.8 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.43 inches
Diametral Gap:

Poison Material: N/A

Spider/Plunger Material: St. Steel 304

Primary Source:

Material: N/A
Length:
Strength:

Secondary Source:

Material: Antimony-Be
Length: 80.0 inches

Spacers:

Material: St. Steel 304
Length: 1.19 inches

Number of Orifice Rods: 12

Number of Burnable Poison Rods: 0

Number of Source Rods,
primary and secondary: 4

Number of Primary Source Rods only: 0

Number of Secondary Source Rods only: 4

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Secondary, 137 Inch Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	3.520	Top
Inconel X-750	0.230	Top
St. Steel 304	2.300	Gas Plenum
St. Steel 304	2.000	In Core
Antimony-Be	2.200	In Core

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
Ginna	(assumed)
San Onofre 1	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)
Westinghouse	14x14	Std/SC (assumed)

Comment:

Reference: SA-07, G03; page B-7 of WTSD-TME-148.

Physical Description Report

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Westinghouse Secondary, 143 Inch Neutron Source

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 143.2 inches
Total Weight: 22.9 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.43 inches
Diametral Gap:

Poison Material: N/A

Spider/Plunger Material: St. Steel 304

Primary Source:

Material: N/A
Length:
Strength:

Secondary Source:

Material: Antimony-Be
Length: 72 inches

Spacers:

Material: St. Steel 304
Length: 1.19 inches

Number of Orifice Rods: 12

Number of Burnable Poison Rods: 0

Number of Source Rods,
primary and secondary: 4

Number of Primary Source Rods only: 0

Number of Secondary Source Rods only: 4

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Secondary, 143 Inch Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	3.520	Top
Inconel X-750	0.230	Top
St.Steel 304	2.300	Gas Plenum
St.Steel 304	2.300	In Core
Antimony-Be	2.100	In Core

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
Ginna	(assumed)
San Onofre 1	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)
Westinghouse	14x14	Std/SC (assumed)

Comment:

Reference: SA-07, G01; page B-7 of WTSD-TME-148.

Physical Description Report

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Westinghouse Secondary, 157 Inch Neutron Source

Designed for:

Fuel Assembly with array size: 14x14
Pressurized Water Reactor

Dimensions:

Total Length: 156.9 inches
Total Weight: 27.7 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.43 inches
Diametral Gap:

Poison Material: N/A

Spider/Plunger Material: St.Steel 304

Primary Source:

Material: N/A
Length:
Strength:

Secondary Source:

Material: Antimony-Be
Length: 72 inches

Spacers:

Material: St.Steel 304
Length: 1.19 inches

Number of Orifice Rods: 12

Number of Burnable Poison Rods: 0

Number of Source Rods,
primary and secondary: 4

Number of Primary Source Rods only: 0

Number of Secondary Source Rods only: 4

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Secondary, 157 Inch Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	3.520	Top
Inconel X-750	0.230	Top
St. Steel 304	2.300	Gas Plenum
St. Steel 304	2.300	In Core
Antimony-Be	2.100	In Core

Used at the Following Reactors:

Reactor	Number in Core
Prairie Island 1	(assumed)
Prairie Island 2	(assumed)
Gienna	(assumed)
San Onofre 1	(assumed)
Point Beach 1	(assumed)
Point Beach 2	(assumed)
Kewaunee	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	14x14	(assumed)
Exxon / ANF	14x14	WE (assumed)
Exxon / ANF	14x14	TOP ROD (assumed)
Westinghouse	14x14	Std/ZCA (assumed)
Westinghouse	14x14	OFA (assumed)
Westinghouse	14x14	Std/ZCB (assumed)
Westinghouse	14x14	Std/SC (assumed)

Comment:

Reference: SA-07, G11; page B-7 of WTSD-TME-148.

Physical Description Report

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Westinghouse Primary, Version 1 Neutron Source

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length: 158.2 inches
Total Weight: 52 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.44 inches
Diametral Gap:

Poison Material: Borosil.Glass

Spider/Plunger Material: St.Steel 304

Primary Source:

Material: Pu-Be
Length: 1.65 inches
Strength: 50 curies

Secondary Source:

Material: Antimony-Be
Length: 121.75 inches

Spacers:

Material: N/A
Length:

Number of Orifice Rods: 4

Number of Burnable Poison Rods: 12

Number of Source Rods,
primary and secondary: 4

Number of Primary Source Rods only: 0

Number of Secondary Source Rods only: 3

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Primary, Version 1 Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	3.500	Top
St.Steel 304	0.760	Gas Plenum
Borosil.Glass	4.500	In Core
St.Steel 304	9.800	In Core
Antimony-Be		In Core
Pu-Be		In Core

Used at the Following Reactors:

Reactor	Number in Core
Robinson 2	(assumed)
Zion 1	(assumed)
Zion 2	(assumed)
Indian Point 2	(assumed)
Turkey Point 3	(assumed)
Turkey Point 4	(assumed)
Indian Point 3	(assumed)
Surry 1	(assumed)
Surry 2	(assumed)
Haddam Neck	(assumed)
Cook 1	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	15x15	St.Stl. (assumed)
Exxon / ANF	15x15	WE (assumed)
Westinghouse	15x15	Std/ZC (assumed)
Westinghouse	15x15	OFA (assumed)
Westinghouse	15x15	Std/SC (assumed)

Comment:

Reference: SA-18, G01; page B-10 of WTSD-TME-148.

Physical Description Report

Page: 1

Westinghouse Primary, Version 2 Neutron Source

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length: 158.2 inches
Total Weight: 52 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.44 inches
Diametral Gap:

Poison Material: Borosil.Glass

Spider/Plunger Material: St.Steel 304

Primary Source:

Material: Polonium-Be
Length:
Strength: 200 curies

Secondary Source:

Material: Antimony-Be
Length: 121.75 inches

Spacers:

Material: N/A
Length:

Number of Orifice Rods: 4
Number of Burnable Poison Rods: 12
Number of Source Rods,
primary and secondary: 4
Number of Primary Source Rods only: 0
Number of Secondary Source Rods only: 3
Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Primary, Version 2 Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	3.500	Top
St.Steel 304	0.760	Gas Plenum
Borosil.Glass	4.500	In Core
St.Steel 304	9.800	In Core
Antimony-Be		In Core
Polonium-Be		In Core

Used at the Following Reactors:

Reactor	Number in Core
Robinson 2	(assumed)
Zion 1	(assumed)
Zion 2	(assumed)
Indian Point 2	(assumed)
Turkey Point 3	(assumed)
Turkey Point 4	(assumed)
Indian Point 3	(assumed)
Surry 1	(assumed)
Surry 2	(assumed)
Haddam Neck	(assumed)
Cook 1	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	15x15	St.Stl. (assumed)
Exxon / ANF	15x15	WE (assumed)
Westinghouse	15x15	Std/ZC (assumed)
Westinghouse	15x15	OFA (assumed)
Westinghouse	15x15	Std/SC (assumed)

Comment:

Reference: SA-15, G02; on page B-9 of WTSD-TME-148

Physical Description Report

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Westinghouse Primary, Version 3 Neutron Source

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length: 156.1 inches
Total Weight: 34 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.44 inches
Diametral Gap:

Poison Material: Borosil.Glass

Spider/Plunger Material: St.Steel 304

Primary Source:

Material: Californium
Length:
Strength: 2-12E+08 curies

Secondary Source:

Material: N/A
Length:

Spacers:

Material: Ag-In-Cd
Length:

Number of Orifice Rods: 7

Number of Burnable Poison Rods: 12

Number of Source Rods,
primary and secondary: 1

Number of Primary Source Rods only: 1

Number of Secondary Source Rods only: 0

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Primary, Version 3 Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	1.700	Top
Inconel X-750	0.360	Top
St.Steel 304	0.950	Gas Plenum
Borosil.Glass	4.500	In Core
St.Steel 304	8.000	In Core
Californium		In Core

Used at the Following Reactors:

Reactor	Number in Core
Robinson 2	(assumed)
Zion 1	(assumed)
Zion 2	(assumed)
Indian Point 2	(assumed)
Turkey Point 3	(assumed)
Turkey Point 4	(assumed)
Indian Point 3	(assumed)
Surry 1	(assumed)
Surry 2	(assumed)
Haddam Neck	(assumed)
Cook 1	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Babcock & Wilcox	15x15	St.Stl.	(assumed)
Exxon / ANF	15x15	WE	(assumed)
Westinghouse	15x15	Std/ZC	(assumed)
Westinghouse	15x15	OFA	(assumed)
Westinghouse	15x15	Std/SC	(assumed)

Comment:

Reference: SA-06, G01; on page B-6 of WTSD-TME-148.

Physical Description Report

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Westinghouse Secondary, 116 Inch Neutron Source

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length: 116.2 inches
Total Weight: 27.9 pounds

Cladding:

Material: Unknown
Outer Diameter: 0.47 inches
Diametral Gap:

Poison Material: N/A

Spider/Plunger Material: St. Steel 304

Primary Source:

Material: N/A
Length:
Strength:

Secondary Source:

Material: Antimony-Be
Length: 94.75 inches

Spacers:

Material: N/A
Length:

Number of Orifice Rods: 16

Number of Burnable Poison Rods: 0

Number of Source Rods,
primary and secondary: 4

Number of Primary Source Rods only: 0

Number of Secondary Source Rods only: 4

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Secondary, 116 Inch Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	3.500	Top
St.Steel 304	3.050	Gas Plenum
Unknown		In Core
Antimony-Be		In Core

Used at the Following Reactors:

Reactor	Number in Core
Robinson 2	(assumed)
Zion 1	(assumed)
Zion 2	(assumed)
Indian Point 2	(assumed)
Turkey Point 3	(assumed)
Turkey Point 4	(assumed)
Indian Point 3	(assumed)
Surry 1	(assumed)
Surry 2	(assumed)
Haddam Neck	(assumed)
Cook 1	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Babcock & Wilcox	15x15	St.Stl.	(assumed)
Exxon / ANF	15x15	WE	(assumed)
Westinghouse	15x15	Std/ZC	(assumed)
Westinghouse	15x15	OFA	(assumed)
Westinghouse	15x15	Std/SC	(assumed)

Comment:

Reference: SA-09, G02; on page B-8 of WTSD-TME-148.
Some information on weight of Source cladding not available;
weights of similar Rods used instead.

Physical Description Report

Page: 1

Westinghouse Secondary, 143 Inch Neutron Source

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length: 143.2 inches
Total Weight: 25.2 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.431 inches
Diametral Gap:

Poison Material: N/A

Spider/Plunger Material: St.Steel 304

Primary Source:

Material: N/A
Length:
Strength:

Secondary Source:

Material: Antimony-Be
Length: 72 inches

Spacers:

Material: St.Steel 304
Length: 1.19 inches

Number of Orifice Rods: 16

Number of Burnable Poison Rods: 0

Number of Source Rods,
primary and secondary: 4

Number of Primary Source Rods only: 0

Number of Secondary Source Rods only: 4

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Secondary, 143 Inch Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	3.520	Top
Inconel X-750	0.500	Top
St.Steel 304	3.000	Gas Plenum
St.Steel 304	2.300	In Core
Antimony-Be	2.100	In Core

Used at the Following Reactors:

Reactor	Number in Core
Robinson 2	(assumed)
Zion 1	(assumed)
Zion 2	(assumed)
Indian Point 2	(assumed)
Turkey Point 3	(assumed)
Turkey Point 4	(assumed)
Indian Point 3	(assumed)
Surry 1	(assumed)
Surry 2	(assumed)
Haddam Neck	(assumed)
Cook 1	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version
Babcock & Wilcox	15x15	St.Stl. (assumed)
Exxon / ANF	15x15	WE (assumed)
Westinghouse	15x15	Std/ZC (assumed)
Westinghouse	15x15	OFA (assumed)
Westinghouse	15x15	Std/SC (assumed)

Comment:

Reference: SA-17, G04; page B-10 of WTSD-TME-148.

Physical Description Report

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Westinghouse Secondary, 157 Inch Neutron Source

Designed for:

Fuel Assembly with array size: 15x15
Pressurized Water Reactor

Dimensions:

Total Length: 156.1 inches
Total Weight: 19 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.431 inches
Diametral Gap:

Poison Material: N/A

Spider/Plunger Material: St.Steel 304

Primary Source:

Material: N/A
Length:
Strength:

Secondary Source:

Material: Antimony-Be
Length: 67.1 inches

Spacers:

Material: N/A
Length:

Number of Orifice Rods: 16

Number of Burnable Poison Rods: 0

Number of Source Rods,
primary and secondary: 4

Number of Primary Source Rods only: 0

Number of Secondary Source Rods only: 4

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Secondary, 157 Inch Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	1.700	Top
St.Steel 302	0.360	Top
St.Steel 304	2.200	Gas Plenum
St.Steel 304	2.300	In Core
Antimony-Be	1.900	In Core

Used at the Following Reactors:

Reactor	Number in Core
Robinson 2	(assumed)
Zion 1	(assumed)
Zion 2	(assumed)
Indian Point 2	(assumed)
Turkey Point 3	(assumed)
Turkey Point 4	(assumed)
Indian Point 3	(assumed)
Surry 1	(assumed)
Surry 2	(assumed)
Haddam Neck	(assumed)
Cook 1	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Babcock & Wilcox	15x15	St.Stl.	(assumed)
Exxon / ANF	15x15	WE	(assumed)
Westinghouse	15x15	Std/ZC	(assumed)
Westinghouse	15x15	OFA	(assumed)
Westinghouse	15x15	Std/SC	(assumed)

Comment:

Reference: SA-06, G03; page B-6 of WTSD-TME-148.
Other Secondary Source Assemblies with 156 inch length are listed, but the total weights seem to be greater than the sum of the weights of the parts.

Physical Description Report

Page: 1

Westinghouse Primary, Version 1 Neutron Source

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length: 156.0 inches
Total Weight: 39 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.385 inches
Diametral Gap:

Poison Material: Borosil.Glass

Spider/Plunger Material: St.Steel 304

Primary Source:

Material: Californium
Length:
Strength: 2-12E+08 curies

Secondary Source:

Material: Antimony-Be
Length: 88.0 inches

Spacers:

Material: Alum. Oxide
Length:

Number of Orifice Rods: 8
Number of Burnable Poison Rods: 12
Number of Source Rods,
primary and secondary: 4
Number of Primary Source Rods only: 1
Number of Secondary Source Rods only: 3
Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Primary, Version 1 Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	2.400	Top
Inconel-718	0.640	Top
St. Steel 304	0.580	Gas Plenum
St. Steel 304		In Core
Borosil. Glass		In Core
Alum. Oxide		In Core
Californium		In Core
Antimony-Be		In Core

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)

Physical Description Report

Page: 3

Westinghouse Primary, Version 1 Neutron Source

Used at the Following Reactors: (continued)

Reactor	Number in Core
Cook 2	(assumed)
Seabrook 1	(assumed)
Seabrook 2	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

Reference: SA-02, G01; page B-5 of WTSD-TME-148.

Physical Description Report

Page: 1

Westinghouse Primary, Version 2 Neutron Source

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length: 156.0 inches
Total Weight: 34.2 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.385 inches
Diametral Gap:

Poison Material: Borosil. Glass

Spider/Plunger Material: St. Steel 304

Primary Source:

Material: Californium
Length: 1.7 inches
Strength: 2-12E+08 curies

Secondary Source:

Material: N/A
Length:

Spacers:

Material: Alum. Oxide
Length: 145 inches

Number of Orifice Rods: 11

Number of Burnable Poison Rods: 12

Number of Source Rods,
primary and secondary: 1

Number of Primary Source Rods only: 1

Number of Secondary Source Rods only: 0

Life Expectancy:

Westinghouse Primary, Version 2 Neutron Source

Design Variations:

Westinghouse makes versions of this part with 12-23 Burnable Poison Rods. The weight of a version can be expressed as $15.80 + (1.54 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations are available for 12 and 23 Rod versions.

Physical Description Report

Page: 3

Westinghouse Primary, Version 2 Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	2.300	Top
Inconel-718	0.420	Top
St.Steel 304	1.400	Gas Plenum
St.Steel 304	4.500	In Core
Borosil.Glass	3.800	In Core
Alum. Oxide		In Core
Californium		In Core

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)

Physical Description Report

Page: 4

Westinghouse Primary, Version 2 Neutron Source

Used at the Following Reactors: (continued)

Reactor	Number in Core	
Seabrook 1		(assumed)
Seabrook 2		(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

Reference: SA-19, G04; page B-10 of WTSD-TME-148.

Physical Description Report

Page: 1

Westinghouse Primary, Version 3 Neutron Source

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length: 156 inches
Total Weight: 51 pounds

Cladding:

Material: St.Steel 304
Outer Diameter: 0.385 inches
Diametral Gap:

Poison Material: Borosil.Glass

Spider/Plunger Material: St.Steel 304

Primary Source:

Material: Californium
Length: 1.7 inches
Strength: 2-12E+08 curies

Secondary Source:

Material: N/A
Length:

Spacers:

Material: Alum. Oxide
Length: 145 inches

Number of Orifice Rods: 0

Number of Burnable Poison Rods: 23

Number of Source Rods,
primary and secondary: 1

Number of Primary Source Rods only: 1

Number of Secondary Source Rods only: 0

Life Expectancy:

Westinghouse Primary, Version 3 Neutron Source

Design Variations:

Westinghouse makes versions of this part with 12-23 Burnable Poison Rods. The weight of a version can be expressed as $15.80 + (1.54 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations are available for 12 and 23 Rod versions.

Physical Description Report

Page: 3

Westinghouse Primary, Version 3 Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St.Steel 304	2.300	Top
Inconel-718	0.420	Top
St.Steel 304	12.000	In Core
Borosil.Glass	7.300	In Core
Alum. Oxide		In Core
Californium		In Core

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)
Seabrook 1	(assumed)

Physical Description Report

Page: 4

Westinghouse Primary, Version 3 Neutron Source

Used at the Following Reactors: (continued)

Reactor	Number in Core
Seabrook 2	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

Reference: SA-19, G02; page B-10 of WTSD-TME-148.

Physical Description Report

Page: 1

Westinghouse Secondary; on Spider Neutron Source

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length: 157 inches
Total Weight: 24.2 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.385 inches
Diametral Gap:

Poison Material: N/A

Spider/Plunger Material: St. Steel 304

Primary Source:

Material: N/A
Length:
Strength:

Secondary Source:

Material: Antimony-Be
Length: 88.0 inches

Spacers:

Material: N/A
Length:

Number of Orifice Rods: 20

Number of Burnable Poison Rods: 0

Number of Source Rods,
primary and secondary: 4

Number of Primary Source Rods only: 0

Number of Secondary Source Rods only: 4

Life Expectancy:

Physical Description Report

Page: 2

Westinghouse Secondary; on Spider Neutron Source

Material	Total Weight (kg)	Zone
St. Steel 304	2.600	Top
Inconel-718	0.200	Top
St. Steel 304	4.400	Gas Plenum
St. Steel 304	2.000	In Core
Antimony-Be	1.600	In Core

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)
Seabrook 1	(assumed)
Seabrook 2	(assumed)

Physical Description Report

Page: 3

Westinghouse Secondary; on Spider Neutron Source

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

On this Secondary Source Assembly, the Source Rods and Thimble Plugs are mounted on a spider rather than a Holddown Assembly. Reference: SA-05, G01; page B-6 of WTSD-TME-148.

Physical Description Report

Page: 1

Westinghouse Secondary, 12 BP Rods Neutron Source

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length: 156.0 inches
Total Weight: 39.4 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.385 inches
Diametral Gap:

Poison Material: Borosil. Glass

Spider/Plunger Material: St. Steel 304

Primary Source:

Material: N/A
Length:
Strength:

Secondary Source:

Material: Antimony-Be
Length: 88.0 inches

Spacers:

Material: N/A
Length:

Number of Orifice Rods: 8

Number of Burnable Poison Rods: 12

Number of Source Rods,
primary and secondary: 4

Number of Primary Source Rods only: 0

Number of Secondary Source Rods only: 4

Life Expectancy:

Westinghouse Secondary, 12 BP Rods Neutron Source

Design Variations:

Westinghouse makes versions of this part with 8-20 Burnable Poison rods. The weight of a version can be expressed as $20.7 + (1.5 * \text{Number of Burnable Poison Rods})$. Radiological characterizations are available for 12 and 26 Rod versions.

Physical Description Report

Page: 3

Westinghouse Secondary, 12 BP Rods Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	2.300	Top
Inconel-718	0.420	Top
St. Steel 304	1.000	Gas Plenum
St. Steel 304	7.800	In Core
Borosil. Glass	3.800	In Core
Antimony-Be	1.900	In Core

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)
Seabrook 1	(assumed)

Physical Description Report

Page: 4

Westinghouse Secondary, 12 BP Rods Neutron Source

Used at the Following Reactors: (continued)

Reactor	Number in Core
Seabrook 2	(assumed)

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

Reference: SA-01, G21; page B-4 of WTSD-TME-148.

Physical Description Report

Page: 1

Westinghouse Secondary, 20 BP Rods Neutron Source

Designed for:

Fuel Assembly with array size: 17x17
Pressurized Water Reactor

Dimensions:

Total Length: 156.0 inches
Total Weight: 50.6 pounds

Cladding:

Material: St. Steel 304
Outer Diameter: 0.385 inches
Diametral Gap:

Poison Material: Borosil. Glass

Spider/Plunger Material: St. Steel 304

Primary Source:

Material: N/A
Length:
Strength:

Secondary Source:

Material: Antimony-Be
Length: 88.0 inches

Spacers:

Material: N/A
Length:

Number of Orifice Rods: 0
Number of Burnable Poison Rods: 20
Number of Source Rods,
primary and secondary: 4
Number of Primary Source Rods only: 0
Number of Secondary Source Rods only: 4
Life Expectancy:

Westinghouse Secondary, 20 BP Rods Neutron Source

Design Variations:

Westinghouse makes versions of this part with 8-20 Burnable Poison Rods. The weight of a version can be expressed as $20.7 + (1.5 * \text{Number of Burnable Poison Rods})$. Radiological Characterizations are available for 12 and 20 Rod versions.

Physical Description Report

Page: 3

Westinghouse Secondary, 20 BP Rods Neutron Source

Composition:

Material	Total Weight (kg)	Zone
St. Steel 304	2.300	Top
Inconel-718	0.420	Top
St. Steel 304	11.900	In Core
Borosil. Glass	6.400	In Core
Antimony-Be	1.900	In Core

Used at the Following Reactors:

Reactor	Number in Core
Farley 1	(assumed)
Farley 2	(assumed)
Harris	(assumed)
Braidwood 1	(assumed)
Braidwood 2	(assumed)
Byron 1	(assumed)
Byron 2	(assumed)
Catawba 1	(assumed)
Catawba 2	(assumed)
McGuire 1	(assumed)
McGuire 2	(assumed)
Beaver Valley 1	(assumed)
Beaver Valley 2	(assumed)
Vogtle 1	(assumed)
Vogtle 2	(assumed)
Wolf Creek	(assumed)
Millstone 3	(assumed)
Diablo Canyon 1	(assumed)
Diablo Canyon 2	(assumed)
Trojan	(assumed)
Salem 1	(assumed)
Salem 2	(assumed)
Summer	(assumed)
Sequoyah 1	(assumed)
Watts Bar 1	(assumed)
Watts Bar 2	(assumed)
Comanche Peak 1	(assumed)
Comanche Peak 2	(assumed)
Callaway	(assumed)
North Anna 1	(assumed)
North Anna 2	(assumed)
Cook 2	(assumed)
Seabrook 1	(assumed)
Seabrook 2	(assumed)

Physical Description Report

Page: 4

Westinghouse Secondary, 20 BP Rods Neutron Source

Used with Following Fuel Assembly Types:

Vendor	Array	Version	
Exxon / ANF	17x17	WE	(assumed)
Westinghouse	17x17	Std	(assumed)
Westinghouse	17x17	OFA	(assumed)

Comment:

Reference: SA-01, G25; page B-4 of WTSD-TME-148.

APPENDIX 2F

USER'S GUIDE TO THE LWR NONFUEL ASSEMBLY

HARDWARE DATA BASE

CONTENTS

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1.0 Introduction

The User's Guide is for the LWR NFA Hardware Data Base system, a part of the Characteristics Data Base being developed under the Waste Systems Data Development Program sponsored by the DOE Office of Civilian Radioactive Waste Management. The LWR NFA Hardware Data Base provides access, at the personal computer level, to the following information about non-fuel assembly (NFA) hardware used in light-water reactors: physical descriptions of NFA hardware, identification of particular assembly types and reactors that utilize the hardware, and radiological descriptions of NFA hardware.

The LWR NFA Hardware Data Base is a user-oriented, menu-driven system. Each menu is instructive about its use. Section 5 of this guide provides a sample session with the data base to assist the user.

2.0 Data and Data Sources

Physical description data were obtained directly from the following non-fuel assembly hardware manufacturers: Babcock and Wilcox, Combustion Engineering, and Westinghouse. Information on other NFA hardware was obtained from reports in the open literature. Efforts to obtain additional information on these fuel assemblies is ongoing.

Radiological data were obtained from the computer code ORIGEN2 by using a methodology similar to that described in Section 2.7.3, Methodology for Radiological Characterization, of the Characteristics of Potential Repository Wastes report. The data are provided for use of the hardware in two types of reactors: pressurized-water and boiling-water reactors. Data for each type of hardware are provided at several representative lengths of exposure. Lengths of exposure are based on number of cycles in the reactor; an average cycle corresponds to a burnup of about 11,000 megawatt days per metric ton of initial heavy metal. Twenty-four decay time frames are provided, which range from discharge to one million years after discharge. The data were calculated for each different material of construction in up to four neutron exposure zones. Data for low-level waste classification are presented. Data are available in four different units: curies, watts, grams, and photon spectra.

3.0 Requirements

The LWR NFA Hardware Data Base is designed for use on IBM personal computers or compatibles. It was developed by using dBASE III Plus, a product of Ashton-Tate. Clipper and Plink86, products of Nantucket Corporation, were used to translate the data base system into an executable file. As a result of this translation, dBASE III Plus is not required to use the data base system. Only some version of personal computer DOS is necessary to run the data base.

The LWR NFA Hardware Data Base requires approximately 3 megabytes of storage and thus is designed to run on Bernoulli Box drives (trademark of iOmega Corporation) or fixed drives. If a math coprocessor chip is installed, the LWR NFA Hardware Data Base will utilize it for faster calculations.

4.0 Reporting Capabilities

Two types of reports are provided by the LWR NFA Hardware Data Base. Both reports are available on the screen and optionally on the printer. Additionally, either report may be directed to a text file for later use.

The Physical Description reports provide detailed information about the physical characteristics of a particular variety of NFA hardware, including dimensions, vendor, limited quantitative data, and materials of construction. Where available, the reactors and assembly types which use the hardware are identified. Radiological Description reports are provided for each piece of NFA hardware by isotope in units of curies, watts, and grams (only the long-lived, radioactive isotopes and isotopic totals are reported). The photon spectra (number of photons versus energy), also provided, are reported by energy.

5.0 Operating Instructions

Installation: Instructions for installation of the data base are included with the LWR NFA Hardware Data Base. If you receive the data base on Bernoulli cartridge, the drive the data base runs from will be C: D:, or E:, dependent on your computer's configuration. If you install (copy) the data base onto a fixed drive, the designated drive will be C:. If you receive the demonstration diskette, the data base will run from A: or B:, and no subdirectory will be used. In the example startup below, the data base is in drive D: and the subdirectory is NFA. If your configuration varies from this chosen example, substitute the correct drive and directory.

System Startup: To use the data base, first start up your computer as usual. The LWR NFA Hardware Data Base must be run from the drive and subdirectory that it is residing on. In other words, if the data base was installed on (copied to) a Bernoulli cartridge and that cartridge is inserted in drive D: of your Bernoulli drive, the current drive and subdirectory must be "D: NFA" to operate the tory when shipped. If you elect to change the subdirectory name, you must now use that new name in place of NFA.)

To ensure that this is the current subdirectory, you must first issue the following commands, pressing the enter key after each command:

```
D:
cd NFA                (do not issue this for the
                        demonstration diskette)
```

You should receive the response:

```
D: NFA>                (for the demonstration diskette
                        this will be A:> or B:>)
```

If you do not receive this response, type in:

```
prompt $p$g
```

and press the enter key. If you still do not receive this response, verify the drive designation and subdirectory. (For the demonstration diskette, the command "cd NFA" is not necessary.) If you still have problems, review the installation procedure.

To initiate the use of the data base, type:

```
NFA    and press the enter key.
```

The remaining pages detail a sample session with the LWR NFA Hardware Data Base.

Sample Session: To initiate use of the data base, type:

NFA and press the enter key

The remaining pages detail a sample session with the LWR NFA Hardware Data Base.

Request for the LWR NFA Hardware Data Base is in progress

This message will appear on the screen while the LWR NFA Hardware Data Base is being loaded into memory. It will take a few seconds to complete this operation.

You are logged into the
LWR NFA HARDWARE DATA BASE SYSTEM
sponsored by
the United States Department of Energy
Office of Civilian Radioactive Waste Management

Press any key to continue . . .

When this introductory screen appears on your terminal, the LWR NFA Hardware Data Base is loaded and running. To begin using the data base, press any key.

Select Physical/Radiological Reports
on NFA Hardware by

1. Type and vendor of Non-fuel Assembly Hardware
2. Associated Light-water Reactor
3. Associated Fuel Assembly Model

- X. Exit the NFA Hardware Data Base

NFA01

Select 1-3, or X 1

Description:

NFA hardware can be reported three different ways: category and manufacturer of NFA hardware, use at a specific reactor, or use with a specific fuel assembly type.

Instructions:

Select 1 to choose a NFA hardware report(s) by category and vendor of hardware. Select 2 to choose report(s) by reactor or select 3 to choose by type of assembly. To end session with the LWR NFA Hardware Data Base, select X at this screen. Press the enter key after making your selection.

In this example, option 1 is chosen to select a NFA hardware report by hardware category.

Select the type of NFA hardware for the report

1. Control Elements
2. Neutron Poisons
3. Neutron Sources
4. Instrumentation
5. BWR Channels
6. Guide Tube Plugs

R. Return to previous menu

X. Exit the NFA Hardware Data Base

NFA02

Select 1-6, R, or X 1

Description:

NFA hardware falls into the above six categories.

Instructions:

Select the category of NFA hardware by number. Select R to return to the initial screen (NFA01) or X to exit the data base. Press the enter key.

In this example, 1 is selected for Control Elements.

Select Control Element Vendor
<ul style="list-style-type: none">1. Babcock and Wilcox2. Combustion Engineering3. General Electric4. Westinghouse <ul style="list-style-type: none">R. Return to previous menuX. Exit the NFA Hardware Data Base
NFA03
Select 1-4, R, or X <u>2</u>

Description:

This screen lists the four vendors that manufacture control elements. The list on this screen will vary according to which hardware category was selected on screen NFA02.

Instructions:

Select the vendor by number. Select R to return to previous screen or X to exit the data base. Press the enter key after making a selection.

In this example, 2 is chosen to select Combustion Engineering Control Elements.

Select from this list of Combustion Engineering Control Elements
for the Physical/Radiological Description Reports

1. 16 x 16 SYS80 4 Rod Part Len
2. 16 x 16 SYS80 12 Rod Full Len
3. 16 x 16 San Onofre Part Len
4. 16 x 16 San Onofre Full Len
5. 16 x 16 ANO2 Part Length
6. 16 x 16 ANO2 Full Length
7. 16 x 16 St. Lucie 2 Part Len
8. 16 x 16 St. Lucie 2 Full Len
9. 14 x 14 Part Length, Ver. 1
10. 14 x 14 Part Length, Ver. 2
11. 14 x 14 Part Length, Ver. 3
12. 14 x 14 Full Length
13. 14 x 14 Ft. Calhoun, Part Len
14. 14 x 14 Ft. Calhoun, Full Len
15. 15 x 15 Palisades Crucifrom

- A. Individual reports on ALL of the above hardware
R. Return to previous menu
X. Exit the NFA Hardware Data Base

NFA04

Select 1-15, A, R, or X 2

Description:

This screen lists control elements manufactured by Combustion Engineering and the type of fuel assembly for which the hardware was designed. This screen will vary dependent on the hardware category and vendor selected on menus NFA02 and NFA03.

Instructions:

Select a specific hardware item by number. For individual reports on all hardware listed here, select A. Select R to return to NFA03, "Select Vendor" screen, or X to exit the data base system and return to DOS. Press the enter key after making your selection.

In this example, 2 is entered to select a report(s) on a Full Length, 12 Rod Control Element used in a Combustion Engineering 16 x 16 System 80 fuel assembly.

Select Type of Report
Report Selection Criteria: Combustion Engineering 16 x 16 SYS80 12 Rod Full Len Control Element
1. Physical Description Report
2. Radiological Description Report
3. Both Physical and Radiological Description
R. Return to MAIN menu (NFA01)
X. Exit the NFA Hardware Data Base
NFA05
Select 1-3, R, or X <u>3</u>

Description:

At this point the hardware item to report on has been selected. Two types of reports are available. If ALL was selected on the previous screen, the selection of type of report will be for all that hardware; selection will not be made on an individual basis.

Instructions:

Select 1 to receive a Physical Description Report, 2 to receive a Radiological Description Report, or 3 to receive both reports. From this screen, select R to return to the first or main menu (NFA01), not the previous menu. Select X to exit the data base. Press enter key after making selection.

In this example, 3 is entered to select both a Physical Description Report and a Radiological Description Report for a Full Length, 12 Rod Control Element used in a Combustion Engineering 16 x 16 System 80 fuel assembly.

Select Type of Output for

Physical Description Report:

Screen, Printer, or File [S/P/F]? S

NFA06

Description:

All reports can be generated on the screen, sent to the printer, or sent to a text file for later use. Here the type of output for Physical Description Reports is chosen. Type of output for Radiological Description Reports will be chosen separately. (Both must be chosen because option 3 was selected on the previous screen for both kinds of reports.)

Instructions:

Select S for screen output. The report will pause until any key is pressed when the screen is full. Select P for output to printer. The printer should be online and have at least 80 columns. Select F for a text file. You will be prompted for the name of the file to be written.

In this example, S is chosen for a Physical Description Report on the screen. Because both physical and radiological reports were selected, the decay time frame and type of output must be chosen for the radiological report before the physical report is printed.

Select Time Frame for
Radiological Description Report

1.	0	9.	50	17.	2,000
2.	1	10.	100	18.	5,000
3.	2	11.	200	19.	10,000
4.	5	12.	300	20.	20,000
5.	10	13.	350	21.	50,000
6.	15	14.	500	22.	100,000
7.	20	15.	1,000	23.	500,000
8.	30	16.	1,050	24.	1,000,000

X. Exit the NFA Hardware Data Base

(all numbers are in years)

NFA07

Select 1-24, or X 4

Description:

This screen instructs you to select the length of time after discharge to use for the Radiological Description Report. All times are in years after discharge from the reactor.

Instructions:

Select 1 for at discharge, and so on, up to 24 for one million years after discharge. Select X to exit the data base (no reports will be printed). Press the enter key after making your selection.

In this example, 4 is chosen to select 5 years after discharge.

Select Type of Output for
Radiological Description Report:
Screen, Printer, or File [S/P/F]? P

NFA06

Description:

The options for the Radiological Description Report are the same as those offered for the Physical Description Report. However, different types of output may be chosen for the different reports.

Instructions:

Select S for screen, P for printer, and F for file. Press the enter key after making your selection.

In this example, P is chosen for a printed Radiological Description Report.

Physical Description Report

Page 1

Combustion Engineering SYS80 12 Rod Full Len Control Element

Designed for:

Fuel Assembly with array size: 16 x 16
Pressurized Water Reactor

Dimensions:

Total Length: 253 inches
Total Weight: 192.2 pounds

Cladding:

Material: Inconel 625
Outer Diameter: 0.816 inches
Wall Thickness: 0.035 inches
Diametral Gap: 0.009 inches

Press any key to continue viewing Physical Description Report . . .

Physical Description Report

Page 1 (continued)

Combustion Engineering SYS80 12 Rod Full Len Control Element

Poison:

Primary Material:	Boron Carbide (CE)
Poison Length:	148 inches
Pellet Diameter:	0.737 inches

Plenum Spring Material:	St. Steel 302
-------------------------	---------------

Spider Material:	St. Steel 304
------------------	---------------

Number of Control Rods:	12
-------------------------	----

Life Expectancy:	4000 EFPD
------------------	-----------

Press any key to continue viewing Physical Description Report . . .

Physical Description Report

Page 2

Combustion Engineering SYS80 12 Rod Full Len Control Element

Composition:

Material	Total Weight(kg)	Neutron Zone
St.Steel 304	8.17	Top
Inconel 625	53.62	Top
Boron Carbide (CE)	20.90	Top
St.Steel 304	0.68	Gas Plenum
Inconel 625	2.20	Gas Plenum
Boron Carbide (CE)	1.60	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Palo Verde 1	48
Palo Verde 2	48
Palo Verde 3	48

Press any key to continue viewing Physical Description Report . . .

Physical Description Report

Page 2 (continued)

Combustion Engineering SYS80 12 Rod Full Len Control Element

Used with the Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	16 x 16	System 80

Report complete. Press any key to continue . . .

Radiological Description Report

Page 1

Combustion Engineering SYS80 12 Rod Full Len Control Element

ISOTOPIC COMPOSITION

Used for 7 cycles (77,000 MWd/MTIHM)

5 years after discharge

Weight: 87.170 kg

Volume of metal: 0.018100 Cu. Meters

Isotope	Grams	Watts	Curies	Curies/m3	Class C	Class C
					Limit	Ratio
C-14	5.348E-04	6.994E-07	2.384E-05	5.311E-03	80	0.6
Ni-59	2.474E-01	7.447E-07	1.876E-02	4.179E+02	220	1.9
Ni-63	3.583E-02	2.227E-04	2.211E+02	4.926E+04	7000	7.0
Co-60	9.512E-03	1.659E-03	1.068E+01	2.397E+03	N/A	N/A
Nb-94	9.760E-03	1.865E-05	1.831E+00	4.097E+02	0.2	220
Total	5.490E+00	1.535E+00	8.349E+03	2.465E+06	N/A	N/A

Used for 10 cycles (111,000 MWd/MTIHM)

5 years after discharge

Weight: 87.170 kg

Volume of metal: 0.018100 Cu. Meters

Isotope	Grams	Watts	Curies	Curies/m3	Class C	Class C
					Limit	Ratio
C-14	5.348E-04	6.994E-07	2.384E-05	5.311E-03	80	0.6
Ni-59	2.474E-01	7.447E-07	1.876E-02	4.179E+02	220	1.9
Ni-63	3.583E-02	2.227E-04	2.211E+02	4.926E+04	7000	7.0
Co-60	9.512E-03	1.659E-03	1.068E+01	2.397E+03	N/A	N/A
Nb-94	9.760E-03	1.865E-05	1.831E+00	4.097E+02	0.2	220
Total	5.490E+00	1.535E+00	8.349E+03	2.465E+06	N/A	N/A

NOTE: The data presented here is only for the purpose of illustrating the form of the Radiological Description Report. It is not intended to be used for any purpose other than that illustration.

PHOTON SPECTRA

<u>Mean Energy (MeV)</u>	<u>Photons/second (77,000 MWd/MTIHM)</u>	<u>Photons/second (110,000 MWd/MTIHM)</u>
0.0100	2.162E+10	3.569E+10
0.0250	3.674E+09	6.063E+09
0.0375	2.088E+09	3.444E+09
0.0575	2.397E+09	3.874E+09
0.0850	9.237E+08	1.524E+09
0.1250	3.548E+08	7.851E+08
0.2250	1.167E+08	1.925E+08
0.3750	3.272E+07	5.396E+07
0.5750	1.879E+06	3.099E+06
0.8500	6.411E+08	9.650E+08
1.2500	7.960E+11	1.313E+12
1.7500	2.253E+01	2.768E+01
2.2500	4.219E+06	6.956E+06
2.7500	1.306E+04	2.152E+04

METALLIC COMPOSITION

(Materials modeled to obtain this report)

<u>Material</u>	<u>Total Weight (kg)</u>	<u>Zone</u>
St. Steel 304	8.17	Top
Inconel 625	53.62	Top
Boron Carbide (CE)	20.90	Top
St. Steel 304	0.68	Gas Plenum
Inconel 625	2.20	Gas Plenum
Boron Carbide (CE)	1.60	Gas Plenum

NOTE: The data presented here is only for the purpose of illustrating the form of the Radiological Description Report. It is not intended to be used for any purpose other than that illustration.

Select Type of Report

Report Selection Criteria:

Combustion Engineering 16 x 16

SYS80 12 Rod Full Length Control Element

1. Physical Description Report
 2. Radiological Description Report
 3. Both Physical and Radiological Description
- R. Return to MAIN menu (NFA01)
- X. Exit the NFA Hardware Data Base

NFA05

Select 1-3, R, or X R

Description:

Reports have been run for these criteria. You may select more reports (with same or different output types) or begin again at the first screen, NFA01, by selecting the return option.

Instructions:

Select 1 to receive a Physical Description Report, 2 to receive a Radiological Description Report, or 3 to receive both reports. Select R to return to the first menu. Press the enter key after making your selection.

In this example, R is selected.

Select Physical/Radiological Reports
on NFA Hardware by

1. Type and vendor of Non-fuel Assembly Hardware
2. Associated Light-water Reactor
3. Associated Fuel Assembly Model

- X. Exit the NFA Hardware Data Base

NFA01

Select 1-3, or X 2

Description:

NFA hardware can be reported three different ways: category and manufacturer of NFA hardware, use at a specific reactor, or use with a specific fuel assembly type.

Instructions:

Select 1 to choose a NFA hardware report(s) by category and vendor of hardware. Select 2 to choose report(s) by reactor or select 3 to choose by type of assembly. To end session with the LWR NFA Hardware Data Base, select X at this screen. Press the enter key after making your selection.

In this example, option 2 is chosen to select a NFA hardware report by associated reactor.

Type up to three letters beginning with the name
of the reactor you wish to select P

Press <F10> for a list of reactor names
from which to choose.

Press <Enter> to return the main menu.

NFA08

Description:

This screen asks for the first one to three characters of a reactor's name. A list of reactor names matching those letters will then be generated. For a complete list of reactor names, press the F10 key on your keyboard. To return to the last menu, press the enter key only.

Instructions:

Enter up to 3 characters beginning with a reactor name(s) and press the enter key. Press the F10 key to look at all the names. In this example, P is entered.

Choose a specific reactor from this list

1. Palisades
 2. Palo Verde 1
 3. Palo Verde 2
 4. Palo Verde 3
 5. Pathfinder
 6. Peach Bottom 2
 7. Peach Bottom 3
 8. Perry 1
 9. Perry 2
 10. Pilgrim
 11. Point Beach 1
 12. Point Beach 2
 13. Prairie Island 1
 14. Prairie Island 2
- R. Return to previous menu
X. Exit the NFA Hardware Data Base

Select 1-14, R, or X 2

Description:

This screen lists the reactors matching the selected criteria. Choose, by number, one reactor from the list to see what NFA hardware is used at that reactor.

Instructions:

Select a number or R to return; choose X to exit.

In this example, 2 is selected for Palo Verde 1.

Select NFA Hardware Element Used at Palo Verde 1

<u>Assembly Type</u>	<u>Hardware Category/Variety</u>
1. CE 16 x 16 SYS80	Control Element/SYS80 4 Rod Part Len
2. CE 16 x 16 SYS80	Control Element/SYS80 12 Rod Full Len
3. CE 16 x 16 SYS80	Instrumentation/SYS80
4. CE 16 x 16 Onofre	Neutron Sources/Standard

- A. All of the above hardware
- R. Return to previous menu
- X. Exit the NFA Hardware Data Base

NFA12

Select number, A, R, or X 2

Description:

All NFA hardware known or assumed to be used at Palo Verde 1 is listed on this screen.

Instructions:

Select any one hardware element by number to the left. Select individual reports on all hardware listed with an A. Select R to return to the last menu or X to exit the data base.

In this example, 2 is selected for a Full Length, 12 Rod Control Element designed for a Combustion Engineering 16 x 16 System 80 assembly.

Select Type of Report
<p>Report Selection Criteria:</p> <p>Combustion Engineering 16 x 16</p> <p>SYS80 12 Rod Full Len Control Element</p> <ol style="list-style-type: none">1. Physical Description Report2. Radiological Description Report3. Both Physical and Radiological Description <p>R. Return to MAIN menu (NFA01)</p> <p>X. Exit the NFA Hardware Data Base</p> <p style="text-align: right;">NFA05</p> <p>Select 1-3, R, or X <u>1</u></p>

Description:

At this point the hardware item to report on has been selected. Two types of reports are available. If ALL was selected on the previous screen, the selection of type of report will be for all that hardware.

Instructions:

Select 1 for Physical Description Report, 2 for Radiological Description Report, or 3 for both reports. Select R to return to the first menu or X to exit the data base.

In this example, 1 is selected.

Select Type of Output for

Physical Description Report:

Screen, Printer, or File [S/P/F]? P

NFA06

Description:

All reports can be generated on the screen, sent to the printer, or sent to a text file for later use. Here the type of output for Physical Description Reports is chosen.

Instructions:

Select S for screenoutput. The report will pause until any key is pressed when the screen is full. Select P for output to printer. The printer should be online and have at least 80 columns. Select F for a text file. You will be prompted for the name of the file to be written.

In this example, P is chosen for a printed Physical Description Report.

Physical Description Report

Page 1

Combustion Engineering SYS80 12 Rod Full Len Control Element

Designed for:

Fuel Assembly with array size: 16 x 16
Pressurized Water Reactor

Dimensions:

Total Length: 253 inches
Total Weight: 192.2 pounds

Cladding:

Material: Inconel 625
Outer Diameter: 0.816 inches
Wall Thickness: 0.035 inches
Diametral Gap: 0.009 inches

Poison:

Primary Material: Boron Carbide (CE)
Poison Length: 148 inches
Pellet Diameter: 0.737 inches

Plenum Spring Material: St. Steel 302

Spider Material: St. Steel 304

Number of Control Rods: 12

Life Expectancy: 4000 Effective Full Power Days

Physical Description Report

Page 2

Combustion Engineering SYS80 12 Rod Full Len Control Element

Composition:		
Material	Total Weight(kg)	Neutron Zone
St. Steel 304	8.17	Top
Inconel 625	53.62	Top
Boron Carbide (CE)	20.90	Top
St. Steel 304	0.68	Gas Plenum
Inconel 625	2.20	Gas Plenum
Boron Carbide (CE)	1.60	Gas Plenum

Used at the Following Reactors:

Reactor	Number in Core
Palo Verde 1	48
Palo Verde 2	48
Palo Verde 3	48

Used with the Following Fuel Assembly Types:

Vendor	Array	Version
Combustion Engineering	16 x 16	System 80

Select Type of Report

Report Selection Criteria:

Combustion Engineering 16 x 16

SYS80 12 Rod Full Len Control Element

1. Physical Description Report
 2. Radiological Description Report
 3. Both Physical and Radiological Description
- R. Return to the MAIN menu (NFA01)
- X. Exit the NFA Hardware Data Base

NFA05

Select 1-3, R, or X R

Description:

At this point, a Physical Description Report has just been printed.

Instructions:

Select 1 to rerun the same report, 2 to run a Radiological Description Report, or 3 for both reports. Select X to exit the data base. Select R to return to the main menu, and select other NFA hardware for reports. Press the enter key after making a selection.

In this example, R is selected to return to main menu.

Select Physical/Radiological Reports
on NFA Hardware by

1. Type and vendor of Non-fuel Assembly Hardware
2. Associated Light-water Reactor
3. Associated Fuel Assembly Model

- X. Exit the NFA Hardware Data Base

NFA01

Select 1-3, or X 3

Description:

NFA hardware can reported three different ways: category and manufacturer of NFA hardware, use at a specific reactor, or use with a specific fuel assembly type.

Instructions:

Select 1 to choose a NFA hardware report(s) by category and vendor of hardware. Select 2 to choose report(s) by reactor or select 3 to choose by type of assembly. To end session with the LWR NFA Hardware Data Base, select X at this screen. Press the enter key after making your selection.

In this example, option 3 is chosen to select a NFA hardware report by associated fuel assembly model.

Select Fuel Assembly Vendor
1. Allis Chalmers
2. Babcock and Wilcox
3. Combustion Engineering
4. Exxon/ANF
5. General Electric
6. Westinghouse
R. Return to previous menu
X. Exit the NFA Hardware Data Base
NFA13
Select 1-6, R, or X <u>3</u>

Description:

This screen lists manufacturers of fuel assemblies used in light-water reactors. After selecting a manufacturer, you will select from a list of the models of fuel assemblies made by that manufacturer and then view the NFA hardware used with a specific fuel assembly model.

Instructions:

Select desired vendor by number. Select R to return to the previous screen or X to exit.

In this example, 3 is selected for Combustion Engineering.

Select Combustion Engineering Fuel Assembly

	<u>Array</u>	<u>Version</u>
1.	14 x 14	Standard
2.	14 x 14	Ft. Calhoun
3.	15 x 15	Palisades
4.	15 x 16	Yankee Rowe
5.	16 x 16	St. Lucie 2
6.	16 x 16	Arkansas Nucl. 2
7.	16 x 16	System 80
8.	16 x 16	San Onofre

R. Return to previous menu

X. Exit the NFA Hardware Data Base

NFA14

Select 1-8, R, or X 7

Description:

This screen lists the Combustion Engineering fuel assembly models for which information on NFA hardware usage is available.

Instructions:

Select an assembly type by number. Select R to return to vendor selection screen or X to exit to DOS. Press the enter key after making a selection.

In this example, 7 is selected for a Combustion Engineering 16 x 16 System 80 assembly.

NFA Hardware Used in Combustion Engineering
16 x 16 System 80 Assemblies

1. CE Control Elements/SYS80 4 Rod Full Len
2. CE Control Elements/SYS80 12 Rod Full Len
3. CE Instrumentation/System 80
4. CE Neutron Sources/Standard

- A. All of the above hardware
- R. Return to previous menu
- X. Exit the NFA Hardware Data Base

NFA14

Select 1-5, A, R, or X 1

Description:

This screen displays the NFA hardware known or assumed to be used with Combustion Engineering's 16 x 16 System 80 fuel assemblies.

Instructions:

Select a hardware element by number or A for individual reports on each hardware element. Select R to return to the previous screen or X to exit to DOS.

In this example, 1 is selected.

Select Type of Report

Report Selection Criteria:

Combustion Engineering 16 x 16

SYS80 12 Rod Full Len Control Element

1. Physical Description Report
 2. Radiological Description Report
 3. Both Physical and Radiological Description
- R. Return to the MAIN menu (NFA01)
- X. Exit the NFA Hardware Data Base

NFA05

Select 1-3, R, or X 2

Description:

At this point, the hardware item to report on has been selected. Two types of reports are available. If ALL was selected on the previous screen, the selection of type of report will be for all that hardware; selection will not be made on an individual basis.

Instructions:

Select 1 for a Physical Description Report, 2 for a Radiological Description Report, or 3 for both reports.

In this example, 2 is selected.

Select Time Frame for
Radiological Description Report

1. 0	9. 50	17. 2,000
2. 1	10. 100	18. 5,000
3. 2	11. 200	19. 10,000
4. 5	12. 300	20. 20,000
5. 10	13. 350	21. 50,000
6. 15	14. 500	22. 100,000
7. 20	15. 1,000	23. 500,000
8. 30	16. 1,050	24. 1,000,000

X. Exit the NFA Hardware Data Base
(all numbers are in years)

NFA07

Select 1-24, or X 16

Description:

This screen instructs you to select the length of time after discharge to use for the Radiological Description Report. All times are in years after discharge from the reactor.

Instructions:

Select 1 for at discharge, and so on, up to 24 for one million years after discharge. Select X to exit the data base (no reports will be printed). Press the enter key after making your selection.

In this example, 16 is chosen to select 1,050 years after discharge.

Select Type of Output for
Radiological Description Report:
Screen, Printer, or File [S/P/F]? F

NFA06

Description:

The options for the Radiological Description Report are the same as those offered for the Physical Description Report. However, different types of output may be chosen for the different reports.

Instructions:

Select S for screen, P for printer, or F for file. Press the enter key after making your selection.

In this example, F is chosen to send the Radiological Description Report to a text file.

Report Selection Criteria

Combustion Engineering 16 x 16

SYS80 12 Rod Full Len Control Element

Radiological Description Report

1,050 Years After Discharge

Select name of file to send report to: CE16SY80

(up to 8 characters file name)
(default extension is .txt)

NFA16

Description:

This screen asks for the name of a file to receive the requested report. That file will be created and will contain the text of the requested radiological report.

Instructions:

Select up to 8 characters for the file name, a period and up to 3 characters for the extension. If you do not select the extension, "txt" will be used. Press the enter key.

In this example, CE16SY80 is entered for the file name. The Radiological Description will be stored in a file, "CE16SY80.TXT."

Select Type of Report
<p>Report Selection Criteria:</p> <p>Combustion Engineering 16 x 16</p> <p>SYS80 12 Rod Full Len Control Element</p> <ol style="list-style-type: none">1. Physical Description Report2. Radiological Description Report3. Both Physical and Radiological Description <p>R. Return to the MAIN menu (NFA01)</p> <p>X. Exit the NFA Hardware Data Base</p> <p style="text-align: right;">NFA05</p> <p>Select 1-3, R, or X <u>X</u></p>

Description:

At this point, a Radiological Description Report has just been sent to the selected file.

Instructions:

Select 1 to run a Physical Description Report, 2 to rerun the Radiological Description Report, or 3 for both reports. Select X to exit the data base. Select R to return to the main menu, and select other NFA hardware for reports. Press the enter key after making a selection.

In this example, X is selected to conclude the sample session with the LWR NFA Hardware Data Base.