VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

August 8, 1997

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

Serial No.	97-079A
NL&OS/ETS	
Docket Nos.	50-338
	50-339
License Nos.	NPF-4
	NPF-7

Gentlemen:

VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNITS 1 AND 2
RELIEF FROM ASME SECTION XI REQUIREMENTS

In a February 24, 1997 letter (Serial No. 97-079), Virginia Electric and Power Company requested relief from ASME Section XI paragraph IWA-5250. The relief would permit continued Service Water System operation for up to eighteen months from the date of discovery of each minor leak or indication of previous leakage attributed to microbiological influenced corrosion (MIC). In a telephone conference call, the NRC staff requested additional information (i.e., a more definitive scope statement) to complete the evaluation of the Code Relief Request. The enclosure to this letter provides the revised relief request (NDE-32), which includes the requested information and a proposed change to the Service Water System walkdown frequency.

The proposed frequency for conducting Service Water System walkdowns has been changed from monthly in the initial relief request to every six weeks. This walkdown frequency was chosen to coincide with our twelve week Maintenance Rule planning schedule for the Charging Pumps in order to limit the time equipment is out of service for testing and maintenance, consistent with the intent to improve availability. Performing walkdowns on a six week frequency permits both proactive identification and repair of flaws as well as reducing the time safety-related equipment is out of service.

Until this relief is approved by the NRC staff, a routine monitoring program has been implemented for the Service Water System. The monitoring program includes walkdowns of the accessible portions of the stainless steel Service Water System piping to identify, monitor and quantify any leakage. When a leak or evidence of previous leakage is identified, an evaluation of the Service Water System is performed

A047/1

to the extent possible in accordance with Generic Letter (GL) 90-05, "Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping," to determine operability and continued safe operation of the units until the necessary ASME Code repairs can be completed.

The revised relief request has been reviewed and approved by the Station Nuclear Safety and Operating Committee.

This letter does not establish any additional commitments. If you have any additional questions concerning this relief request, please contact us.

Very truly yours,

RF Saunders

R. F. Saunders,
Vice President - Nuclear Engineering and Services

Enclosure

cc: U. S. Nuclear Regulatory Commission
Region II
Atlanta Federal Center
61 Forsyth St., SW, Suite 23T85
Atlanta, Georgia 30303

Mr. M. J. Morgan
NRC Senior Resident Inspector
North Anna Power Station

ENCLOSURE

Revised
ASME Section XI Relief Request
NDE-32

MIC Monitoring Program

Virginia Electric and Power Company
North Anna Power Station Units 1 and 2

Virginia Electric & Power Company
North Anna Power Station Unit 1 and Unit 2
Second 10 Year Interval
Request for Relief Number NDE-32 Revision 2

I. IDENTIFICATION OF COMPONENTS

	Drawing #
Service Water System	11715-CBB-40D-2 SHTS. 1 and 2
	11715-CBM-78A-2 SHTS. 1 and 4
	11715-CBM-78B-2 SHTS. 1 and 3
	11715-CBM-78C-2 SHT. 2
	11715-CBM-78G-2 SHTS. 1 and 2
	11715-CBM-73H-2 SHT. 1

Components within the scope of this Request for Relief include the welds and associated piping which comprise the moderate energy stainless steel piping of the Service Water System (SW). This piping system provides cooling water from the Service Water Reservior to safety related equipment and return the Service Water back to the return headers. Normal operating pressure is 100 PSIG. The design pressure is 150 PSIG and the design temperature is 150°F. This is an ASME, Section XI, Class 3 system.

Attachment 2 provides an identification of each piping segment within the scope of this Request for Relief. The piping segments are identified by their line number designation which is a unique identifier. The graphics represented on the associated drawings of each piping segment along with the associated line number designation provide a defining boundary for each pipe segment. The identification of piping segments as components is appropriate as both the welds and piping forming the piping segments are subject to developing through wall leaks.

II. IMPRACTICABLE CODE REQUIREMENTS

The Service Water System has experienced through-wall leakage caused by Microbiological Influenced Corrosion (MIC). Chemical treatment of the Service Water System has not been effective in eliminating MIC. The Service Water System is being monitored for MIC. Identification of additional through-wall leakage is anticipated. Through-wall leakage must be located and evaluated in accordance with the requirements of IWA-5250 of the 1983 Edition and Summer 1983 Addenda for Unit 1 and 1986 Edition for Unit 2. The specific Code requirement for which relief is requested is IWA-5250(a)(2).

"IWA-5250 Corrective Measures:

(a) The source of leakage detected during the conduct of a system pressure test shall be located and evaluated by the Owner for corrective measures as follows:...

    (2) repairs or replacements of components shall be performed in accordance with IWA-4000 or IWA-7000, respectively."

Articles IWA-4000 and IWD-4000 of ASME Section XI Code repair requirements would require removal of the flaw and subsequent weld repair.

Code repairs for through-wall leaks require the line to be isolated and drained. Taking a train of service water out of service in some instances is a major evolution and requires entering a Technical Specification action statement. Welds and piping with through-wall flaws caused by MIC can typically be shown to have adequate structural integrity to remain in service. This type of through-wall flaw is unpredictable but not normally subject to catastrophic failure. It is impractical to require a Code repair within the time specified by the Technical Specification Limiting Condition for Operation every time a through-wall flaw is identified.

Generic Letter 90-05, "Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping", provides guidance for submitting relief requests to allow continued operation with a through-wall flaw. Submitting a relief request for each instance of through-wall leakage caused by MIC is an administrative burden and causes additional unnecessary reviews for the NRC. Implementing GL 90-05 each time a through-wall flaw is identified is also impractical.

This relief request establishes a plan for continued operation with through-wall flaws in stainless steel piping in the Service Water System based upon the guidance of GL 90-05 to the extent it is believed practical. This relief request will be implemented upon receiving NRC approval. In the interim, GL 90-05 will be followed for through-wall flaws and relief requests will be submitted.

III. ISI BASIS FOR RELIEF REQUEST

This relief request is submitted in a format laid out in NRC GL 90-05. The following information and justification is provided in accordance with the guidelines of Part B and C of Enclosure 1 to GL 90-05.

Scope, Limitations and Specific Considerations

Scope

The scope consists of welds and stainless steel piping, pipe class 153A and 163, with evidence of possible through-wall leaks in the Service Water System at North Anna Power Station Units 1 and 2.

Limitations

Based on radiographic examinations and laboratory examinations of removed portions of piping from replacements, North Anna Power Station is experiencing MIC in its stainless steel piping. The MIC caused flaws originate on the inner diameter of the pipe. The Service Water System is common to both Units. As long as one Unit is in Mode 1, 2, 3, or 4 both trains of service water must be operable. If both Units are in Mode 5 or 6 then one train of Service Water must be operable. The intent of this relief is to permit continued operation with the identified through-wall flaws until repairs are accomplished in a scheduled service water outage.

Specific Considerations

System interactions, i.e. consequences of flooding and spray will be evaluated. The flaws located on piping, such that potential through-wall leakage could affect plant safety related equipment will be declared inoperable and the appropriate Technical Specification action statement entered.

Butt welds and piping accessible to radiography with through-wall flaws will be evaluated for structural integrity within 14 days of identification for all design loading conditions, including dead weight, pressure, thermal expansion and seismic (DBE) loads. The methods used in the structural integrity analysis will consist of area reinforcement, fracture mechanics, and limit load analyses. These methods are detailed in Attachment 1. The welds that are found to be unacceptable will be declared inoperable and the appropriate Technical Specification action statement entered.

A 3/4" hole will be postulated for any location with a through-wall flaw that can not be characterized volumetrically by ultrasonics or radiography, socket welds and welds that are inaccessible for radiography. Laboratory examination of cut sections of MIC degraded socket weld samples indicate that flaws are enveloped within the 3/4" size. A leaking socket weld location will be analyzed by treating the cross section as equivalent to the cross section of the attached pipe with a 3/4" hole. The methods used in the structural integrity analysis will consist of area reinforcement, fracture mechanics, and limit load analyses. These methods are detailed in Attachment 1. A through-wall flaw size is postulated in order to perform a structural analysis. Additional monitoring is performed for a period of two (2) months on socket welds to assure the degradation mechanism is behaving in a manner expected for a MIC flaw.

The structural integrity for all welds identified with evidence of through-wall leakage will be monitored by the following methods:

- Weekly visual monitoring of through-wall flaws from the time of identification until completion of structural integrity analysis. If the welds are determined to be structurally acceptable then the visual monitoring frequency will be decreased to once every six weeks.

- Weekly visual monitoring of through-wall flaws in socket welds and butt welds inaccessible to radiography for a period of two (2) months. If there is no significant change in the leakage rate the monitoring frequency will be decreased to once every six weeks until the welds are repaired.

- A significant change is defined as a 0.5 gpm increase in the leakage rate from the initial observed leakage condition for each weld. Should any location reach the threshold of a significant change the weld will be reassessed for structural integrity and flood/spraying consequences.

- A total leakage rate limit of 1.0 gpm for a single supply or return line to an individual component will be established. If this total leakage rate limit is exceeded then an evaluation will be performed to determine if design service water flow is available to affected components. Inadequate service water supply will cause the associated service water lines and equipment to be declared inoperable and appropriate action will be taken according to Technical Specifications.

The temporary non-code repair will be to leave the welds as they are found, subject to monitoring and meeting the criteria for consequences and for structural integrity as described above.

<u>Evaluation</u>

<u>Flaw Detection During Plant Operation and Impracticality Determination</u>

The Service Water System is a common system for both Units at North Anna Power Station. Both trains are required to be operational or the appropriate Technical Specification action statement be entered. The through-wall flaws on Service Water lines in service are anticipated based on the North Anna Power Station history of MIC. Virginia Electric and Power Company requests to evaluate the flaws and leave acceptable through-wall flaws in service in order to perform Code repairs in controlled conditions during scheduled service water outages.

Root Cause Determination and Flaw Characterization

The Service Water System at North Anna Power Station has previously experienced MIC. Radiograph examinations of service water welds having evidence of through-wall leakage revealed small voids surrounded by exfoliation, which is typical of MIC. No other type of inservice defects were identified by the radiographs near the areas with through-wall leaks. Additionally, a visual examination performed by a Virginia Electric and Power Company staff metallurgist of a sample of piping segments removed to repair the leaking welds confirmed the presence of MIC.

Butt welds identified with through-wall leakage and accessible for radiography will be radiographed and evaluated for structural integrity within 14 days of discovery.

Through-wall flaws that cannot be characterized by radiography, socket welds and inaccessible butt welds, will be characterized as a 3/4" hole for each area of leakage.

Flaw Evaluation

Flaw evaluation for welds with through-wall leakage will be performed as described in Attachment 1. The flaws in butt welds that can be characterized by radiography will be evaluated by three types of analyses, area reinforcement, limit load analyses, and fracture mechanics using the guidance from NRC Generic Letter 90-05. The flaws in welds that cannot be characterized by radiography, i.e. socket welds and inaccessible butt welds, will be evaluated by the same analysis by assuming a 3/4" hole for each point of leakage within a weld with through-wall leakage. Socket welds will be analyzed by treating the cross section at the socket weld as equivalent pipe cross section.

IV. AUGMENTED INSPECTION

An augmented inspection program will monitor a sample of butt welds in the Service Water System using radiography. Radiography will be performed every three (3) months. The frequency of radiography will be assessed after a year and may be adjusted for each location based on the results of the radiographs.

V. ALTERNATE PROVISIONS

As an alternative to performing Code repairs in accordance with IWA-5250(a)(2) to through-wall flaws in the Service Water System the through-wall flaws will be left as is. The through-wall flaws will be monitored for leakage and must meet the criteria for flooding and spraying consequences and for structural integrity as described to remain in service. Operation in this mode will continue until the subject welds are replaced. All welds identified with through-wall flaws will be replaced within 18 months from the time of discovery.

The structural integrity of the Service Water System will be monitored by the following methods until the repairs required by IWA 5250(a)(2) are completed.

- Weekly visual monitoring of through-wall flaws from the time of identification until completion of structural integrity analysis. If the welds are determined to be structurally acceptable then the visual monitoring frequency will be decreased to once every six weeks.

- All welds identified as having a through-wall flaw will be assessed for structural integrity within 14 days of detection. Butt welds will be radiographed, if accessible, to characterize the flaws. Socket welds and butt welds inaccessible to radiography will be assessed for structural integrity by assuming a conservative large hole. Welds determined to be structurally adequate will be included in the above monitoring program. Identification of a structurally inadequate weld will result in the associated piping to be declared inoperable and the appropriate Technical Specification action statement to be taken.

- Weekly visual monitoring of through-wall flaws in socket welds and butt welds inaccessible to radiography for a period of two (2) months. If there is no significant change in the leakage rate the monitoring frequency will be decreased to once every six weeks until the welds are repaired.

- A significant change is defined as a 0.5 gpm increase in the leakage rate from the initial observed leakage condition for each weld. Should any location reach the threshold of a significant change, the weld will be reassessed for structural integrity and flood/spraying consequences.

- A walkdown of the accessible stainless steel portions of the Service Water System will be performed every six weeks. This inspection frequency qas chosen to coincide with the existing 12 week Maintenance Rule schedule for Charging Pumps in order to limit the time equipment is out of service for testing and maintenance consistent with the intent of the Maintenance Rule. Two one week windows, six weeks apart, are available within this schedule to perform service water repairs. Performing inspections within this schedule will allow repairs to be made in a timely manner and reduce the time safety related equipment is out of service. The frequency of the walkdowns will be assessed after a year and maybe adjusted based on the results of the inspections.

- A total leakage rate limit of 1.0 gpm for a single supply or return line for an individual component will be established. If this total leakage rate limit is exceeded then an evaluation will be performed to determine if design service water flow is available to affected components. Inadequate service water supply will cause the associated service water lines and equipment to be declared inoperable and appropriate action will be taken according to Technical Specifications.

- An augmented inspection program will monitor a sample of butt welds in the Service Water System using radiography. Radiography will be performed every three (3) months. The frequency of radiography will be assessed after a year and may be adjusted for each location based on the results of the radiographs.

The proposed alternative stated above will ensure that the overall level of plant quality and safety will not be compromised.

VI IMPLEMENTATION SCHEDULE

This alternative to Code requirements will be followed upon receiving NRC approval for the remainder of the second ten-year inspection intervals. The Unit 1 second ten-year inspection interval will end on December 24, 1998 and the Unit 2 second ten-year interval will end on December 14, 2000.

Attachments:

1. Flaw Evaluation Methods and Results
2. Drawing/Line Number Designations

References:

1. USAS B31.1 Power Piping 1967 Edition
2. EPRI Report NP-6301-D, "Ductile Fracture Handbook"
3. Nuclear Regulatory Commission Generic Letter 90-05 "Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping"

ATTACHMENT 1
Flaw Evaluation Methods and Results

Introduction

Butt welds identified as having possible through-wall leaks will be radiographed, if accessible. Flaws in butt welds that are inaccessible for radiography will be postulated as a 3/4" hole for each area identified with a through-wall flaw. All butt welds will be analyzed for structural integrity by three methods, area reinforcement, limit load analysis, and linear elastic fracture mechanics evaluation.

Flaw size in socket welds identified as having possible through-wall leaks cannot be characterized by nondestructive examination. A conservatively large hole, 3/4", will be postulated for each area identified with a through-wall flaw. The postulated flaw will be analyzed for structural integrity by treating the cross section as equivalent to the cross section of the attached pipe.

Area Reinforcement Analysis

The area reinforcement analysis is used to determine if adequate reinforcing exists such that ductile tearing would not occur. The guidelines of ANSI B31.1 paragraph 104.3.(d) 2 (reference 1) are used to determine the Code required reinforcing area. The actual reinforcing area is calculated and is checked against the required reinforcement area.

The Code required reinforcement area in square inches is defined as:

$$1.07(tm)(d1)$$

Where tm is the code minimum wall, and d1 is the outside diameter

The Code reinforcement area required is provided by the available material around the flaw in the reinforcing zone.

Limit Load Analysis

The structural integrity of the piping in the degraded condition will be established by calculating the minimum margin of safety based upon a Limit Load Analysis. These methods are documented in EPRI report NP-6301-D (Ductile Fracture Handbook) (reference 2).

$$MR = \sqrt{MY^2 + MZ^2 + T^2}$$

The limit load analysis of the postulated flawed sections will be performed with a material flow stress representing the midpoint of the ultimate strength and yield point stress. The flawed sections will be subjected to deadweight, thermal, and seismic DBE loading.

The allowable limit load is given by,

$Ma = 2 \cdot \sigma f \cdot Rm2 \cdot t \cdot (2\cos(\beta) - \sin(\Theta))$ in-lbf

σf = flow stress = 0.5 (Sy + Su) psi
Sy = yield stress psi
Su = ultimate stress psi
Rm = mean radius of the pipe

$$\beta = \frac{\Theta}{2} + \frac{\Pi \bullet (R_i^2 \bullet P) + F}{4 \bullet \sigma_f \bullet R_m \bullet t}$$

Ri = internal radius of the pipe
P = pressure psig
F = axial load in lbs
t = pipe thickness = inches
D = Outside diameter inches
Θ = half angle of the crack (radians) = $\frac{\text{crack length}}{2 \cdot Rm}$

MR = Resultant Moment

MY = Bending Moment
MZ = Bending Moment
T = Torsion

The calculated factor of safety is,
$FS = \frac{Ma}{(MR)}$

The minimum factor of safety of 1.4 is required to be qualified for continued operation.

Fracture Mechanics Evaluation

A linear elastic fracture mechanics analysis will be performed for circumferential through-wall crack using the guidance provided in NRC Generic Letter 90-05. The structural integrity of the piping in the degraded condition was established by calculating the minimum margin of safety based upon a Fracture Mechanics evaluation. This method is documented in EPRI report NP-6301-D (Ductile Fracture Handbook) (reference 2).

A through-wall circumferential crack will be postulated for every area containing MIC. The cracks will be subjected to a design pressure loading in addition to the deadweight, normal operating thermal and seismic DBE loadings. For the purpose of this evaluation a generic allowable stress intensity factor of KIC = 135 ksiÖin will be used for the stainless steel material per NRC GL 90-05.

The applied stress intensity factor for bending, KIB, is found by:

$$KIB = [\sigma b \cdot (\pi \cdot Rm \cdot \Theta)0.5] \cdot Fb$$

The applied stress intensity factor for internal pressure, KIP, is found by:

$$KIP = \sigma m \cdot (\pi \cdot Rm \cdot \Theta)0.5 \cdot Fm$$

The applied stress intensity factor for axial tension, KIT is found by:

$$KIT = \sigma t \cdot (\pi \cdot Rm \cdot \Theta)0.5 \cdot Ft$$

The stress intensity factor for residual stresses, KIR is found by:

$$KIR = S \cdot (\pi \cdot Rm \cdot \Theta)0.5 \cdot Ft$$

Total applied stress intensity KT includes a 1.4 safety factor and is calculated by:

$$KT = 1.4 \cdot (KIB + KIP + KIT) + KIR$$

The allowable stress intensity factor is taken from Generic Letter 90-05.

KALL = 135 ksiΓin

Stress Intensity Factor Ratio is defined as:

$$SR = \frac{KT}{KALL}$$

The stress intensity factor ratio shall be less than 1.0 for continued operation.

ATTACHMENT 2

List of drawings containing the Service Water System and the associated line number designations for pipe class 153A and 163.

DRAWING 11715-CBB-040D-2, SHEET 1

1-1/4"-WS-G37-153A-Q3	4"-WS-G01-163-Q3
3/4"-WS-F83-163	4"-WS-F99-163-Q3
3/4"-WS-F82-163-Q3	

DRAWING 11715-CBB-040D-2, SHEET 2

1-1/4"-WS-H78-153A-Q3	1-1/4"-WS-H81-153A-Q3

DRAWING 11715-CBM-078A-2, SHEET 1

3/4"-WS-G31-163-Q3	3/4"-WS-F67-163-Q3
3/4"-WS-H77-163-Q3	4"-WS-F64-163-Q3
4"-WS-H76-163-Q3	3/4"-WS-F80-163-Q3
3/4"-WS-G30-163-Q3	3/4"-WS-F68-163-Q3
3/4"-WS-339-163-Q3	4"-WS-F65-163-Q3
3/4"-WS-G36-163-Q3	3/4"-WS-F69-163-Q3
3/4"-WS-930-163-Q3	8"-WS- 93-163-Q3
1/2"-WS-F61-163-Q3	8"-WS- 94-163-Q3
2"-WS-D72-163-Q3	4"-WS-F62-163-Q3
3/4"-WS-F78-163-Q3	3/4"-WS-F66-163-Q3
4"-WS-F63-163-Q3	3/4"-WS-F79-163-Q3

DRAWING 11715-CBM-078A-2, SHEET 4

8"-WS-515-163-Q3	8"-WS-516-163-Q3
8"-WS-513-163-Q3	8"-WS-514-163-Q3
4"-WS-H48-163-Q3	3/4"-WS-F64-163-Q3
3/4"-WS-H52-163-Q3	3/4"-WS-H53-163-Q3
4"-WS-H50-163-Q3	3/4"-WS-H66-163-Q3
3/4"-WS-H54-163-Q3	4"-WS-H51-163-Q3
3/4"-WS-H67-163-Q3	3/4"-WS-H55-163-Q3
3/4"-WS-G32-163-Q3	3/4"-WS-G33-163-Q3
8"-WS-115-163-Q3	8"-WS-116-163-Q3
8"-WS-113-163-Q3	4"-WS- 46-163-Q3
4"-WS- 47-163-Q3	2"-WS-926-163-Q3
3/4"-WS-H60-163-Q3	3/4"-WS-H61-163-Q3
3/4"-WS-H62-163-Q3	3/4"-WS-H63-163-Q3
4"-WS- 56-163-Q3	4"-WS- 57-163-Q3
8"-WS-114-163-Q3	

DRAWING 11715-CBM-078B-2, SHEET 1

1-1/2"-WS-346-163-Q3
1"-WS-G06-163-Q3
1-1/2"-WS-348-163-Q3
1"-WS-G05-163-Q3
1-1/2"-WS-350-163-Q3
1"-WS-G04-163-Q3
1-1/2"-WS-352-163-Q3
1"-WS-G03-163-Q3
3/4"-WS-347-163-Q3
3/4"-WS-351-163-Q3

1"-WS-347-163-Q3
1-1/2"-WS-347-163-Q3
1"-WS-349-163-Q3
1-1/2"-WS-349-163-Q3
1"-WS-351-163-Q3
1-1/2"-WS-351-163-Q3
1"-WS-353-163-Q3
1-1/2"-WS-353-163-Q3
3/4"-WS-349-163-Q3
3/4"-WS-353-163-Q3

DRAWING 11715-CBM-078B-2, SHEET 3

1-1/2"-WS-724-163-Q3
1"-WS-933-163-Q3
1-1/2"-WS-726-163-Q3
1"-WS-934-163-Q3
1"-WS-729-163-Q3
1-1/2"-WS-729-163-Q3
1"-WS-731-163-Q3
1-1/2"-WS-731-163-Q3
3/4"-WS-725-163-Q3
3/4"-WS-729-163-Q3

1"-WS-725-163-Q3
1-1/2"-WS-725-163-Q3
1"-WS-727-163-Q3
1-1/2"-WS-728-163-Q3
1"-WS-935-163-Q3
1-1/2"-WS-730-163-Q3
1"-WS-936-163-Q3
1-1/2"-WS-727-163-Q3
3/4"-WS-725-163-Q3
3/4"-WS-731-163-Q3

DRAWING 11715-CBM-078C-2, SHEET 2

4"-WS- 46-163-Q3
3/4"-WS-A47-163-Q3
1"-WS- 81-163-Q3
1"-WS- 77-163-Q3
1"-WS-477-163-Q3
1"-WS-481-163-Q3
3"-WS- 73-163-Q3
4"-WS- 47-163-Q3
3/4"-WS-A49-163-Q3
1"-WS- 82-163-Q3
1"-WS- 78-163-Q3
1"-WS-478-163-Q3
1"-WS-482-163-Q3
3"-WS- 74-163-Q3
4"-WS- 56-163-Q3
3/4"-WS-A48-163-Q3

1"-WS- 85-163-Q3
1"-WS-485-163-Q3
1"-WS-487-163-Q3
1"-WS-489-163-Q3
1"-WS-491-163-Q3
3"-WS- 75-163-Q3
3"-WS- 76-163-Q3
3/4"-WS- 79-163-Q3
3/4"-WS-381-163-Q3
2"-WS- 80-163-Q3
3/4"-WS- 83-163-Q3
3/8"-WS-383-163-Q3
3/8"-WS-382-163-Q3
2"-WS-376-163-Q3
3/8"-WS-397-163-Q3
3/8"-WS-398-163-Q3

11715-CBM-078C-2, SHEET 2 (Cont'd)

11715-CBM-078C-2, SHEET 2 (Cont'd)

1"-WS- 90-163-Q3
3/4"-WS-C06-163-Q3
1"-WS- 92-163-Q3
1"-WS- 86-163-Q3
3/4"-WS-C01-163-Q3
1"-WS-488-163-Q3
3/4"-WS-913-163-Q3
1"-WS-490-163-Q3
1"-WS- 78-163-Q3
1"-WS-478-163-Q3
1"-WS-492-163-Q3
4"-WS- 57-163-Q3
3/4"-WS-773-163-Q3
2"-WS-772-163-Q3
3/8"-WS-910-163-Q3
3/8"-WS-914-163-Q3
2"-WS-776-163-Q3
3/8"-WS-916-163-Q3
2"-WS-777-163-Q3
1"-WS-486-163-Q3

2"-WS-377-163-Q3
3/8"-WS-C01-163-Q3
3/8"-WS-399-163-Q3
3/4"-WS-378-163-Q3
2"-WS- 84-163-Q3
3/4"-WS-379-163-Q3
1"-WS- 88-163-Q3
3/4"-WS-380-163-Q3
3/4"-WS- 83-163-Q3
3/8"-WS-383-163-Q3
3/4"-WS-A50-163-Q3
1"-WS- 89-163-Q3
3/4"-WS-400-163-Q3
3/4"-WS-774-163-Q3
2"-WS-775-163-Q3
3/8"-WS-913-163-Q3
3/8"-WS-915-163-Q3
3/4"-WS-779-163-Q3
3/4"-WS-909-163-Q3
3/8"-WS-912-163-Q3

DRAWING 11715-CBM-078G-2, SHEET 1

2"-WS-D46-153A-Q3
1"-WS-D50-153A-Q3
3/4"-WS-D39-153A-Q3
1"-WS-D30-153A-Q3
3/4"-WS-D41-153A-Q3
3/4"-WS-D55-163-Q3
1"-WS-D31-153A-Q3
3/4"-WS-D43-153A-Q3
3"-WS- 73-163-Q3
2"-WS- 54-163-Q3
2"-WS- 52-163-Q3
3/4"-WS-D67-163-Q3
2"-WS- 50-163-Q3
3"-WS- 74-163-Q3
2"-WS- 55-163-Q3
3/4"-WS-D54-163-Q3
2"-WS- 53-163-Q3
3/4"-WS-D68-163-Q3
2"-WS- 51-163-Q3

2"-WS-C88-153A-Q3
2"-WS-C81-153A-Q3
2"-WS-C87-153A-Q3
2"-WS- 63-163-Q3
3/4"-WS-D61-163-Q3
2"-WS- 62-163-Q3
2"-WS-C80-153A-Q3
3/4"-WS-C67-153A-Q3
3/4"-WS-C73-153A-Q3
3/4"-WS-C76-153A-Q3
3/4"-WS-C70-153A-Q3
2"-WS-C86-153A-Q3
2"-WS- 79-153A-Q3
2"-WS-C85-153A-Q3
3/4"-WS-D62-163-Q3
2"-WS- 60-163-Q3
3"-WS- 75-163-Q3
3/4"-WS-D69-163-Q3
2"-WS- 61-163-Q3

11715-CBM-078G-2, SHEET 1 (Cont'd)

11715-CBM-078G-2, SHEET 1 (Cont'd)

3/4"-WS-D56-163-Q3
2"-WS-C83-153A-Q3
2"-WS-C89-153A-Q3
3/4"-WS-D60-163-Q3
2"-WS- 64-163-Q3
2"-WS- 65-163-Q3
2"-WS-C82-153A-Q3
3/4"-WS-C68-153A-Q3
3/4"-WS-C74-153A-Q3
3/4"-WS-C71-153A-Q3
3/4"-WS-D70-163-Q3
3"-WS- 76-163-Q3
2"-WS-C78-153A-Q3
3/4"-WS-C66-153A-Q3
3/4"-WS-C72-153A-Q3
3/4"-WS-C75-153A-Q3
3/4"-WS-C69-153A-Q3
2"-WS-C84-153A-Q3
3/4"-WS-C77-153A-Q3

DRAWING 11715-CBM-078G-2, SHEET 2

2"-WS-D46-153A-Q3
3/4"-WS-D71-153A-Q3
1"-WS-D47-153A-Q3
3/4"-WS-D33-153A-Q3
3/4"-WS-D51-163-Q3
1"-WS-D48-153A-Q3
3/4"-WS-D35-153A-Q3
3/4"-WS-D52-163-Q3
1"-WS-D49-153A-Q3
3/4"-WS-D37-153A-Q3
3/4"-WS-D53-163-Q3
3"-WS- 73-163-Q3
3/4"-WS-D63-163-Q3
3"-WS- 74-163-Q3
2"-WS-454-163-Q3
2"-WS-455-163-Q3
2"-WS-452-163-Q3
2"-WS-453-163-Q3
2"-WS-450-163-Q3
2"-WS-451-163-Q3
2"-WS-949-153A-Q3
1-1/2"-WS-981-153A-Q3
1-1/2"-WS-965-153A-Q3
2"-WS-955-153A-Q3
3/4"-WS-D57-163-Q3
2"-WS-464-163-Q3
2"-WS-465-163-Q3
3"-WS- 75-163-Q3
3"-WS- 76-163-Q3
3/4"-WS-D59-163-Q3
2"-WS-461-163-Q3
3/4"-WS-D65-163-Q3
3/4"-WS-D66-163-Q3
3/4"-WS-934-153A-Q3
2"-WS-948-153A-Q3
3/4"-WS-940-153A-Q3
1-1/2"-WS-976-153A-Q3
1-1/2"-WS-982-153A-Q3
3/4"-WS-943-153A-Q3
3/4"-WS-937-153A-Q3
2"-WS-954-153A-Q3
2"-WS-947-153A-Q3
1-1/2"-WS-977-153A-Q3
1-1/2"-WS-963-153A-Q3
2"-WS-953-153A-Q3
3/4"-WS-D58-163-Q3
2"-WS-462-163-Q3
2"-WS-463-163-Q3
2"-WS-946-153A-Q3
1-1/2"-WS-979-153A-Q3
1-1/2"-WS-978-153A-Q3
2"-WS-952-153A-Q3
2"-WS-945-153A-Q3
1-1/2"-WS-980-153A-Q3
1-1/2"-WS-961-153A-Q3
2"-WS-460-163-Q3
2"-WS-945-153A-Q3
2"-WS-944-153A-Q3
1-1/2"-WS-975-153A-Q3
1-1/2"-WS-971-153A-Q3
2"-WS-950-153A-Q3

DRAWING 11715-CBM-078H-2, SHEET 1

1"-WS- 9-163	1"-WS- 10-163
3/4"-WS-E03-163	3/4"-WS-F45-163
3/4"-WS-F44-163	2"-WS-E64-163
1"-WS-G07-163	1/2"-WS-E68-163
3/4"-WS-E08-163	1"-WS-D97-163
1"-WS-947-163	2"-WS-D91-163
1"-WS-G50-163	1"-WS-H48-163