



Exelon Generation®

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10 CFR 50.55a

RS-19-055
NMP2L2700
TMI-19-045

April 30, 2019

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Braidwood Station, Units 1 and 2
Renewed Facility Operating License Nos. NPF-72 and NPF-77
NRC Docket Nos. STN 50-456 and STN 50-457

Byron Station, Units 1 and 2
Renewed Facility Operating License Nos. NPF-37 and NPF-66
NRC Docket Nos. STN 50-454 and STN 50-455

Calvert Cliffs Nuclear Power Plant, Units 1 and 2
Renewed Facility Operating License Nos. DPR-53 and DPR-69
NRC Docket Nos. 50-317 and 50-318

Clinton Power Station, Unit 1
Facility Operating License No. NPF-62
NRC Docket No. 50-461

LaSalle County Station, Units 1 and 2
Renewed Facility Operating License Nos. NPF-11 and NPF-18
NRC Docket Nos. 50-373 and 50-374

Limerick Generating Station, Units 1 and 2
Renewed Facility Operating License Nos. NPF-39 and NPF-85
NRC Docket Nos. 50-352 and 50-353

Nine Mile Point Nuclear Station, Unit 2
Renewed Facility Operating License Nos. DPR-63 and NPF-69
NRC Docket Nos. 50-220 and 50-410

Three Mile Island Nuclear Station, Unit 1
Renewed Facility Operating License No. DPR-50
NRC Docket No. 50-289

Subject: Proposed Alternative to Utilize Code Case N-879

In accordance with 10 CFR 50.55a(z)(1), Exelon Generation Company, LLC (Exelon) is requesting a proposed alternative to the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," on the basis that the proposed alternative provides an acceptable level of quality and safety, equivalent to compliance with ASME Section III and XI requirements.

Enclosures 1, 2, 3, 4, and 5 transmitted herewith contains Proprietary Information. When separated from attachments, this document is decontrolled.

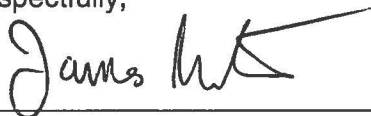
Specifically, this proposed alternative concerns the use of Code Case N-879, "Use of Micro-Alloyed Carbon Steel Bar in Patented Mechanical Joints and Fittings, Classes 1, 2, and 3 Section III, Division 1." This Code Case permits use of a material that does not comply with the limitations on material specifications and grades mandated by ASME Section III, NB/NC/ND-2121(a).

Enclosures 1, 2, 3, 4, and 5 contain information proprietary to Lokring Technology, LLC (Lokring). Lokring requests that these documents be withheld from public disclosure in accordance with 10 CFR 2.390(b)(4). Affidavits supporting this request are contained in each Enclosure.

There are no regulatory commitments contained in this letter. Exelon requests your review and approval of this fleet request by April 30, 2020.

If you have any questions, please contact Tom Loomis (610) 765-5510.

Respectfully,



James Barstow
Director - Licensing and Regulatory Affairs
Exelon Generation Company, LLC

Attachment: Proposed Alternative to Utilize Code Case N-879

- Enclosures:
- 1) Affidavit and "Impact Test Results"
 - 2) Affidavit and "Welding Procedure and Qualification Record"
 - 3) Affidavit and "Metallurgical Test Report"
 - 4) Affidavit and "HAZ Hardness Testing"
 - 5) Affidavit and "Elevated Temperature Tensile Testing"
 - 6) Exelon PowerPoint Presentation, Request for use of ASME Code Case N-879 for Exelon Nuclear Power Plants, January 23, 2019

- cc:
- Regional Administrator - NRC Region I
 - Regional Administrator - NRC Region III
 - NRC Senior Resident Inspector - Braidwood Station
 - NRC Senior Resident Inspector - Byron Station
 - NRC Senior Resident Inspector - Calvert Cliffs Nuclear Power Plant
 - NRC Senior Resident Inspector - Clinton Power Station
 - NRC Senior Resident Inspector - LaSalle County Station
 - NRC Senior Resident Inspector - Limerick Generating Station
 - NRC Senior Resident Inspector - Nine Mile Point Nuclear Station
 - NRC Senior Resident Inspector - Three Mile Island Nuclear Station
 - NRC Project Manager - Braidwood Station
 - NRC Project Manager - Byron Station
 - NRC Project Manager - Calvert Cliffs Nuclear Power Plant
 - NRC Project Manager - Clinton Power Station
 - NRC Project Manager - LaSalle County Station

Proposed Alternative to Utilize Code Case N-879

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cc (continued):

NRC Project Manager - Limerick Generating Station

NRC Project Manager - Nine Mile Point Nuclear Station

NRC Project Manager – Three Mile Island Nuclear Station

Illinois Emergency Management Agency - Department of Nuclear Safety

R. R. Janati - Bureau of Radiation Protection, Commonwealth of Pennsylvania

D. A. Tancabel - State of Maryland

A. L. Peterson - NYSERDA

ATTACHMENT

Proposed Alternative to Use Code Case N-879

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Proposed Alternative to Use Code Case N-879 in Accordance with 10 CFR 50.55a(z)(1)

1. ASME Code Component(s) Affected:

All ASME Class 2 and 3 carbon steel piping systems Nominal Pipe Size (NPS) 2 and smaller. Note that Case N-879 is also applicable to Class 1 piping; however, Exelon is not requesting permission to use Case N-879 for Class 1 fittings. This request applies only to Class 2 and 3 fittings.

2. Applicable ASME Section XI Edition and Addenda:

<u>PLANT</u>	<u>INTERVAL</u>	<u>EDITION</u>	<u>START</u>	<u>END</u>
Braidwood Station, Units 1 and 2	Fourth	2013 Edition	August 29, 2018 November 5, 2018	July 28, 2028 October 16, 2028
Byron Station, Units 1 and 2	Fourth	2007 Edition, through 2008 Addenda	July 16, 2016	July 15, 2025
Calvert Cliffs Nuclear Power Plant, Units 1 and 2	Fifth	2013 Edition	July 1, 2019	June 30, 2029
Clinton Power Station, Unit 1	Third	2004 Edition	July 1, 2010	June 30, 2020
Clinton Power Station, Unit 1	Fourth	2013 Edition	July 1, 2020	June 30, 2030
LaSalle County Stations, Units 1 and 2	Fourth	2007 Edition, through 2008 Addenda	October 1, 2017	September 30, 2027
Limerick Generating Station, Units 1 and 2	Fourth	2007 Edition, through 2008 Addenda	February 1, 2017	January 31, 2027
Nine Mile Point Nuclear Station, Unit 2	Fourth	2013 Edition	October 6, 2018	August 22, 2028
Three Mile Island Nuclear Station, Unit 1	Fourth	2004 Edition	April 20, 2011	April 19, 2022

3. Applicable Code Requirements:

ASME Code, Section III, NC/ND-2121(a), of the 1971 Edition through the 2017 Edition, provides requirements for materials to be used in Class 2 and 3 piping systems. This requirement is mandated by IWA-4220, of the ASME Section XI Edition and Addenda applicable to each

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nuclear power plant. Exelon has determined that relief is not needed from ASME Code B31.1 and B31.7.

4. Reason for Request:

In accordance with 10 CFR 50.55a(z)(1), Exelon Generation Company, LLC (Exelon) is requesting a proposed alternative from the ASME Section III, NC/ND-2121(a) requirements for compliance with the specifications for material given in ASME Section II, Part D (previously Section III, Division 1, Appendix I, Tables I-1.1, I-7.1, and I-8.1), Subpart 1, Table 1A, for ferrous materials, on the basis that Code Case N-879 provides an acceptable level of quality and safety, equivalent to compliance with the requirements of ASME Section III, NC/ND-2121(a) and Section II, Part D Subpart 1, Table 1A, for ferrous materials.

Exelon desires to use nonstandard, proprietary, welded, or nonwelded pipe fittings in applications requiring compliance with ASME Section III, without having to comply with the limitations on material specifications and grades mandated by Section III, NC/ND-2121(a).

Most piping fabrication and installation joints have been traditionally fabricated by welding. Installation of pipe and piping subassemblies by mechanical means can save significant amounts of time, money, critical path time, and radiation exposure to plant personnel and installation and examination contractors. In systems containing radioactive materials, or in systems near irradiated components, personnel can be subjected to significant amounts of radiation during preparation for welding, during welding, and nondestructive examination (NDE) of the welds. Most of this exposure can be eliminated by use of mechanical connections. The amount of time to which mechanical installation personnel are exposed is a fraction of the time to which a welder or a nondestructive examiner would be exposed. Without installation welds, there is no associated installation NDE.

5. Proposed Alternative and Basis for Use:¹

Exelon proposes to implement the requirements of Code Case N-879 for procurement of nonstandard, proprietary, welded and nonwelded pipe fittings, NPS 2 or smaller.

ASME Section XI requires fittings to be designed and manufactured in accordance with the original Construction Code, which, for these specific applications, is ASME Section III. The only ASME Code requirement for which Exelon is seeking an alternative is that of ASME Section III, NC/ND-2121(a), which requires compliance with the specifications for material given in ASME Section II, Part D (previously Section III, Division 1, Appendix I, Tables I-1.1, I-7.1, and I-8.1), Subpart 1, Table 1A, for ferrous materials.

The requested alternative is provided in Code Case N-879, "Use of Micro-Alloyed Carbon Steel Bar in Patented Mechanical Joints and Fittings, Classes 1, 2, and 3 Section III, Division 1," which permits use of a micro-alloyed steel composition similar to that of ASME SA-675 and ASTM A 576 Grade 1524, with additions of carbon, manganese, vanadium, and nitrogen, to increase the yield strength to 80 ksi, to ensure a high-strength, leak-tight, mechanical joint. The material meets all other requirements of ASME Section II, Part A, SA-675. It has chemical composition similar to ASME SA-737, Grade C, which is approved for use in

¹ Responds to NRC Question 4 (Reference 1).

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ASME Section III applications. The additional material strength ensures that the deformation produced during installation of the fittings occurs in the pipe material, rather than in the fitting material. It is this deformation that produces the stresses necessary for the joint structural and leak-tight integrity.

This Code Case will expand Exelon's ability to use these proprietary fittings in safety-related piping, by including coverage for ASME Section III, Class 2 and 3 systems NPS 2 or smaller.

The material described in Code Case N-879 is already permitted to be used in safety-related pipe fittings manufactured in accordance with ASME B31.1, paragraph 123.1.2. This material is also already permitted to be used in compression-type fittings in ASME Section III, Class 1, 2, and 3 instrument lines, up to NPS 1, in accordance with NB/NC/ND-2121, in the 1971 Edition through the 2017 Edition. However, for piping systems in nuclear power plants for which Section III was used for construction, the applicable material requirements in NB/NC/ND-2121 do not address, or specifically permit, use of this material in fittings other than instrument lines up to NPS 1.

Section III does not require fracture toughness testing for this material, because tubular products of the desired size are too small and too thin to make fracture toughness test specimens. Nonetheless, this material has been impact tested in bar form. The fracture toughness values are attached in Enclosure 1. The results demonstrate that fracture toughness testing is not necessary, and that the increase in hardness in the HAZ is minimal. Lokring imposes a maximum tensile strength of 130 ksi.²

P-Numbers for welding procedure and performance qualification are normally provided by ASME Section IX. Because this material is not a standard product and is used only in limited applications, the Section IX committee has not been requested to provide a P-Number. Section IX, QW-420 identifies that P-Numbers are provided for the purpose of reducing the number of welding qualifications required, but are not necessary. Materials not having a P-Number are required to be qualified separately. Separate qualifications have been performed for this material welded to P-No. 1 piping materials, such as SA-106 Grade B.³ The filler material is that most applicable to welding of SA-106 Grade B pipe, such as ER70.⁴ Any welds will be preheated to 70°F and will not be post-weld heat treated. Post-weld heat treatment (PWHT) is undesirable, as it decreases the yield strength to the point that the fittings would not be able to resist the compression forces necessary to produce a leak-tight joint.⁵ A typical welding procedure and results of welding qualifications are shown in Enclosure 2. There is minimal heat-affected-zone hardening and no evidence of martensite formation in the HAZ. A metallurgical test report, with photomicrographs, is shown in Enclosure 3. HAZ hardness testing results are shown in Enclosure 4. Bend tests have been demonstrated to meet ASME Section IX requirements as shown in Enclosure 2.

The Section III Code Editions and Addenda used in constructing the Class 2 and 3 piping systems at Braidwood, Byron, Calvert Cliffs, Clinton, LaSalle, Limerick, Nine Mile Point Nuclear Station, Unit 2, and Three Mile Island, Unit 1 include primarily the Winter 1972 Addenda, the

² Responds to NRC Question 5 (Reference 1).

³ Responds to NRC Question 8 (Reference 1).

⁴ Responds to NRC Question 7 (Reference 1).

⁵ Responds to NRC Question 6 (Reference 1).

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1974 Edition, including the Summer 1974 and Summer 1975 Addenda, and the 1977 Edition with the Summer 1978 and Summer 1979 Addenda. At Calvert Cliffs Nuclear Power Plant, Units 1 and 2, several new post-TMI modifications were designed to add systems constructed using the 1977 Edition of Section III, including the Summer 1978 Addenda.⁶

Exelon desires to be able to install fittings made using the material permitted by Code Case N-879 for any application in which plain carbon steel materials, such as SA-106 Grade B are used, subject to the NPS 2 size limitation of Code Case N-879. However, the typical applications in which the subject proprietary fittings will be used are generally limited to instrumentation, sampling, and cooling water piping lines. They exclude Class 1 systems and any systems containing boric acid. Design temperatures may be up to 650°F, but will generally be less than 200°F. Design pressures could be as high as 1000 psi, but will generally be less than 200 psi. The environmental conditions are anything in the nuclear power plant environment, including air, water, or steam systems, and possibly lube oil or fuel systems. They could be inside or outside containment. Prior operating experience for these fittings in these environments have shown successful performance, with no leaks or structural failures, as long as they are installed in accordance with the manufacturer's instructions. They have been successfully used in pipe schedules from 10 to 160, subject to the manufacturer's recommendations and limitations.⁷

The material addressed in Code Case N-879 is somewhat unique in that it will be used in fittings designed and qualified by testing, rather than by calculating stresses. Due to the complex shape of the fittings, calculating stresses is not practical. For this reason, B31.1 and Section III contain provisions for proving the capability of such fittings by testing. These requirements do not include design margins or load combinations based on allowable stresses.⁸ Rather, the margins are based on the ratio between burst pressure and the design pressure of the coupled piping. The rated pressure is downrated from the burst pressure, based on elevated-temperature tensile testing. The results of these tests are shown in Enclosure 5.

The proprietary fittings that Exelon desires to use are typically designed in accordance with ASME Section III, NB-3671.7, "Sleeve Coupled and Other Patented Joints," using the option of prototype testing. Alternatively, NC/ND-3671.7 may be used for Class 2 or 3 fittings, as applicable. The fittings will also comply with similar requirements in ASME B31.1, paragraph 123.1.2.⁹

The fittings Exelon desires to use have been extensively tested by Exelon and Lokring to demonstrate that the fittings will not fail before the pipe on which they are installed. The fittings have been tested by tensile (pull-out) testing, pressurization to burst, fatigue testing, and torsion testing. Fatigue analysis is not required for the requested applications, but is performed for the purpose of establishing a stress intensification factor (SIF), for use by the piping system designer.¹⁰

⁶ Responds to NRC Question 1 (Reference 1).

⁷ Responds to NRC Questions 2 and 4 (Reference 1).

⁸ Responds to NRC Question 10 (Reference 1).

⁹ Responds to NRC Question 9 (Reference 1).

¹⁰ Responds to NRC Question 10 (Reference 1).

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Reconciliation and use of editions and addenda of ASME Section III will be in accordance with ASME Section XI, IWA-4220, and only editions and addenda of ASME Section III that have been accepted by 10 CFR 50.55a may be used. The Code of Record for the specific 10-year ISI interval at each nuclear unit as identified under Section 2 above, will be used when applying the requirements of Section XI, unless specific regulatory relief to use other editions or addenda is approved.

All other ASME Section XI requirements for which relief was not specifically requested and authorized by the NRC Staff will remain applicable, including third party review by the Authorized Nuclear Inservice Inspector. All other Section III requirements, other than NC/ND-2121, will also remain applicable.

Based on the above, use of Code Case N-879 provides an acceptable level of quality and safety when compliance with the ASME Section III requirements for material given in ASME Section II, Part D (previously Section III, Division 1, Appendix I, Tables I-1.1, I-7.1, and I-8.1), Subpart 1, Table 1A, for ferrous materials are mandatory.

Code Case N-879 was approved by the ASME Board on Nuclear Codes and Standards on May 10, 2017, and was published in ASME Nuclear Code Cases, 2017 Edition, Supplement 1. It has not yet been incorporated into NRC Regulatory Guide 1.84, "Design, Fabrication, and Materials Code Case Acceptability, ASME Section III," and thus is not available for application at nuclear power plants without specific NRC approval. Therefore, Exelon requests use of the alternative material requirements described in this Code Case via this relief request.

In addition to the above-referenced documents, attached is the PowerPoint Presentation from the NRC-Exelon meeting on January 23, 2019 (Enclosure 6).¹¹

6. Duration of Proposed Alternative:

The proposed alternative is for use of the Code Case for the remainder of each plant's 10-year Inservice Inspection interval as specified in Section 2 and for the remainder of the plant's life.

7. Precedent:

None

8. Enclosures:

- 1) Affidavit and "Impact Test Results"
- 2) Affidavit and "Welding Procedure and Qualification Record"
- 3) Affidavit and "Metallurgical Test Report"
- 4) Affidavit and "HAZ Hardness Testing"
- 5) Affidavit and "Elevated Temperature Tensile Testing"
- 6) Exelon PowerPoint Presentation, "Request for Use of ASME Code Case N-879 for Exelon Nuclear Power Plants," January 23, 2019 (ML19022A200)

¹¹ Responds to NRC Question 3 (Reference 1).

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9. References:

- 1) Letter from B. Purnell (U.S. Nuclear Regulatory Commission) to B. Hansen (Exelon Generation Company, LLC), Supplemental Information Needed for Acceptance of Requests to Use ASME Code Cases N-878, N-879, and N-880 (EPIDS L-2018-LLR-0076 and L-2018-LLR-0077), dated July 10, 2018

ENCLOSURE 6

Exelon PowerPoint Presentation, Request for Use of ASME Code Case N-879 for Exelon Nuclear Power Plants," January 23, 2019 (ML19022A200)

Request for use of ASME Code Case N-879 for Exelon Nuclear Power Plants

January 23, 2019



Relief Request Scope/Subject Matter

- Requesting use of ASME Case N-879 for alternative material for use in Lokring Pipe Fittings for Class 2 and 3 Applications
 - This request is for the material only – not for design, fabrication, or testing
- Case N-879 has been approved and published by ASME
 - Published in ASME Nuclear Cases, 2017 Edition, Supplement 1
 - Not yet generically endorsed in Reg. Guide 1.84
- Case N-879 material has micro-alloying elements (C, Mn, V, N) to enhance yield strength.
 - Although containing extra alloying elements (Mn, V, N), meets all other requirements in ASME Section III-approved material specification SA-675.
 - N-879 material has a composition very similar to Pressure Vessel Plate Specification SA-737 Grade C (also approved for ASME Section III).
- Yield strength of 80 ksi is required, to confine installation deformation to pipe, rather than fitting.
 - Specified properties ensure no leakage or separation of joint during service

Existing ASME Code Requirements

- ASME Section XI, IWA-4220 requires compliance with Construction Code requirements (or later Codes) for materials used in repair/replacement activities.
- For older plants, B31.1 is required
 - Case N-879 material is permitted by B31.1 for these applications.
 - B31.1 Case 164 or B31.1, 123.1.2, Unlisted Materials
- For newer plants, Section III is required
 - NC/ND-2121(a) requires materials selected from Section III, Appendix I or Section II, Part D.
 - NC/ND-2121(d) permits use of other materials, such as Case N-879 material, for fittings up to NPS 1.

Applications Currently Permitted

- Lokring fittings made from stainless steel materials are already permitted without restrictions.
- Lokring fittings made from micro-alloyed carbon steel material permitted by Case N-879 are already permitted by ASME B31.1.
- Therefore permitted to be used in safety-related service with no restrictions at
 - Calvert Cliffs, Dresden, Fitzpatrick, Ginna, Nine Mile Point 1, Peach Bottom, Quad Cities, and TMI
- Lokring fittings made with Case N-879 material are already permitted in piping up to NPS 1, for all design conditions.

Relief Being Requested

- NRC acceptance of Case N-879 will permit use of micro-alloyed carbon steel material in Class 2 and 3 piping larger than NPS 1 and up to NPS 2 at
 - Braidwood, Byron, Clinton, LaSalle, Limerick, Nine Mile Point 2

Hardship Reasons for Relief Request

- Safety hazards
 - Welding and NDE in high-radiation environments
- Lokring mechanical installation – without welding or associated weld NDE – reduces radiation exposure and outage time.
- None of the carbon or low-alloy steel materials listed for Section III applications are suitable for both the service conditions and the Lokring installation conditions.
- The materials listed for Section III application do not have both of the following characteristics in combination.
 - Similar chemistry to the pipe materials on which the fittings will be applied.
 - Adequate yield strength to limit deformation to less than that of the pipe materials on which the fittings will be applied.

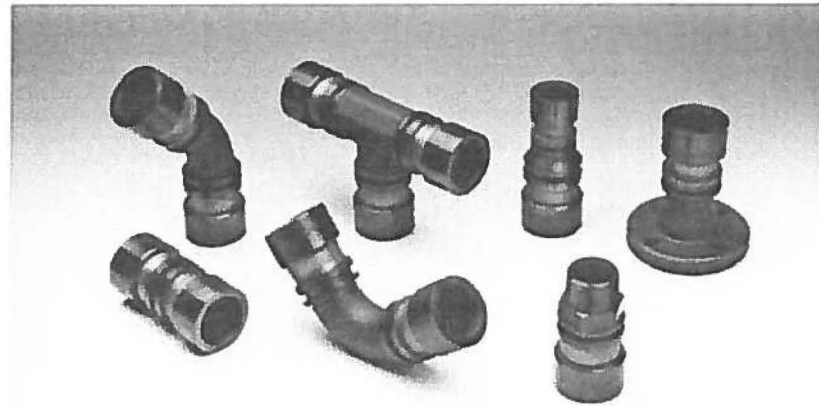
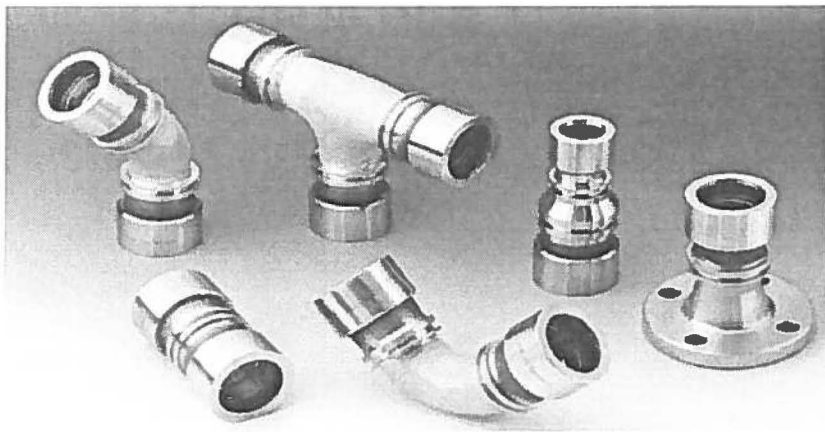
Responses to NRC Questions/Concerns

- Construction Code Editions and Addenda used:
 - B31.1: 1965 through 1968
 - Section III: 1971, 1974, S74, S75
 - Some later Editions and Addenda for new or modified systems, such as TMI modifications at Calvert Cliffs
- Systems include any made with carbon steel piping NPS 2 or smaller:
 - Typically, instrumentation, sampling, cooling water piping
 - Excludes borated systems (RCS, charging, chemical and volume control, etc.)
 - Design temperature: ambient to 650°F
 - Design pressure: ~100 to ~1000 psi
 - Environment: air, water, or steam, inside or outside containment

Responses to NRC Questions/Concerns

Lokring Technology is a manufacturer of pipe and tube fittings developed and qualified for use in ASME B31 pressure piping systems

- Fitting materials: Stainless Steel, Carbon Steel, Copper Nickel
- Pipe Schedules 10, 40, 80, 160
- Sizes 1/4" OD to NPS 4"



Responses to NRC Questions/Concerns

- Description and drawing

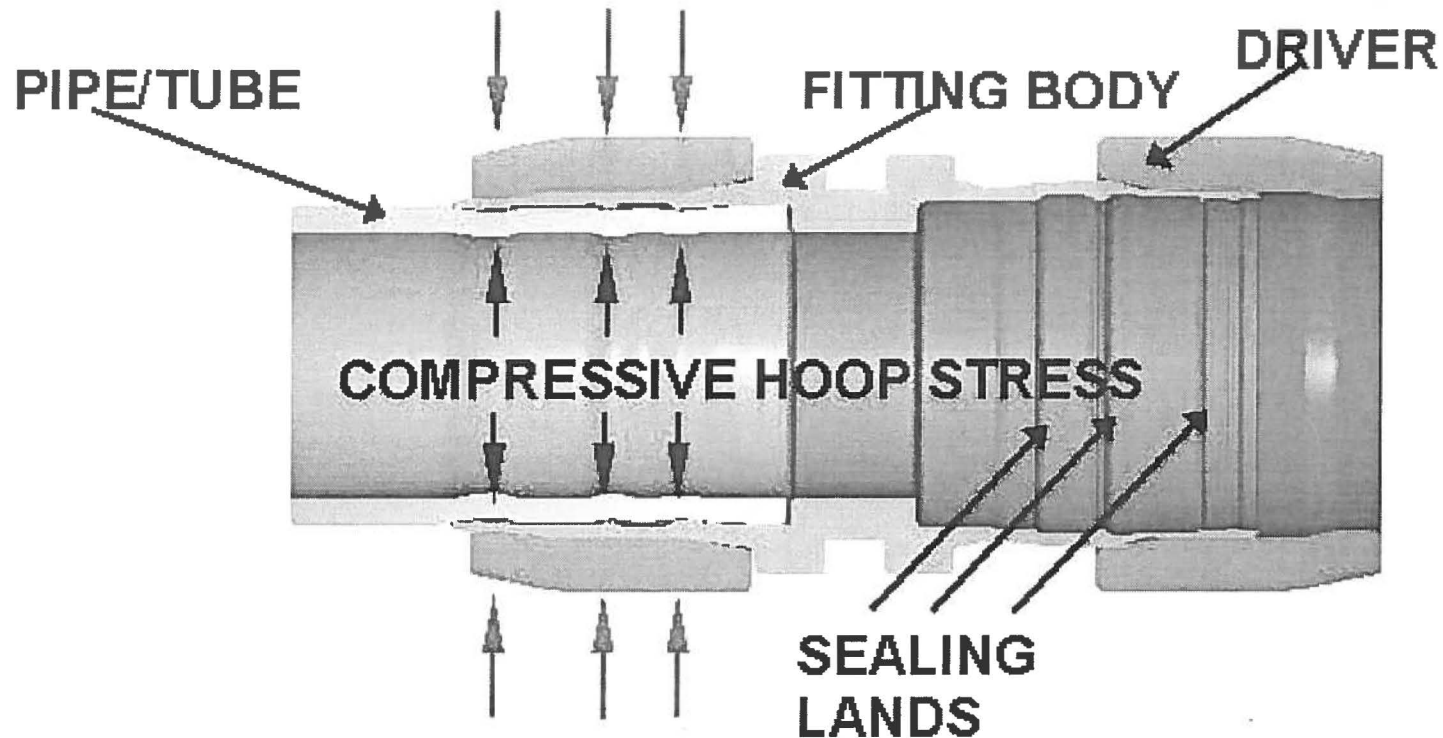
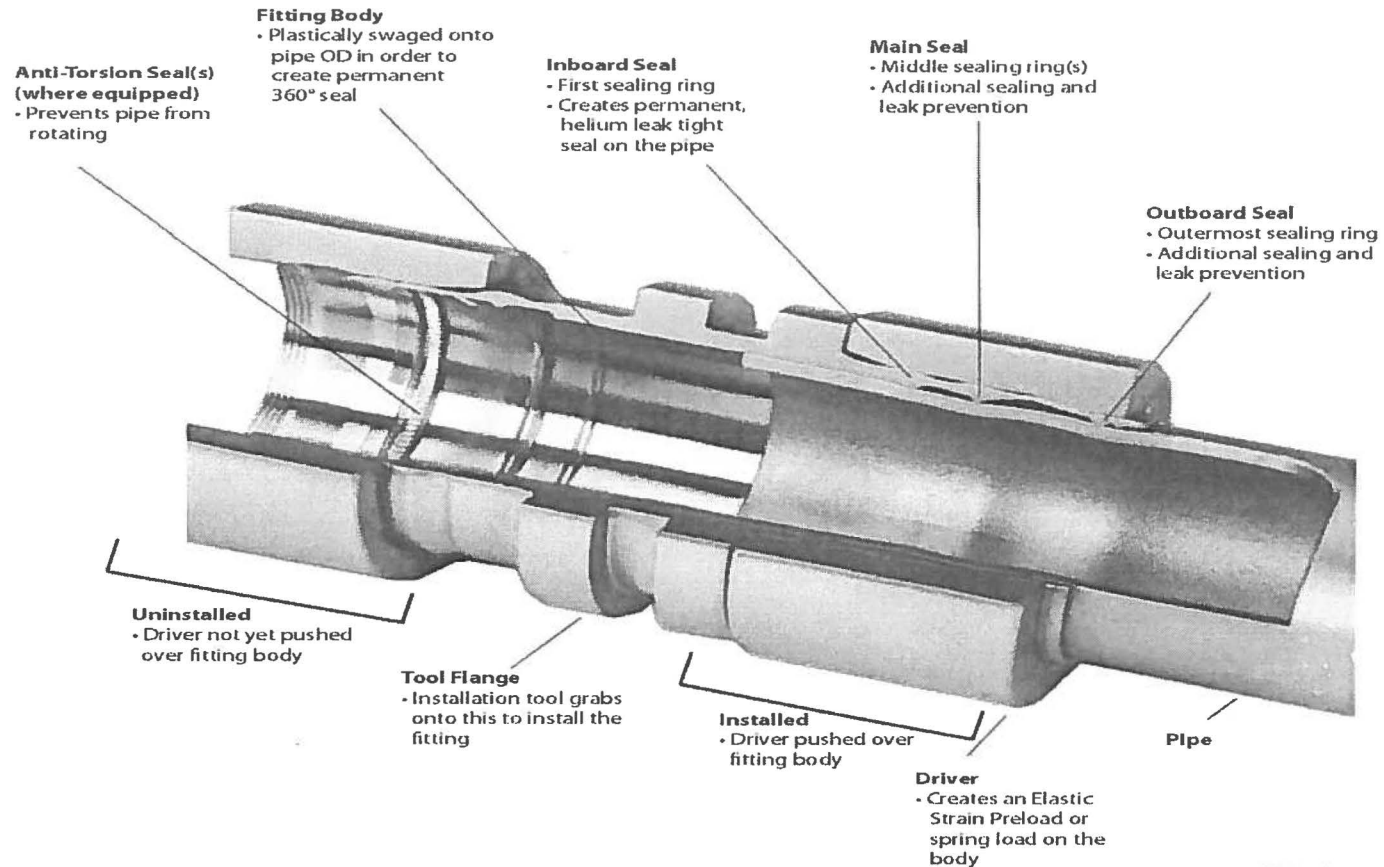


Diagram of Installed and Sectioned Lokring Fitting/Pipe

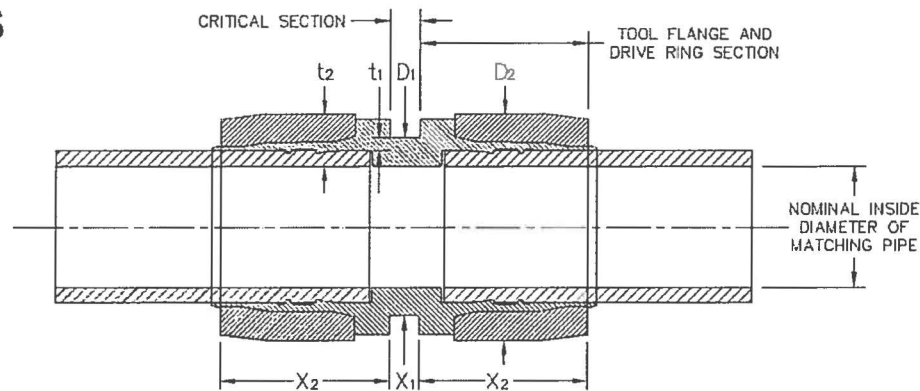
Responses to NRC Questions/Concerns

- Description and drawing



Responses to NRC Questions/Concerns

- Dimensions



Fitting Size	Tool Flange + Drive Ring Outside Diameter		Tool Flange + Drive Ring Length		Tool Groove Outside Diameter		Tool Groove Section Wall Thickness		Tool Groove Length	
	D_2		X_2		D_1		t_1		t_1	
NPS (DN)	in	(mm)	in	(mm)	in	(mm)	in	(mm)	in	(mm)
1/4 (8)	1.050	(26.7)	0.909	(23.1)	0.764	(19.4)	0.100	(2.5)	0.203	(5.2)
3/8 (10)	1.240	(31.5)	1.012	(25.7)	0.830	(21.1)	0.068	(1.7)	0.203	(5.2)
1/2 (15)	1.460	(37.1)	1.080	(27.4)	1.004	(25.5)	0.068	(1.7)	0.203	(5.2)
3/4 (20)	1.600	(40.6)	1.212	(30.8)	1.235	(31.4)	0.079	(2.0)	0.278	(7.1)
1 (25)	1.954	(49.6)	1.500	(38.1)	1.524	(38.7)	0.091	(2.3)	0.263	(6.7)
1-1/4 (32)	2.285	(58.0)	1.633	(41.5)	1.813	(46.1)	0.062	(1.6)	0.273	(6.9)
1-1/2 (40)	2.610	(66.3)	1.795	(45.6)	2.064	(52.4)	0.068	(1.7)	0.283	(7.2)
2 (50)	3.250	(82.6)	2.203	(56.0)	2.574	(65.4)	0.075	(1.9)	0.303	(7.7)

Partial Application List – Exelon Installations – 2016 - 2018

Site	Services in which Lokring Fittings are Installed	# of Lokring Fittings Installed
Braidwood	<ul style="list-style-type: none"> • Circulating water system small bore piping (1-inch) • 4-inch vent line in diesel oil storage tank system • Service Building Chiller rerouting water lines above the chiller heads • Aux Boiler modification for diesel line • Line replacement on WE in RH pump room 	202
Byron	<ul style="list-style-type: none"> • Diesel Oil Storage Tank loop seal modification. Used to prevent the need for welding on diesel piping 	20
LaSalle	<ul style="list-style-type: none"> • 3-inch repair to exciter cooler service water piping • SPE modification / line replacement • Generic EC for up to 2-inch non-safety pipe 	187
Quad Cities	<ul style="list-style-type: none"> • Upgrade drain line and vent lines for waste collector filter dome piping • Replace fuel pool filter demin dome drain valve • Replace sight glass on line for HPCI draing going to RBEDT • Replace piping associated with turbine bearing lift pump discharge bearing 5 RV & 7 RV • Reroute vent lines so travelling screen could be removed (TMod) • Reroute U-1 and U-2 reactor building sink outlets • Offgas piping • Gland water supply to circ pump 	117
Dresden	<ul style="list-style-type: none"> • EHC modification to install vertical pumps • "A" Concentrator replacement • 3A RFP casing replacement • 3A IAC Replacement • Feedwater Heater Drain Valves 	347
Clinton	<ul style="list-style-type: none"> • Scheduled to use on 2FP52A Fuel Line Replacement 	187
Nine Mile Point	<ul style="list-style-type: none"> • Feedwater and condensate system; used in three different applications • EHC system isolation valves installed at turbine valves (1600 psi) 	377
Oyster Creek	<ul style="list-style-type: none"> • Reactor Water clean up and Boiler system 	27

Partial Application List – Non-Nuclear Applications

Industry	Year	Work Description	Product (Pipe and Fitting Material and Size)	Pressure	Temperature
Steel Manufacturing	2005	6 Temper Mill Hydraulics	CS, NPS 1/2 – NPS 3, Sch. 40	250-1000 psi	Ambient
Steel Manufacturing	1999	Hydraulics	CS, Sch. 40/80	1500 psi	Ambient
Steel Manufacturing	2009	3000 - 5000 psi Hydraulics; high vibration	NPS 2, Sch. 160	3000-5000 psi	
Steel Manufacturing	2009	Hydraulics	CS & SS, NPS 1/2 through 2	1000 psi	
Refining	1999	Condensate Lines	NPS 1, NPS 1-1/2, Sch. 80	2250 psi	Ambient
Petrochem	1999	Propylene	NPS 1-1/2, Sch. 80	2068 kPa	100°C
Offshore/Onshore	2007	Class 900 and Class 1500 RTJ flanges and couplings		1435 psi	
Pulp & Paper	1991	Hydraulic Fluid	NPS 1-1/4, NPS 1-1/2, Sch. 40	1000 psi	200°F
Chemical	1993	Lube Oil	NPS 1-1/2, Sch. 80	1200-3500 psi	Ambient
Chemical	1991	Hydraulics	NPS 3/4, Sch.40	1500 psi	Ambient
Chemical	2009	Natural Gas	CS, NPS 1/2	3800 psi	Ambient
Petrochem	1997 - 2009	Paraxylene Unit and Ethylene Unit; 1/2" fittings installed in high vibration service in Ethylene Unit Product Compressors.	NPS 1/2 – NPS 3	1450 psi	
Automotive	1998	Sealer	CS, NPS 2, Sch.160	3500 psi	125°F
Railroad	2004	Hydraulic Lines on Equipment	CS, A53 Seamless, NPS 1/2, NPS 1, Sch. 80	3000 psi	Ambient
Steel Manufacturing	1999	Hydraulics	CS, NPS ½ – NPS 2, Sch. 40	3000 psi	Ambient
Petrochem	1998	Gas Dehydration	NPS 1, NPS 1-1/2, NPS 2, Sch. 80	1500 psi	250°F
Petrochem	1993	Hydrogen	NPS 1-1/2	2400 psi	
Petrochem	1993	Hydrogen	NPS ½	2400 psi	Ambient
Petrochem	1992	Helium	NPS 1/2, Sch. 40	2400 psi	Ambient
Pulp & Paper	1993	Hydraulic Oil	NPS 1, Sch. 40	2500 psi	120°F
Chemical	1999	Treated Boiler Feedwater	NPS 1-1/2, Sch. 80	1270 psi	400°F
Chemical	1989	Hydraulics	NPS 1-1/2, NPS 2	1200 psi	Ambient

CS = Carbon Steel SS = Stainless Steel



Exelon Generation.

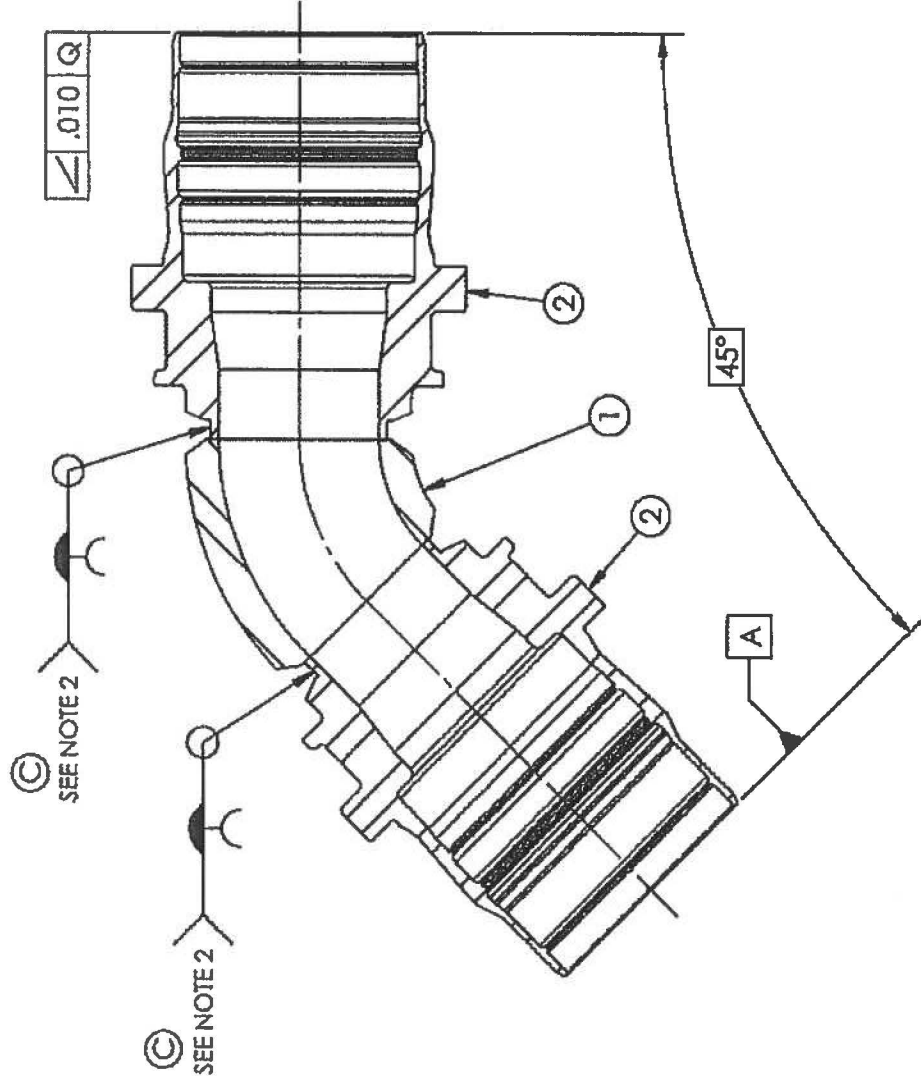
Tensile Strength and Fracture Toughness

- Minimum tensile strength: 110 ksi
- Maximum tensile strength: 130 ksi
- Fracture toughness is difficult to determine, because material is too thin to obtain impact test specimens.
- Maximum thickness of Lokring fittings for use with NPS 2 Schedule 80 pipe is $\sim 3/8$ in.
- Impact testing is not required by B31.1.
- Impact testing is exempted by Section III, NC/ND-2311, based on section thickness $< 5/8$ in., and based on diameter $< \text{NPS } 6$.

Welding Variables

- **P-Number of Micro-alloyed, 80ksi Steel**
 - This material has no P-Number assigned by ASME.
 - Separate Welding Procedure Qualification was performed using the micro-alloyed, 80ksi steel.
- **Filler Material**
 - ER70, plain carbon steel, corresponding to the properties of the A106 Grade B (or equivalent) pipe, tee, or elbow to which the Lokring fitting is attached.
- **Preheat and Postweld Heat Treatment**
 - Preheat temperature is 70°F minimum.
 - No PWHT is permitted, as it would degrade the required mechanical strength.

Weld Configuration



Welding Qualification Test Results

- PQR Test Results

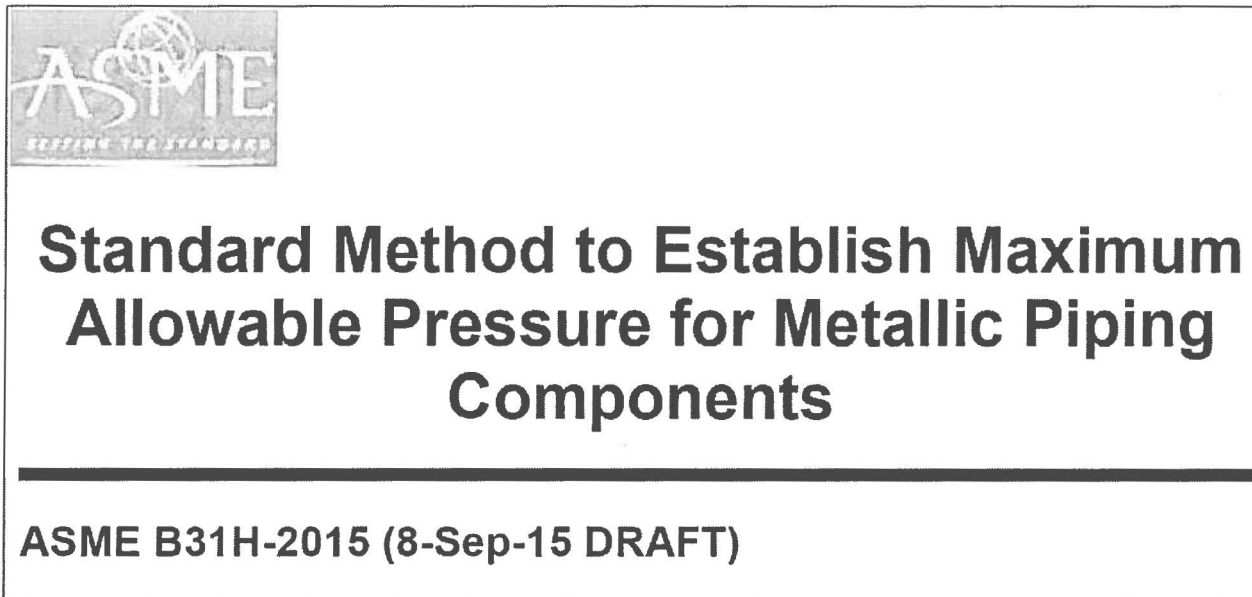
- Tensile Strength 81 ksi
- Tensile specimen fracture was ductile and in the weld metal
- Procedure qualification base metal tensile strength is 114 ksi. Base metal hardness corresponds to 114 ksi. HAZ hardness with no preheat or PWHT corresponds to 124 ksi.
- Bend tests were acceptable.

Structural Integrity and Qualification Methods

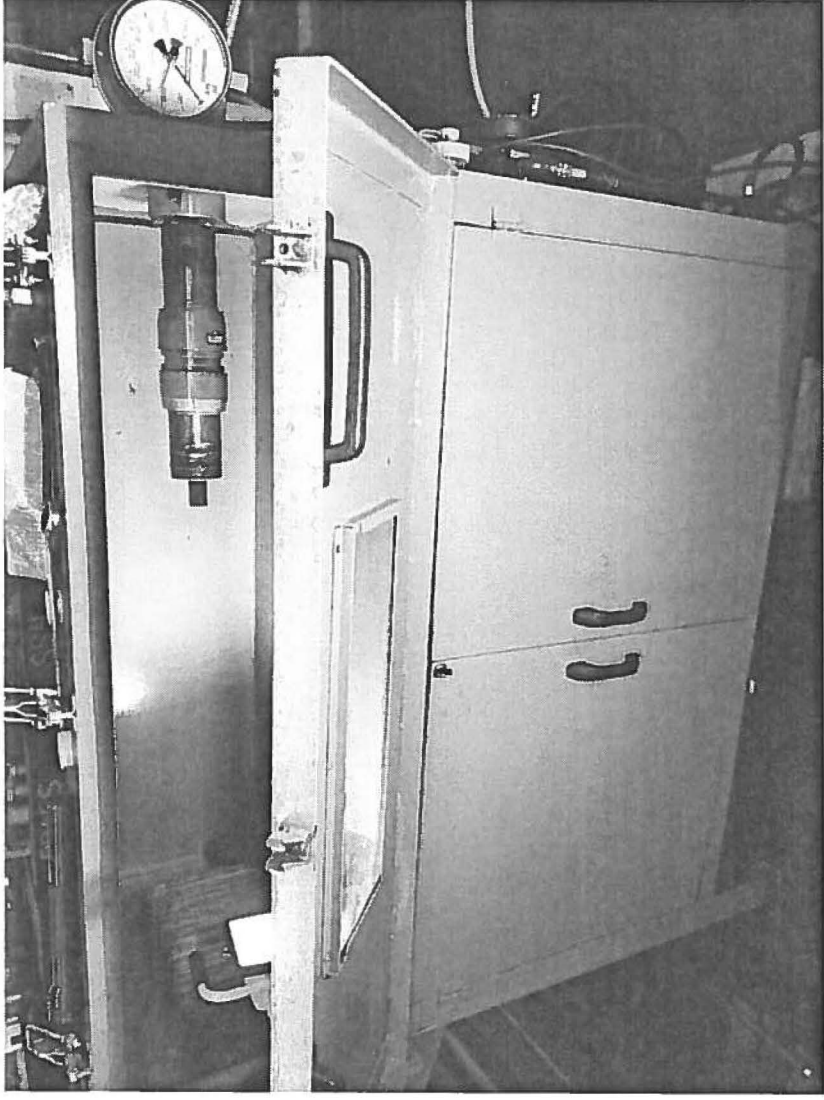
- Lokring fittings, with Case N-879 material, have extensive testing and service experience.
- Proven by testing in accordance with Section III, NC/ND-3671.7 and NC/ND-3649.
- Stress analysis is impractical, due to fitting configuration.
- Testing performed:
 - Burst
 - Fatigue
 - Tensile (pull out)
 - Torsion
 - Vibration
- Extensive use in similar, but non-safety-related, service in multiple applications.

Structural Integrity and Qualification Methods

- Burst Testing
 - Lokring performs proof tests in accordance with ASME B16.9, MSS SP-97, or Section VIII, Division 1, UG-101, and Section 1
 - Test per ASME B31H

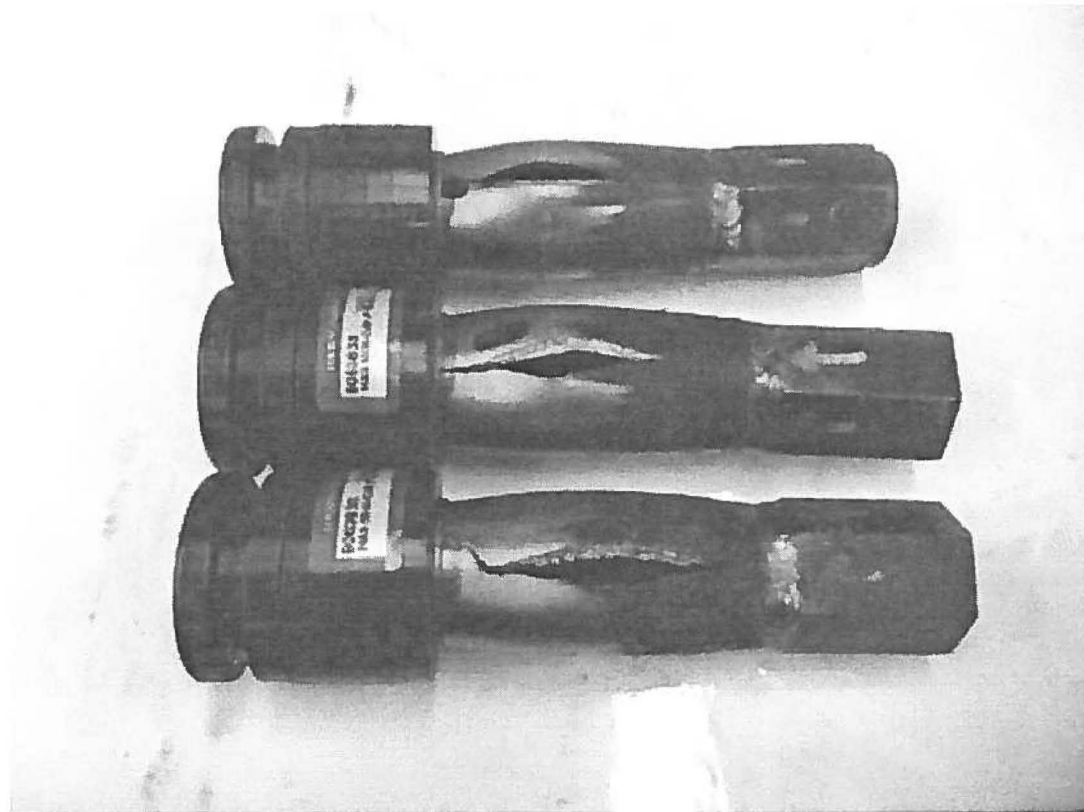


Structural Integrity and Qualification Methods



Burst pressure test chamber

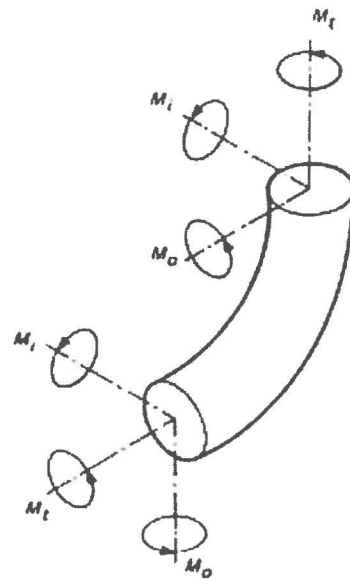
Structural Integrity and Qualification Methods



Burst test specimen- MAS 3000 CAP P16 installed on ASTM A106 B, A53 B, API 5L B
schedule 80

Structural Integrity and Qualification Methods

- Fatigue Testing
 - Lokring performs proof tests in accordance with ASME B31.1 Section 119.7.3 method to determine Flexibility and Stress Intensification Factors for components of piping systems
 - Test per ASME B31J



ASME B31J-2017
(Revision of ASME B31J-2000 (B31.1J))

**Stress Intensification
Factors (*i*-Factors),
Flexibility Factors
(*k*-Factors), and Their
Determination for
Metallic Piping
Components**

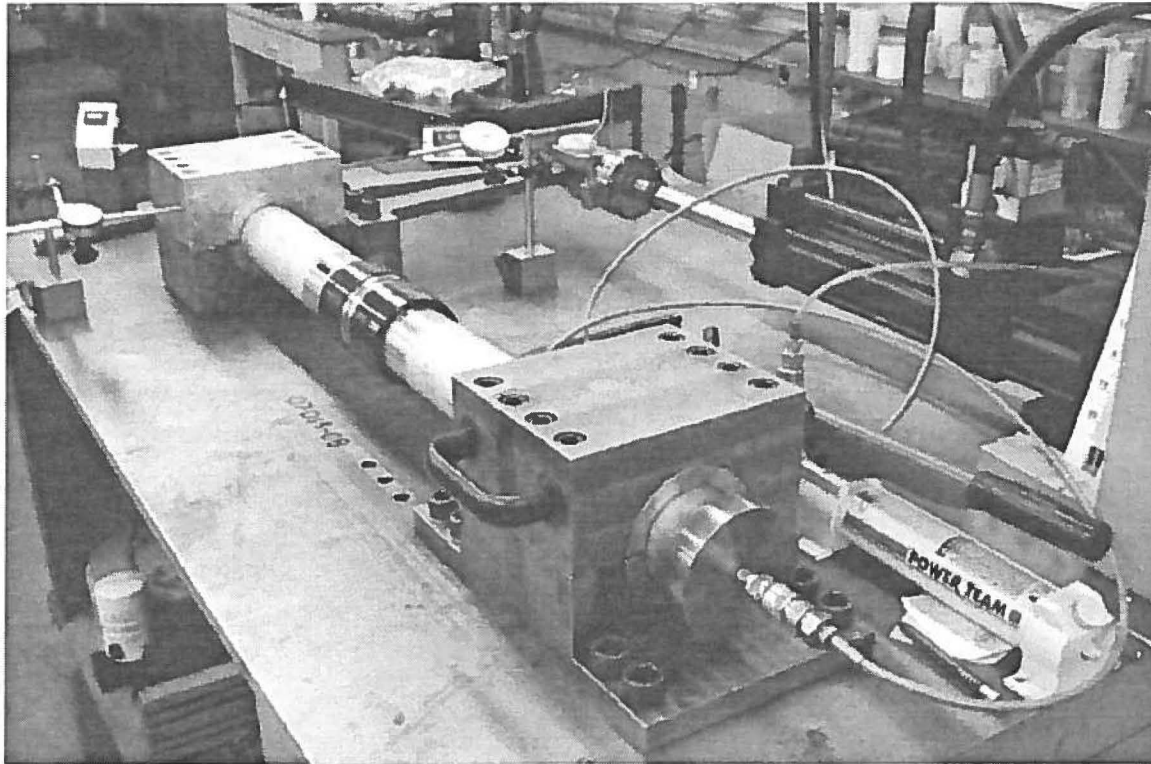
ASME Code for Pressure Piping, B31

AN AMERICAN NATIONAL STANDARD



Exelon Generation.

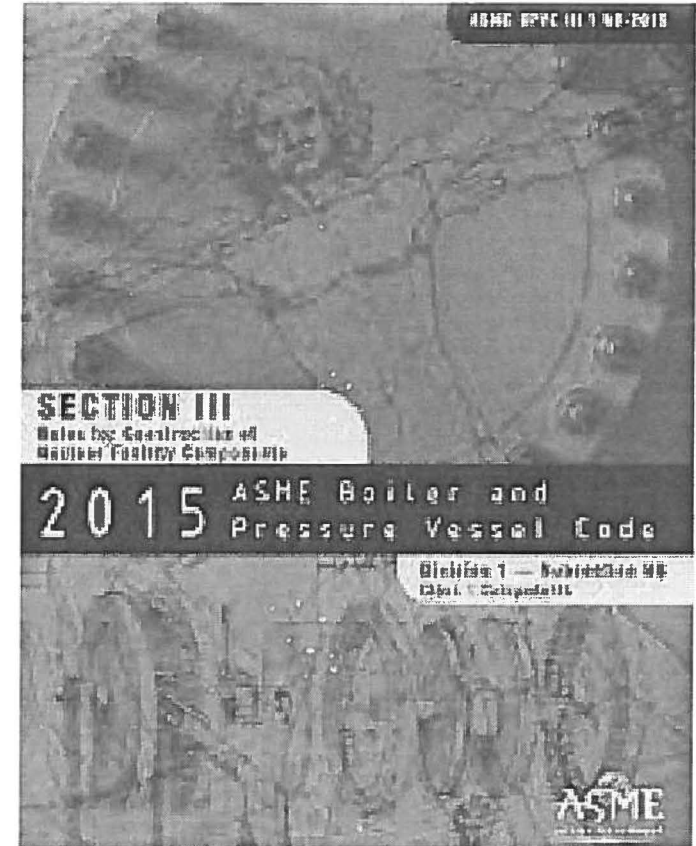
Structural Integrity and Qualification Methods



A bending moment is created from the Hydraulic Cylinder and Bending Arm, which creates a moment in a plane passing through the neutral axis of the Pipe and Coupling specimen assembly. In one complete flexural cycle, the Pipe and Coupling specimen assembly bends an equal distance to either side of the neutral axis.

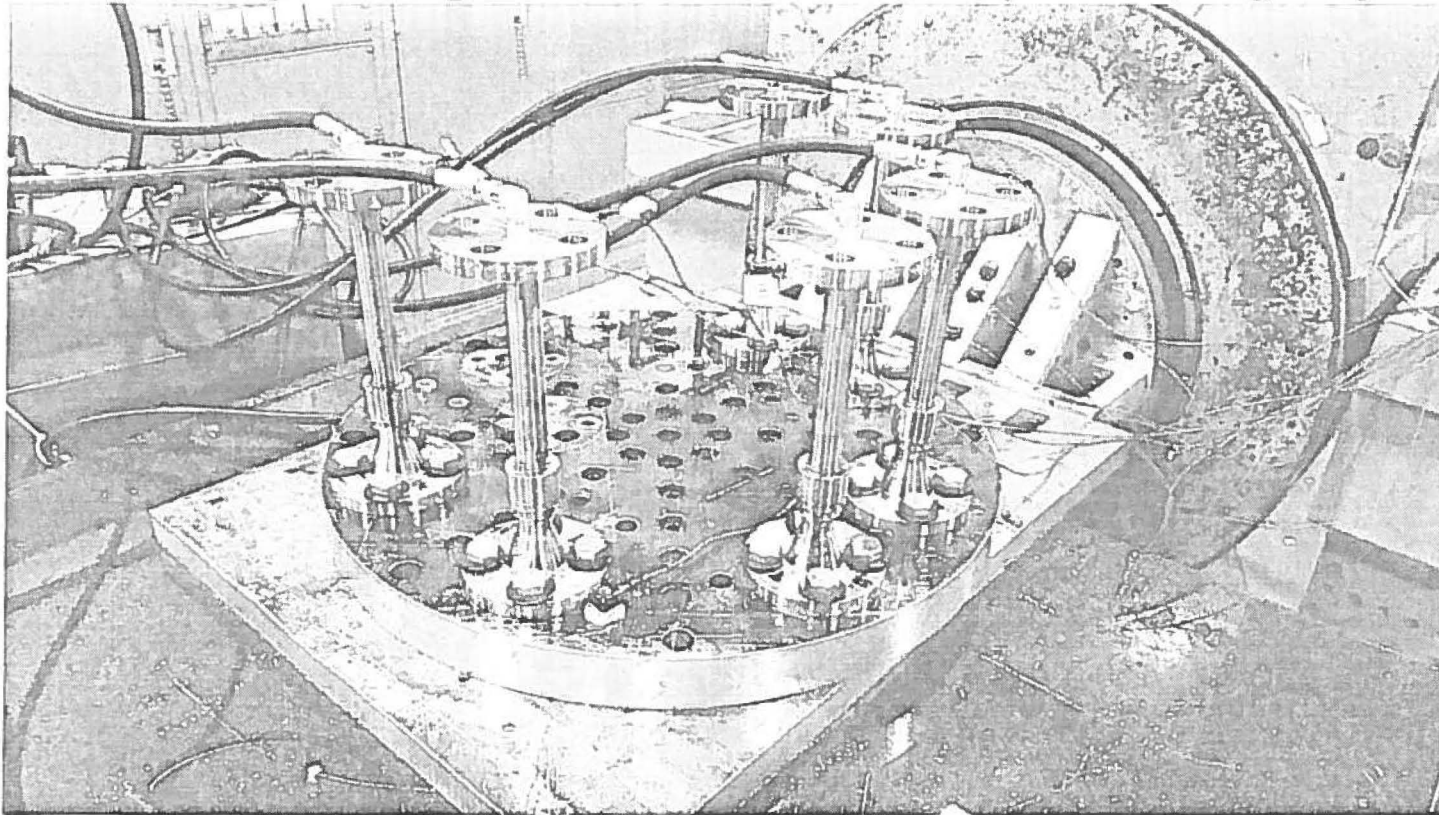
Structural Integrity and Qualification Methods

- Vibration Testing
 - Lokring performs proof tests in accordance with ASME BPVC, Section III Article NB-3200
 - Experimental Stress Analysis Testing for the effects of Vibration (High Cycle, Low Amplitude) fatigue



Structural Integrity and Qualification Methods

- Lokring fittings being tested under low amplitude, high cycle loading.



Design Margins, Load Combinations, Cumulative Usage Factor

- Design Margins and Load Combinations are not relevant, because Lokring fittings are qualified by testing and have been demonstrated in accordance with Section III, NC/ND-3671.7 and NC/ND-3649 to be as good as 2:1 socket welded joints.
- Cumulative Usage Factors are not applicable, because Lokring fittings made from Case N-879 material are used only in applications where fatigue analysis is not required.
- However, Lokring has conducted an extensive testing program to determine appropriate stress indices for its fittings, for use in the piping system design.

Overall Summary

- Requesting use of ASME Case N-879 for alternative material for use in Lokring Pipe Fittings larger than NPS 1 and up to NPS 2.
- Extra alloying elements in CC N-879 Micro-Alloyed Carbon Steel Material, refine the grain size and significantly increase the tensile and yield strengths of the material while still maintaining acceptable ductility, toughness and corrosion resistance.
- Case N-879 has been approved and published by ASME.
- Case N-879 material is permitted by B31.1. NRC acceptance is not required for these applications.
- Case N-879 material is permitted by NC/ND-2121(d) for fittings up to NPS 1. NRC has already accepted the Section III provisions that permit use of this material for this application.
- Lokring mechanical installation reduces radiation exposure and outage time.

Questions and Feedback

- Questions and feedback?

