SR 99 Tunnel Project

Tunnel Boring Machine Repair Plan Update

6/16/14
Objectives of repair plan:

- Replace seals with more robust seal system
- Install new main bearing
- Add steel repair pieces accommodate the new seal system and provide additional rigidity
- Configure TBM operation and performance monitoring enhancements
Update on Work in Progress
# Hitachi Zosen Corporation

## Manufacturing Schedule

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<tr>
<th>ITEM</th>
<th>Apr-14</th>
<th>May-14</th>
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Outer seal ring
June 2, 2014
Outer seal ring
June 9, 2014
Bearing block
June 2, 2014
Bearing block
June 9, 2014
OLD SEAL SYSTEM

NEW SEAL SYSTEM

Thrust seal (design value: 12mm)
Radial seal clearance (design value: 12mm)
Labyrinth seal (design value of both thrust and radial: 10mm)
RIB PART: 4pc.
RIB PART: (INSIDE) 22pc.
PLATE PART: (REAR) 2pc.
PLATE PART: (MIDDLE) 30pc. (REAR) 30pc.
RIB PART: (REAR) 30pc.
The number of repair pieces: 118
Additional repair weight: approx. 34ton
Front body
The number of repair pieces: 98
Additional repair weight: approx. 52ton
Hitachi Zosen

Tunnel Boring Machine Repair Plan

6/16/14
Video goes here
Hitachi Zosen
Tunnel Boring Machine Repair Plan

A. Preparation work in the shaft – 12 steps

B. Disassembly work in the shaft and lifting – 12 steps

C. Preparation work on the ground – 2 phases

D. Disassembly work on the ground – 10 steps

E. Assembly work on the ground – 9 steps

F. Lowering and assembly work in the shaft – 6 steps

G. Final activities – 8 activities
A. Preparation work in the shaft
Steps 1 to 5

1. Cutter Head: 45degree at top position
2. Bearing block and Middle body: Fix at top position.
   ※ Cutter support jack: Working.
3. Hose and Cable in the TBM: Disconnect.
   ※ Put a counter-mark
5. Fix plate for Passage way: Cutting the welding bead at Middle body upper side.
A. Preparation work in the shaft
Steps 6 to 9

6. Cutter Electric motor: Dismount (No. 9, 10, 11, 12, 13, 14, 15, 16)
7. Rotary Joint: Disconnect.
9. Inside deck: Remove from inner cylinder.
A. Preparation work in the shaft
Steps 10 to 12

10. Bit and Wear resistant steel on the Cutter Head:
   Take off for lifting piece.
12. Lifting piece on the Front-middle body upper, right and left side: Welding
B. Disassembly work in the shaft and lifting work
Steps 1 to 5

1. Front body outer seal ring and Front body bulkhead: Cutting the welding bead.
2. Front body upper side: Disassembly and lifting to the ground.
3. Front body right and left side: Disassembly and lifting to the ground.
4. Passage way: Take off and lifting to the ground.
5. Front body outer seal ring: Cutting and lifting to the ground.
Disassembly work in the shaft and lifting work
Steps 6 to 9

6. Cutter support jack mount: Cutting the lower right and left side.
7. Lifting trunnion: Set on the bearing block.
8. Cutter head/Driving unit: Lifting by MLT.
9. Bearing block and middle body’s fixing and cutter support jack: Take off.
B. Disassembly work in the shaft and lifting work

Steps 10 to 11

10. Cutter head/Driving unit: To go forward. (2066mm)

11. Cutter head/Driving unit: Make to vertical and lifting to the ground.
B. Disassembly work in the shaft and lifting work

Step 12

12. Cutter head/Driving unit: Lifting to the ground, turn over and set on the working stage.
C. Preparation work on the ground
Phase 1 of 2
C. Preparation work on the ground
Phase 2 of 2
D. Disassembly work on the ground
Steps 1 to 4

2. Bearing block: Disassembly, lifting and set on the working stage.
3. Outer seal and bearing block(front): Cutting and removal from bearing block.
4. New bearing block(middle): Install to the bearing block(rear).
D. Disassembly work on the ground
Steps 5 to 10

5. Inner seal ring, inner cylinder and agitator: Disassembly and lifting and set on the working stage.
6. Agitator: Extend the blade (500mm)
7. Agitator: Exchange the new seal.
8. Main bearing: Disassemble.
E. Assembly work on the ground

Steps 1 to 3

1. New main bearing: Assembly on the cutter column.
2. Inner seal: Exchange the new seal.
3. Inner seal, inner cylinder and agitator: Install on the cutter column.
E. Assembly work on the ground
Steps 4 to 9

4. Outer seal ring, bearing block(front):
5. Bearing block(middle and rear): Install on the cutter column.
7. Pre cutting bit: Exchange the new bit. (Max 101PCS)
8. Cutter head slit baffle plate: Cutting. (64 places)
9. Foam injection port: Exchange the new port. (22 places)
F. Lowering and assembly work in the shaft
Steps 1 to 4

1. Cutter head/driving unit: Lowering on the front body lower.
2. Lifting trunnion: Take off from bearing block.
3. Bearing block and Middle body: Fix at top position.
   ※Cutter support jack: Working.
4. Passage way: Install and connect the manlock.
F. Lowering and assembly work in the shaft
Steps 5 to 6

5. Front body right and left side: Install.
G. Final activities

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<tbody>
<tr>
<td>1.</td>
<td>Lifting piece: Cutting and take off.</td>
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<td>2.</td>
<td>Bit and wear resistant steel on the cutter head: Mount and welding.</td>
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<td>3.</td>
<td>Cutter electric motor: Reassembly.</td>
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<td>4.</td>
<td>Inside deck: Reconnect to inner cylinder.</td>
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<td>5.</td>
<td>Rotary joint: Reconnect.</td>
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<td>7.</td>
<td>Manlock and passage way: Reconnect to the Front body.</td>
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<td>8.</td>
<td>Hose and cable: Reconnect.</td>
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Repair Schedule Milestones

Late May: Begin building the access pit’s underground walls.

Late July through September: Excavate the pit.

October: Remove the machine’s cutterhead and begin repairing damage to the seal system and main bearing.

February 2015: Test machine to ensure it is ready to tunnel beneath downtown.

Late March 2015: Resume tunneling.