

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, D.C. 20555

September 30, 1993

NRC INFORMATION NOTICE 93-79: CORE SHROUD CRACKING AT BELTLINE REGION WELDS
IN BOILING-WATER REACTORS

Addressees

All holders of operating licenses or construction permits for boiling-water reactors (BWRs).

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees that cracks have been observed in the weld regions of the core support shroud in boiling water reactors. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

During the current refueling outage at Brunswick Unit 1 (a BWR-4 reactor), in-vessel visual inspection revealed cracks at weld regions of the core support shroud. The shroud is a stainless steel cylinder that serves to direct the flow of water inside the reactor vessel. The shroud is completely contained inside the 15.2 centimeter [6 inch] thick reactor vessel. The structural integrity of the reactor vessel is not impacted by the cracks in the shroud.

Carolina Power and Light Company (CP&L), the licensee for Brunswick, found both circumferential and axial cracks in the shroud. The circumferential cracks were located in the inside shroud surface in the heat-affected zone (HAZ) of weld H-3 and extended 360° around the circumference of the shroud (see Figures 1 and 2). Weld H-3 is a horizontal weld which fuses the top guide support ring to the lower shroud. The first axial crack discovered was located on the outside shroud surface of weld H-4 in the lower shroud. CP&L performed additional visual testing (VT) and ultrasonic testing (UT) of the shroud and removed boat samples to evaluate the length and size of the cracks.

Discussion

In 1990, crack indications were reported at core shroud welds located in the beltline region of an overseas reactor (BWR4). This reactor had completed approximately 190 months of power operation before the cracks were discovered. As a result of this discovery, General Electric (GE) issued Rapid Information Communication Services Information Letter (RICSIL) 054, "Core Support Shroud

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Crack Indications," on October 3, 1990, to all owners of GE BWRs. The RICSIL summarized the cracking found in the overseas reactor and recommended that at the next refueling outage plants with high-carbon-type 304 stainless steel shrouds perform a visual examination of the accessible areas of the seam welds and associated HAZ on the inside and outside surfaces of the shroud.

Since early July, CP&L has performed VT inspections of the Unit 1 inside and outside shroud surface in the vicinity of welds. These inspections were performed in accordance with GE RICSIL 054 and discovered cracks in the weld regions. CP&L determined that in order to perform an adequate VT it was necessary to remove the outer blade guides, pre-clean inspection areas, and obtain an improved resolution of "1-millimeter wire" (in lieu of the Code-prescribed resolution). Camera and lighting positions were also found to be crucial in performing adequate VTs. Also, CP&L has worked with GE to develop more sophisticated UT equipment to identify how deeply into the shroud metal the crack extends.

Additional VT inspections revealed more axial cracks at the inside surface of weld H-4 as well as cracks at welds H-1, H-2, and H-5 of the shroud. One of the additional cracks, a circumferential crack at weld H-5, appears to be approximately 76.2 centimeters [30 inches] in length. The majority of the cracks are located in the HAZ of the welds, although one crack was discovered in the central region of shroud plate P-6. The crack in P-6, however, may be associated with a possible weld repair of a surface defect in the plate after its fabrication at the mill.

The results from the boat samples indicated intergranular stress-corrosion cracking (IGSCC) as the mechanism. Preliminary results suggest that the crack in the HAZ of weld H-3 may be 3.8 centimeters [1.5 inches] or more in depth. The location of this crack is shown in Figure 2.

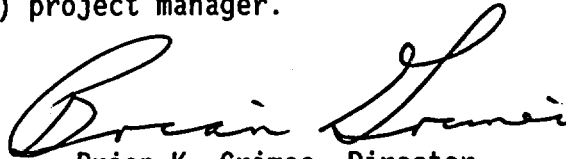
As a result of the shroud cracks being discovered on Unit 1, CP&L re-examined the results of the inspection performed during the 1991 refueling outage of Unit 2. The re-examination revealed three minor crack indications in the HAZ of weld H-2. The licensee concluded that the cracks do not pose a concern to normal operation of the reactor.

CP&L plans to repair the Brunswick Unit 1 core shroud before the plant is brought back into service. CP&L intends to restore the strength of the shroud by adding stiffening braces around the top portion of the shroud. However, the licensee will continue to examine and evaluate the cracks in the core shroud.

General Electric issued Revision 1 to RICSIL 054 on July 21, 1993, to update the information on the core support shroud cracks and to provide revised interim recommendations to perform visual examination of accessible areas of the shroud at all GE BWRs during the next scheduled outage. The NRC has been informed by GE that they are evaluating the Brunswick results and will provide

updated information to owners of GE BWRs. The NRC staff is evaluating the implications of the shroud cracks for reactor core configuration and emergency core cooling system performance under accident conditions at operating plants and will consider the need for additional generic communications.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.



Brian K. Grimes, Director
Division of Operating Reactor Support
Office of Nuclear Reactor Regulation

Technical contacts: R. A. Hermann, NRR (301) 504-2768 J. Medoff, NRR (301) 504-2715
P. Byron, Region II (919) 457-9531 T. Greene, NRR (301) 504-1175

Attachments:

1. Figure 1: Weld and Plate Locations in the Beltline Region of the Brunswick Unit 1 Core Shroud
2. Figure 2: Details of Weld Locations H-2 and H-3 in the Brunswick Unit 1 Core Shroud
3. List of Recently Issued NRC Information Notices

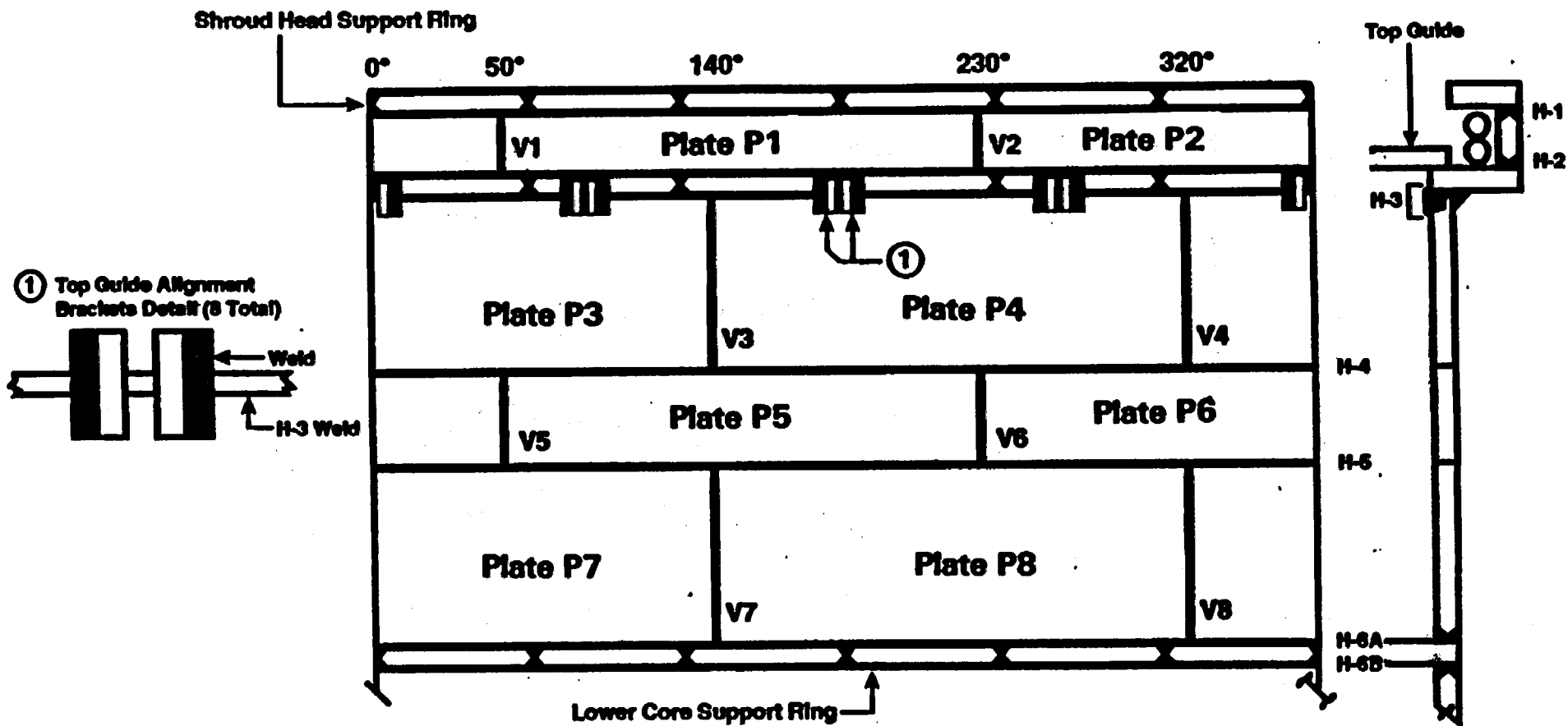


Figure 1. Weld and Plate Locations in the Beltline Region of the Brunswick Unit 1 Core Shroud (From CP&L)

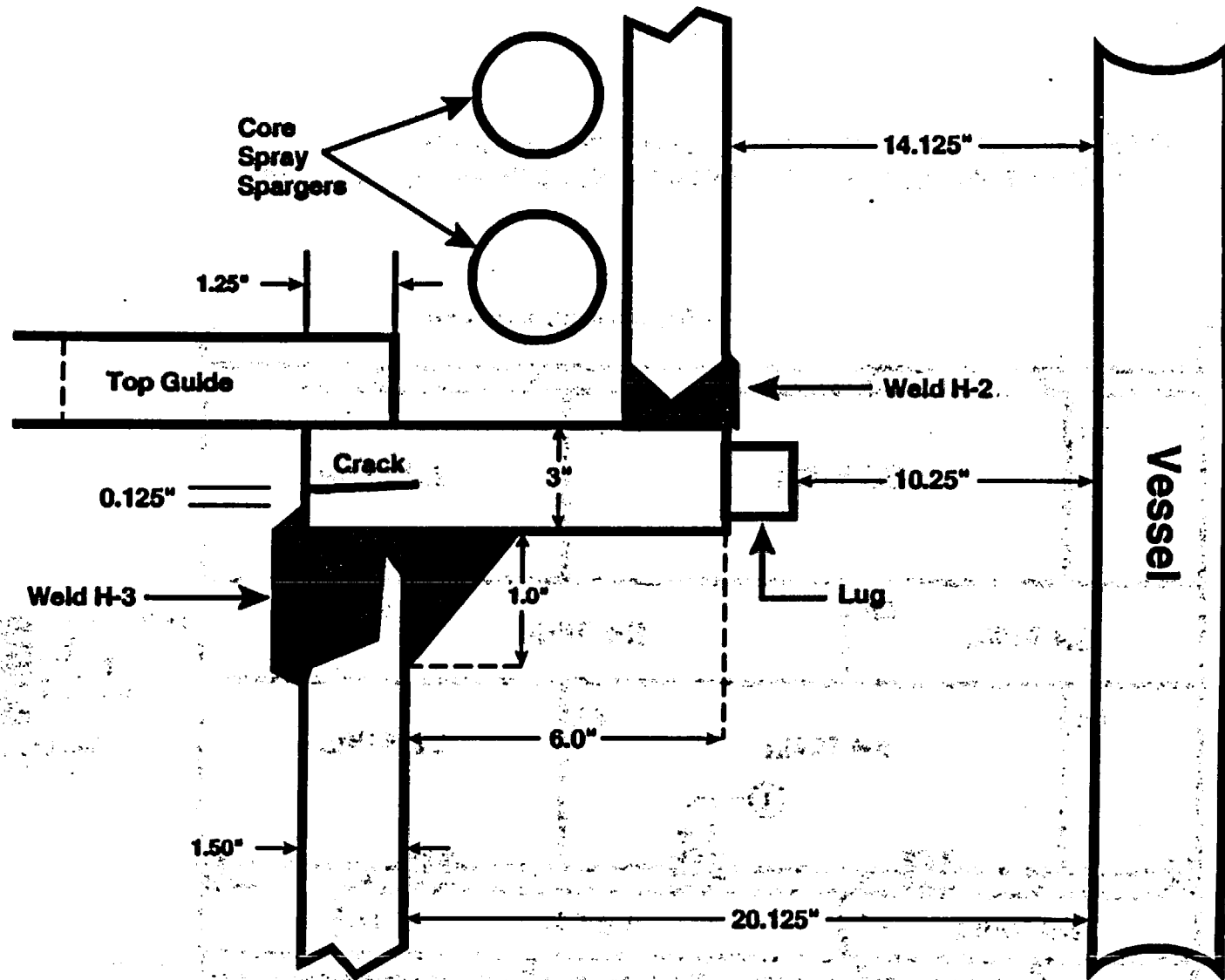


Figure 2. Details of Weld Locations H-2 and H-3 in the Brunswick Unit 1 Core Shroud (From CP&L)

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LIST OF RECENTLY ISSUED
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
93-78	Inoperable Safety Systems At A Non-Power Reactor	10/04/93	All holders of OLs or CPs for test and research reactors.
93-77	Human Errors that Result in Inadvertent Transfers of Special Nuclear Material at Fuel Cycle Facilities	10/04/93	All nuclear fuel cycle licensees.
93-76	Inadequate Control of Paint and Cleaners for Safety-Related Equipment	09/21/93	All holders of OLs or CPs for nuclear power reactors.
93-75	Spurious Tripping of Low-Voltage Power Circuit Breakers with GE RMS-9 Digital Trip Units	09/17/93	All holders of OLs or CPs for nuclear power reactors.
93-74	High Temperatures Reduce Limitorque AC Motor Operator Torque	09/16/93	All holders of OLs or CPs for nuclear power reactors.
93-73	Criminal Prosecution of Nuclear Suppliers for Wrongdoing	09/15/93	All NRC licensees.
93-72	Observations from Recent Shutdown Risk and Outage Management Pilot Team Inspections	09/14/93	All holders of OLs or CPs for nuclear power reactors.
93-71	Fire at Chernobyl Unit 2	09/13/93	All holders of OLs or CPs for nuclear power reactors.
93-70	Degradation of Boraflex Neutron Absorber Coupons	09/10/93	All holders of OLs or CPs for nuclear power reactors.

OL = Operating License
CP = Construction Permit

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WASHINGTON, D.C. 20555-0001

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updated information to owners of GE BWRs. The NRC staff is evaluating the implications of the shroud cracks for reactor core configuration and emergency core cooling system performance under accident conditions at operating plants and will consider the need for additional generic communications.

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orig /s/'d by BKGrimes
 Brian K. Grimes, Director
 Division of Operating Reactor Support
 Office of Nuclear Reactor Regulation

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 P. Byron, Region II (919) 457-9531 T. Greene, NRR (301) 504-1175

Attachments:

- Figure 1: Weld and Plate Locations in the Beltline Region of the Brunswick Unit 1 Core Shroud
- Figure 2: Details of Weld Locations H-2 and H-3 in the Brunswick Unit 1 Core Shroud
- List of Recently Issued NRC Information Notices

*See previous concurrences

OFC	OEAB:DORS	SC/OEAB:DORS	PUB:ADM	C/OEAB:DORS
NAME	TAGreene*	RDennig*	Tech Ed*	AChaffee*
DATE	09/30/93	09/30/93	09/30/93	09/30/93

OFC	EMCB:DE	SC/EMCB:DE	C/EMCB:DE	PDII-1:DRP
NAME	JMedoff*	RAHermann*	JRStrosnider*	PDMilano*
DATE	09/28/93	09/28/93	09/28/93	09/28/93

OFC	PDII-1:ADR2	RII	D/DE	OGCB:DORS
NAME	SBajwa*	PByron*	JWiggins	NCampbell*
DATE	09/30/93	09/30/93	/ /93	09/30/93

OFC	C/OGCB:DORS	D/DORS
NAME	GMarcus*	BGrimes
DATE	09/30/93	09/30/93

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DATE	09/28/93	09/28/93	09/28/93	09/28/93

OFC	PDII-1:ADR2	RII	D/DE	OGCB:DORS
NAME	SBajwa	PByron	JHiggins	NCampbell
DATE	9/30/93	9/30/93	9/30/93	9/30/93

OFC	C/OGCB:DORS	D/DORS
NAME	JWMarcus	BGrimes
DATE	9/30/93	1/93

discovered in the central region of shroud plate P-6. The crack in P-6, however, may be associated with a possible weld repair of a surface defect in the plate after its fabrication at the mill.

The results from the boat samples revealed that the cracking mechanism is by intergranular attack (IGSCC). Preliminary results suggest that the cracks in weld H-3 may be 1.5 inches or more in depth. The intergranular cracking mechanism may be assisted by the high degree of neutron fluence emanating from the core. The licensee is continuing to examine and evaluate the cracks in the core shroud. Figures 1. and 2. are provided to show the weld locations.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact (one of) the technical contact(s) listed below or the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

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Technical contact(s): T. Greene, NRR (301) 504-1175 J. Medoff, NRR (301) 504-2715 R. A. Hermann (301) 504-2768

- Attachments: 1) Figure Showing Locations of Welds in the Brunswick Unit 1 Core Shroud
 2) Figure Showing Details of Welds in the Top Guide Support Ring Region
 3) List of Recently Issued NRC Information Notices

OFC	OEAB:DORS	SC/OEAB:DORS	PUB:ADM	C/OEAB:DORS
NAME	TAGreene		Tech Ed	AChaffee
DATE	/ /93	/ /93	/ /93	/ /93

OFC	EMCB:DE	SC/EMCB:DE	C/EMCB:DE	PDII-1:DRP
NAME	JMedoff <i>JM</i>	RAHermann <i>RAH</i>	RStrosnider <i>RS</i>	PDMilano <i>PM</i>
DATE	9/28/93	9/28/93	9/28/93 <i>with comments</i>	9/28/93

OFC	C/OGCB:DORS	D:DORS		
NAME	GHMarcus	BKGrimes		
DATE	/ /93	/ /93	/ /93	/ /93

*See previous concurrences

OFC	OEAB:DORS	SC/OEAB:DORS	PUB:ADM	C/OEAB:DORS
NAME	TAGreene	RDennig	Tech Ed <i>RA</i>	ACHaffee
DATE	/ /93	/ /93	9/30/93	/ /93

OFC	EMCB:DE	SC/EMCB:DE	C/EMCB:DE	PDII-1:DRP
NAME	JMedoff*	RAHermann*	JRStrosnider*	PDMilano*
DATE	09/28/93	09/28/93	09/28/93	09/28/93

OFC	RII	RII	D/DE	C/OGCB:DORS
NAME	PByron	JJohnson	JWiggins	GHEMarcus
DATE	/ /93	/ /93	/ /93	/ /93

OFC	D:DORS
NAME	BKGrimes
DATE	/ /93

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