DESIGN REQUIREMENTS

for the

SOUTH PARK BRIDGE – FINAL DESIGN

June 23, 2009
Revision: Draft E

For:

KING COUNTY - DEPARTMENT OF TRANSPORTATION

WASHINGTON
Agreement No. E00082E07

By:

HNTB Corporation

Job No. 45647

PROJECT NAME: SOUTH PARK BRIDGE – FINAL DESIGN

Office: Seattle (004)

Design Requirement Version Control Table

Revision	Date of Issue	Author	Description
Draft A	December, 2008	HNTB	Initial document for HNTB internal review
Draft B	February 9, 2009	HNTB	Provided to King County for Review and Comment
Draft C [1]	March 6, 2009	HNTB	This version includes revisions to address King County's and third party comments as well as to document revisions and additions due to advancement of the project design.
Draft D [2]	June 6, 2009	HNTB	This version includes revisions to address King County's and third party comments as well as to document revisions and additions due to advancement of the project design.
Draft E [3]	June 23, 2009	HNTB	This version includes previous revisions and is issued for the Intermediate Design review.

1: King County's and third party's comments on Revision Draft B, as well as the design team's responses to the comments are available in the electronic version of the Revision Draft B.

2: King County's and third party's comments on Revision Draft C, as well as the design team's responses to the comments are available in the electronic version of the Revision Draft C.

3: Third party's comments on Revision Draft D, as well as the design team's responses to the comments are available in the electronic version of the Revision Draft D.

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Bridges 2^{nd} Edition, 1994		
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1.2. Washington State Department of Transportation (WSDOT) Publications:		
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1.3. King County Publications:		
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1.3.2. Consultant Geotechnical Report Guidelines for King County Capital Improvement Projects		
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1.3.4. King County Code		
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1.4. City of Seattle Publications:		
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1.5. Other Publications:		
1.5.1. Highway Capacity Manual		
1.5.2. International Building Code [1]	1: Technical aspects to be applied to the design of only the control towers as identified in the design criteria which will be developed early in Phase I.	
1.5.3. Manual of Steel Construction LRFD		
1.5.4. Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD)		
1.5.5. National Electrical Code (NEC)		
1.5.5.1. A variance from NEC clearances will be necessary for the drive motors,		

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auxiliary motor and brakes located at the Machinery Level with the drive system. 1.5.5.2. A variance will be requested based on the argument that: 1.5.5.2.1. Access to the above electrical equipment will not be required while the equipment is energized, and 1.5.5.2.2. Full compliance with the NEC clearance requirements would require substantial increase in the foot print of the drive system and the size of the bascule piers.		
1.5.6. Section 106 of National Historic Preservation Act		
1.5.7. Seismic Retrofitting Manual for Highway Structures		
1.5.8. Technical Advisory T 6640.8A		

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2. ADDITIONAL DESIGN SPECIFICATIONS		
2.1. FDOT Standard Heavy Duty Fender System (Index 21910)	2.1: This is a self imposed specification to be used for the fender system / R Johnson / June 6, 2009	
2.2. NFPA – 70 (NEC) National Fire Protection Agency, National Electric Code		
2.3. NFPA – 502 Standard for Road Tunnels, Bridges, and Other Limited Access Highways, 2008 Edition		
2.4. U.S. Coast Guard 33 CFR Part 118 – Navigation Lights/Signals		
2.5. AASHTO “Guide Specifications for LRFD Seismic Bridge Design,” May 2007 (to be used as a guide for seismic design of the approach structures and selected aspects of the bascule structure)	Application of Guide Specification refined since Revision Draft B – RMJ – 3/6/09	
2.6. South Park Bridge Replacement, Vol. 1: Preliminary Design Report, August 2007		

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(hereafter referred to as PDR)		
2.7. South Park Bridge Replacement, Vol. 2: Preliminary Design Plans, August 2007 (hereafter referred to as PE plans)		
2.8. City of Seattle Standards / ROW Manual / Specifications will be applied at the direction of King County when the work is within COS jurisdiction.	Added in accordance with COS request / R Johnson / June 5, 2009	
3. UNITS / TEMPERATURE / DATUM		
3.1. The bridge will be designed using the customary English units of feet, pounds, degrees Fahrenheit, etc.		
3.2. The units shown on the final plans and specifications will be English units.		
3.3. Dimensions given on the plans are for the bridge at mean temperature of 64˚, unless otherwise noted.		
3.4. All plan dimensions are measured horizontally or		

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vertically in two orthogonally perpendicular planes as indicated by relative orientation, unless otherwise noted		
3.5. The horizontal datum for the project is NAD 83/91	Added since Revision Draft B – RMJ – 3/6/09	
3.6. The vertical datum for the project is NAVD88		
3.7. Elevation of 0.0 on the existing South Park Bridge as-built drawings corresponds to an NAVD88 elevation of 9.6 feet as published in the Preliminary Design Report dated August 2007.		
4. CROSS SECTION CONFIGURATION		
4.1. Traffic lanes along South Park Bridge alignment between Dallas Ave S. and the northerly project limits include 11-foot lanes in both northbound and southbound directions for a total of four 11-foot lanes. From Dallas Ave S., the roadway transitions to the existing channelization at Cloverdale Street. A bus stop proposed along the east side of the roadway will be designed to		

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follow King County Metro's design requirements. The pullout for the parking along the east side between Dallas Ave S. and Cloverdale Street will follow the City of Seattle Right of Way Manual.		
4.2. Bicycle lanes should include one 5-foot lane out board of the traffic lanes in each direction between Dallas Ave S. and the northerly project limits. There will be no bike lanes south of Dallas Ave S. and from the northerly project limits to E. Marginal Way.		
4.3. Sidewalks between Dallas Ave S. and the northerly project limits include a 6-foot sidewalk on both the east and west sides of the roadway. On the west side of the 14th Ave S. between Dallas Ave S. and Cloverdale Street, the sidewalk width will be 10 feet. Along the east side, at the location of the bus stop, the sidewalk width will be 11 feet. Beyond the bus stop, at the location of the on-street parking, the sidewalk will		

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be 6 feet with a 5-foot planter between the roadway and the sidewalk.		
4.4. Outboard (exterior) railings will be considered a pedestrian railing with a minimum height of 42 inches in accordance with current AASHTO requirements. (Deck space has been allocated to bicycle traffic on the traffic deck of the bridge and approaches.)		
4.4.1. Allow 10" width for railing		
4.4.2. The pedestrian railing will be designed to conform to AASHTO's 6 inch sphere test.		
4.4.3. A pedestrian railing will, at a minimum, be provided when the vertical distance between the sidewalk elevation and the proposed ground elevation is 18 inches or greater.	Self imposed requirement. AASHTO requires railings when the distance between the surface and the adjacent ground exceeds 30 inches.	
4.5. Traffic barrier will be a tubular metal traffic rail on concrete base (metal based on bascule span).		

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5. VERTICAL PROFILE		
5.1. Design Speed is 35 mph		
5.2. Posted Speed is 30 mph		
5.3. Design Speed for calculating intersection Sight Distance – 40 mph		
5.4. Stopping Sight Distance (Max.) is 267 feet		
5.5. SSD Calculation based on Vehicle height of 3.5’, Object height of 0.5’		
5.6. Vertical Clearance at ORR Street – 14.5’		
5.7. Vertical Clearance at Boeing Access Rd – 14’ min., 14.5’ desirable		
5.8. Maximum grade is 5%.		
6. HORIZONTAL ALIGNMENT		
6.1. The new bridge will roughly parallel to the existing bridge		
6.2. Design based on AASHTO Low-Speed Urban criteria		
6.3. Design Vehicle – WB 50		

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6.4. Curb Radii – King County – 35" R, City of Seattle – 25' R. Design to accommodate WB-40 truck turning movement at NW and SW corner of Dallas Ave S. / 14th Ave S. Actual radius to be used was determined in coordination between COS, KC and HNTB.		
6.5. The distance between the new and old bridge will be controlled by the ability to construct the new bridge without significantly affecting the operation of the existing bridge		
6.6. The minimum distance between Boeing's 2-15 building in the northwest quadrant of the project area, and the project will be 30 feet.		
7. NAVIGATION CLEARANCE		
7.1. The lateral navigation clearance will be a minimum 125-foot clear channel centered on the Duwamish Waterway, with unlimited vertical clearance while the bridge is in the full open position in accordance with the PDR.		

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7.2. The center channel vertical navigation clearance will be a minimum of 34 feet above elevation 7.64 (MHW) within a 33.4 feet wide channel centered on the Duwamish Waterway as shown in the PE plans.		
7.2.1. MHW level defined as -2.1 feet relative to City of Seattle.		
7.2.2. For purposes of this project, the more conservative (higher) MHW elevation converted from the King County datum will be used and set at a value of 7.64 feet (NAVD88) in accordance with the PDR.		
7.3. The vertical clearance at the edge of the navigation channel will be a minimum of 30 feet above elevation 7.64 (MHW).		
8. STRUCTURE TYPE		

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8.1. The main span structure will be a two-leaf trunnion bascule bridge		
8.1.1. The counterweight will be under-slung with vehicular deck spanning the counterweight well		
8.2. The approach spans will be two-span prestressed concrete girder with CIP deck structures similar to that shown in the PE Plans.		
8.3. The bascule foundations will be constructed of sand-island sunken concrete caissons bearing on competent soils and will support the bascule piers.		
8.4. The approach structures will be founded on drilled shafts		
9. BASCULE SUPERSTRUCTURE		
9.1. The bascule span girders will be fabricated of		

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conventional welded plate steel girders with triangles cut out of the web to simulate a "truss". Steel edges of the cuts will be dressed to mitigate potential of accelerating paint deterioration and corrosion.		
9.2. Splice Location: A field splice will be located roughly 21 feet on the channel side of the trunnion to allow the superstructure joined at mid-span by temporary works, floated on barges and hoisted vertically into position with use of heavy cranes.		
9.3. Deck: The superstructure deck will be solid to reduce tire noise and collect surface water for treatment prior to discharge into the waterway.		
9.4. If surface (deck) mounted bolts are used for joints, only recessed hex head bolts will be used. (Countersunk flat screws will not be used.)		

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9.5. Joints within the sidewalk and bicycle lane will be detailed to accommodate bicycle and foot traffic (cover joints).		
9.6. Deck joints over the trunnion will be avoided if possible. Deck joints will be designed to minimize water and debris intrusion.		
9.7. Pockets will be provided within the counterweight below the center of gravity in the full up position to allow placement of balance blocks and fine tuning of the leaf balance near the full open position.		
9.8. Normal access will be provided to the counterweight pockets in the closed position. Two rows of pockets will be located in the front of the counterweight to allow adjustment of the balance between the counterweight and bascule span, and adjustment of the centroid of the counterweight.		

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9.8.1. Additional pockets will be provided along the sides or top of the counterweight to allow gross adjustments to be made primarily prior to initial commissioning of the bridge in either the open or closed position.		
10. BASCULE PIERS		
10.1. Height clearance		
10.1.1. Minimum height clearance for personnel will be 6-feet 8-inches where possible in accordance with the PDR		
10.1.2. Minimum height clearance for machinery removal and replacement operations will be 8- to 10-feet in accordance with the PDR		
10.2. Lift Points: Lifting equipment and lifting eyes (pick points) or overhead chain hoist rail will be	Details to be determined during the intermediate design coordination meeting - once the project is better defined – RMJ – 6/5/09	

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provided to aid in machinery maintenance		
10.3. Stairs: 10.3.1. Stairway width will be a minimum of 36 inches, measured between walls, as specified by the IBC 1009.1 – Exceptions for occupant load of 50 or less. Where possible, the stairs will be 48 inches, measured between, to allow two people to pass or one person to navigate the stairs carrying equipment. 10.3.2. Stairs within the bascule piers need be provided on only one side (east or west) of the pier. 10.3.3. Stairs will be in accordance with the requirements of the AASHTO specifications and current OSHA Standards. 10.3.4. Stairs over the drive train shafts will be provided for maintenance personnel to step over the components if personnel can not walk around the equipment.	Minimum stair width is 36 inches. Provide up to 48 inches if possible – RMJ – 3/6/09	

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10.3.5. Stairs will be considered the preferred method to access the counterweight pit, and will be provided if practical. If stairs are not practical, ladders will be provided in lieu of stairs.		
10.4. Access:		
10.4.1. Control Towers' vicinity ladders, platforms, and walkways provided will be in accordance with the requirements of the AASHTO specifications and current OSHA Standards. (Railings within the Control Towers will be in accordance with the IBC.)		
10.4.2. Access to the center locks will be from a below deck catwalk. An opening in the end floor beams will be provided to allow maintenance forces to traverse from one bascule leaf to the other at mid-span.		
10.4.3. Access to the trunnion bearings will be from ships stairs, ladders, and/or platforms		

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accessed from the Machinery Level. 10.4.4. Suitable platforms and supports will be provided for maintenance access to the tail locks.		
10.4.5. A 4-foot horizontal (lateral) clearance will be provided on one side of machinery for maintenance purposes to the extent practical. A 3-foot clearance on the opposite side, to the extent practical.	Need to verify actual clearances and vet them with the owner(s) prior to the end of March, 2009 – RMJ – 3/6/09	
10.4.6. Bascule pier personnel access will be provided as follows: 10.4.6.1. No provisions will be made to get between the east and west of the bascule piers at the Roadway Level. 10.4.6.2. Maintenance forces will need to go down the Machinery Level to get from the one side of the Equipment of the bascule pier to the other side. 10.4.6.3. Access between the west and east		

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sides of the bascule piers will be provided at the Machinery and Footing Levels only.		
10.4.6.4. An floor door (access hatch) will be provided in the “look out” areas of the bascule piers to allow the bridge tender to gain access to the Roadway Level from the Equipment Level on the side of the bascule pier opposite the Control Tower.		
10.5. Curtain walls will be provided on the channel side of the bascule pier to minimize unauthorized access to the interior of the pier, enclose the machinery from the elements and mitigate the potential for birds to nest within the pier. Bird control will be provided at all possible entry points to the interior of the bascule piers.	Bird control requirements added by King County – RMJ – 3/6/09	
10.6. Interior floors and walkways of the bascule pier will be sloped, to a maximum of 2%, to drain to the low point sump within the counterweight pit.	Sloped of floors limited to 2% - RMJ – 3/6/09	

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11. CONTROL TOWERS		
11.1. Control Tower Level Nomenclature:		
11.1.1.1. Operator Level: Bridge operations level (up one flight of stairs from the Roadway Level)		
11.1.1.2. Roadway Level: Level at or near roadway elevation		
11.1.1.3. Equipment Level: One level below the roadway level		
11.1.1.4. Machinery Level: Two levels below the roadway level		
11.2. Two control towers will be provided, one on each bascule pier		
11.2.1. Operation of the bascule leaves will be under the control of the bridge tender that will be located in Operator Level of the control tower located on the west side of the north bascule pier		

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11.2.2. The non-operational (maintenance and equipment) control tower will be located on east side of the south bascule pier		
11.3. IBC Occupancy Group: For purposes of technical design, the control towers are considered to be two story buildings with the following Occupancy Group Classification.		
11.3.1. Operators Level		
11.3.1.1. North Tower: Occupancy Group B (Business IBC 304.1) with an occupancy of 2.		
11.3.1.2. South Tower: Occupancy Group B (Business IBC 304.1) with an occupancy of 2.		
11.3.2. Roadway Level:		
11.3.2.1. North Tower: Occupancy Group B (Business IBC 304.1)		
11.3.2.2. South Tower: Occupancy Group B (Business IBC 304.1)		
11.3.3. Equipment Level:		

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11.3.3.1. North Tower: Occupancy Group U (Utility) 11.3.3.2. South Tower: Occupancy Group U (Utility)		
11.4. Space Heat Type: For purposes of determining building envelop requirements, the control towers will be designed with the following space heat type: 11.4.1. Operators Level 11.4.1.1. North Tower: Conditioned space – electric resistance 11.4.1.2. South Tower: Unconditioned space 11.4.2. Roadway Level: 11.4.2.1. North Tower: Conditioned space – electric resistance 11.4.2.2. South Tower: Conditioned space – electric resistance 11.4.3. Equipment Level: 11.4.3.1. North Tower: Unconditioned space	The only conditioned spaces are: • South Tower Operator Level • South Tower Roadway Level • North Tower Operator Level • North Tower Roadway Level RMJ – 6/5/09 Ventilation of electrical level is not required because the space is conditioned.	

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11.4.3.2. South Tower: Unconditioned space 11.5. Building Envelope: The building envelope of the conditioned spaces of the control towers will be design to the general requirements of Chapter 6 of the Washington State Energy Code, 2006, for Group R-3, Zone 1 as a conservative measure for energy conversation. The design will conform to the following requirements: 11.5.1. Operator Level Ceiling 11.5.1.1. North Tower: Min. R-38 11.5.1.2. South Tower: Min. R-38 11.5.2. Operator Level Walls 11.5.2.1. North Tower: Min. R-21 11.5.2.2. South Tower: Min. R-21 11.5.3. Operator Level Floor: No requirements 11.5.4. Roadway Level Ceiling 11.5.4.1. North Tower: No requirements 11.5.4.2. South Tower: No requirements 11.5.5. Roadway Level Walls 11.5.5.1. North Tower: R-21		

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11.5.5.2. South Tower: R-21		
11.5.6. Roadway Level Floor:		
11.5.6.1. North Tower: R-30 (insulated below from Equipment Level)	The HVAC equipment is located in the Equipment Level, but this level is not conditioned – RMJ – 3/6/09	
11.5.6.2. South Tower: R-30 (insulated below from Equipment Level)		
11.5.7. Equipment Level Ceiling: no requirements		
11.5.8. Equipment Level Walls: no requirements		
11.5.9. Equipment Level Floor: no requirements		
11.6. Windows:		
11.6.1. Configuration: Windows will consist of plate glass on the lower light, and operable awing lights with muntins on the upper light.		
11.6.2. Energy Conservation:		
11.6.2.1. North Tower: Windows will be double glazed with a thermal break and a maximum U-factor of 0.35 to reduce heating and cooling demand.		

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11.6.2.2. South Tower: Windows will be double glazed with a thermal break and a maximum U-factor of 0.35 to reduce heating and cooling demand.		
11.6.3. Operation: All lower lights of glass will be fixed. One awning light on the northwest, southwest and southeast faces of the control towers will be operable and hinged at the top of the window. All remaining awning lights will be fixed.	The requirement for the number of operable awning windows was changed from 4 to 3 to allow operable windows on the diagonal walls, except the one with the door in it – RMJ – 3/6/09	
11.6.4. Security Glazing – North (operational) Control Tower: 11.6.4.1. The exterior glazing of windows will be shatterproof glass in accordance with AASHTO Movable 2.1.5. 11.6.4.2. The interior glazing will be as necessary to meet the energy conservation requirements.	The bullet resistant glass requirement was removed based on development of the design – RMJ – 3/6/09	

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11.6.5. Security Glazing – South (maintenance) Control Tower: 11.6.5.1. The glazing of all lower light (plate glass) windows will be shatterproof glass in accordance with AASHTO Movable 2.1.5. 11.7. Doors 11.7.1. The roadway level entrance doors will be an insulated metal door without glazing and will be bullet resistant in consideration of AASHTO movable 1.6.2. The door will have a maximum U-Factor of 0.20. 11.7.2. The north (operational) control tower will be fitted with an exterior Operator Level door that is an insulated metal door with a single pane 3/4 lite of bullet resistant glass (UL 752 Bullet Resistant Glass – Level 1).		

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11.7.3. The south (maintenance) control tower will be fitted with an insulated metal door without glazing.		
11.8. Vapor Retarders: Vapor retarders will be installed on the warm side (in winter) of insulation in conditioned spaces within the control towers.		
11.9. HVAC		
11.9.1. An electric central HVAC system composed of a heat pump with supplementary electrical resistance heat will be provided in both the control towers. The HVAC system will be located in the Equipment Level, but will not condition the Equipment Level.		
11.9.2. The heating system will be sized to provide heating of the Operators (north tower only) and Roadway Levels (both towers) to a design temperature of 72 ºF, based on ASHRAE climate data for the area.		
11.9.3. The cooling system will be sized to provide		

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cooling of the Operators (north tower only) and Roadway Levels (both towers) to a design temperature of 78ºF, based on ASHRAE climate data for the area.		
11.9.4. Temperature controls will be used to control both heating and cooling, and be set for a range of 55˚ F to 85˚F and will be capable of operating the system heating and cooling in sequence. The temperature control will have an adjustable deadband of not less than 10˚F.		
11.9.5. A programmable thermostat will be provided for the heat pump system. The cut-on temperature for the compression heating will be higher than the cut-on temperature for the supplementary heat, and the cut-off temperature for the compression heating will be higher than the cut-off temperature for the supplementary heat.		

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11.10. Details:		
11.10.1. A catwalk will be provided on the roadway side of the control towers to allow the tender to view pedestrian in accordance with the City of Seattle wishes.		
11.10.2. An access hatch will be provided within the catwalk over the clock in the tower to provide an initial means of accessing the exterior of the clocks. No additional means of access (bosoms chairs, lifting wenches, etc.) will be provided as part of the project.		
11.10.3. North and south control towers will be fitted with kitchen, bathroom and storage facilities.		
11.11. Flooring: The flooring of all levels of the control towers will be manufactured of electrically insulating material such as vinyl or rubber tiles in accordance with AASHTO Movable 1.1.6.		

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11.12. Water Heating		
11.12.1. The electric water heaters will be on-demand systems and not require storage of heated water in unheated spaces.		
11.12.2. Storage water heaters used in combination with space heat and water heat applications shall have either an Energy Factor (EF) or a Combined Annual Efficiency (CAE) of not less than 0.58 and 0.71 respectively.		
11.13. Electrical:		
11.13.1. Lighting over the control console will be on a dimmer switch to reduce window reflections and glare.		
11.13.2. 20 amp outlets will be provided throughout the control towers as convenience outlets.		
11.13.3. A minimum of two 120 v circuits will be provided in each level of the control towers		

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in addition to the dedicated circuits. 11.13.4. The electrical system will be configured such that a 240 volt circuit may be added, initiating at the circuit panel, in the future. 11.13.5. A voice communication system (intercom) between the exterior service door at the Roadway Level and bridge tender in the Operators Level in the north control tower will be provided. 11.14. Fire protection and Detection: 11.14.1. Fire Protection: Fire sprinklers are not required based on section 903.2.10 of IBC and the IFC because of the low occupancy and will not be provided. 11.14.2. Fire detection is not required by the IBC or the IFC because of the low occupancy. Heat detection alarms will be provide in all three levels of the control tower as protection beyond that required by codified regulations. Neither heat detection nor smoke detection alarms will		

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be provide within the "bascule piers" themselves. Said differently, except for the individual rooms within the control towers, no form of fire detection will be provided.		
11.15. ADA Requirements:		
11.15.1. King County's bridge tender job description requires able body personnel to complete the duties		
11.15.2. City of Seattle's bridge tender job description:	To be completed once information is received from COS – RMJ – 3/6/09	
11.15.3. ADA Curb Ramps standards 1:12 maximum slope.		
11.15.4. No elevator will be required in the control towers in accordance with the PDR		
11.16. Exterior Finishes		
11.16.1. Exterior of control towers to be finished with brick to reflect existing bridge. The color of		

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the brick is yet to be determined as of 3-3-09.		
11.16.1.1. The brick will inset within the outboard face of the concrete.		
11.16.2. Roof of control towers to be finished with metal treated with factory applied coating (power coating / paint) to prevent leaching of leachable materials. Galvanizing will not be considered an acceptable coating. The factory applied coating is considered to be consistent with the definition of "treated to prevent leaching" in accordance King County's 2005 Surface Water Design Manual.		
11.16.2.1. A layer of sound insulation will be provided beneath the metal roofing mitigate the sound from rain and hail on metal roof.		
11.16.3. Roof Drainage System:		

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11.16.3.1. Roof drains (gutters) will be provided on all sides of the control towers except the side facing up and down the waterway (west side of north towers, east side of south tower) to mitigate impairment of the bridge tender's sight of the roadway and bascule span during rain events.		
11.16.3.2. Roof drains (gutters) will be allowed to discharge onto flat areas provided the storm water flows away from the building in accordance with the provision of the 2003 International Plumbing Code for one- and two-family dwellings.		
11.16.3.3. Scuppers will be provided in the roof drains (gutters) on the west side of the north tower, and east side of the south tower, to discharge the stormwater collected by the roof drain system.		
12. AESTHETIC CONSIDERATIONS		
12.1. SHPO has no architectural design requirements		

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for the project 12.2. The configuration of the pedestrian railing will be developed by project artist, administered by 4Culture, as communicated to HNTB. **13. FENDER SYSTEM (PIER PROTECTION)** 13.1. Design Philosophy 13.1.1. The fender system is considered to be sacrificial 13.1.1.1. The fender system is designed to be a flexible, energy absorbing structure to mitigate damage to vessels and fenders during minor collisions and redirect some vessel impacts that would otherwise damage the bascule pier 13.2. Manufactured materials such as Sea Timber, Structural Composite Lumber, or Plastic Lumber		

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will be used for planking of the fender system rather than natural timber to the extent deem practical.		
14. UTILITIES		
14.1. Service Connections		
14.1.1. North end: All service connections to the bridge will be clustered near the west side, of the south face of the north abutment to allow enclosure for security		
14.1.2. South end: All service connection to the bridge will be clustered near the east side, of the north face of the south abutment to allow enclosure for security		
14.2. Utilities on Bridge		
14.2.1. No existing or identified utilities will be carried on the bridge other than those		

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required for operation and maintenance of the bridge 14.2.1.1. Two un-used (spare) 4 inch ducts will be carried from end of project to end of project, including within the submarine conduit.		
14.2.2. Potable Water: 14.2.2.1. Potable water will be provided to the Roadway level of both control towers for wash rooms and toilet facilities.	The number and location of water spigots at the Roadway Level needs to be defined and vetted – RMJ – 3/6/09	
14.2.2.2. Potable water for maintenance will be provided: 14.2.2.2.1. In each quadrant of each bascule pier at the Machine Level and Footing Level. 14.2.2.2.2. At one location on the east and west side at the Equipment Level. 14.2.2.2.3. At one location on the east and west side at the Roadway Level.		

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14.2.3. 120 V duplex service receptacles will be provided for maintenance purposes as follows		
14.2.3.1. In each quadrant of each bascule pier at the Equipment Level, Machine Level and Footing Level.		
14.2.3.2. At one location on the east and west side at the Roadway Level.		
14.2.4. Sanitary sewer service will be provided to both north and south control towers		
14.2.5. Telephone service will be provided to both north and south control towers.		
14.2.6. Either cable (Qwest) or fiber optics (Comcast) for communications with the COS's computer) will be provided to both the north and south control towers.	Need to resolve to allow for development of construction documents / R Johnson / June 6, 2009	
15. DRAINAGE		
15.1. General Drainage Requirements		

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15.1.1. Per KCSWDM, Flow Control is not required		
15.1.2. Per KCSWDM, Basic water quality treatment is required; enhanced treatment is not required.		
15.1.3. Per King County, only added Pollution Generating Impervious Surface should be treated.		
15.1.4. Conveyance will meet the 25 year storm event and a check is required to make sure that the 100 year event will not cause flooding. If needed, an emergency overflow to be provided.		
15.1.5. Water quality treatment – 60% of 2 year storm event.		
15.1.6. Oil control is not required; spill control needs to be considered.		
15.2. General TESC requirements		
15.2.1. Consider all areas including staging areas		

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15.2.2. Consider 2 year and 10 year storm events for design.		
16. LANDSCAPE		
16.1. Plantings will be native species and drought tolerant		
16.2. No artificial irrigation will be provided		
16.3. Soils for planting will consist of imported topsoils/compost		
16.4. LID techniques in the form of a rain garden will be included in the design phase of the project		
16.5. Habitat enhancement techniques will be utilized for riverbank restoration.		
16.6. Street trees will be sized as 2 1/2 inch caliper		
17. STREET LIGHTING		
17.1. Illumination Requirements		
17.1.1. Roadway/Bicycle Lanes:		
17.1.1.1. The roadway will be considered “major” (over 3,500 ADT) with “high” pedestrian conflict potential as		

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described within Illuminating Engineering Society (IES) publication RP-8		
17.1.1.2. The roadway/bicycle surface will be illuminated to a minimum average level of 1.7 foot candles (fc).		
17.1.1.2.1. Average light level of 1.7 fc exceeds the WSDOT and IES RP-8 requirements of 1.2 and 1.3 fc respectively.		
17.1.2. Walkway/Sidewalk:		
17.1.2.1. The walkway/sidewalk surface will be illuminated to a minimum average level of 1.5 fc.		
17.1.2.1.1. Average light level of 1.5 fc exceeds the IES RP-8 requirement of 1.0 fc.		
17.2. Light Fixtures will be Architectural Area Lighting (AAL)		
17.2.1. Fixture: Universe Collection Large (UCL)		

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17.2.2. Solid Rings (SR)		
17.2.3. Flared Hood (FLR)		
17.2.4. Optics: H2 (Type 2 horizontal reflector, flat glass lens)		
17.2.5. Lamp: 400HPS mogul base, ED-18 lamp		
17.2.6. Mounting height will be 38.5 feet above sidewalk surface		
17.2.7. Lighting shields and/or cutoff luminaires will be utilized, as deemed practical and effective, to reduce the light overflow into the waterway and adjacent communities		
17.2.8. Lighting shields and/or cutoff luminaires will be utilized, as deemed practical and effective, to reduce the glare within the visual field of the bridge tenders.		
17.2.9. Full cutoff horizontal reflectors		
17.3. Light Poles will be Valmont DS50		
17.3.1. Manufactured of steel		
17.3.2. Fluted - 16 flat		
17.3.3. Base Plate		

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17.3.3.1. Bolt circle: 11-1/2 inch 17.3.3.2. No. of Bolts: 4 bolts each base plate 17.3.3.3. Bolt Size: 1 inch 17.4. Mast Arms 17.4.1. Mast arms will be limited to 2 lengths, approximately 2 adjacent to the bascule span, and 4- to 8-feet elsewhere 17.4.2. Connection of the mast arm to the light pole will consist of a 3-bolt pattern currently used as a standard by Seattle City Light. 17.5. Light Pole Mounting/Connection 17.5.1. The light pole mounting surface / bridge connection will be design similar to WSDOT's STEEL LIGHT STANDARD ELBOW MOUNTING ON BRIDGE & RETAINING WALL – STANDARD PLAN J-28.45-00. 17.5.1.1. The connection will custom designed to allow the Seattle City		

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Light standard 4-bolt mounting connection.		
17.5.1.2. The elbow will consist of a 10 inch diameter standard steel short radius pipe elbow with mounting flanges attached at 90 degrees from each other.		
17.6. Light Pole Spacing		
17.6.1. Light poles will not be mounted on the movable bascule span to minimize the future maintenance associated with vibration, torsion and metal fatigue associated with the movable span.		
17.6.2. Light poles immediately adjacent to the bascule span will be located at all four corners of the bridge, in the bascule piers, forward of the Control Towers. The fixtures will be mounted in excess of 20 above the elevation of the Operator's Level.		

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18. MATERIALS		
18.1. Concrete Class:		
18.1.1. Caisson: Class 4000P		
18.1.2. Caisson seal (mass concrete): Class 4000W,		
18.1.3. Caisson cap (mass concrete): Class 4000P		
18.1.4. Approach columns: CL 4000		
18.1.5. Barrier, approach wing wall: Class 4000		
18.1.6. Drilled shafts: Class 4000P or 4000W		
18.1.7. Approach bridge deck: Class 4000D		
18.1.8. Sidewalk, curb, gutter: Class 4000		

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18.1.9. Bascule pier: Class 4000		
18.1.10. Bascule deck: Class 4000D		
18.1.11. Precast Prestressed Concrete Girder: Class 7000 or higher		
18.2. Reinforcing Steel:		
18.2.1. Deformed Steel Bars: ASTM A 706, Grade 60, Modulus of elasticity, Es = 29,000ksi		
18.2.2. Epoxy coated reinforcement will be used in the following locations: 18.2.2.1. Approach span deck 18.2.2.2. Caisson / Distribution Cap / Piers elements within the splash zone defined as elevation -15 feet to + 12 feet		
18.3. Prestressed Reinforcing Steel:		
18.3.1. Prestressing Strand: AASHTO M 230,		

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Grade 270, Low relaxation strand, Es = 28,500ksi		
18.3.2. Prestressing Bar: AASHTO M 275, Tensile strength 150 ksi, Es = 30,000ksi		
18.4. Structural Steel:		
18.4.1. AASHTO M 270, Grade 36 or 50, Es = 29,000ksi		
18.4.2. Mechanical couplers will be required to develop no less than 125% of the yield strength of the bar		
18.4.3. Structural steel will be painted with a 3-coat solid color in accordance with WSDOT pre-qualified methods and paint suppliers. Bridge rail will be galvanized before a 3-coat paint system is applied.	Duplex coating required for railings – RMJ – 3/6/09	
18.5. Bolts:		

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18.5.1. High strength bolts: AASHTO M164 (ASTM A 325)		
18.5.2. Friction type connection with Class B coating on fraying surfaces		
18.5.3. Anchor bolts: ASTM F1554 (AASHTO M314) Bolts Grade 105, galvanized per AASHTO M 232		
18.6. Bearings and Expansion Joints:		
18.6.1. Concrete: Temperature range 0^{o}F to $+100^{o}$F		
18.6.2. Steel: Temperature range 0^{o}F to $+120^{o}$F with fabrication temperature at 64^{o}F		
18.6.3. Elastomeric Bearing: Durometer hardness 60		
18.6.4. Disc Bearing: Polyether urethane disc with a unfactored stress 5000psi for dead and		

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live load		
18.7. Architectural Fascia Panels: Non-load bearing steel architectural element.		
19. STRUCTURAL DESIGN METHOD		
19.1. Load Resistance Factor Design will be used for structural design unless noted otherwise.		
19.2. Load Resistance Factor Design will be used for Caisson Foundations		
19.3. Expansion joints:		
19.3.1. Expansion joints and their supports shall be designed using LRFD design method.		
19.3.2. Expansion devices and their support systems will be designed for 100% impact and over 2,000,000 cycles for fatigue.		
20. APPROACH STRUCTURE SEISMIC DESIGN		
20.1. Importance Category: Essential bridge located		

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within 6 miles of active Seattle Fault Zone		
20.2. Ground Improvement Requirements		
20.2.1. Structural Earth Walls (MSE walls)		
20.2.2. Abutments		
20.2.3. Approach piers		
20.3. Design Earthquake: 7.5% probability of exceedance in 75 years (975-year return period)		
20.4. Performance Level: Life safety without collapse		
20.5. Seismic Ground Shaking Hazard: Response spectrum was developed by Shannon & Wilson, Inc. and was presented in “Supplement Geotechnical Report , Phase II, South Park Bridge Project, King County, Washington, June 22, 2007” .		
20.5.1. The 0.2-second period spectral		

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acceleration, Ss = 1.03		
20.5.2. The 1-second period spectral acceleration, S1 = 0.35		
20.5.3. Site Classification: E with liquefiable soil layers		
20.5.4. Site coefficient for the short-period range, Fa = 0.90		
20.5.5. Site coefficient for the long-period range, Fv = 2.64		
20.5.6.		
20.6. Lateral spreading of soils around the approach structures due to liquefaction is expected. The drilled shafts will be designed to resist the forces of the lateral spreading of soils. Design of the drilled shafts will consider one-half of the seismic loads due to the design level earthquake	The seismic loads applying to the drilled shafts were determined from the minimum of the elastic seismic response forces under liquefied case and the forces due to plastic hinging of the associated column bents per AASHTO LRFD Section 3.10.9.4. Under the considered seismic loads, the forces were then applied to the top of the shaft for the soil layers with liquefied properties without lateral	

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combined with the lateral spreading forces.	spreading. The L-Pile Plus analyses were performed to determine the forces in the drilled shafts. For the lateral spreading case, the 50% of the seismic loads combined with the lateral spreading forces as proposed by the geotechnical engineer were then used to determine the response of the drilled shafts under lateral spreading conditions. The analytical model of L-Pile Plus for the lateral spreading cases were based upon the method of Imposed Soil Pressure (ISP) to evaluate the lateral spreading effects on the drilled shafts as proposed by the project geotechnical engineer, Shannon & Wilson, Inc. The maximum response forces of the previous two cases are the design forces for the drilled shafts. /Luke Su/June 9, 2009/	
20.7. Seismic Design Category, SDC = D, Seismic Performance Zone 4		
20.8. Vertical Ground Motion Effects in accordance with vertical ground response spectrum.		
20.9. The γ_{EQ} load factor for the live load in the		

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extreme event limit state shall be taken as 0.5. The γ_{EQ} factor should be applied to the live load force effect obtained from the bridge live load analysis. Live load mass should be ignored in the dynamic analysis		
21. BASCULE STRUCTURE SEISMIC DESIGN		
21.1. The bascule seismic design will follow AASHTO "LRFD Movable Highway Bridge Design Specifications," 2nd Edition, 2007, which utilizes a force-based design approach.		
21.2. Importance Category: Essential bridge located within 6 miles of active Seattle Fault Zone		
21.3. Seismic Loads		
21.3.1. The bridge will be designed using two levels of design earthquakes; 1) Design Earthquake: An upper level seismic event that has ground motions corresponding to a 7.5% probability of exceedance in 75		

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years, or an approximate return period of 975 years, 2) Operational Earthquake: A lower level seismic event that has ground motions corresponding to 50% probability of exceedance in 75 years, or an approximate return period of 108 years.		
21.3.2. One-half of the seismic loads due to the design level earthquake may be used for other positions other than the closed position. Seismic loads resulting from operational level earthquake shall not be reduced. During bridge operation, seismic effects on operating components may be ignored – interpreted to mean the bridge need not be protected seismically while the bridge is opening or closing.		
21.3.3. Seismic loads shall include vertical accelerations in both event levels.		

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21.3.4. The Seismic Performance Zone is 4		
21.4. Ground Motions		
21.4.1. The response spectra for the design level and operational level earthquakes were generated by Shannon & Wilson, Inc. The response spectra by SWI are in "Geotechnical Report, Final Design, South park Bridge" dated June 09, 2009. The time histories developed by EMI are in "Technical Memorandum – Caisson Analysis of South Park Bridge" date February 06, 2009		
21.4.2. The site-specific time histories for the design level and operational level earthquakes were generated by EMI, Inc.		
21.5. Geotechnical Parameters		

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21.5.1. Site Class is classified as "E" by Shannon & Wilson, Inc. based on site average shear wave velocity.		
21.5.2. Lateral spreading of soils adjacent to the bascule pier caissons from liquefaction is expected. The caissons have adequate lateral capacity to resist the lateral spreading. Therefore, no ground improvement is need for protection of the caissons.		
21.6. Limit States		
21.6.1. The Design earthquake and Operational Earthquake shall be considered at the extreme event limit states.		
21.6.2. The γ_{EQ} load factor for the live load in the extreme event limit state shall be taken as 0.5. The γ_{EQ} factor should be applied to		

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the live load force effect obtained from the bridge live load analysis. Live load mass should be ignored in the dynamic analysis.		
21.7. Design Earthquake (upper level) Performance Criteria		
21.7.1. After a Design Earthquake the damage to the bridge may be described as “minor to moderate damage with some loss of operation,” Moderate damage implies visible and significant signs of damage with repairs or stabilization likely to be completed under emergency contracts and is characterized by:		
21.7.1.1. Minimal damage to the superstructure		
21.7.1.2. Limited damage to piers, including yielding of reinforcement and spalling of concrete cover		

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21.7.1.3. Minimal damage to Caissons and Distribution Caps		
21.7.1.4. Small permanent deformations, not interfering with serviceability of the bridge		
21.7.1.5. Damage to expansion joints that can be temporarily bridged with steel plates and replaced with relative ease.		
21.7.1.6. In the case of mechanical machinery, no damage is permitted to the motor, trunnion, rack, and pinion shaft. Minimal damages will be permitted to pinion bearings, and moderate damages will be permitted to shaft coupling, center Locks, tail locks and live load shoes. All the damaged		

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components of the machinery will be designed to be replaceable.		
21.7.2. Limitations for the Design Earthquake expressed in terms of permanent lateral displacement or drift resulting from soil deformations at the pier are as follows:		
21.7.2.1. Long. Dir. / Trans. Dir. Btwn. Top/Bot. of Caisson 3” / 3” Bottom of Caisson 3” / 3”	Magnitudes to be verified by the design team and acknowledged by owner(s) – RMJ – 3/6/09 Not sure I can follow this completely. For a non-ductile structure like the bascule pier, how would the drift be defined?/Y Teo/ Mar. 10, ‘09 The piers and caissons are behaving elastically but the soils surrounding the caissons behave inelastically. The permanent movements of the caissons are a result of the inelastic behavior of the soils under seismic loading. The target permanent movements have been lowered to provide a more stringent but achievable goal based on the analysis results. /YJ/June 8, 2009/	
21.7.2.2. Caisson settlement under the Design Earthquake will be designed to not		

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exceed 6.0 inches.		
21.7.2.3. Current condition of the river floor as well as one half (1/2) the full depth of scour from the scour analysis shall be considered with the design level earthquake.		
21.7.3. If practical, the operating components will be protected, in both the open and closed positions, with a combination of breaks and restraint devices designed and detailed to resist the inertial forces developed by the Design Earthquake. If practical breaking and resistant device can not be designed to resist the Design Earthquake, the Operating system shall be designed based on Operational Earthquake and capacity protected from the Design Earthquake.		

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21.8. Operational Earthquake (lower level) Performance Criteria		
21.8.1. After an Operational Earthquake the bridge will be designed to suffer “no loss of operations,” with minor damage to structure. Minor damage implies essentially elastic performance, and is characterized by:		
21.8.1.1. Minor inelastic response	Due to high inelastic behavior of the soils surrounding the caissons, there will be minor inelastic response even at Operational Earthquake as indicated by small permanent settlement for analysis results and is allowed per Section 21.8.2. /YJ/June 8, 2009/	
21.8.1.2. Narrow cracking in concrete		
21.8.1.3. No apparent permanent deformations		
21.8.1.4. Damage to expansion joints that can be		

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bridged with steel plates		
21.8.2. Caisson permanent settlement under the Operational Earthquake will be design not to exceed 1.0.		
21.9. RESPONSE MODIFICATION FACTORS		
21.9.1. The R-factors are designed to achieve the performance goals previously identified.		
21.9.2. R-factors for steel superstructure components will be taken as 1.0 for main structural members and connections for mechanical components, 0.8 for critical connections, including trunnions and shafts, and 1.2 for secondary members for the Design Earthquake.		
21.9.3. R-factor for caissons and pier walls will be taken as 1.5 for the Design Earthquake.		

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21.9.4. R-factors greater than 1.0 will not be used for the Operational Earthquake.	Capacity protection concept is valid only for the Design Earthquake and is not applicable for the Operational Earthquake. The force effects are relatively small at Operational Earthquake and all components behave elastically. /YJ/June 8, 2009/	
21.10. Seismic Analysis		
21.10.1. Demands on structural components of the bridge will be determined by analysis of global three dimensional computer models of the bridge that represent its dominant linear and nonlinear behavior and the effects of soil-structure interaction. Demands will be evaluated as load-type quantities (forces and moments) or as displacement-type quantities (displacements, relative displacements, and rotations) as required by the evaluation criteria for various components.		
21.10.2. Seismic demands will be determined by non-linear multi-support dynamic time-		

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history analysis. Three sets of ground motions will be used for the Design Earthquakes; one set of ground motions shall be used for Operational Earthquake. The design will be based on the maximum response obtained from these analyses in conjunction with the performance goals for the two levels of events.		
21.10.3. The nonlinear structural model will explicitly consider the geometric nonlinearity, nonlinear boundary conditions, other inelastic elements (e.g. dampers), and inelastic structural components if any.		
21.10.4. Rayleigh damping will be incorporated into the model with values for each element group representing the expected extent of inelastic energy dissipation in that group.		

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21.10.5. Soil-Structure Interaction shall be considered using nonlinear springs in the global model. The properties of the springs will be determined from local models.		
21.10.6. For seismic evaluation, reinforced concrete strength will be calculated as 10% higher than the 28-day concrete strength.		
21.11. Soil Structure Interaction		
21.11.1. The approach to Soil-structure interaction (SSI). SSI will conform to the following requirements:		
21.11.1.1. For caisson foundations, the unbounded soil medium is conceptually substructured into two domains: a near-field domain and a far-field domain.		

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21.11.1.2. The behavior of the far field as a region remote from the foundation is dominated by the propagation of seismic waves. An elasto-dynamic approach will be used to derive this far-field model.		
21.11.1.3. The behavior of the near field domain is dominated by the interaction with the foundation where nonlinear stress-strain behavior of the nearfield soil and nonlinearity due to foundation uplift from structural inertia forces will be accounted for. Static push-over analyses will be conducted using 3-dimensional nonlinear finite element techniques for the soil to derive the near-field model.		

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21.11.1.4. A resultant rheologic model (including nonlinear load-deflection springs for each component of generalized displacements) will be generated, in terms of uncoupled nonlinear rotational and translational springs along with viscous dashpots for global structural response analysis. For shallow foundations, cross-coupling between rotation and lateral translational springs will be neglected.		
22. LOADS AND LOAD COMBINATIONS		
22.1. Permanent Loads:		
22.1.1. WSDOT Bridge Design Manual LRFD, M 23-50, Section 3.8		
22.1.2. AASHTO LRFD Bridge Design		

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Specifications, Section 3.5		
22.2. Live Loads (Vehicular and Pedestrian)		
22.2.1. WSDOT Bridge Design Manual LRFD, M 23-50, Sections 3.9 and 3.10		
22.2.2. AASHTO LRFD Bridge Design Specifications, Section 3.6.		
22.3. Water Loads: AASHTO LRFD Bridge Design Specifications, Section 3.7		
22.4. Wind Loads:		
22.4.1. WSDOT Bridge Design Manual LRFD, M 23-50, Section 3.11		
22.4.2. AASHTO LRFD Bridge Design Specifications, Section 3.8		
22.5. Down drag		

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22.5.1. Supplemental Geotechnical Report, Phase II, South Park Bridge Project, Shannon & Wilson, Inc.		
22.5.2. Geotechnical Report, Final Design, South Park Bridge Project, Shannon & Wilson, Inc., 2009		
22.6. Earth Pressure		
22.6.1. AASHTO LRFD Bridge Design Specifications, Section 3.11		
22.6.2. Geotechnical Report, Phase II, South Park Bridge Project, Shannon & Wilson, Inc., 2004		
22.6.3. Supplemental Geotechnical Report, Phase II, South Park Bridge Project, Shannon & Wilson, Inc., 2007		
22.6.4. Geotechnical Report, Final Design, South		

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Park Bridge Project, Shannon & Wilson, Inc., 2009		
22.7. Thermal Effects		
22.7.1. Temperature Range: WSDOT Bridge Design Manual LRFD, M 23-50, Section 3.15		
22.7.2. Concrete : Coefficient of thermal Expansion: 6x10-6/Of		
22.7.3. Steel : Coefficient of thermal Expansion: 6.5x10-6/Of		
22.8. Fatigue Limit State: AASHTO LRFD Bridge Design Specifications, Section 3.6.1.4		
22.9. Live Load Surcharges: AASHTO LRFD Bridge Design Specifications, Section 3.11.6.4		
22.10. Load Factors and combinations		
22.10.1. WSDOT Bridge Design Manual LRFD,		

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M23-50, Section 3.5		
22.10.2. AASHTO LRFD Bridge Design Specifications, Section 3.5		
22.10.3. AASHTO LRFD Movable Highway Bridge Design Specifications, Section 2.4		
23. BASCULE SPAN MECHANICAL OPERATIONS		
23.1. A central type drive system mounted in each pier will be used to raise and lower the bascule spans. Electric motors will drive oil-filled enclosed gear drives that provide power to two pinion gears that each engage a longitudinal rack mounted to each girder. The rack will be inverted.		
23.2. Normal Operation: Under normal conditions, operating power for each leaf will be supplied by a D.C. electric motor with a D.C. drive controller.		
23.3. Auxiliary Operation: In the event of a failure of the		

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normal operating system, the central reducers will be driven by an auxiliary drive A.C. electric motor with across the line starting capabilities.		
23.4. Trunnion Journal: The trunnion journal will be supported by a bronzed bushed bearing that meets the requirements of AASHTO. Lubrication of the bushing/journal interface will be provided by straight longitudinal grease grooves that are milled in the bushing surfaces.		
23.5. Operation Time:		
23.5.1. General: The approximate time of operation is the time required to either raise or lower the span exclusive of any time for pedestrians to traverse the bridge or navigation traffic to pass beneath the bridge.		
23.5.2. Normal Operation: The operation time using main drive motors will be targeted to	As of June 3, 2009, COS was to provide preferred logic and HNTB will attempt to emulate that and adjust the control panel resemble COS's current	

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not exceed the durations identified below: 23.5.2.1. Set Traffic Signal to Red 0.0 to 6.9 sec. 23.5.2.2. Lower Southbound On-coming Gate 8.9 to 22.7 sec. 23.5.2.3. Lower Northbound On-coming Gate 24.7 to 38.5 sec. 23.5.2.4. Lower Southbound Off-going Gate 37.7 to 51.5 sec. 23.5.2.5. Lower Northbound Off-going Gate 53.5 to 67.3 sec. 23.5.2.6. Lower N Traffic Barrier 69.3 to 90.0 sec. 23.5.2.7. Lower S Traffic Barrier 71.3 to 92.0 sec. 23.5.2.8. Pull Span & Tail Locks 92.0 to 114.0 sec. 23.5.2.9. Raise Spans 114.0 to 217.5 sec. 23.5.2.10. Marine Traffic Passes	panels / R Johnson / June 6, 2009	

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23.5.2.11. Lower Spans 217.5 to 326.8 sec. 23.5.2.12. Drive Span & Tail Locks 326.8 to 348.8 sec. 23.5.2.13. Raise N Traffic Barrier 350.8 to 371.5 sec. 23.5.2.14. Raise S Traffic Barrier 352.8 to 373.5 sec. 23.5.2.15. Raise SB & NB Off-going Gates 375.5 to 389.3 sec. 23.5.2.16. Raise Southbound On-Coming Gate 391.3 to 405.1 sec. 23.5.2.17. Raise Northbound On-Coming Gate 393.3 to 407.1 sec. 23.5.2.18. Set Traffic Signals to Green 409.1 to 411.0 sec. 23.5.3. The resulting normal operation duration from traffic signal red to the full- open position is 3.63 minutes 23.5.4. The resulting normal operation duration		

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from full-open to traffic signal green is 3.23 minutes		
23.5.5. Auxiliary Operation: The operation time using the auxiliary motor will be about 6-8 minutes.		
23.6. Slow seating speeds will be provided at the fully down position to provide for a soft final seating.		
24. MECHANICAL FEATURES		
24.1. Shaft Couplings: All couplings will be gear type couplings, either flex-rigid or flex-flex, as determined appropriate for each specific application, unless otherwise noted.		
24.2. Motor Couplings: Motor couplings will be fully flexible tapered grid couplings to reduce shock during motor starts.		
24.3. Brakes:		

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24.3.1. General: Spring set, electro-hydraulic thruster released drum shoe brakes will be provided for the motor and machinery brakes.		
24.3.2. Motor Brakes: One motor brake will be provided on each of two input shafts of the central reducer. No motor brake is required on the auxiliary motor.		
24.3.3. Machinery Brakes: One machinery brakes on each of two input shafts will be supplied on the central reducer output shaft, downstream of the differential.		
24.4. Central Reducer: A totally enclosed parallel shaft reducer with dual input shafts and dual differential output shafts will be provided.		
24.5. Auxiliary Reducer: A totally enclosed in-line shaft reducer with single input and single output shafts		

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will be provided.		
24.6. Reducer Bearings: Reducers will be specified to be provided with roller element bearings having an L-10 life of at least 40,000 hours.		
24.7. Reducer Lubrication: Reducers will be specified to use synthetic oil for reduced maintenance replacement requirements.		
24.8. Reducer Lubrication: Oil level within reducers will be as recommended by the reducer manufacturer.		
24.9. Reducer Breathers: Air breathers for reducers will be specified to be hygroscopic type with automatic indication when replacement is required.		
24.10. Auxiliary Clutch: A spring released, electrically engaged disc clutch will be specified to isolate the auxiliary drive from the main drive and to engage		

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the auxiliary drive system. 24.11. Shafting: Hot rolled steel or forged steel shafting will be specified as appropriate for the final diameter of each shaft. 24.12. Center Span Locks: Two span locks will be provided, one each bascule girder. The center locks will be Cushionloks® manufactured by Steward Machine Co. (Birmingham, AL). Provisions will be made for emergency manual operation. 24.13. The design will incorporate some method of jacking the trunnions to allow removal and/or maintenance of the trunnion bearings in the future or to allow realigning the leaf after a seismic event. 24.14. Sight glass on reducers to allow “at a glance” confidence that adequate lubrication is provided will be provided.		

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24.15. Counterweight heel locks on underside of counterweight will be provided to allow the bridge to be locked into the fully open position to allow for deck or machinery replacement.		
24.16. Consideration will be given to incorporate acoustic monitoring into the mechanical drive system to compare real-time operating values to a baseline and alert operating personnel if the operating values exceed a pre-determined threshold.	Owner(s) like this provision – RMJ – 3/6/09	
24.17. Removable drip pans and associated supports will be detailed for the pinions gears and the entire length of the rack gears.		
24.18. Ready reference drawings of the mechanical components (span locks, etc.) will be displayed in proximity of the equipment.		
24.19. The machinery supports (pedestals) will be		

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designed and detailed such that there is easy access to the machinery bolts.		
24.20. Miscellaneous:		
24.20.1. The control houses will house spare parts and tools that will be supplied in accordance with the AASHTO Specifications.		
24.20.2. A workbench complete with vise and storage cabinet complete with necessary maintenance tools will be provided in both control houses.		
24.20.3. Access hatches on the bascule span will be detailed such that they are hinged closest to midspan so the hatch will not open when the bridge is raised.		
25. ELECTRICAL		
25.1. **Electrical Service**:		

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25.1.1. Commercial electric secondary service will be obtained from the utility transformer that will be sited near the west side of the south face of the north abutment		
25.1.2. The transformer and primary electric service will be provided by the electric utility company. HNTB will coordinate with King County. King County will coordinate directly with the electric utility representatives on specific requirements.		
25.1.3. Secondary commercial electric services for the bridge distribution system will be 480 volts, 3-phase, 4-wire, grounded neutral.		
25.1.4. Secondary service will be extended from the utility transformer to the north control tower using single conductor cables in conduit by the project. Service connections will be in accordance with		

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utility requirements.		
25.1.5. Main service disconnects will be fuse protected for 125% of the required maximum demand load. Branch circuits will be protected by circuit breakers.		
25.1.6. The required interrupting rating for the main service fuses will be as required by the fault circuit requirements.		
25.1.7. Main disconnect switches will be mounted in separate cabinets or enclosures at the utility transformer and at the entrance to each electrical distribution room.		
25.1.8. All distribution circuit breakers as well as all motor starters for traffic gates, traffic barriers, span locks, tail locks, auxiliary drive motors, thruster brakes and other A.C. motors will be housed in motor control center cabinets located the electrical		

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distribution rooms (within control towers).		
25.1.9. Power circuits to traffic gate motors, traffic barrier motors, span lock motors, tail lock motors, main drive motor controllers, auxiliary drive motors and brake thrusters will be 480 volt, 3-phase, 3-wire grounded service.		
25.1.10. Lighting branch circuits will be 120 volt A. C.		
25.1.11. Control and interlocking circuits will be 120 volt A. C.		
25.1.12. The bridge structure, control tower and electric service will be grounded and inter-bonded integral with a lightning protection system.		
25.1.13. Conduits will be located in an organized fashion, overhead and out of the way of	Added at the request of the owner(s) – RMJ – 3/6/09	

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maintenance activities and walkways.		
25.1.14. Generator Set		
25.1.14.1. In the event of commercial power failure from the utility service feed, standby electrical power will be provided by diesel fueled generator set with an automatic transfer switch.		
25.1.14.2. The generator set will be located near the west side of the south face of the north abutment.		
25.1.14.3. The standby generator will be sized to operate the bridge using the auxiliary drive motor only. The main drive motors will be interlocked to prevent operation when the generator is operating. The standby generator and auxiliary drive motor will be sized to operate both leaves		

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simultaneously. 25.1.14.3.1. The control system of the main drives will be supported with an UPS to eliminate the need for a re-boot when the grid power returns and the standby generator is no longer needed.		
25.2. Main Drive System 25.2.1. Two main drive motors will be provided for the operation of each bascule span. 25.2.2. Each main drive motor will be heavy duty D.C. Motors, 60 minute intermittent rating, totally enclosed, non-ventilated, with Class F insulation. Base speed of the motors will be 850 RPM. 25.2.3. Main drive motor bearings will be end-shield mounted grease lubricated ball bearings.		

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25.2.4. Rather than utilizing condensation space heaters, the purpose of them will be achieved by maintaining the field windings in a reduced-current condition during non-use period in order to protect against corrosion within the motors.		
25.2.5. Normal operation will be to operate both drive motors operating at an overspeed of 1100 RPM. Load sharing will be utilized when operating in the two motor mode of operation.		
25.2.6. The span will be capable of being operated with one main drive motor at the base speed of 850 RPM under normal loading conditions.		
25.2.7. The electric bridge drive will be a Solid State D.C. drive capable of stepless speed control. Countertorque will be provided		

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using regenerative braking circuitry within the drive controller.		
25.2.8. A separate drive controller will be provided for each main drive motor.		
25.3. **Auxiliary Drive Motors**		
25.3.1. One auxiliary drive motor will be provided on each bascule leaf.		
25.3.2. The auxiliary drive motor will be a severe duty, continuous duty rated 480 volt 3 phase A.C. squirrel cage induction motor.		
25.3.3. The auxiliary drive motor will be an 1800 RPM, 900 RPM two speed constant torque motor with a service factor of 1.15.		
25.3.4. Motor bearings will be end-shield mounted grease lubricated ball bearings.		
25.3.5. Power will be applied by a 2-speed,		

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reversing motor starter within the motor control center located in the electrical distribution rooms of each control house. The auxiliary motors will be controlled from control console located in the north control tower.		
25.3.6. Condensation space heaters will be provided to protect against corrosion within the motor.		
25.4. **Miscellaneous Motors**		
25.4.1. Motors for thruster brakes will be 480 volt 3 phase continuous duty rated A. C. squirrel cage induction motors.		
25.4.2. Motors for span locks, tail locks (if required), traffic gates, traffic barriers and other miscellaneous motors will be 480 volt, 3 phase intermittent duty rated squirrel cage induction motors unless more		

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severe requirements are indicated for specific applications.		
25.4.3. Condensation space heaters will be provided in the span lock and tail lock motors to protect against corrosion within the motors.		
25.5. **Bridge Control Features**		
25.5.1. The normal operation of the bridge will be by automatic mode. The operator will have the option of going to the completely manual mode if necessary. The operator will have full control of the navigation sound signals and bridge traffic control equipment at all times. Operation of the span locks, tail locks and the span raise and lower sequences are capable when in the manual mode of operation.		
25.5.2. Once the operator sets the traffic signals to		

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'STOP', the traffic signals will activate and change to YELLOW for five seconds and then automatically change to RED.		
25.5.2.1. The 5 second hold on yellow will be automated and not require bridge tender input.		
25.5.3. The operator initiates the command to lower the north bound and south bound on-coming traffic gates followed by lowering the off-going traffic gates. The off going traffic gates will be interlocked to prevent lowering until the on-coming traffic gates are fully lowered. Operation of the traffic barriers will be interlocked to prevent lowering until all traffic gates are fully lowered. Bypass switches will be provided to permit out of sequence gate operation.		
25.5.4. When operating in the automatic mode of operation, once the operator initiates the		

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raising sequence, the span locks and tail locks will automatically withdraw, and the leaves will rise, automatically slow to approach speed and stop at full open position without further operator action. 25.5.4.1. Two raise switches will be provided – one for the neat leaf, and one for the far leaf. 25.5.4.2. The raise switches will be a spring loaded “return to neutral” upon release thus providing the equivalent of a dead-man switch. 25.5.5. When operating in the automatic mode of operation, once the operator initiates the lowering sequence, the leaves will lower, automatically slow to seating speed at the neat seat position and continue until the spans are fully seated. 25.5.6. Once the leaves are fully seated, the span		

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locks and tail locks will be set by the bridge tender.		
25.5.7. Separate control switches will be provided on the control console for operation and control of span locks, tail locks, brakes and other miscellaneous control functions for maintenance and emergency operations.		
25.5.8. A maintenance speed switch will be provided in the control console to operate the spans at reduced speed when and if desired.		
25.5.9. A normal stop switch on the control console will permit stopping the span in any position by normal deceleration using the main drive motor counter torques before applying thruster brakes.		
25.5.10. An emergency stop switch on the control console will stop the span in any position		

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by removing power and applying thruster brakes. The E-Stop will be hard wired.		
25.5.11. General position of each pair of leaves will be signaled on the control desk by indicating lights for closed, near closed, near open and fully open.		
25.5.12. The precise position of each pair of leaves will be indicated on the control console by a digital display under the control of a position resolver.		
25.5.13. Position indication will be provided by indicating lights on the control console for the traffic signals, traffic gates, traffic barriers, span locks, tail locks, brakes, and span seating. All indicating lights will utilize LED lamps to reduce power consumption and extend the service life of each lamp.		

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25.5.14. Meters will be provided on the control console to monitor voltage and power requirements. Individual current meters will be provided to monitor current draw of each main drive motor.		
25.5.15. An air horn will be provided for communication with marine traffic. The air compressor and air storage tank will be housed in the control house. The air horn will be located a good distance away from the normal travel paths of maintenance forces.		
25.6. Bridge interlocking features		
25.6.1. Automatic sequencing and most interlocking will be accomplished using an industrial grade programmable logic controller (PLC) having math handling capabilities. Redundant or machine tool relays will be used to augment the PLC		

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where deemed advisable. Allen/Bradley SLC series will be call for to the extent procurement procedures allow.		
25.6.2. The primary PLC equipment will be located in the north side control house with remote PLC equipment to be located in the south control house.		
25.6.3. Primary span control functions will be monitored from position sensing resolvers and geared rotary limit switches mounted on the line shaft within the machinery areas on the north leaf and the south leaf. The span control equipment will be driven through a gear system.		
25.6.4. Heavy-duty limit switches will provide additional position sensing inputs at critical control locations.		
25.6.5. Machine tool relays will be provided to		

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provide necessary control inputs for the auxiliary drive system when the PLC is inoperable.		
25.6.6. Main drive motors will automatically reduce and maintain the speed of each leaf in the near closed zone and the near open zone to 15 percent of full speed.		
25.6.7. Main drive motors will automatically reduce the speed of each leaf to a creeping speed at the near seat position, for precise stopping of the span.		
25.6.8. At the fully open position, the leaves will be stopped, the brakes set automatically, and the navigation lights will change from red to green.		
25.6.9. When under auxiliary drive operation, the slow speed of the auxiliary drive motor will be automatically energized at each end of		

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travel.		
25.6.10. When the bridge is locked in the fully closed position for vehicular traffic, all indicating lights will show GREEN.		
25.6.11. Complete manual operation of the bridge will be capable from the control room without requiring the operator to leave the control station.		
25.6.12. The traffic signals will be inoperable until the bridge control system has been activated.		
25.6.13. The on-coming traffic gates will be inoperable to lower until the traffic signals are set to 'STOP'.		
25.6.14. The off-going traffic gates will be inoperable to lower until the on-coming traffic gates are lowered. Traffic barriers		

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will be inoperable to lower until all traffic gates are lowered.		
25.6.15. Span locks and tail locks will be inoperable until the traffic gates and traffic barriers are lowered.		
25.6.16. Main drive motors and auxiliary drive motors will be inoperable until the span locks and tail locks are fully withdrawn.		
25.6.17. Span locks will be inoperable until the leaves are fully closed and the brakes are set.		
25.6.18. The four traffic barriers will be inoperable to raise until the span locks and tail locks are fully driven. The four traffic gates will be inoperable to raise until the traffic barriers are full raised.		
25.6.19. The traffic signals will not be allowed to turn to GREEN until all traffic gates are		

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raised.		
25.6.20. Main drive motors will be inoperable if any motor or machinery brake is released by its hand release. This action will be monitored with indicating lights on the control console.		
25.7. **Miscellaneous Additional Features**:		
25.7.1. Spare parts will be specified for essential equipment as required and specified by AASHTO.		
25.7.2. Control towers, machinery areas and bascule pier areas will be provided with overhead lighting conforming to minimum requirements for service lighting levels.		
25.7.3. Convenience power outlets and hose bibs will be provided in both east and west ends of each level of the bascule piers.		

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25.7.4. Maintenance stairways and walkways will be provided with lights for nighttime visibility. Light switches will be located at top and bottom of each stairway.		
25.7.5. All outdoor outlets and all outlets within bascule piers (excluding control tower) will be in weatherproof outlet boxes with weather tight cover plates.		
25.7.6. An intercom system will be provided to permit communication between the machinery areas, equipment rooms, control tower, roadway level, and counterweight pit level.		
25.7.7. New submarine cable will be provided in the form of a bored steel micro-tunnel casing with fiberglass reinforced epoxy inner ducts below the river channel from Pier 3 to Pier 4.		

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25.7.8. A fire detection system will be provided to monitor selected areas of the bascule piers, levels of the both control houses and the machinery areas of the bridge structure. Alarm notification will be directed to the operator's level of the north Control Tower.		
25.7.9. A closed circuit television (CCTV) system will be provided to enhance and improve the bridge operator's visibility of the traffic gate areas, up stream, down stream and channel area beneath the bascule piers. Cameras will be provided with pan/tile/zoom capabilities with monitors located on the operator's level of the north control house. All cameras will be high resolution color type for improved visibility of the viewed image. CCTV monitors shall be located such that operator can easily view the monitors while operating the		

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bridge.		
25.7.10. Intrusion Alarms: An intrusion alarm (as well as door ajar) system will be provided for selected points of access to the piers and Control Towers, including the south Control Tower. Alarm notification will be directed to the operator's level of the north Control Tower.		
25.7.11. A new marine band radio will be provided in the operator's room to provide radio communications with the marine traffic in the river channel. The radio will continually monitor the marine band emergency channel and the designated channel for the South Park Bridge.		
25.7.12. The mountings and mounting details for limit switches will be robust and detailed in the construction documents rather than left to the construction contractor's imagination and preference.	Owner(s) like this provision – RMJ – 3/6/09	

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26. CONSTRUCTION CONTRAINTS		
26.1. Hazardous Materials		
26.1.1. Boeing Plant 2 and the Lower Duwamish Waterway Superfund Site have been identified as substantially contaminated areas within the PDR		
26.1.2. Preliminary study concluded that the upper 15- to 20-feet of sediment in the waterway floor is contaminated to some extent by the PDR		
26.2. In Water Work Window		
26.2.1. The project area is within a designated critical habitat area for various species of fish		
26.2.2. Preliminary “in-water” construction activities extend from August 1 through February 15 of each year		

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26.2.2.1. In-water work is considered to be construction of cofferdams and driving pile outside of cofferdams by the PDR and any other construction outside of cofferdam and over or in water.	Need to resolve what is "over water work" and when it can not accomplished – RMJ – 3/6/09	
26.2.2.2. Excavation and other work within the cofferdam is not considered to be subject to general in-water restrictions by the PDR		
26.3. Noise and Vibration		
26.3.1. The north and south bascule piers and flanking intermediate piers of the existing bridge are anticipated to be adversely effected by vibrations from construction activities		
26.3.1.1. Shaft casings, piles and cofferdams installed within 40 feet of the existing piers will subject to future		

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considerations and limitations based on the geotechnical engineers' recommendation sited within the PDR and the results of the test piles to be conducted in late 2009.		
26.3.2. Noise receptors exist near the southern limits of the project. Noise mitigation measures need to be utilized during construction		
26.4. Site Constraints		
26.4.1. The U.S. Coast Guard requires the navigation channel to be maintained operational for marine traffic		
26.4.1.1. Full channel closures for up to a week could be arranged on a case-by-case basis according to the PDR		
26.5. Environmental Controls		
26.5.1. TESC		

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26.5.2. Spill Prevention, Control, and Countermeasures Plan		
26.5.3. Erosion and Sedimentation Control Features		
26.5.4. Stormwater Treatment Facilities		
27. SEISMIC REPAIR CONSIDERATIONS		
27.1. To be defined		