Appendix A
Request for Proposal Examples for Alternative Delivery Projects

This appendix provides two examples of service life design-related input to requests for proposal (RFPs) for bridge projects with extended service life requirements. Section A1 provides an example of a signature bridge with a service life of 100 years while Section A2 provides an example of a design-build corridor project with multiple highway bridges all with a service life of 100 years. Specific service life requirements provided in the examples are intended to be demonstrative only and actual service life requirements for an actual bridge project shall take due consideration of project-specific requirements, exposure conditions, etc. These examples may be considered for guidance; however, these examples are not directly appropriate for use. Locations were additional project-specific inputs are required are indicated by text in *red font and italics*.

As described in Section 3 of the main report, RFP authors may tailor the level of specificity of their requirements to the service life design process. Changing the specificity of an RFP alters the extent of flexibility for designers to consider different solutions and adjusts the responsible party for the given aspect of the service life design process. If so desired, the RFP can provide specific requirements to exposure conditions (e.g., surface chloride concentrations, sulfate exposure classification, steel exposure classes, etc.), allowance or exclusions of specific materials (e.g., reinforcement types, coatings/membranes, etc.), and other design parameters (e.g., critical chloride content, required reliability index, etc.). Alternatively, the RFP may require the contractor/designer to evaluate site conditions, establish appropriate exposure classes and conditions, select appropriate materials based on exposure, and to determine appropriate design parameters based on test results, codes, literature, etc.

The example RFPs provided in this appendix demonstrate two different levels of specificity. Example 1 provides only limited service life design requirements with basic design parameters (e.g., duration of service life and required reliability index for the probabilistic-based design to resist durability strategy) and places the responsibility for assessment of exposure conditions, selection of materials, etc. on the designer. Example 2 provides a more prescriptive RFP wherein required exposure condition considerations, material selections, etc. are provided. As desired by the RFP author, various combinations of provided prescriptive requirements versus requiring the design to assess the situation may be realized. For example, an RFP may set requirements to the exposure condition (e.g., surface chloride concentration for reinforced concrete elements by exposure zone) while leaving decisions on material selection (e.g., reinforcement type) to the designer.

The test methods mentioned in the examples below are solely exemplary and project-specific consideration of appropriate test methods (e.g., based on project-specific exposure conditions, etc.). Test frequencies are not provided (blank spaces are provided in place of numbers) as such determinations must be made on a project-specific based by experienced engineers with service life design expertise.

A1 Example 1 – Signature Bridge

This RFP example considers a major cable-stayed bridge, designed to achieve a service life of 100 years.

A1.1 Design for Durability

A1.1.1 Standards

The Design-Builder shall perform the service life design activities in accordance with the following standards:

- *fib* Bulletin 34 Model Code for Service Life Design or ISO 16204 Durability – Service Life Design of Concrete Structures;
- AASHTO LRFD Bridge Design Specifications;
- AASHTO LRFD Bridge Construction Specifications;
- ACI 318 Building Code Requirements for Structural Concrete;
- ACI 301 Specifications for Structural Concrete;
- International Standards Organization, ISO 12944 – Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 2: Classifications of environments;
- NACE Paper 7422, Expected Service Life and Cost Considerations for Maintenance and New Construction Protective Coating Work, 2016

(When additional agency specific codes or standards are to be used, list them below.)

- ________ Department of Transportation, Structures Design Manual

A1.1.2 General Service Life Requirements

Service life requirements for the components of the structure are shown in Table 1. Service life shall be defined as the period of time during which the component is used for its intended purpose. For non-replaceable components, service life requirements shall be achieved with preservation activities (i.e., cyclical and condition-based maintenance) and without the need for replacement, rehabilitation, or preventative maintenance. For replaceable components, preservation activities (i.e., cyclical and condition-based maintenance) is permissible during the service life and replacement shall occur at or after the minimum service life per Table 1. Definitions and examples of preservation activities (i.e., cyclical and condition-based maintenance), replacement, rehabilitation, preventative maintenance, and routine maintenance are provided in Section A1.1.7. Condition-based maintenance may include maintenance of sub-components, for example, strip seals, moving surfaces, etc., prior to reaching the minimum service life of the entire component.

The service life design shall address all physical or chemical factors in concrete structures, such as chloride penetration, carbonation, sulfate attack, alkali-aggregate reaction (AAR), delayed ettringite formation (DEF), abrasion, and corrosion of the steel reinforcement, steel spacers, steel accessories, and embedded items. For steel structures, the service life design shall address corrosion of structural steel and breakdown of protective coatings. Exposure conditions that adversely affect the durability shall be identified and taken into account in the service life design to ensure the specified service life is achieved. The design shall take full account of the prevailing soil and groundwater conditions and anticipated use of de-icing salts on the bridge during the service life.

The PROPOSER shall use one or more of the following methods for providing the required design service life for each identified potential deterioration mechanism:

- Avoid the deterioration mechanism;
- Design to resist the deterioration mechanisms by:
    a. Applying supplementary protective measures that are deemed-to-satisfy the durability requirements for the required period of time[1];

[1] A "deemed-to-satisfy" durability design is based on provisions from codes and standards, such as AASHTO LRFD. The provisions are typically based on experience, field observations, and limited research data. An example of a deemed-to-satisfy durability design for reinforced concrete structures comprises the specification of limiting values for maximum water/cement ratio, minimum cement content, and minimum cover for various cement types in different exposure environments.

b. Selecting materials and details which, through mathematical modeling, resist the deterioration mechanism for the required period of time;

The required service life for replaceable and non-replaceable components are shown in Table 1 below. Replaceable elements for the structure shall be outlined in the Maintenance and Inspection Manual. The requirements specified in the table are minimum requirements.

Table 1: Required Service Life for Replaceable and Non-Replaceable Components.

Non-Replaceable Components	Minimum Service Life (years)*
Towers, foundations, abutments, piers, pier caps, deck, superstructure, approach slabs, MSE walls	100
Replaceable Components	**Minimum Service Life (years)***
Stay cables	60
Stay cable vibration suppression system	30
Bridge bearings	50
Expansion joints	30
Bridge traffic and pedestrian/bicycle barriers	40
Separate bridge deck wearing surface	25
Drainage system piping	75
Access systems (tower and piers): Internal access ladders, platforms, lifts, etc. (galvanized and painted)	60
Stay cable dampers	40
Stay cable dehumidification system**	30
Painting and coatings	25
Electrical and mechanical parts of access systems (travelers, catwalks, inspection platforms, and other access structures/systems)	30
(List other project specific components and minimum service life not cited above.)	______

* Durations shown are for informative purpose only and should be revised based on the characteristics of the specific project.
** If required by Service Life Design Report.

A1.1.3 Service Life Requirements for Concrete Components

The PROPOSER shall model chloride-induced corrosion in concrete by using a full probabilistic model in accordance with the methodology presented in fib Bulletin 34 “Model Code for Service Life Design”.

The model shall be used to determine the combination of concrete cover thickness, concrete properties, and type of embedded steel that will achieve the design service life. The PROPOSER shall design the concrete components of the bridge to achieve the specified service life with a target of confidence level of 90 percent (or a target reliability index of 1.3). Minimum and nominal concrete cover thicknesses shall be assessed by the model. For the purpose of the modeling, the following apply:

- The end of service life shall be defined as the point of corrosion initiation, that is when the chloride concentration reaches the corrosion threshold at the depth of the reinforcement.
- The cover thickness must be modelled considering the specified cover thickness and construction tolerances. At a minimum, cover thicknesses shall meet requirements in AASHTO LRFD Bridge Design Specifications.

The primary approach to achieve the required service life shall be based on the need to achieve a high-quality concrete with sufficient cover, paying particular attention to structural detailing. Secondary measures including cathodic protection, sealers or coatings, and corrosion inhibiting admixtures shall not be considered for mitigation of expected corrosion effects in structures, and shall not be a justification for relaxation of the primary approach to achieve the required design service life.

For deterioration mechanisms other than chloride-induced corrosion, the PROPOSER shall develop avoidance or deemed-to-satisfy mitigation methods and demonstrate that these methods will be sufficient to achieve the target service life.

Post-tensioning systems shall comply with ____________ *(Appropriate controlling code and requirement to selected based on project-specific considerations)*, while stay cables shall comply with ___________ *(Appropriate controlling code and requirement to selected based on project-specific considerations)*.

A1.1.4 Service Life Requirements for Steel Components

The PROPOSER shall determine the appropriate protection method for steel components, such as the use of coatings, use of sacrificial corrosion allowance, and by paying particular attention to structural detailing.

If corrosion allowance is the protection method chosen, the PROPOSER shall determine appropriate corrosion allowance based on exposure conditions and in accordance with ________ *(Appropriate controlling code and requirement to selected based on project-specific considerations, e.g., FHWA Design and Construction of Driven Piles Foundations – Volume 1)*. The determination of the corrosion allowance shall be documented.

If coating system(s) is the protection method chosen, the PROPOSER shall consider deterioration of the coating system due to water intrusion, chloride intrusion, ultraviolet radiation, weathering, abrasion, thermal cycling, and consumption of sacrificial elements. Exposure conditions for coating systems shall be determined in accordance with ________ *(Appropriate controlling code and requirement to selected based on project-specific considerations, e.g., ISO 12944-2 "Classification* *of Environments")*. The end of service life for the coating system is reached at the time a full recoating is required. Required maintenance activities to achieve the service life of the coating shall be documented in accordance with ________ *(Appropriate controlling code and requirement to selected based on project-specific considerations, e.g., NACE Paper 7422.)*

A1.1.5 Service Life Design Report

The PROPOSER shall provide a Service Life Design Report that details the selection of materials, design details, and all other provisions necessary for achieving the specified service life.

The Service Life Design Report shall, at a minimum, include the following:

- A conceptual approach to achieving the required service life for non-replaceable and replaceable components;
- Identification of each component with the corresponding environmental exposure conditions for each component (e.g. buried, submerged, exposed to atmosphere, exposed to aggressive chemicals, exposed to sea water splash/spray, exposed to surface runoff containing deicing salts chemicals);
- Identification of relevant deterioration mechanisms and corresponding mitigation measures for each component. Quantify deterioration processes and resistances to these processes with respect to time. Provide details of the models used in the plan. For chloride-induced reinforcement corrosion in concrete structures, use a model as required in Section A1.1.3 to evaluate the time-related changes in performance depending on the component, environmental conditions, and any proposed protective measures.
- Confirmation of the expected service life of each component, based on the proposed material, exposure condition, relevant deterioration mechanism, and any proposed mitigation or protective measures, taking into account the proposed inspection/maintenance schedule. List any corrosion allowances and thresholds used. Include the level of reliability or probability of the predicted service life of each element as well as the expected interval of replacement or renewal of the protective measures within the service life duration (e.g. thickness of coats, number of times to recoat paint that protects steel members);
- Explanation of what will be done during construction to ensure that the requirements of the service life design are achieved (including ensuring uniform compaction of the concrete, adequate concrete cover, proper curing for the element). Identify critical material properties that shall be validated during the construction period. Describe proposed quality control and quality assurance program for each material, including testing frequency to outline how the parameters on which the design is based will be achieved through construction. Program shall be in accordance with Section A1.1.6;
- Describe the general procedure for assessing non-conformances occurring during construction that may negatively affect the service life of the component. Describe potential

remediation methods that may be considered. Remediation methods provided shall return the affected materials and components to a condition consistent with the service life requirements;

- Summarize for each component, in a tabular format, an estimate of the life-cycle costs for the service life of the structure. The life-cycle cost analysis shall consider condition-based maintenance, cyclical maintenance, routine maintenance, and replacement of components, see Section A1.1.7 for definitions. The life-cycle cost analysis for the components shall use a real discount rate of ________% per year *(Value to be selected)* to convert future costs to present value.

Conclusions of the Service Life Design Report (i.e., durability requirements) shall be transferred to Supplementary Specifications for concrete, coatings, etc. Following construction, the PROPOSER shall prepare an as-built Service Life Design Report. This report will confirm that the constructed components meet all requirements necessary to ensure the intended design service life is achieved. For any components not meeting all requirements, identify necessary changes to the approved Service Life Design Report needed to achieve the service life, including any remediation methods implemented during construction and/or needs for additional inspection or maintenance actions. The as-built Service Life Design Report shall become part of the Maintenance and Inspection Manual[2]. Any assumptions on inspection and maintenance in the as-built Service Life Design Report shall be described in the Maintenance and Inspection Manual.

A1.1.6 Required Concrete Durability Testing[3]

The PROPOSER shall ensure that high quality construction is achieved that meets the selected analysis parameters and specified concrete durability properties. The concrete transport properties of the concrete mixes used in the permanent works shall be tested using the test method provided in NT Build 492 *Concrete, mortar and cement-based repair materials: Chloride migration coefficient from non-steady-state migration experiments, Nordtest, 1999* on concrete with 28-day maturity age. One NT Build 492 test result is the average of three specimens tested together and sampled from the same concrete batch. If a different service life modeling method was approved by the Owner, an alternative test method consistent with the numerical modeling may be used.

Concrete mixes shall be prequalified prior to their use in the final works. Prequalification shall consist of ________ *(Selection prequalification regime, e.g., testing of concrete mix designs*

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[2] This example assumes that a Maintenance and Inspection Manual is also included as a requirement in the RFP; however, specific requirements to the Maintenance and Inspection Manual are outside the scope of this example.

[3] It is noted that this section would also be suited for inclusion in a project-specific technical specification for concrete as part of an "Employer's Requirements" volume.

batched for the production mixer, mock-up or full scale trials, etc.). As a minimum of one trial batch for each concrete mix used on the project shall be performed.

Prequalification concrete durability tests for each mix design on the project shall include, at a minimum, the requirements in Table 2.

Table 2: Requirements to Prequalification Concrete Durability Tests for Each Mix Design.

Concrete Property	Required Test Standard	Requirements	Frequency for Prequalification
Concrete initial chloride content	ASTM C1152	Maximum 0.1% by total mass of cementitious materials	______________ *
Plastic air content	AASHTO T152 / AASHTO T196	As determined by the service life design. Where entrained air is specified, meet minimum requirements of ACI 318	______________ *
Hardened air content spacing factor	ASTM C457	Where entrained air is specified, average of 3 tests ≤ 0.008", no individual test > 0.010"	______________ *
Chloride migration coefficient	NT Build 492	As determined by the service life design	______________ *
Freeze-thaw resistance	ASTM C666 Method A	Durability factor equal or greater than 90 at 300 cycles	______________ *
Aggregate AAR properties	Testing plan to be in accordance with AASHTO R 80	In accordance with AASHTO R 80	______________ *
Scaling resistance	ASTM C672	Visual rating equal or less than 3	______________ *
(Additional durability-related test requirements determined on a project-specific basis)			

* Frequencies are to be determined on project-specific basis.

During production of concrete, the NT Build 492 test shall be performed for each mix design used at the following frequency: one test every ___ cy for the first ___ cy. Then, if compliance is achieved for an individual mix design, every ____ cy thereafter or once a ____ *(day, week, month, etc.)*, whichever comes first. If non-compliance occurs, the test frequency shall revert back to the initial frequency until compliance is achieved *(frequencies to be determined on project-specific basis)*.

Following concrete placement, the PROPOSER shall measure and report to the Owner as-built concrete cover of each element to ensure that the in-place construction is consistent with the requirements of the Service Life Design Report. Acceptance of as-built concrete cover shall conform to the requirements of ________ *(Appropriate controlling code and requirement to selected* *based on project-specific considerations, e.g., the German Concrete and Construction Association - DBV, Technical Report, Concrete Cover and Reinforcement per Eurocode 2)*.

A1.1.7 Definitions

Table 3 provides maintenance related definitions which influence the service life design. A definition for routine maintenance is also provided which is not part of service life design.

Table 3: Definitions and Examples of Preservation Activities (Condition-based Maintenance and Cyclical), Replacement, Rehabilitation, Preventative Maintenance, and Routine Maintenance.

Term	Definition	Examples
Condition-based Maintenance	Condition-based maintenance activities are performed on bridge components or elements in response to known defects. Condition-based maintenance improves the condition of that portion of the element, but may or may not result in an increase in the component condition rating. Replacement of replaceable components is part of condition-based maintenance.	• Repair/replacement of crash barrier(s), steel coatings, etc. in response to reaching end of service life • Repair or replacement of strip seals in expansion joints • Bearing restoration (cleaning, lubrication, resetting, replacement) • Spot/zone/full painting of steel elements
Cyclical Maintenance	Maintenance activities performed on pre-determined intervals that aim to preserve and delay deterioration of bridge elements or component conditions.	• Cleaning of dirt, debris, bird droppings, etc. from structural steel • Flush drains • Cleaning of expansion joints, bearings, etc. • Periodic application of grease, lubricants where appropriate • Repair of concrete surfaces due to mechanical damages or local surface cracks and spalls • Apply sealers to concrete surfaces
Preservation	Actions or strategies that prevent, delay, or reduce deterioration of bridges or bridge elements; restore the function of existing bridges; and keep bridges in good or fair condition. Preservation actions include cyclical maintenance, condition-based maintenance, and preventative maintenance, the latter being a form of preservation intended to extend service life.	See definitions of cyclical maintenance, condition-based maintenance, and preventative maintenance for examples

Table 3: Definitions and Examples of Preservation Activities (Condition-based Maintenance and Cyclical), Replacement, Rehabilitation, Preventative Maintenance, and Routine Maintenance.

Term	Definition	Examples
Preventative Maintenance	A proactive and cost-effective approach to extend the service life of a bridge. Preventative maintenance is not foreseen as part of the service life design of the structure.	• Application of cathodic protection to arrest ongoing reinforcement corrosion • Electrochemical chloride extraction from concrete • Mechanical strengthening of the bridge or component
Rehabilitation	Major work required to restore the structural integrity of a bridge, as well as work necessary to correct major safety defects.	• Partial or complete deck replacement • Superstructure replacement, • Substructure/culvert strengthening or partial/full replacement.
Replacement	Total replacement of an existing bridge with a new facility in the same general traffic corridor.	Not applicable for service life design of new structures
Routine Maintenance	Work performed in reaction to an event, season, or activities that are done for short-term operational need that do not have preservation value. This work requires regular reoccurring attention.	• Trash, Litter, and Dead Animal Removal • Snow Removal/Application of Salt/De-icing Chemicals • Graffiti Removal • Hazardous Material Removal • Asphalt Patch with No Membrane on Concrete Deck • Accident Damage to Bridge and Its Appurtenances • Storm Damage

A2 Example 2 – Design-Build Corridor Project

This RFP example is for a design-build corridor project with multiple typical highway structures with 100-year service life.

A2.1 Design for Durability

A2.1.1 Standards

The Design-Builder shall perform the service life design activities in accordance with the following Standards:

- *fib* Bulletin 34 Model Code for Service Life Design or ISO 16204 Durability – Service Life Design of Concrete Structures;
- AASHTO LRFD Bridge Design Specifications;
- AASHTO LRFD Bridge Construction Specifications;
- ACI 318 Building Code Requirements for Structural Concrete;
- ACI 301 Specifications for Structural Concrete;

(When additional agency specific codes or standards are to be used, list them below.)

- ________ Department of Transportation, Structures Design Manual

A2.1.2 General Service Life Requirements

Service life shall be defined as the period of time during which the component is used for its intended purpose. For non-replaceable components, service life requirements shall be achieved with preservation activities (i.e., cyclical and condition-based maintenance) and without the need for replacement, rehabilitation, or preventative maintenance. For replaceable components, preservation activities (i.e., cyclical and condition-based maintenance) is permissible during the service life and replacement shall occur at or after the minimum service life. Definitions and examples of preservation activities (i.e., cyclical and condition-based maintenance), replacement, rehabilitation, and preventative maintenance, are provided in Section A2.1.5.

The service life design shall address all physical or chemical factors in concrete structures, such as chloride penetration, carbonation, sulfate attack, alkali-aggregate reaction (AAR), delayed ettringite formation (DEF), abrasion, and corrosion of the steel reinforcement, steel spacers, steel accessories, and embedded items. For steel structures, the service life design shall address corrosion of structural steel and breakdown of protective coatings. The Design-Builder shall meet the required design service life either by selecting materials with reduced corrosion potential, by designing to resist deterioration from the environment using approved approaches in Section A2.1.3, or by the avoidance of deterioration method.

In general, concrete reinforcement shall be carbon-steel. Selective use of stainless steel reinforcement (ASTM A955) is permissible for concrete elements in the heavy de-icing salt zones.

Minimum service life requirements for non-replaceable and replaceable components are as shown in Table 4.

Table 4: Required Service Life for Replaceable and Non-Replaceable Components

Non-Replaceable Components	Minimum Service Life (years)*
Shafts or piles	100
Shaft or pile caps	100
Piers (wall-type, pile bents, or columns)	100
Pier caps and cross beams	100
Girders, floor beams, stringers, diaphragms, cross frames	100
Concrete deck	100
Replaceable Components	**Minimum Service Life (years)***
Bridge bearings	30
Expansion joints	20
Deck wearing surface	15
Draining systems	30
Internal access ladders, platforms, etc.	30
High performance paint for structural steel	30
Electrical and mechanical parts	20
Concrete bridge rails	30
Steel bridge rail elements	30
Approach guard rail	20
Traveler systems	30
Overhead sign structures	30
(List other project specific components and minimum service life not cited above.)	_____

* Durations shown are for informative purpose only and should be revised based on the characteristics of the specific project.

A2.1.3 Models for Predicting Deterioration

Acceptable models for predicting deterioration of components are as follows:

Concrete elements

Model the chloride-induced corrosion process in concrete components based on the fib Bulletin 34 approach using a full probabilistic model. The model should be used to determine the combination of concrete covers, concrete properties, and type of embedded steel that will achieve the design service life.

The concrete transport properties of the concrete mixes used in the permanent works shall be tested using a test consistent with the chosen model. The NT Build 492 test shall be used if the modeling is performed according to the fib Bulletin 34 chloride-induced corrosion model.

The end of the design service life is reached when the chloride concentration reaches the corrosion threshold at the reinforcement (corrosion initiation). The limit state is to achieve the specified service life with a target confidence level of 90% (or a target reliability index of 1.3).

Secondary durability measures including cathodic protection, coatings, corrosion inhibitor, etc. shall not be relied upon to relax primary protective measures against reinforcement corrosion (i.e., combination of concrete covers, concrete properties, and type of embedded steel).

Steel elements

Model coating system deterioration due to water intrusion, chloride intrusion, ultraviolet radiation, weathering, abrasion, thermal cycling, and consumption of sacrificial elements. A “deemed-to-satisfy” approach based on consideration of the listed causes of deterioration is acceptable.

The end of service life for the coating system is reached when there is 10% coating breakdown and active rusting of the substrate is present.

A2.1.4 Environmental Loading

The chloride loading on decks, sidewalks, curbs, and barriers shall be taken as a log-normal distribution with the following parameters for different exposure zones:

- Heavy deicing salts zone: mean of ___% by mass of cementitious material with a coefficient of variation of ___ ***(appropriate values to be selected based on e.g., test results available from the Owner for similar structures, e.g., 4% and 0.5 respectively)***.
- Moderate deicing salts zone: mean of ___% by mass of cementitious material with coefficient of variation of ___ ***(appropriate values to be selected based on e.g., test results available from the Owner for similar structures, e.g., 2% and 0.5 respectively)***.

A2.1.5 Definitions

Table 5 provides maintenance related definitions which influence the service life design. A definition for routine maintenance is also provided which is not part of service life design.

Table 5: Definitions and Examples of Preservation Activities (Condition-based Maintenance and Cyclical), Replacement, Rehabilitation, and Preventative Maintenance

Term	Definition	Examples
Condition-based Maintenance	Condition-based maintenance activities are performed on bridge components or elements in response to known defects. Condition-based maintenance improves the condition of that portion of the element, but may or may not result in an increase in the component condition rating. Replacement of replaceable components (see Section 2.4) is part of condition-based maintenance.	• Repair/replacement of crash barrier(s), steel coatings, etc. in response to reaching end of service life • Repair or replacement of strip seals in expansion joints • Bearing restoration (cleaning, lubrication, resetting, replacement) • Spot/zone/full painting of steel elements
Cyclical Maintenance	Maintenance activities performed on pre-determined intervals that aim to preserve and delay deterioration of bridge elements or component conditions.	• Cleaning of dirt, debris, bird droppings, etc. from structural steel • Flush drains • Cleaning of expansion joints, bearings, etc. • Periodic application of grease, lubricants where appropriate • Repair of concrete surfaces due to mechanical damages or local surface cracks and spalls • Apply sealers to concrete surfaces
Preservation	Actions or strategies that prevent, delay, or reduce deterioration of bridges or bridge elements; restore the function of existing bridges; and keep bridges in good or fair condition. Preservation actions include cyclical maintenance, condition-based maintenance, and preventative maintenance, the latter being a form of preservation intended to extend service life.	See definitions of cyclical maintenance, condition-based maintenance, and preventative maintenance for examples
Preventative Maintenance	A proactive and cost-effective approach to extend the service life of a bridge. Preventative maintenance is not foreseen as part of the service life design of the structures.	• Application of cathodic protection to arrest ongoing reinforcement corrosion • Electrochemical chloride extraction from concrete

Table 5: Definitions and Examples of Preservation Activities (Condition-based Maintenance and Cyclical), Replacement, Rehabilitation, and Preventative Maintenance

Term	Definition	Examples
		• Mechanical strengthening of the bridge or component
Rehabilitation	Major work required to restore the structural integrity of a bridge, as well as work necessary to correct major safety defects.	• Partial or complete deck replacement • Superstructure replacement, • Substructure/culvert strengthening or partial/full replacement.
Replacement	Total replacement of an existing bridge with a new facility in the same general traffic corridor.	Not applicable for service life design of new structures
Routine Maintenance	Work performed in reaction to an event, season, or activities that are done for short-term operational need that do not have preservation value. This work requires regular reoccurring attention.	• Trash, Litter, and Dead Animal Removal • Snow Removal/Application of Salt/Deicing Chemicals • Graffiti Removal • Hazardous Material Removal • Asphalt Patch with No Membrane on Concrete Deck • Accident Damage to Bridge and Its Appurtenances • Storm Damage

A2.2. Service Life Design Report

The Design-Builder shall prepare a detailed Service Life Design Report for the Bridges. At a minimum, the report must include the following:

- An executive summary describing the conceptual approach to achieving the required service life for non-replaceable components;
- Identification of each bridge component with the corresponding environmental exposure conditions for each component (e.g., buried, submerged, exposed to atmosphere, exposed to corrosive chemicals, exposed to splash/spray, exposed to surface runoff containing deicing chemicals);
- Identification of relevant deterioration and protective mechanisms for each bridge component. Quantify deterioration processes and resistances to these processes with respect to time. For chloride-induced corrosion in concrete structures, use a model as required in

Section A2.1.3 to evaluate the time-related changes in performance depending on the component, environmental conditions, and any proposed protective measures. Models shall be listed in the plan;

- Confirmation of the expected service life of each bridge component based on the proposed material, exposure condition, relevant deterioration mechanism, and any proposed protective measures, taking into account the proposed inspection/maintenance schedule. List any corrosion allowances and thresholds used. Include the level of reliability or probability of the predicted service life of each element as well as the expected interval of replacement or renewal of the protective measures within the service life duration (e.g., thickness of coats, number of times to recoat paint that protects steel members);
- Explanation of what will be done during construction to ensure that suitably high quality products are achieved (including ensure uniform compaction of the concrete, adequate concrete cover, proper curing for the element, and quality control testing).