Early Implementation Project:

Installation of New Piezometers in Oroville Dam

Reference TM No. ODSCNA-2019-01

Oroville Dam Safety – Ad Hoc Committee Meeting No. 5
August 9, 2019
Early Implementation Project:
Installation of New Piezometers in Oroville Dam

Presentation Outline

- Review of Seepage Control and Monitoring Systems
- Review of Past Seepage/Drainage Measurements
- Planned Installation of 11 New Piezometers
  - **Phase 1**: 6 piezometers at D/S Toe
  - **Phase 2**: 5 piezometers in Core Block/Grout Galleries
Seepage Control and Monitoring Design

- Central Clayey Core
- Internal Gravel Drain / Seepage Collection System
- Seepage Measuring Weir House / Vault
- Line of Grouted Boreholes in Bedrock
- Drain Holes
- Seepage Collection Barrier
Oroville Dam Grout Gallery and Drains

Diagram showing the layout and features of the grout gallery and drains, including:
- Grout cap where necessary above Sta. 10+23
- Normal pool EL 300
- Discontinue curtain in this area
- Limit of grout envelope for Power Plant and Diversion Tunnels
- Location of future power
- Diversion Tunnel No. 1 (N.I.C.)
- Drain holes 80° o.c.
- Grout holes
- Profile of "B" holes
- Profile of "A" holes
- Estimated rock foundation for grout gallery and core block
- Estimated rock foundation for grout gallery and core block
- Bottom of core trench
- Drain holes

Inset images showing details of the grout gallery and drains.
Twin-tube Hydraulic Piezometers Installed in Oroville Dam
Pore Pressures Measured in Downstream Pervious Zones and Foundation
Pore Pressures Measured in Surviving Hydraulic Piezometers up to 2000

from Performance Report No. 10 (2000)

Reservoir

P-1

P-2, 3, 4, and 5
Seepage Control and Monitoring Design

- Central Clayey Core
- Internal Gravel Drain/Seepage Collection System
- Seepage Measuring Weir House/Vault
- Line of Grouted Boreholes in Bedrock
- Drain Holes
- Seepage Collection Barrier
Seepage Control and Monitoring Design

Low Internal Seepage Pool
~Elevation 239 feet
Seepage Collection Barrier, 30-inch Seepage Conduit, and Seepage Vault and Weir System at D/S Toe of Oroville Dam

Reservoir Elevation

D/S Toe Weir Flow

Precipitation
Seepage Measured at Downstream Toe of Oroville Dam

Seepage During Dry Seasons
~10 gpm
Proposed 11 New Piezometers to be Installed in Oroville Dam

- **Phase 1**: 6 piezometers at D/S Toe
- **Phase 2**: 5 piezometers in Core Block/Grout Galleries
Proposed 11 New Piezometers to be Installed in Oroville Dam

✓ **Phase 1:** 6 piezometers at D/S Toe

**Purpose:**
- Improve understanding of 3D seepage in foundation rock near Seepage Collection Barrier
- Determine whether some portions of the seepage are passing over or around the Seepage Collection Barrier without being measured

✓ **Phase 2:** 5 piezometers in Core Block/Grout Galleries

**Purpose:**
- 1 piezometer to replace previous piezometers measuring the upstream portion of the Seepage Collection Pool
- 4 piezometers in bedrock to confirm indications of reduced seepage through the foundation rock – trends observed in gallery drains
Proposed 6 New Piezometers Installed
In Lower River Channel at Downstream Toe

Access Road (~40 ft wide)
P-200a (Projected 23 ft NW)
P-200b (Projected 33 ft NW)
P-201a (Projected 22 ft NW)
P-201b (Projected 32 ft NW)

Zone 3 Gravels
Zone 3 Gravels

Dam Embankment
Waste Fill
Waste Fill

Elev 245 ft
Elev 235 ft
Elev 242 ft
Elev 160 ft
Bottom target Elev 150 ft
Proposed 6 New Piezometers Installed
In Lower River Channel at Downstream Toe
Proposed 6 New Piezometers Installed
In Lower River Channel at Downstream Toe
Proposed New Piezometers Installed at Downstream Toe

6 Piezometers Installed from Downstream Toe

- 2 Piezometers installed vertically down into Zone 3 and Zone 5 Pervious Zones – straddling Seepage Barrier
- 4 Piezometers drilled vertically down into foundation rock
  - 2 in center of river channel
  - 2 in lower left and right abutments
Proposed Replacement Piezometers Installed in Core Block
Proposed Replacement Piezometers Installed In Left and Right Abutment Grout Galleries

Vertical Boreholes Drilled from Abutment Grout Galleries for Piezometers P-103 and P-104
<table>
<thead>
<tr>
<th>Replacement Piezometer</th>
<th>Location</th>
<th>Approx. Embankment Dam Station</th>
<th>Alignment</th>
<th>Approximate Gage/Surface Elevation (feet)</th>
<th>Approximate Tip Elevation (feet)</th>
<th>Approx. Depth/Length (feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-100 D/S Zone 2</td>
<td>Core Block D/S Zone 2</td>
<td>53+15 (33+15)*</td>
<td>Horiz.</td>
<td>232</td>
<td>232</td>
<td>40</td>
</tr>
<tr>
<td>P-101 Foundation</td>
<td>Core Block</td>
<td>53+15 (33+15)*</td>
<td>Vertical</td>
<td>227.6</td>
<td>150</td>
<td>77.6</td>
</tr>
<tr>
<td>P-102 Foundation</td>
<td>Core Block</td>
<td>53+11 (33+11)*</td>
<td>Vertical</td>
<td>236.7</td>
<td>150</td>
<td>86.7</td>
</tr>
<tr>
<td>P-103 Foundation</td>
<td>Left Grout Gallery</td>
<td>~63+00</td>
<td>Vertical</td>
<td>562</td>
<td>482</td>
<td>80</td>
</tr>
<tr>
<td>P-104 Foundation</td>
<td>Right Grout Gallery</td>
<td>~39+00</td>
<td>Vertical</td>
<td>562</td>
<td>482</td>
<td>80</td>
</tr>
<tr>
<td>P-200A D/S Zone 5A</td>
<td>D/S Toe U/S of Barrier</td>
<td>~53+00</td>
<td>Vertical</td>
<td>350</td>
<td>236 - 244</td>
<td>114</td>
</tr>
<tr>
<td>P-200B Foundation</td>
<td>D/S Toe U/S of Barrier</td>
<td>~53+00</td>
<td>Vertical</td>
<td>350</td>
<td>15-20 feet below TOR**</td>
<td>180</td>
</tr>
<tr>
<td>P-201A D/S Zone 3</td>
<td>D/S Toe D/S of Barrier</td>
<td>~52+50</td>
<td>Vertical</td>
<td>275</td>
<td>220 - 225</td>
<td>55</td>
</tr>
<tr>
<td>P-201B Foundation</td>
<td>D/S Toe D/S of Barrier</td>
<td>~52+50</td>
<td>Vertical</td>
<td>275</td>
<td>15-20 feet below TOR**</td>
<td>110</td>
</tr>
<tr>
<td>P-200 Left Abutment</td>
<td>D/S Toe</td>
<td>~54+00</td>
<td>Vertical</td>
<td>350</td>
<td>220 - 225</td>
<td>130</td>
</tr>
<tr>
<td>P-203 Right Abutment</td>
<td>D/S Toe</td>
<td>~51+00</td>
<td>Vertical</td>
<td>335</td>
<td>220 - 225</td>
<td>115</td>
</tr>
</tbody>
</table>
Questions?