Nuclear Operating Company

South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

Withhold Enclosure 3 from Public Disclosure in Accordance with 10 CFR 2.390.

January 30, 2020
NOC-AE-20003708
10 CFR 50.55a
10 CFR 2.390
File No.: D43.01

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

South Texas Project
Unit 2
Docket No. STN 50-499
Inservice Inspection Summary Report – 2RE20

Attached is the South Texas Project Electric Generating Station Unit 2 summary report for inservice inspections performed prior to and during scheduled refueling outage 2RE20 completed in November 2019. This summary report satisfies the reporting requirements of American Society of Mechanical Engineers ASME Code Section XI, Article IWA-6230.

Enclosure 3 contains technical information for the indication evaluation prepared by Westinghouse Electric Company, LLC that includes proprietary information. It is respectfully requested that this information be withheld from public disclosure in accordance with 10 CFR 2.390. An application for withholding proprietary information from public disclosure is included in Enclosure 4.

There are no commitments in this letter.

If there are any questions regarding this report, please contact Ali Albaaj at (361) 972-8949 or me at (361) 972-7743.

Roland Dunn, Jr.
General Manager, Engineering

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Enclosures:
1. Summary Report for the 2RE20 Inservice Inspection of Unit 2 South Texas Project Electric Generating Station
2. South Texas Unit 2 Pressurizer Upper Head Safety Nozzle to Shell Weld ASME Section XI Evaluation of As-Found Indication **[Non-Proprietary]**
3. South Texas Unit 2 Pressurizer Upper Head Safety Nozzle to Shell Weld ASME Section XI Evaluation of As-Found Indication **[Proprietary]**
4. Application for Withholding Proprietary Information from Public Disclosure

Withhold Enclosure 3 from Public Disclosure in Accordance with 10 CFR 2.390.

STI: 34977438

Withhold Enclosure 3 from Public Disclosure in Accordance with 10 CFR 2.390.

cc:

Regional Administrator, Region IV
U.S. Nuclear Regulatory Commission
1600 East Lamar Boulevard
Arlington, TX 76011-4511

Withhold Enclosure 3 from Public Disclosure in Accordance with 10 CFR 2.390.

Enclosure 1
Summary Report for the 2RE20 Inservice Inspection of Unit 2 South Texas Project Electric Generating Station

SUMMARY REPORT
for the
2RE20
INSERVICE INSPECTION
of
UNIT 2
SOUTH TEXAS PROJECT
ELECTRIC GENERATING STATION

STP NUCLEAR OPERATING COMPANY

Fall 2019

COVER SHEET

2RE20 INSERVICE INSPECTION SUMMARY REPORT

SOUTH TEXAS PROJECT ELECTRIC GENERATING STATION, UNIT 2

P.O. BOX 289

WADSWORTH, TEXAS 77483

USNRC DOCKET NO: 50-499

OPERATING LICENSE NO: NPF-80

COMMERCIAL OPERATION DATE: June 19, 1989

Prepared by: _____ Date: January 15, 2020
Eric Lantz, ISI Program Engineer

Reviewed by: _____ Date: January 15, 2020
Clayton Bonnot, Supervisor Engineering Testing/Programs

SCOPE

COMPONENT SUPPORTS (IWF), REPAIR AND REPLACEMENT, AND WELD INSPECTION PROGRAMS (IWB, IWC, IWD)

The examinations summarized in this report were performed in accordance with the 2004 Edition of the ASME Code, Section XI that is applicable to the South Texas Project, Unit 2, third ten-year interval (09/25/2010-09/24/2020), third period (12/20/2017-09/24/2020). This report covers selected ASME Code Class 1, 2, and 3 Systems/Components and is documented in accordance with the requirements of ASME Section XI Code Case N-532-4.

Examinations and tests required by the Code are scheduled in accordance with "Inspection Program B" as defined in IWB-2412 for ASME Code Class 1 Systems/Components, IWC-2412 for ASME Code Class 2 Systems/Components and IWD-2412 for ASME Code Class 3 Systems/Components and IWF-2410, component supports.

ASME Code Class 1 components were examined as prescribed by Table IWB-2500-1 and the applicable Examination Categories, which establish the examination method and frequency. Likewise, the ASME Code Class 2, 3, and Component Supports were examined in accordance with Tables IWC-2500-1, IWD-2500-1, and IWF-2500-1, respectively.

The Containment Metal Liner examinations summarized in this report were performed in accordance with the 2013 Edition of the ASME Code, Section XI, which is applicable to the South Texas Project, Unit 2, third ten-year interval (09/09/2019-09/08/2029), first period (09/09/2019-09/08/2022). This report covers selected ASME Code Class CC liner & MC Components.

The Containment Tendon Test / End Anchorage and Adjacent Concrete Inspection was performed in accordance with the 2004 Edition of the ASME Code, Section XI, Subsection IWL as supplemented and modified by 10CFR50.55a(b)(2)(viii).

Examinations and tests required by the Code are scheduled in accordance with "Inspection Program B" as defined in IWE-2412 for ASME Code Class CC liner & MC Components. The Containment Metal Liner Components were examined in accordance with Table IWE-2500-1, and applicable Examination Categories.

FORM OAR-1 OWNER'S ACTIVITY REPORT (Code Case N-532-4)

Report Number OAR-2RE20

Plant South Texas Project Electric Generating Station

Unit No. 2 (If applicable) Commercial service date June 19, 1989 Refueling outage no. 2RE20

Current inspection interval IWB, IWC, IWD, IWF – 3rd ; IWE –3rd ; IWL-35th Year
(1st, 2nd, 3rd, 4th, other)

Current inspection period IWB, IWC, IWD, IWF –3rd ; IWE –1st ; IWL-35th Year
(1st, 2nd, 3rd)

Edition and Addenda of Section XI applicable to the inspection plan 2004

Date and revision of inspection plan October 15, 2019 / Revision 9,

Edition and Addenda of Section XI applicable to repairs/replacement activities, if different than the inspection plan N/A

Code Cases used: N-532-4, N-729-4, N-578-1, N-722-1, N-770-2

CERTIFICATE OF CONFORMANCE

I certify that (a) the statements made in this report are correct; (b) the examinations and tests meet the Inspection Plan as required by the ASME Code, Section XI; and (c) the repair/replacement activities and evaluations supporting the completion of 2RE20 conform to the requirements of Section XI.
(Refueling outage number)

Signed Eric Lantz ISI Program Engineer Date 15 Jan 2020
(Owner or Owner's ~~Designee~~, Title)

CERTIFICATE OF INSERVICE INSPECTION

I, the undersigned, holding a valid commission issued by the National Board of Boiler and pressure Vessel Inspectors and the State or Province of Florida and employed by One CIS Insurance Co. of Lynn, Massachusetts have inspected the items described in this Owner's Activity Report, and state that, to the best of my knowledge and belief, the Owner has performed all activities represented by this report in accordance with the requirements of Section XI.

By signing this certificate neither the Inspector nor his employer makes any warranty, expressed or implied, concerning the repairs/ replacements activities and evaluation described this report. Furthermore, neither the inspector nor his employer shall be liable in any manner for any personal injury or property damage or a loss of any kind arising from the connected with this inspection.

Robert Wayman Commissions NB# 12442 AZ1
Inspector's Signature National Board, State, Province, and Endorsements

Date 01/15/2020

TABLE 1

ITEMS WITH FLAWS OR RELEVANT CONDITIONS THAT
REQUIRED EVALUATION FOR CONTINUED SERVICE

2RE20
October 2019

ASME Category	Item Number	Item Description	Evaluation Description
F-A	F1.41	Member Group J Valve Support Plate Assembly, PRS1. [Summary 116700]	Inservice Inspection identified a loose bolt on Safety & Relief Valve Support at top of Pressurizer. [VTC-2019-008] Corrective Action to tighten bolt. [CR 19-11675] Additional Exams performed in 2RE20 accordance with IWF-2220. Re-examination scheduled for 2RE21
F-A	F1.30D	Component Support Guide for ECW Pump 2A Discharge Strainer Emergency Backflush Line [Summary 419600]	Inservice Inspection identified corrosion on base plate for a Guide. [VTC-2019-042] Tier 2 Operability or Functionality Review or Determination performed. Results conclude no structural integrity concern with Interaction Ratio less than 1.0 [CREE 19-12308-3] Corrective Action to remove corrosion and apply protective coating to inhibit future degradation. [WAN 621685]
B-D	B3.110	Safety Nozzle to Shell weld PRZ-2-N4C [Summary 011000]	Inservice Inspection identified an area of interest, requiring evaluation. [UT-2019-031] Material Deficiency Evaluation found results outside of IWB-3512 acceptability. [CREE 19-11865-2] Additional Exams performed in 2RE20 accordance with IWB-2430(a). [CR-19-11865-3] Analytical Evaluation performed by Westinghouse determined indication is acceptable in accordance with IWB-3132.3 and IWB-3600. [LTR-SDA-19-095-P Rev 0] - [STI 34937975] Re-examination scheduled for 2RE21 in accordance with IWB-2420(b) and (c).

TABLE 2
ABSTRACT OF REPAIRS/REPLACEMENT ACTIVITIES
REQUIRED FOR CONTINUED SERVICE

CLASS	CORRECTIVE MEASURE	ITEM DESCRIPTION	SYSTEM	DESCRIPTION OF WORK	DATE COMPLETED	REPAIR.REPLACMENT PLAN
3	REPLACEMENT	VALVE	CHILLED WATER	REPLACED 6" VALVE PARTS AND FLANGE BOLTING.	5/16/2018	2-16-034
3	REPLACEMENT	VALVE	CHILLED WATER	REPLACED 6" VALVE PARTS AND FLANGE BOLTING.	5/16/2018	2-16-035
3	REPLACEMENT	EW SCREEN WASH	ESSENTIAL COOLING WATER	REPLACED PIPING. WELDING.	4/17/2019	2-17-003
3	REPLACEMENT	VALVE	ESSENTIAL COOLING WATER	REPLACE 30" PIPE AND FLANGE. WELDING	5/19/2018	2-17-005
3	REPLACEMENT	EW SCREEN WASH	ESSENTIAL COOLING WATER	REPLACED EW PIPING 2"/3"/4" & VALVES. WELDING.	5/17/2018	2-17-031
3	REPLACEMENT	VALVE	REACTOR MAKEUP	REPLACE 4" VALVE AND FASTENERS.	10/26/2019	2-17-037
3	REPLACEMENT	PUMP COOLER	MECHANICAL AUXILIARY BUILDING HVAC	REPLACED PIPE STUBS. WELDING	5/17/2018	2-17-039
3	REPLACEMENT	EW SCREEN WASH	ESSENTIAL COOLING WATER	INSTALLED SHIPPING BAR. WELDINIG.	7/10/2018	2-17-040
3	REPLACEMENT	EW SCREEN WASH	ESSENTIAL COOLING WATER	REPLACED 4" PIPE. WELDING. !	7/10/2018	2-17-041

TABLE 2
ABSTRACT OF REPAIRS/REPLACEMENT ACTIVITIES
REQUIRED FOR CONTINUED SERVICE

CLASS	CORRECTIVE MEASURE	ITEM DESCRIPTION	SYSTEM	DESCRIPTION OF WORK	DATE COMPLETED	REPAIR.REPLACMENT PLAN
3	REPAIR	EW SCREEN WASH	ESSENTIAL COOLING WATER	REMOVED/INSTALLED PIPE SUPPORTS. WELDING.	7/10/2018	2-17-042
3	REPLACEMENT	EW SCREEN WASH	ESSENTIAL COOLING WATER	REPLACED 4" PIPE. WELDING.	7/10/2018	2-17-043
3	REPAIR	EW SCREEN WASH	ESSENTIAL COOLING WATER	REMOVED/INSTALLED PIPE SUPPORTS. WELDING.	7/10/2018	2-17-044
3	REPAIR	VALVE	SPENT FUEL POOL COOLING	PERFORMED BODY TO BONNET SEAL WELD	5/18/2018	2-18-008
3	REPLACEMENT	VALVE	ESSENTIAL COOLING WATER	REPLACED VALVE PLUG AND SEAT.	5/17/2018	2-18-017
2	REPLACEMENT	VALVE	MAIN STEAM	REPLACED VALVE AND PARTS.	10/11/2019	2-18-022
2	REPLACEMENT	VALVE	CHEMICAL VOLUME CONTROL	REPLACE PIPE SUPPORT PLATE	10/22/2019	2-18-023
1	REPLACEMENT	PUMP	REACTOR COOLANT	REPLACE SEAL PACKAGE ON #2A RCP.	10/10/2019	2-18-026
3	REPLACEMENT	VALVE	COMPONENT COOLING	REPLACE VALVE.	10/27/2019	2-18-028
3	REPLACEMENT	PUMP	REACTOR COOLANT	REPLACED COOLERS	10/28/2019	2-18-029

TABLE 2
ABSTRACT OF REPAIRS/REPLACEMENT ACTIVITIES
REQUIRED FOR CONTINUED SERVICE

CLASS	CORRECTIVE MEASURE	ITEM DESCRIPTION	SYSTEM	DESCRIPTION OF WORK	DATE COMPLETED	REPAIR.REPLACMENT PLAN
1	REPLACEMENT	VALVE	REACTOR COOLANT	REPLACED / REMOVED VALVE	10/16/2919	2-18-030
1	REPLACEMENT	VALVE	REACTOR COOLANT	REPLACED / REMOVED VALVE	10/16/2019	2-18-031
1	REPLACEMENT	VALVE	REACTOR COOLANT	REPLACED / REMOVED VALVE	10/16/2019	2-18-032
1	REPLACEMENT	VALVE	REACTOR COOLANT	REPLACED / SWAPPED VALVE	10/20/2019	2-18-033
1	REPLACEMENT	VALVE	REACTOR COOLANT	REPLACED / SWAPPED VALVE	10/22/2019	2-18-034
1	REPLACEMENT	VALVE	REACTOR COOLANT	REPLACED / SWAPPED VALVE	10/19/2019	2-18-035
3	REPLACEMENT	EW CHILLER	CHILLED WATER	REPLACED FASTENERS	3/15/2019	2-19-007
3	REPLACEMENT	VALVE	ESSENTIAL COOLING WATER	REPLACED VALVE	3/12/2019	2-19-009
3	REPLACEMENT	EW SCREEN WASH	ESSENTIAL COOLING WATER	REPLACED PIPE AND PIPE PITTINGS. WELDING.	3/14/2019	2-19-011
3	REPAIR	EW SCREEN WASH	ESSENTIAL COOLING WATER	REMOVED/INSTALLED PIPE SUPPORTS. WELDING.	3/14/2019	2-19-012
3	REPLACEMENT	EW SCREEN WASH	ESSENTIAL COOLING WATER	REPLACED PIPE AND PIPE PITTINGS. WELDING.	3/14/2019	2-19-013

TABLE 2
ABSTRACT OF REPAIRS/REPLACEMENT ACTIVITIES
REQUIRED FOR CONTINUED SERVICE

CLASS	CORRECTIVE MEASURE	ITEM DESCRIPTION	SYSTEM	DESCRIPTION OF WORK	DATE COMPLETED	REPAIR.REPLACMENT PLAN
3	REPAIR	EW SCREEN WASH	ESSENTIAL COOLING WATER	REMOVED/INSTALLED PIPE SUPPORTS. WELDING.	3/14/2019	2-19-014
3	REPLACEMENT	EW SCREEN WASH	ESSENTIAL COOLING WATER	REPLACED 30" SPOOL.WELDING	5/1/2019	2-19-015
2	REPLACEMENT	VALVE	COMPONENT COOLING	REPLACED VALVE. VALVE WAS REPLACED AND TESTED AGAIN PER RR 2-19-032 ON 4/18/19.	4/17/2019	2-19-019
3	REPAIR	EW SCREEN WASH	ESSENTIAL COOLING WATER	INSTALLED SHIPPING BAR TABS. WELDING	4/25/2019	2-19-020
3	REPLACEMENT	EW SCREEN WASH	ESSENTIAL COOLING WATER	REPLACED PIPE AND PIPE FITTINGS. WELDING	4/25/2019	2-19-021
3	REPAIR	EW SCREEN WASH	ESSENTIAL COOLING WATER	REMOVED/INSTALLED PIPE SUPPORTS.	4/25/2019	2-19-022
3	REPLACEMENT	EW SCREEN WASH	ESSENTIAL COOLING WATER	REPLACED PIPE AND PIPE FITTINGS. WELDING	4/25/2019	2-19-023
3	REPAIR	EW SCREEN WASH	ESSENTIAL COOLING WATER	REMOVED/INSTALLED PIPE SUPPORTS.	4/25/2019	2-19-024
3	REPLACEMENT	VALVE	ESSENTIAL COOLING WATER	REPLACED VALVE PARTS	10/8/2019	2-19-029

TABLE 2
ABSTRACT OF REPAIRS/REPLACEMENT ACTIVITIES
REQUIRED FOR CONTINUED SERVICE

CLASS	CORRECTIVE MEASURE	ITEM DESCRIPTION	SYSTEM	DESCRIPTION OF WORK	DATE COMPLETED	REPAIR.REPLACMENT PLAN
1	REPAIR	REACTOR VESSEL	REACTOR COOLANT	MSIP MODIFICATION OF REACTOR VESSEL NOZZLES STEP 3.9 FOR W MRS-SSP-3502, NDE REPORT WDI-PJF-1316781-FSR-001,	10/26/2019	2-19-030
1	REPAIR	REACTOR VESSEL	REACTOR COOLANT	MSIP ADJUST SG SHIMS POST MSIP OF REACTOR VESSEL NOZZLES	10/7/2019	2-19-031
2	REPLACEMENT	VALVE	COMPONENT COOLING	REPLACED VALVE.	4/18/2019	2-19-032
2	REPLACEMENT	VALVE	MAIN STEAM	REPLACE VALVE PARTS.	10/30/2019	2-19-033
1	REPLACEMENT	REACTOR VESSEL	REACTOR COOLANT	MSIP, ADJUST SG SHIMS POST MSIP OF REACTOR VESSEL NOZZLES	10/19/2019	2-19-037
3	REPLACEMENT	VALVE	COMPONENT COOLING	REPLACED VALVE	7/23/2019	2-19-040
2	REPLACEMENT	VALVE	RESIDUAL HEAT REMOVAL	REPLACE EXISTING PSV.	10/10/2019	2-19-044
2	REPLACEMENT	VALVE	CHEMICAL VOLUME CONTROL	REPLACED VALVE.	10/21/2019	2-19-045
2	REPLACEMENT	VALVE	CHEMICAL VOLUME CONTROL	REPLACED SNUBBER	10/22/2019	2-19-048
MC	REPLACEMENT	EQUIPMENT HATCH	INTEGRATED LEAK RATE TEST	REPLACED SWING BOLT	10/28/2019	2-19-049

Enclosure 2
South Texas Unit 2 Pressurizer Upper Head Safety Nozzle to Shell Weld ASME Section XI
Evaluation of As-Found Indication [Non-Proprietary]

LTR-SDA-19-095-NP Revision 0

South Texas Unit 2 Pressurizer Upper Head Safety Nozzle to Shell Weld ASME Section XI Evaluation of As-Found Indication

January 2020

Author: Anees Udyawar*
Reactor Vessel/Containment Vessel Design & Analysis

Verifier: Alexandria Carolan*
Reactor Vessel/Containment Vessel Design & Analysis

Clair Song*
Reactor Vessel Upper Internals Design Analysis

Manager: Lynn Patterson*
Reactor Vessel/Containment Vessel Design & Analysis

**Electronically approved records are authenticated in the electronic document managing system*

Westinghouse

Forward

This document contains Westinghouse Electric Company LLC proprietary information and data which has been identified by brackets. Coding (a,c,e) associated with the brackets sets forth information which is considered proprietary.

The proprietary information and data contained within the brackets in this report were obtained at considerable Westinghouse expense and its release could seriously affect our competitive position. This information is to be withheld from public disclosure in accordance with the Rules of Practice 10CFR2.390 and the information presented herein is safeguarded in accordance with 10CFR2.390. Withholding of this information does not adversely affect the public interest.

This information has been provided for your internal use only and should not be released to persons or organizations outside the Directorate of Regulation and the ACRS without the express written approval of Westinghouse Electric Company LLC. Should it become necessary to release this information to such persons as part of the review procedure, please contact Westinghouse Electric Company LLC, which will make the necessary arrangements required to protect the Company's proprietary interests.

Background and Purpose

During the Fall 2019 refueling outage at South Texas Unit 2, in-service examinations of the pressurizer upper head safety nozzle to shell weld (South Texas 2 pressurizer safety nozzle designation N4C - see Figure 1) discovered one ultrasonic testing (UT) indication [1]. A general schematic of the top head of the pressurizer and the safety nozzle to shell weld is provided in [2]. The conventional UT examinations (performed from the OD-outside diameter surface) was based on the 0, 45, and 60 degree probes. The indication was discovered to be embedded, with the following flaw characteristics:

Total flaw depth (2a) = 0.30"

Half flaw depth (a) = 0.15"

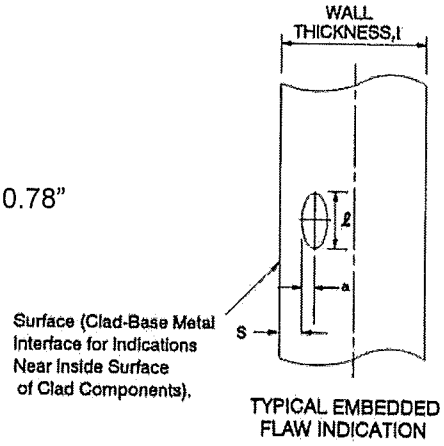
Flaw length (l) = 3.58"

Distance of the crack tip to the inside surface (S) = 0.78"

Thickness at the location of the flaw (t) = 3.58"

a/l = 0.0419

a/t = 0.0419



The above indication was evaluated based on ASME Section XI 2004 Edition Paragraph IWB-3512 (Acceptance Standards) and determined to be not acceptable and required a fracture mechanics evaluation to ASME Section XI IWB-3600 requirements [3].

This particular weld was previously inspected during the pre-service inspection (1988), at the 1st 10-year interval (1995), and the 2nd 10-year interval (2004) in-service examinations based on Southwest Research Institute UT procedure. There were no indications detected during these previous inspections at the safety nozzle to shell weld. Shop fabrication inspection of the nozzle to shell weld based on Radiographic Testing (RT) also did not reveal any indications. South Texas NDE (Non-Destructive Examination) examiner's review of the previous UT examinations in 1988 and 1995 did reveal the scanning sensitivity was performed at a gain setting of 2 times or 6dB above the reference level sensitivity where-as the UT examination performed during the current Fall 2019 outage was performed at a gain setting of 5 times or 14dB above the reference level sensitivity. The scanning sensitivity during the 2004 UT examination was recommended to be at a gain setting of 5 times or 14dB above the reference level sensitivity (if practical), but the scanning level sensitivity could not be confirmed. Based on the past inspection investigation and available data, it is concluded that this particular indication was detected due to increased scan sensitivity during the Fall 2019 outage.

Weld defects can potentially occur in welds as a result of operating stresses. Stresses come from many potential sources, including direct loading, thermal transients, and cyclic fatigue. Customer review of thermal and pressure transients for the South Texas Unit 2 pressurizer demonstrated that operations (and therefore stresses) are within normal and acceptable design tolerances.

During 2007, structural weld overlays (SWOL) were installed at the nickel alloy dissimilar metal weld safe end region to mitigate any potential for primary water stress corrosion cracking on the pressurizer top head for three safety nozzles, one relief nozzle, and one spray nozzle. The structural weld overlay design criteria were all met during installation. Due to the discovery of the indication at the N4C pressurizer safety nozzle to shell weld, three additional extent of condition weld locations were inspected during Fall 2019. These three additional weld locations included the pressurizer safety nozzle to shell weld (N3), relief nozzle to shell weld (N4A), and the spray nozzle to shell weld (N2) – see Figure 1. Based on the UT inspections, there were no recordable indications at these nozzle to shell welds. Thus, it is concluded that the pressurizer nozzle to shell weld indication is only isolated to the N4C safety nozzle.

[

]$^{(a,c,e)}$

As mentioned previously, since the indication did not meet the ASME Section XI IWB-3500 Acceptance Standards, Westinghouse was contacted to evaluate the acceptability of the rejectable indication per the ASME Section XI IWB-3600 requirements. In order to facilitate an expedient analysis, Westinghouse proposed evaluating the acceptability of the flaws for continued plant operation through at least two refueling cycles (36 months), and then provide a more detailed flaw evaluation, if necessary, to determine a maximum duration of plant operation between the pressurizer head inspections (typically 10 years). Thus, this letter will justify continued operation of the pressurizer with leaving the as-found indication as-is without repair for at least two refueling cycles.

Methodology for ASME Section XI Flaw Evaluation

Indications that are rejectable based on ASME Section XI IWB-3500 can be evaluated per a detailed fracture mechanics evaluation based on ASME Section XI IWB-3600 [3] to demonstrate flaw acceptability. The flaw evaluation considers the appropriate loadings (transient stresses) due to normal/upset/test and emergency/faulted conditions. The transient stresses are used to calculate the stress intensity factors (K_I) for the appropriate as-found flaw orientation, size and shape. The stress intensity factors are then used to calculate fatigue crack growth. The stress intensity factor for the flaw size after crack growth will be compared to the fracture toughness (K_{Ic}) to determine acceptability. The fracture toughness is calculated per ASME Section XI Appendix A equation for K_{Ic} based on the pressurizer RT_{NDT} (nil-ductility reference temperature of the material) and material temperature.

Provided in the following section is the ASME Code acceptance criteria for the evaluation of ferritic components in the ASME Section XI, paragraph IWB-3610. [

]^{a,c,e} At the location of the indication, the approximate thickness is 3.58” based on NDE results, per [1]. Note that the IWB-3610 criteria are for components with a 4” thickness or larger; however, the rules for components with thicknesses 4” and less are the same as IWB-3610, as stated in IWB-3620.

ASME Code Acceptance Criteria for Ferritic Components

There are two alternative sets of flaw acceptance criteria for ferritic components in paragraph IWB-3600 of ASME Code Section XI to assess continued service without repair.

1. Acceptance Criteria Based on Flaw Size (IWB-3611)
2. Acceptance Criteria Based on Stress Intensity Factor (IWB-3612)

To determine whether a flaw is acceptable for continued service without repair, the more beneficial of the two criteria (IWB-3611 and IWB-3612) may be used. For thick sections, the two criteria are essentially identical, but for sections such as the pressurizer nozzle to shell weld region, IWB-3612 criteria provide more margin in the fracture mechanics analysis. Therefore, the evaluations for the South Texas Unit 2 pressurizer safety nozzle to shell weld were based on the IWB-3612 acceptance criteria for ease of use, as well as to obtain the maximum margin since these criteria will generally be less restrictive for surface and embedded flaws.

Criteria Based on Stress Intensity Factor per ASME Section XI IWB-3612

The term stress intensity factor (K_I) is defined as the driving force on a crack. It is a function of the size of the crack and the applied stresses, as well as the overall geometry of the structure. In contrast, the fracture toughness (K_{Ic}) is a measure of the resistance of the material to propagation of a crack. It is a material property and a function of temperature. ASME Section XI Appendix A-4000 provides the K_{Ic} correlation for low-alloy steel materials [ ]^{a,c,e} for use in the fracture mechanics evaluations. It should be noted that per ASME Section XI Appendix A-4400, neutron fluence embrittlement may need to be considered for degradation of the material fracture toughness due to irradiation. However, since the pressurizer is far away from the reactor core and shielded within its own compartment, there is no concern for degradation due to

irradiation. Lastly, note that an upper shelf fracture toughness value of 200 ksi√in is used in the K_{Ic} calculations.

The criteria based on ASME Section XI IWB-3612 are provided below:

$K_I < \frac{K_{Ic}}{\sqrt{10}}$ For normal conditions (upset and test conditions inclusive)

$K_I < \frac{K_{Ic}}{\sqrt{2}}$ For faulted conditions (emergency conditions inclusive)

where:

K_I = The maximum applied stress intensity factor for the flaw size a_f to which a detected flaw will grow, during the conditions under consideration, for a specified period, or to the next inspection.

K_{Ic} = Fracture toughness based on fracture initiation for the corresponding crack tip temperature, based on ASME Section XI Appendix A, as follows:

$K_{Ic} = 33.2 + 20.734 \exp [0.02(T - RT_{NDT})]$ where, K_{Ic} is in units of ksi√in

T = Material temperature at location of flaw, °F

RT_{NDT} Nil-ductility reference temperature. [

] a,c,e

To determine whether a flaw is acceptable for continued service without repair, both criteria must be met.

Primary Stress Limits

In addition to satisfying the fracture criteria, the primary stress limits of the ASME Code Section III, paragraph NB-3000 must be satisfied, by assuming a local area reduction of the pressure retaining membrane that is equal to the area of the detected flaw based on NDE information.

Analysis and Results

ASME Section XI Flaw Evaluation

Based on the UT results [1], one embedded indication was reported as rejectable per ASME Section XI IWB-3500 at the South Texas Unit 2 pressurizer head safety nozzle to shell weld. The as-found flaw dimensions are given in Table 1.

Based on the as-found indications, fatigue crack growth (FCG) was performed per the guidance of ASME Section XI, Appendix A-4000 [3] for ferritic steels exposed to air environment (embedded flaws) as shown in the following equation:

$$\frac{da}{dN} = C_o\ (\Delta K_I)^n$$

The crack growth rate (da/dN) is a function of the applied stress intensity factor range (ΔK_I) and the R ratio (K_{min}/K_{max}) for a given stress profile.

$$da/dN = 1.99 \times 10^{-10}\ (S)(\Delta K_I)^{3.07} \qquad \text{in/cycle}$$

where

$$S = 25.72(2.88 - R)^{-3.07} \qquad (0 \le R \le 1.0)$$

$$\Delta K_I = K_{max} - K_{min}$$

The methodology in ASME Section XI Appendix A-3000 [3] is used to calculate the stress intensity factors for the embedded (subsurface) indication.

The fatigue crack growth considers the through-wall maximum and minimum transient stress profiles and the number of cycles. The South Texas Unit 2 pressurizer normal, upset, and test transients are provided in Table 2. For the FCG evaluation, a representative set of normal, upset, and test transient stresses and cycles was considered in the fracture mechanics analysis for South Texas Unit 2.

The results of the FCG evaluation for the as-found embedded indication are provided in Table 3 for duration of two refueling outages (36 months). The stress intensity factors for the final flaw size after 36 months of crack growth are also provided in Table 3. For each of the operating conditions (normal/upset/test and emergency/faulted), the fracture toughness was also determined with the appropriate structural factor (see Table 3) based on ASME Section XI IWB-3612 criteria. As shown in Table 3, the stress intensity factors for the final flaw size after 36 months of crack growth are below the fracture toughness values for the appropriate loading conditions. Therefore, the embedded indication at the South Texas Unit 2 pressurizer safety nozzle to shell weld is acceptable per the ASME Section XI IWB-3600 fracture mechanics evaluation for up to 36 months (2 refueling outages). Therefore, no repair or corrective actions for this weld is necessary during the Fall 2019 outage.

Primary Stress Limits

A primary stress evaluation was performed to consider the effect of the local wall reduction due to the as-found flaw indication, with consideration of subsequent growth over the next two fuel cycles (36 months). It should be noted that at the location of the as-found indication, the wall thickness is approximately 3.58” based on Table 1. After considering the amount of fatigue crack growth as shown in Table 3, the wall thickness is reduced by a minimal amount. For the embedded indication from Table 3, the wall thickness is reduced to approximately 3.27” (e.g. t - 2a).

[

].[a,c,e] Therefore, the primary stress results with a local wall reduction due to the embedded as-found flaw is bounded by the ASME Section III NB-3000 results in [4, 6].

Conclusion

Ultrasonic examinations of the South Texas Unit 2 pressurizer head safety nozzle to shell weld during the Fall 2019 refueling outage revealed an embedded indication. Based on ASME Section XI, 2004 Edition, Paragraph IWB-3512, the as-found indication is not acceptable and required fracture mechanics evaluation to ASME Section XI IWB-3600 requirements.

The as-found embedded indication was evaluated based on ASME Section XI IWB-3600 and determined to be acceptable for at least 36 months (two fuel cycles) of plant operation. Therefore, no repair or corrective actions for this weld is necessary during the Fall 2019 outage.

References

1. South Texas Unit 2 Ultrasonic Examination Record # UT-2019-031, PRZ-2-N4C/Safety Nozzle to Shell. NDE Examiner/Reviewer: James Hoover, Chris Williams, James Williams. Dated: October 18, 2019.
2. [ ]a,c,e
3. ASME Boiler & Pressure Vessel Code, 2004 Edition, Section XI, “Rules for Inservice Inspection of Nuclear Power Plant Components.”
4. [ ]a,c,e
5. South Texas Project Updated Final Safety Analysis Report (UFSAR), Revision 19, April 2018.
6. [ ]a,c,e

a,c,e

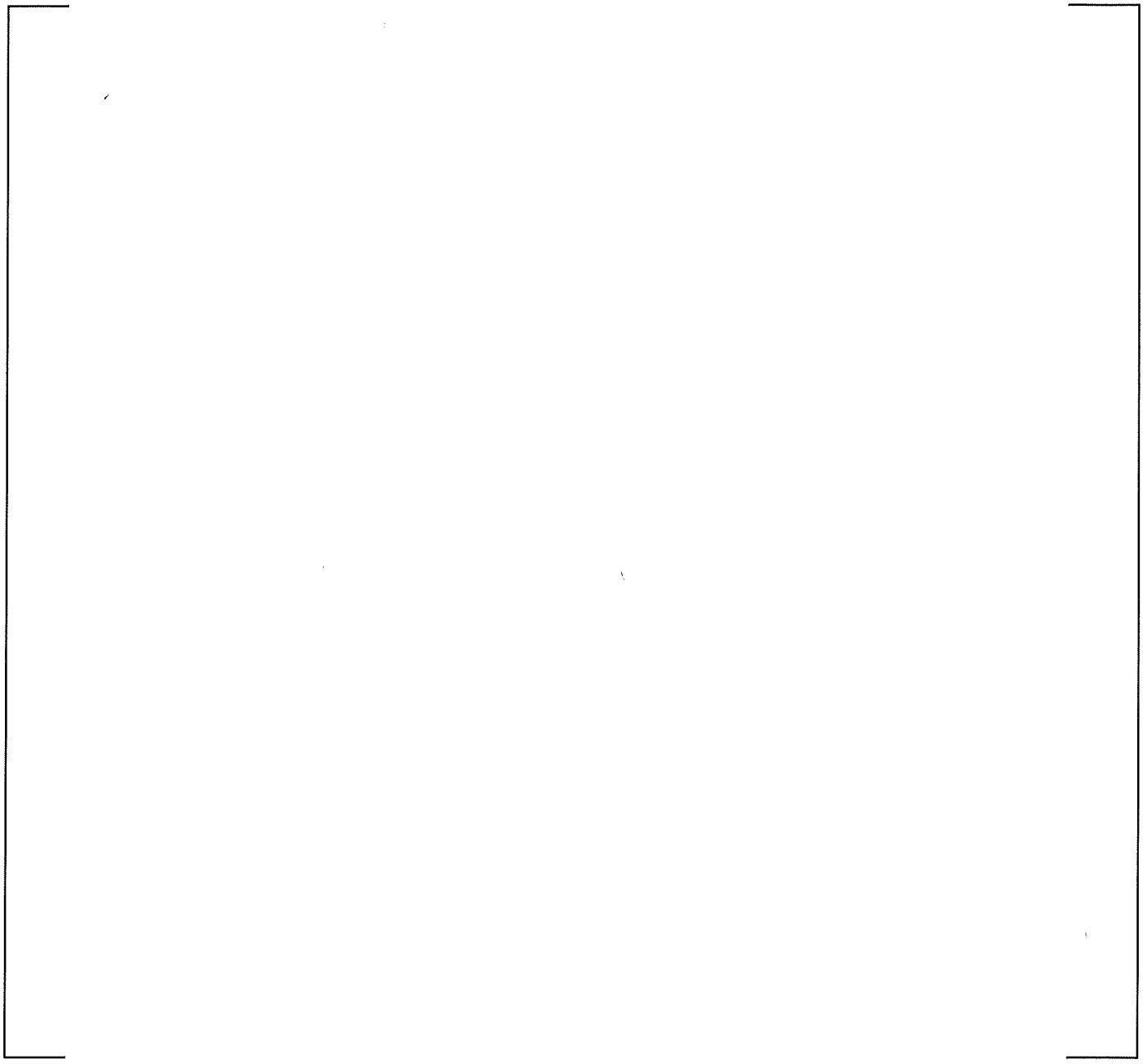


Figure 1: South Texas Unit 2 Pressurizer Top Head Safety Nozzle to Shell Weld Location

Table 1: South Texas Unit 2 Pressurizer Head Safety Nozzle to Shell Weld As-found Embedded Flaw Dimensions (Fall 2019)

Total Flaw Depth (2a)[1]	Flaw Depth (a)[1]	Flaw Length (l)	Thickness (t) without Cladding	S, Distance to the Inside Surface	Flaw Shape (a/l)[1]	Percent Through-Wall Flaw Size (a/t)[1]
0.30"	0.15"	3.58"	3.58"	0.78"	0.0419	4.19%

Note:

1. For embedded flaws, the flaw depth (a) in the above table is half flaw depth and total flaw depth would be considered as (2a), see figure below.

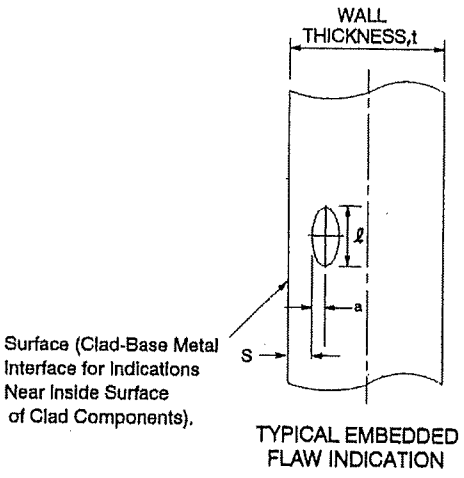


Table 2 South Texas Unit 2 Pressurizer Normal, Upset and Test Transients

a,c,e

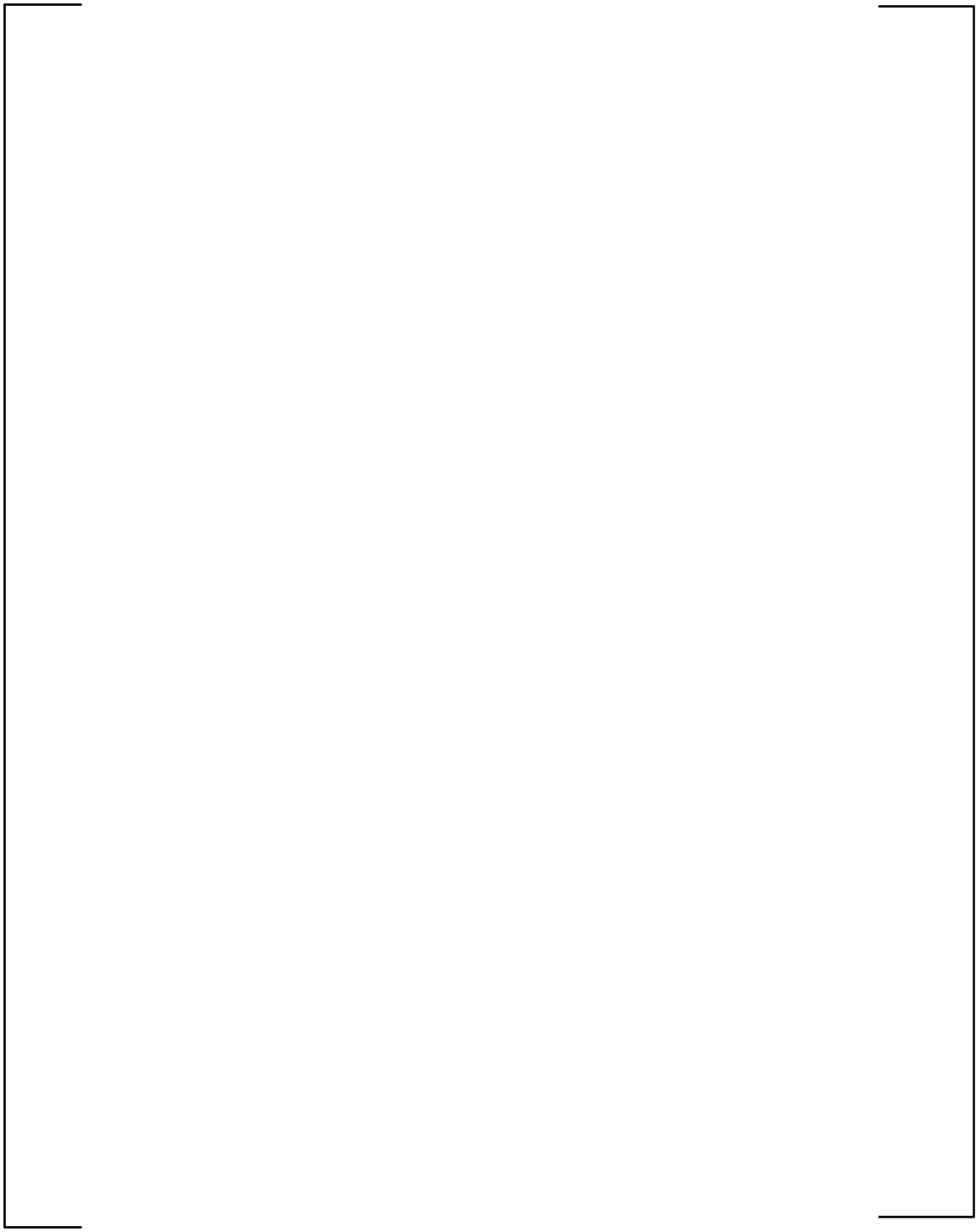


Table 3: South Texas Unit 2 Pressurizer Head Safety Nozzle to Shell Weld

Flaw Size After 36 Months and Flaw Acceptability per ASME Section XI IWB-3600

Thickness (t) without Cladding	Initial Flaw Size (a/t) and (a) [1]	Flaw Size (a/t) and (a)[1] <u>After 36 months</u>	Stress Intensity Factor[2] K_I (ksi√in)	Fracture Toughness K_{Ic} (ksi√in)
3.58”	a/t = 4.19% a = 0.15” (Embedded)	a/t = 4.30% a = 0.15394” (Embedded)	Normal/Upset/Test 62.46 ksi√in	K_{Ic} /√ 10 = 63.2 ksi√in
			Emergency/Faulted 83.28 ksi√in	K_{Ic} /√ 2 = 141.4 ksi√in

Notes:

1. For embedded flaws, the flaw depth (a) in the above table is half flaw depth and total flaw depth would be considered as (2a).
2. Stress Intensity factor (K_I) is calculated for the final flaw sizes after 36 months of fatigue crack growth. The stress intensity factor is shown to be below the fracture toughness (K_{Ic}) for both normal/upset/test and emergency/faulted conditions. Thus, the acceptance criteria based on ASME Section XI IWB-3612 are met.

Enclosure 4
Application for Withholding Proprietary Information from Public Disclosure

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:
COUNTY OF BUTLER:

(1) I, Korey L. Hosack, have been specifically delegated and authorized to apply for withholding and execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse).

(2) I am requesting the proprietary portions of LTR-SDA-19-095-P, Revision 0 be withheld from public disclosure under 10 CFR 2.390.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged, or as confidential commercial or financial information.

(4) Pursuant to 10 CFR 2.390, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse and is not customarily disclosed to the public.

(ii) Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar technical evaluation justifications and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

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(5) Westinghouse has policies in place to identify proprietary information. Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage (e.g., by optimization or improved marketability).

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

(6) The attached documents are bracketed and marked to indicate the bases for withholding. The justification for withholding is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These

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lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (5)(a) through (f) of this Affidavit.

I declare that the averments of fact set forth in this Affidavit are true and correct to the best of my knowledge, information, and belief.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on: 2020 01 27

Korey L. Hosack, Manager
Licensing, Analysis, & Testing