



71-9300

Big Rock Point Restoration Project
Major Component Removal

10269 US 31 North
Charlevoix, MI 49720-9436
Tel: (231) 547-8357
Fax: (231) 237-2585

Mr. E. William Brach

Director, Office of Nuclear Material Safety and Safeguards
11555 Rockville Pike
Rockville MD 20852-2738

Your Docket No. 71-9300
ref: TAC No. L23336

Our ref: BRP-2003-06-094
WBS: 1.3.08

July 1, 2003

**Subject: Big Rock Point Restoration Project - 5339 – Certificate of Compliance for
Radioactive Material Package Certificate Number 9300, Docket No. 71-9300, TAC No.
L23336**

Dear Mr. Brach:

By letter dated April 8, 2002, your Office transmitted to BNFL Inc. the subject Certificate. The Certificate was issued on the basis of the Big Rock Point Reactor Vessel Package Safety Analysis Report (BRP RVP SAR-5339). Since the time of issuance of the CoC, an improvement to the package design has been identified. The improvement relates to the package top plate attachment to the Reactor Vessel flange. In the original design, the package top plate is attached to the Reactor Vessel flange using 14 existing, rethreaded A-193 B7 RV head studs with new cap nuts. Improvements in machining techniques allow for an option of using new RV head studs machined from SA-540 Grade B23 Class 5 material in addition to, or instead of, the existing RV head studs credited in the original design.

The mechanical properties of the new SA-540 Grade B23 Class 5 stud material exceeds the properties of the existing A-193 B7 material for the specified stud diameter. One of the structural evaluation options documented in Appendix 2-1, Attachment F of BRP RVP SAR-5339 uses the material properties for SA-193 Grade B7 studs. It is conservative to substitute SA-540 Grade B23 Class 5 material for the studs since the strength of A-193 studs with special properties and the SA-540 Grade B23 Class 5 studs is higher than the SA-193 Grade B7 studs evaluated. BNFL intends to use a combination of the currently approved stud design along with a number of new studs machined out of SA-540 Grade B23 Class 5 material.

NMSSOI

July 1, 2003

Therefore, BNFL Inc. respectfully requests a review and approval of this design improvement, identified on the attached change pages for the BRP RVP SAR-5339 and requests that NRC issue a revision to CoC Number 9300 recognizing this design improvement and incorporating these change pages into Revision 2 of BRP RVP SAR-5339. BNFL Inc. has also re-reviewed BRP RVP SAR-5339 to assure that the material contained therein accurately reflects the actual and as-built package configuration. Updates to some of the attached pages reflect the results of this re-review. Seven copies of the changed pages including change page instructions and a list of effective pages are provided for your use.

For ease of review, it is recommended that the BRP RVP SAR-5339 update first be incorporated per the insertion/deletion instructions provided. As with our original submittal, a review of the material being submitted with this letter identified no proprietary information.

Should you have any questions or comments, please do not hesitate to contact me at 231-547-8228, or Mick Papp at 231-547-8384.

Sincerely,



Mr. P. T. Daly, MCR Project Manager
BNFL Inc.

cc:

Ms. N. L. Osgood, USNRC, NMSS/SFPO – Rockville

M. Papp, BNFL Inc. – BRP

J. Vorees, BNFL Inc. – Oak Ridge

Cc w/out attachments:

K. Haas, CEC Co – BRP

G. Withrow, CEC Co – BRP

J. Christian, BNFL Inc. – Crystal City

D. Brown, BNFL Inc. – Oak Ridge

C. Smith, BNFL Inc. – Denver

Attachments

BRP RVP SAR-5339 UPDATE INSTRUCTIONS
REVISION 2, JUNE 26, 2003

REMOVE PAGES

Cover Page, Rev. 1
TOC, Page i, Rev. 0
TOC, Page vii, Rev. 0
TOC, Page ix, Rev. 1
TOC, Page x, Rev. 1
Chapter 2, TOC, page i, Rev. 0
Chapter 2, TOC, page iii, Rev. 0
Page 2-2, Rev. 0
Page 2-3, Rev. 0
Page 2-36, Rev. 0
Page 2-37, Rev. 0
Page 2-38, Rev. 0
Page 2-41, Rev. 0
Page 2-42, Rev. 0

INSERT PAGES

Cover Page, Rev. 2
TOC, Page i, Rev. 2
TOC, Page vii, Rev. 2
TOC Page ix, Rev. 2
TOC, Page x, Rev. 2
Chapter 2, TOC, page i, Rev. 2
Chapter 2, TOC, page iii, Rev. 2
Page 2-2, Rev. 2
Page 2-3, Rev. 2
Page 2-36, Rev. 2
Page 2-37, Rev. 2
Page 2-38, Rev. 2
Page 2-41, Rev. 2
Page 2-42, Rev. 2



**Big Rock Point
Reactor Vessel Package
Safety Analysis Report**

Revision 2

June 26, 2003

Report Number BRP RVP SAR-5339

Docket Number: 71-9300

Prepared and Revised by:

Sargent & Lundy

For:

BNFL Inc.
10269 US 31 North
Charlevoix, MI 49720-9436



TABLE OF CONTENTS

	<u>PAGE</u>
1.0 GENERAL INFORMATION	1-1
1.1 INTRODUCTION / PURPOSE OF APPLICATION.....	1-1
1.1.1 Application Basis	1-1
1.2 PACKAGE DESCRIPTION.....	1-2
1.2.1 Package	1-2
1.2.2 Package Lifting Devices	1-3
1.2.3 Package Tie-down Devices	1-4
1.2.4 Operational Features	1-4
1.2.5 Package Contents	1-4
1.2.6 Determination of Package Category	1-6
1.3 REFERENCES.....	1-6
 2.0 STRUCTURAL EVALUATION	 2-1
2.1 STRUCTURAL DESIGN.....	2-1
2.1.1 Structural Description	2-1
2.1.2 Design and Acceptance Criteria.....	2-2
2.1.2.1 Normal Conditions of Transport	2-3
2.1.2.2 Hypothetical Accident Conditions	2-4
2.1.2.3 Buckling.....	2-5
2.1.2.4 Fracture Toughness.....	2-6
2.1 WEIGHTS AND CENTERS OF GRAVITY	2-6
2.3 MECHANICAL PROPERTIES OF MATERIALS.....	2-6
2.4 GENERAL STANDARDS FOR ALL PACKAGES.....	2-6
2.4.1 Minimum Package Size.....	2-7
2.4.2 Tamper-Proof Feature	2-7
2.4.3 Positive Closure	2-7
2.4.4 Chemical and Galvanic Reactions.....	2-7
2.4.5 Package Valves	2-8
2.4.6 Effectiveness of Package Containment.....	2-9
2.4.7 Accessible Surface Temperature.....	2-9
2.4.8 Venting.....	2-9
2.5 LIFTING AND TIEDOWN DEVICES	2-9
2.6 NORMAL CONDITIONS OF TRANSPORT.....	2-10
2.6.1 Heat	2-11



LIST OF FIGURES

<u>Figure</u>	<u>Title</u>	<u>Page No.</u>
1-1	General Arrangement of Remaining RV Internals	1-7
2-1	Package Configuration and Dimensions	2-36
2-2	Package FEA Model in Vertical Position	2-43
2-3	Package FEA Model in Horizontal Position With Tie-down System	2-44
2-4	Package FEA Side View With Tie-down System	2-45
2-5	Key Locations of Package Model for HAC Analyses	2-46
2-6	Vertical Drop Horizontal Deformation	2-47
2-7	Horizontal Drop Vertical Deformation	2-48
2-8	Corner Drop Vertical Deformation	2-49
2-9	Corner Drop High Stress Location	2-50
2-10	Slap Down Drop Vertical Deformation	2-51
2-11	Slap Down Drop Horizontal Deformation	2-52
2-12	Typical Puncture Drop Stress Distribution	2-53
2-13	HAC Fire Temperature Distribution 30 Minutes After Event Initiation	2-54
5-1	Source, Shielding, and Dose Point Locations	5-23
5-2	QAD Geometry Model	5-24
5-3	Streaming Path Model	5-25

LIST OF EFFECTIVE PAGES

TABLE OF CONTENTS

i.....	Rev. 2
ii.....	Rev. 0
iii.....	Rev. 0
iv.....	Rev. 0
v.....	Rev. 0
vi.....	Rev. 0
vii.....	Rev. 2
viii.....	Rev. 1
ix.....	Rev. 2
x.....	Rev. 2

CHAPTER 1

i.....	Rev. 0
1-1.....	Rev. 0
1-2.....	Rev. 0
1-3.....	Rev. 0
1-4.....	Rev. 0
1-5.....	Rev. 0
1-6.....	Rev. 0
1-7.....	Rev. 0

CHAPTER 2

i.....	Rev. 2
ii.....	Rev. 0
iii.....	Rev. 2
2-1.....	Rev. 0
2-2.....	Rev. 2
2-3.....	Rev. 2
2-4.....	Rev. 0
2-5.....	Rev. 0
2-6.....	Rev. 0
2-7.....	Rev. 0
2-8.....	Rev. 0
2-9.....	Rev. 0
2-10.....	Rev. 0
2-11.....	Rev. 0
2-12.....	Rev. 0
2-13.....	Rev. 0
2-14.....	Rev. 0

2-15.....	Rev. 0
2-16.....	Rev. 0
2-17.....	Rev. 0
2-18.....	Rev. 0
2-19.....	Rev. 0
2-20.....	Rev. 0
2-21.....	Rev. 0
2-22.....	Rev. 0
2-23.....	Rev. 0
2-24.....	Rev. 0
2-25.....	Rev. 0
2-26.....	Rev. 0
2-27.....	Rev. 0
2-28.....	Rev. 0
2-29.....	Rev. 0
2-30.....	Rev. 0
2-31.....	Rev. 0
2-32.....	Rev. 0
2-33.....	Rev. 0
2-34.....	Rev. 0
2-35.....	Rev. 0
2-36.....	Rev. 2
2-37.....	Rev. 2
2-38.....	Rev. 2
2-39.....	Rev. 0
2-40.....	Rev. 1
2-41.....	Rev. 2
2-42.....	Rev. 2
2-43.....	Rev. 0
2-44.....	Rev. 0
2-45.....	Rev. 0
2-46.....	Rev. 0
2-47.....	Rev. 0
2-48.....	Rev. 0
2-49.....	Rev. 0
2-50.....	Rev. 0
2-51.....	Rev. 0
2-52.....	Rev. 0
2-53.....	Rev. 0
2-54.....	Rev. 0



CHAPTER 3

i	Rev. 0
3-1	Rev. 0
3-2	Rev. 0
3-3	Rev. 0
3-4	Rev. 0
3-5	Rev. 0
3-6	Rev. 0
3-7	Rev. 0
3-8	Rev. 0
3-9	Rev. 0
3-10	Rev. 0
3-11	Rev. 0
3-12	Rev. 0
3-13	Rev. 0

CHAPTER 4

i	Rev. 0
4-1	Rev. 0
4-2	Rev. 0
4-3	Rev. 0
4-4	Rev. 1
4-5	Rev. 0
4-6	Rev. 0
4-7	Rev. 1

CHAPTER 5

i	Rev. 0
5-1	Rev. 0
5-2	Rev. 0
5-3	Rev. 1
5-4	Rev. 0
5-5	Rev. 0
5-6	Rev. 0
5-7	Rev. 0
5-8	Rev. 0
5-9	Rev. 0
5-10	Rev. 0
5-11	Rev. 0

5-12	Rev. 1
5-13	Rev. 0
5-14	Rev. 0
5-15	Rev. 0
5-16	Rev. 0
5-17	Rev. 0
5-18	Rev. 0
5-19	Rev. 0
5-20	Rev. 0
5-21	Rev. 0
5-22	Rev. 0
5-23	Rev. 0
5-24	Rev. 0
5-25	Rev. 0

CHAPTER 6

i	Rev. 0
6-1	Rev. 0

CHAPTER 7

i	Rev. 0
7-1	Rev. 0
7-2	Rev. 0
7-3	Rev. 0
7-4	Rev. 0
7-5	Rev. 0
7-6	Rev. 0
7-7	Rev. 0
7-8	Rev. 0
7-9	Rev. 0
7-10	Rev. 0

CHAPTER 8

i	Rev. 0
8-1	Rev. 0
8-2	Rev. 1
8-3	Rev. 0
8-4	Rev. 1
8-5	Rev. 1

John Vorees, BNFL Inc.
Licensing Manager

6/25/03
Date



TABLE OF CONTENTS

	<u>PAGE</u>
2.0 STRUCTURAL EVALUATION	2-1
2.1 STRUCTURAL DESIGN	2-1
2.1.1 Structural Description	2-1
2.1.2 Design and Acceptance Criteria	2-2
2.1.2.1 Normal Conditions of Transport	2-3
2.1.2.2 Hypothetical Accident Conditions	2-4
2.1.2.3 Buckling	2-5
2.1.2.4 Fracture Toughness	2-6
2.1 WEIGHTS AND CENTERS OF GRAVITY	2-6
2.3 MECHANICAL PROPERTIES OF MATERIALS	2-6
2.4 GENERAL STANDARDS FOR ALL PACKAGES	2-6
2.4.1 Minimum Package Size	2-7
2.4.2 Tamper-Proof Feature	2-7
2.4.3 Positive Closure	2-7
2.4.4 Chemical and Galvanic Reactions	2-7
2.4.5 Package Valves	2-8
2.4.6 Effectiveness of Package Containment	2-9
2.4.7 Accessible Surface Temperature	2-9
2.4.8 Venting	2-9
2.5 LIFTING AND TIEDOWN DEVICES	2-9
2.6 NORMAL CONDITIONS OF TRANSPORT	2-10
2.6.1 Heat	2-11
2.6.2 Cold	2-11
2.6.3 Increased External Pressure	2-11
2.6.4 Reduced External Pressure	2-12
2.6.5 Vibration	2-12
2.6.6 Water Spray	2-13
2.6.7 Free Drop	2-13
2.6.8 Corner Drop	2-14
2.6.9 Compression	2-14
2.6.10 Penetration	2-14
2.6.11 Test Pressure	2-15
2.6.12 Weld and Stud Evaluations	2-15
2.6.12.1 Package Welds	2-15
2.6.12.2 Internal Shield Plate and Ring Plate Welds	2-15
2.6.12.3 Donut Support Welds	2-15
2.6.12.4 RV Studs at Top Plate	2-16
2.6.13 Conclusion of NCT Evaluations	2-16



FIGURES	2-1	Package Configuration and Dimensions (7 Sheets)	2-36
	2-2	Package FEA Model in Vertical Position	2-43
	2-3	Package FEA Model in Horizontal Position with Tie-Down System	2-44
	2-4	Package FEA side view with Tie-Down System.....	2-45
	2-5	Key Locations of Package Model for HAC Analysis	2-46
	2-6	Vertical Drop Horizontal Deformation	2-47
	2-7	Horizontal Drop Vertical Deformation	2-48
	2-8	Corner Drop Vertical Deformation	2-49
	2-9	Corner Drop High Stress Location.....	2-50
	2-10	Slap Down Drop Vertical Deformation	2-51
	2-11	Slap Down Drop Horizontal Deformation	2-52
	2-12	Typical Puncture Drop Stress Distribution	2-53
	2-13	HAC Fire Temperature Distribution 30 Minutes after Event Initiation	2-54



positioned starting at a distance of approximately 8'-6" from the bottom of the package, and is secured by 1" fillet welds at both ends. Also, a 3" thick, 40" long reinforcing ring plate is attached to the interior surface of the package shell by ½" fillet welds at both ends. This ring plate is designed for use with the trunnion attachments which are part of the package lifting devices. The lifting devices will be removed from the package prior to shipment as stated in Section 2.5, but the ring plate will be included in the package configuration during transport. Therefore this plate is modeled in the computer structural analyses, but is not credited for shielding.

The package 4" thick bottom plate is shop welded to the shell with a full penetration weld. A donut shape support structure at the bottom of the package is designed to support the bottom of the RV when the package is in both horizontal and vertical positions.

The package top cover is a 4" thick circular plate. The RV flange is attached to the top plate² with fourteen studs, including a combination of A-193 re-threaded studs and new SA-540 Grade B23 Class 5 studs and new SA-105 or SA-266, Grade 2 cap nuts. These studs support the RV during loading, NCT, and HAC. After the RV has been loaded into the package, the top plate will be field welded to the package shell with a full penetration weld, as discussed in Section 7.1.2.

The remaining twenty-eight RV studs will be cut off as close as possible to the RV flange. However, there may be a potential for some of these studs to extend beyond the RV flange and cause an interference with the top plate. To facilitate this potential interference, twenty-eight dimples are specified on the top plate inner surface, along the stud circle as shown in Figure 2-1.

The penetration holes in the body of the package as well as the holes in the top plate used for injecting the LDCC as discussed in Sections 1.2.1 and 7.1.2 will be plugged and seal welded after use and prior to shipment. The RV attachment cap nuts will also be seal welded.

2.1.2 Design and Acceptance Criteria

The package is designed for the NCT of 10 CFR 71.71. The performance of the package is also evaluated under the HAC of 10 CFR 71.73. The load combinations used in the analyses are in compliance with the guidance set forth in Regulatory Guide 7.8 as shown in Table 2-1.

Compliance with the "General Standards for All Packages" specified in 10 CFR 71.43 and the "Lifting and Tie-down Standards" specified in 10 CFR 71.45 are discussed in Sections 2.4 and 2.5 respectively.

² A lifting lug will be bolted to the top plate for loading the RV into the package and positioning the package during up-ending and down-ending operations discussed in Chapter 7. The lifting lug is not a structural part of the package (Section 2.5) and will be removed prior to shipment (Section 7.1.2.1). The lifting lug bolt holes will be plugged and seal welded after use and prior to shipment.



Additional details on the evaluation methodology and acceptance criteria under NCT and HAC are presented in Sections 2.1.2.1 and 2.1.2.2, with buckling and fracture toughness criteria addressed in Sections 2.1.2.3 and 2.1.2.4.

2.1.2.1 Normal Conditions of Transport

The design of the package under the NCT is in compliance with the guidance set forth in Regulatory Guide 7.6. Linear elastic analyses are used in the structural evaluations under the NCT. For vibration analysis, the package is designed to sustain the vertical, lateral, and longitudinal accelerations specified by:

- The Association of American Railroads (AAR) set forth in Part 1 of the "Open Top Loading Rules Manual," and
- ANSI N14.2, "Tie-down for Truck Transport of Radioactive Materials, (Draft)".

Material properties and design stress intensities (S_m) for the package shell are taken from the ASME Boiler and Pressure Vessel Code (ASME BPV), Section III, Division 1, Subsection NB. For the NCT load cases, service level A applies with the following stress limits:

Package Shell, Top and Bottom Plates, SA-516 Gr. 70

Allowable primary membrane stress per Subsection NB-3221.1:	1 S_m
Allowable primary membrane plus bending stress per Subsection NB-3221.3:	1.5 S_m
Allowable primary plus secondary stress per Subsection NB-3222.2:	3 S_m

At a temperature of less than 200°F, $S_m = 23.1$ ksi

RV Studs at Top Plate³

Allowable average stress per Subsection NB-3232.1:	2 S_m
Allowable maximum stress per Subsection NB-3232.2:	3 S_m

At a temperature of less than 200°F, $S_m = 23.3$ ksi

Package Shell, Top and Bottom Plates Full Penetration Welds

The allowable stress value for the full penetration weld is the same as the base material.

³ The existing RV flange studs, which are used to secure the RV to the top plate, are A-193 with special properties, including a minimum yield strength of 120 ksi and a minimum tensile strength of 140 ksi. The structural evaluation documented in Appendix 2-1 uses the material properties for SA-193 Grade B7. The mechanical properties for the new SA-540 Grade B23 Class 5 stud material exceeds the properties of SA-193 B7 material for the specified stud diameter. This is conservative since the strength of A-193 studs with special properties and the SA-540 Grade 23 Class 5 studs is higher than that of the SA-193 Grade B7 studs used in the analysis.



FIGURE WITHHELD UNDER 10 CFR 2.390



BNFL
Inc.

**Big Rock Point Reactor Vessel Package Safety Analysis Report
(BRP RVP SAR)**

**BRP RVP SAR-5339, Rev. 2
Docket Number 71-9300**

FIGURE WITHHELD UNDER 10 CFR 2.390



BNFL

Inc.

**Big Rock Point Reactor Vessel Package Safety Analysis Report
(BRP RVP SAR)**

**BRP RVP SAR-5339, Rev. 2
Docket Number 71-9300**

FIGURE WITHHELD UNDER 10 CFR 2.390



FIGURE WITHHELD UNDER 10 CFR 2.390



BNFL
Inc.

Big Rock Point Reactor Vessel Package Safety Analysis Report
(BRP RVP SAR)

BRP RVP SAR-5339, Rev. 2
Docket Number 71-9300

<div style="display: flex; justify-content: space-around; align-items: center;"><div style="text-align: center;"><div style="border: 1px solid black; width: 400px; height: 150px; margin: 0 auto; position: relative;"><div style="position: absolute; top: -20px; left: 50%; transform: translateX(-50%);">6"</div><div style="position: absolute; right: -20px; top: 50%; transform: translateY(-50%);">2 1/4"</div><div style="position: absolute; bottom: 10px; left: 10px;">PACKAGE MODEL NO.: BRP RVP SAR-5339 PACKAGE SERIAL NO.: BRP-001 GROSS WEIGHT: 565,000 LBS PACKAGE I.D. NO.: USA/9300/B(U)-85</div></div><div style="text-align: center;">1</div></div><div style="text-align: center; margin-top: 20px;">TEXT TO BE STENCILED WITH MINIMUM 3/16" HIGH LETTER</div><div style="text-align: center; margin-top: 20px;"><div style="border: 1px solid black; width: 500px; height: 40px; border-radius: 15px; margin: 0 auto;"></div><div style="text-align: center;">1</div></div></div>																																			
<div style="display: flex; justify-content: space-between;"><div style="width: 60%;"><table border="1" style="width: 100%;"><thead><tr><th colspan="5">FIGURE RELEASE RECORD</th></tr><tr><th>REV</th><th>DATE</th><th>PREPARED</th><th>REVIEWED</th><th>APPROVED</th></tr></thead><tbody><tr><td>0</td><td>6/15/01</td><td>ON FILE</td><td>ON FILE</td><td>—</td></tr><tr><td>1</td><td>6/25/03</td><td><i>peyca</i></td><td><i>SS</i></td><td>—</td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr></tbody></table></div><div style="width: 35%; text-align: center;"><div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">NAME PLATE PACKAGE CONFIGURATION AND DIMENSIONS</div><div style="border: 1px solid black; padding: 5px; margin-bottom: 5px;">Figure 2-1, Sheet 7 of 7</div><div style="display: flex; align-items: center; justify-content: center;"><div style="text-align: center;"> BNFL Inc.</div><div style="margin-left: 20px;"></div></div><div style="font-size: 0.8em; margin-top: 5px;">Big Rock Point 10269 US 31 North Charlevoix, MI 49720-9436</div></div></div>						FIGURE RELEASE RECORD					REV	DATE	PREPARED	REVIEWED	APPROVED	0	6/15/01	ON FILE	ON FILE	—	1	6/25/03	<i>peyca</i>	<i>SS</i>	—										
FIGURE RELEASE RECORD																																			
REV	DATE	PREPARED	REVIEWED	APPROVED																															
0	6/15/01	ON FILE	ON FILE	—																															
1	6/25/03	<i>peyca</i>	<i>SS</i>	—																															