INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN

Possum Point Power Station CCR Surface Impoundment: Pond E

Submitted To: Possum Point Power Station
19000 Possum Point Road
Dumfries, VA 22026

Submitted By: Golder Associates Inc.
2108 W. Laburnum Avenue, Suite 200
Richmond, VA 23227

April 2018

Project No. 16-62150
Table of Contents

1.0 Certification .......................................................................................................................... 1
2.0 Introduction .......................................................................................................................... 2
3.0 Inflow Design Flood Control System Plan ............................................................................ 2
   3.1 Hazard Potential Classification ............................................................................................ 2
   3.2 Inflow Design Flood .............................................................................................................. 2
   3.3 Inflow and Outflow Control ................................................................................................... 2
4.0 Conclusions .......................................................................................................................... 3

Tables
Table 1 HEC-HMS Output

Appendices
Appendix A NOAA Atlas 14 Rainfall
Appendix B Hydraulic Modeling Analysis
1.0 CERTIFICATION

This Inflow Design Flood Control System Plan for the Possum Point Power Station’s Pond E was prepared by Golder Associates Inc. (Golder). The document and Certification/Statement of Professional Opinion are based on and limited to information that Golder has relied on from Dominion and others, but not independently verified, as well as work products produced by Golder.

On the basis of and subject to the foregoing, it is my professional opinion as a Professional Engineer licensed in the Commonwealth of Virginia that this document has been prepared in accordance with good and accepted engineering practices as exercised by other engineers practicing in the same discipline(s), under similar circumstances, at the same time, and in the same locale. It is my professional opinion that the document was prepared consistent with the requirements in §257.73(c) of the United States Environmental Protection Agency’s “Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments,” published in the Federal Register on April 17, 2015, with an effective date of October 19, 2015 [40 CFR §257.73(c)], as well as with the requirements in §257.100 resulting from the EPA’s “Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals From Electric Utilities; Extension of Compliance Deadlines for Certain Inactive Surface Impoundments; Response to Partial Vacatur” published in the Federal Register on August 5, 2016 with an effective date of October 4, 2016 (40 CFR §257.100).

The use of the word “certification” and/or “certify” in this document shall be interpreted and construed as a Statement of Professional Opinion, and is not and shall not be interpreted or construed as a guarantee, warranty, or legal opinion.

Daniel McGrath
Print Name

Associate and Senior Consultant
Title

Signature

Date

[Signature]

(Commonwealth of Virginia)

DANIEL P. McGrath
Lic. No. 040703

4/13/18
2.0 INTRODUCTION

This Inflow Design Flood Control System (FCS) Plan was prepared for the Possum Point Power Station’s (Station) inactive Coal Combustion Residuals (CCR) surface impoundment, Pond E. This FCS Plan was prepared in accordance with 40 CFR Part §257, Subpart D and is consistent with the requirements of 40 CFR §257.82.

The Station, owned and operated by Virginia Electric and Power Company d/b/a Dominion Energy Virginia (Dominion), is located in Dumfries, Virginia at 19000 Possum Point Road. The Station includes inactive CCR surface impoundment Pond E, as defined by the Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule (40 CFR §257; the CCR rule). In anticipation of closure, Pond E has been excavated and the material placed in Pond D. This FCS Plan has been developed based on the existing Pond E topography as of April 28, 2017.

3.0 INFLOW DESIGN FLOOD CONTROL SYSTEM PLAN

3.1 Hazard Potential Classification

As indicated in Golder’s Hazard Potential Classification Assessment, Pond E is assigned a “Significant” hazard potential rating per 40 CFR §257.73.

3.2 Inflow Design Flood

According to 40 CFR §257.82(a)(3)(ii), a hazard potential rating of Significant requires an evaluation of the pond and appurtenances ability to manage a 1000-year storm event. Per the NOAA Atlas-14, provided in Appendix A, the 1000-year event rainfall total for the 24-hour duration is 13.6 inches.

3.3 Inflow and Outflow Control

Inflow to Pond E is primarily stormwater runoff from within the pond (43.9 ac) and the adjacent wooded areas (50.7 ac). The total drainage area to Pond E is approximately 94.6 acres. The majority of stormwater arrives in Pond E through overland flow. Other than maintaining pre-established runoff control measures, there are no inflow control measures proposed.

Pond E’s primary outlet for stormwater is a 6-ft by 6-ft square riser, fitted with stoplogs, that discharges through a 72-inch corrugated metal pipe (CMP) into an unnamed tributary of Quantico Creek. This demonstration assumes that the permanent pool is maintained below the stoplog crest. The stage-storage curve for Pond E was developed using the April 28, 2017 topography, and shows that Pond E has approximately 892.8 acre-feet of available water storage volume at the embankment crest (approximately el. 40.0 ft).

The Pond E stormwater system was modeled in the U.S. Army Corps of Engineers Hydrologic Engineering Center’s Hydraulic Modeling System (HEC-HMS), and the analysis is included in
Appendix B. The analysis was conducted using the 24-hour, 1,000-year event, which was modeled as 13.6 inches of rain. Based on this analysis, Pond E’s inflow design flood control system is capable of adequately managing the inflow from the 1,000-year event without overtopping the embankment.

<table>
<thead>
<tr>
<th>$Q_{in}$ (CFS)</th>
<th>Max Hw (Ft El*)</th>
<th>Primary $Q_{out}$ (CFS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>778.4</td>
<td>13.2</td>
<td>0.0</td>
</tr>
</tbody>
</table>

* Top of berm elevation = el. 40.0 ft

4.0 CONCLUSIONS

Through work performed by Golder, both field inspection and document review, it is our opinion that the Pond E inflow design flood control system has sufficient capacity for the 1000-year storm event, as required by 40 CFR §257.82.
APPENDIX A – NOAA Atlas 14 Rainfall
### PF tabular

<table>
<thead>
<tr>
<th>Duration</th>
<th>Average recurrence interval (years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-min</td>
<td>0.356</td>
</tr>
<tr>
<td>10-min</td>
<td>0.569</td>
</tr>
<tr>
<td>15-min</td>
<td>0.711</td>
</tr>
<tr>
<td>30-min</td>
<td>0.975</td>
</tr>
<tr>
<td>60-min</td>
<td>1.22</td>
</tr>
<tr>
<td>2-hr</td>
<td>1.42</td>
</tr>
<tr>
<td>3-hr</td>
<td>1.53</td>
</tr>
<tr>
<td>6-hr</td>
<td>1.88</td>
</tr>
<tr>
<td>12-hr</td>
<td>2.28</td>
</tr>
<tr>
<td>24-hr</td>
<td>2.57</td>
</tr>
<tr>
<td>2-day</td>
<td>2.98</td>
</tr>
<tr>
<td>3-day</td>
<td>3.16</td>
</tr>
<tr>
<td>4-day</td>
<td>3.35</td>
</tr>
<tr>
<td>7-day</td>
<td>3.89</td>
</tr>
<tr>
<td>10-day</td>
<td>4.46</td>
</tr>
<tr>
<td>20-day</td>
<td>6.00</td>
</tr>
<tr>
<td>30-day</td>
<td>7.37</td>
</tr>
<tr>
<td>45-day</td>
<td>9.27</td>
</tr>
<tr>
<td>60-day</td>
<td>11.0</td>
</tr>
</tbody>
</table>

1. Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.
PDS-based depth-duration-frequency (DDF) curves
Latitude 38.5466°, Longitude -77.2872°

Average recurrence interval (years)
- 1
- 2
- 5
- 10
- 25
- 50
- 100
- 200
- 500
- 1000

Average recurrence interval (years)
- 1
- 2
- 3
- 4
- 7
- 10
- 20
- 30
- 45
- 60
- 24

Maps & aerials
Small scale terrain
APPENDIX B

Hydraulic Modeling Analysis
The purpose of this evaluation is to determine the hydraulic performance of the existing Pond E CCR impoundment at the Possum Point Power Station (PPPS) during the 1,000-year storm event. This evaluation is in support of the Inflow Design Flood Control System Plan, and is based on a "Significant" hazard potential classification as defined in §257.53 of the CCR Rule.

1.0 CALCULATIONS

1.1 Pond Storage Volume

Pond E’s storage volume was computed based on the existing condition, as surveyed in April 2017, which is excavated of CCR. The maximum available storage in the pond is approximately 892.8 acre-feet at elevation 40.0. Attachment 1 contains the stage storage rating table used in the HMS model.

1.2 Outlet Design and Capacity

The existing Pond E outfall structure consists of a rectangular riser box fitted with stoplogs to adjust the pond’s permanent pool. For this analysis, the pond was conservatively evaluated with a permanent pool at elevation 0.0 ft (approximately 3.0 ft of water) and no discharge through the riser structure.

1.3 Storm Routing Calculations

Analysis of the Pond E stormwater system was performed using the US Army Corps of Engineers Hydrologic Engineering Center’s Hydraulic Modeling System (HEC-HMS) software package (ref #1). The direct drainage area to the pond is 94.6 acres. The predominant soil types in the area are Hydrologic Soil Group (HSG) B soils.

Per §257.82(a)(3)(ii), the impoundment is required to adequately manage flow resulting from the 1,000-Yr storm event. The 24-hour, 1,000-Yr storm event precipitation amount was obtained from the Precipitation Frequency Data Server (PFDS, ref #2) for Dumfires, Virginia, as 13.6 inches.

Figure 1 illustrates the connectivity of the stormwater elements and the data inputs as modeled in HEC-HMS.
The following table summarizes the results of the HEC-HMS analysis for the 1,000-Yr storm event.

<table>
<thead>
<tr>
<th>( \text{Q}_{\text{in}} ) (CFS)</th>
<th>Max Hw (Ft El*)</th>
<th>Primary ( \text{Q}_{\text{out}} ) (CFS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>778.4</td>
<td>13.2</td>
<td>0.0</td>
</tr>
</tbody>
</table>

* Top of berm elevation = el. 40.0 ft

2.0 CONCLUSIONS

Based on the calculations presented herein, Pond E can pass the 1,000-Yr event without overtopping.

3.0 REFERENCES

1) U.S. Army Corps of Engineers Hydrologic Engineering Center – Hydrologic Modeling System (HEC-HMS) release 4.2.1
2) Precipitation Frequency Data Server (NOAA Atlas 14) https://hdsc.nws.noaa.gov/hdsc/pfds/

4.0 ATTACHMENTS

1) Stage-Storage Table
2) Outlet Discharge
3) HEC-HMS
<table>
<thead>
<tr>
<th>Elevation (ft)</th>
<th>Area (sqft)</th>
<th>Area (acres)</th>
<th>Volume (cuft)</th>
<th>Volume (CY)</th>
<th>Cumulative Volume (cuft)</th>
<th>Cumulative Volume (ac-ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.00</td>
<td>1656480.0</td>
<td>38.028</td>
<td>3287953.38</td>
<td>121776.05</td>
<td>1440415.08</td>
<td>38891207</td>
</tr>
<tr>
<td>38.00</td>
<td>1631505.0</td>
<td>37.454</td>
<td>3236438.74</td>
<td>119868.10</td>
<td>1318639.03</td>
<td>35603254</td>
</tr>
<tr>
<td>36.00</td>
<td>1604970.0</td>
<td>36.845</td>
<td>3179831.64</td>
<td>117771.54</td>
<td>1198770.93</td>
<td>32366815</td>
</tr>
<tr>
<td>34.00</td>
<td>1574909.0</td>
<td>36.155</td>
<td>3113602.06</td>
<td>115318.59</td>
<td>1080999.38</td>
<td>29186983</td>
</tr>
<tr>
<td>32.00</td>
<td>1538763.0</td>
<td>35.325</td>
<td>3041332.50</td>
<td>109640.50</td>
<td>965680.79</td>
<td>26073381</td>
</tr>
<tr>
<td>30.00</td>
<td>1502641.0</td>
<td>34.496</td>
<td>2960293.85</td>
<td>105787.57</td>
<td>853038.84</td>
<td>23032049</td>
</tr>
<tr>
<td>28.00</td>
<td>1457766.0</td>
<td>33.466</td>
<td>2856264.43</td>
<td>105787.57</td>
<td>743398.34</td>
<td>20071755</td>
</tr>
<tr>
<td>26.00</td>
<td>1398702.0</td>
<td>32.110</td>
<td>2743351.65</td>
<td>101605.62</td>
<td>637610.77</td>
<td>17215491</td>
</tr>
<tr>
<td>24.00</td>
<td>1344826.0</td>
<td>30.873</td>
<td>2618523.85</td>
<td>96982.36</td>
<td>536005.15</td>
<td>14472139</td>
</tr>
<tr>
<td>22.00</td>
<td>1274017.0</td>
<td>29.247</td>
<td>2466408.63</td>
<td>91348.47</td>
<td>439022.79</td>
<td>11853615</td>
</tr>
<tr>
<td>20.00</td>
<td>1192837.0</td>
<td>27.384</td>
<td>2113342.44</td>
<td>78271.94</td>
<td>347674.32</td>
<td>9387207</td>
</tr>
<tr>
<td>18.00</td>
<td>926123.0</td>
<td>21.261</td>
<td>1725850.10</td>
<td>63920.37</td>
<td>269402.38</td>
<td>7273864</td>
</tr>
<tr>
<td>16.00</td>
<td>801234.0</td>
<td>18.394</td>
<td>1492305.41</td>
<td>55270.57</td>
<td>205482.00</td>
<td>5548014</td>
</tr>
<tr>
<td>14.00</td>
<td>692395.0</td>
<td>15.895</td>
<td>1251074.27</td>
<td>46336.08</td>
<td>150211.43</td>
<td>405709</td>
</tr>
<tr>
<td>12.00</td>
<td>560982.0</td>
<td>12.878</td>
<td>885038.08</td>
<td>32779.19</td>
<td>103875.35</td>
<td>2804634</td>
</tr>
<tr>
<td>10.00</td>
<td>333827.0</td>
<td>7.664</td>
<td>561417.09</td>
<td>20793.23</td>
<td>71096.16</td>
<td>1919596</td>
</tr>
<tr>
<td>8.00</td>
<td>230753.0</td>
<td>5.297</td>
<td>410592.97</td>
<td>15207.15</td>
<td>50302.93</td>
<td>1358179</td>
</tr>
<tr>
<td>6.00</td>
<td>180852.0</td>
<td>4.152</td>
<td>317532.34</td>
<td>11760.46</td>
<td>35095.79</td>
<td>947586</td>
</tr>
<tr>
<td>4.00</td>
<td>137661.0</td>
<td>3.160</td>
<td>248431.20</td>
<td>9201.16</td>
<td>23335.33</td>
<td>630054</td>
</tr>
<tr>
<td>2.00</td>
<td>111239.0</td>
<td>2.554</td>
<td>198584.65</td>
<td>7354.99</td>
<td>14134.17</td>
<td>381623</td>
</tr>
<tr>
<td>0.00</td>
<td>87807.0</td>
<td>2.016</td>
<td>140080.32</td>
<td>5188.16</td>
<td>6779.19</td>
<td>183038</td>
</tr>
<tr>
<td>-2.00</td>
<td>53667.0</td>
<td>1.232</td>
<td>42957.73</td>
<td>1591.03</td>
<td>1591.03</td>
<td>42958</td>
</tr>
<tr>
<td>-3.00</td>
<td>33075.0</td>
<td>0.759</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Basin Elevations
- **Invert**: 3 ft
- **Embankment**: 40 ft

### 5. Dewatering Device
- **Type**: None
- **Crest**: 38.3 ft
- **Width**: 72 in
- **Cd (orifice)**: 0.6
- **Cw (weir)**: 3.33
- **Orifice Area**: 0.00 ft²
- **Riser Area**: 27.00 ft²
- **Multiple Rows? (Y or N)**: N
- **Type**: Rect. Weir

### 6. Principal Spillway
- **Type**: Riser (Box)
- **Invert**: 9.22 ft
- **Width**: 72 in
- **Length**: 140 ft
- **Crest**: 42.8 ft
- **Slope**: 0.0054 ft/ft
- **Material**: CMP
- **Cd (orifice)**: 0.6
- **Cw (weir)**: 3.33
- **Orifice Area**: 27.00 ft²
- **Riser Area**: 36.00 ft²
- **Number of Spillways**: 1

### 7. Secondary Spillway
- **Type**: Barrel

### 8. Discharge Pipe
- **Min. Elev.**: 38 ft
- **Interval**: 0.1 ft

### 9. Emergency Spillway
- **Width**: 358 ft
- **Side Slope**: 10 : 1
- **Top Width**: 358 ft

### Water Elevation
- **Min. Elev.**: 38 ft
- **Interval**: 0.1 ft

### Well-Controlled Discharge
- **Head**: Hz
- **Discharge**: cfs

### Outlet-Controlled Discharge
- **Head**: Hz
- **Discharge**: cfs

### Pond E Outlet Discharge

<table>
<thead>
<tr>
<th>Water Elevation</th>
<th>Head (ft)</th>
<th>Discharge (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>38.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>38.10</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>38.20</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>38.30</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>38.40</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>38.50</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>38.60</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>38.70</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>38.80</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>38.90</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>39.00</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>39.10</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>39.20</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>39.30</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>39.40</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>39.50</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>39.60</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>39.70</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>39.80</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>39.90</td>
<td>0.00</td>
</tr>
</tbody>
</table>

### Pond E Outlet Discharge Graph

- **Total Discharge**
- **Dewatering Device [None]**
- **Principal Spillway: Rect. Weir**
- **Secondary Spillway: Riser (Box)**
- **Barrel**
- **Emergency Spillway**

### Summary

- **Min. Elev.**: 38 ft
- **Interval**: 0.1 ft
- **Total Discharge**: 44.29 cfs
- **Dewatering Device**: [None]
- **Principal Spillway**: Rect. Weir
- **Secondary Spillway**: Riser (Box)
- **Barrel**
- **Emergency Spillway**
Pond E HEC-HMS

<table>
<thead>
<tr>
<th>Drainage Area</th>
<th>Area (ac)</th>
<th>CN</th>
<th>Lag Time (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pond E Ex</td>
<td>43.9</td>
<td>82</td>
<td>6.0</td>
</tr>
<tr>
<td>Pond E DA</td>
<td>50.7</td>
<td>60</td>
<td>30.1</td>
</tr>
</tbody>
</table>

Computed Results

- Peak Inflow: 778.36 (CFS)
- Peak Discharge: 0.00 (CFS)
- Inflow Volume: 76.93 (AC-FT)
- Discharge Volume: 0.00 (AC-FT)

- Date/Time of Peak Inflow: 17 Apr 2017, 11:59
- Date/Time of Peak Discharge: 17 Apr 2017, 00:00
- Peak Storage: 76.93 (AC-FT)
- Peak Elevation: 13.17 (FT)
Established in 1960, Golder Associates is a global, employee-owned organization that helps clients find sustainable solutions to the challenges of finite resources, energy and water supply and management, waste management, urbanization, and climate change. We provide a wide range of independent consulting, design, and construction services in our specialist areas of earth, environment, and energy. By building strong relationships and meeting the needs of clients, our people have created one of the most trusted professional services organizations in the world.

Golder Associates Inc.
2108 W. Laburnum Avenue, Suite 200
Richmond, VA 23227 USA
Tel: (804) 358-7900
Fax: (804) 358-2900

solutions@golder.com
www.golder.com