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Rail *Safety*

Oversight and Expertise

Appendix - Guideline for Bridge Safety Management with Clarification Comments on Grey Background

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Canada

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Foreword

The objective of this Guideline is to provide railway companies with Transport Canada's (TC) expectations with respect to bridge safety.

The responsibility of a railway company is to ensure the safety of its operation and consequently, that bridges retain their structural integrity, and do not suffer catastrophic failures or undesired events resulting in death, injury, environmental damage, property damage or other loss.

The railway authority, whose track passes under an overhead bridge for which the railway authority does not have inspection and maintenance responsibilities, should provide reasonable assurance that safe railway operations are not threatened by its condition.

Section Analysis - Foreword

This Guideline was developed in consultation with the Railway Industry, and is harmonized to the extent possible with the U.S. Federal Railroad Administration's (FRA) "Bridge Safety Standards".

Part A – General

0.1 - Definitions

For the purposes of this Guideline, the terms and definitions given in the *Railway Safety Act* and the *Railway Safety Management System Regulations* apply in addition to those given below:

“bridge” means a **“railway bridge”** or an **“overhead bridge”** that the railway authority is responsible for with respect to inspection, evaluation, repairs, and the posting of load limits.

“Bridge Safety Management Program (BSMP)” means part of an overall railway safety management system that facilitates the management of risks associated with bridges. This includes the railway corporate structure, planning activities, responsibilities, practices, procedures, processes, standards, drawings, and personnel resources for developing, implementing, achieving, reviewing and maintaining the program.

“cursory inspection” means an inspection made by a Railway Bridge Engineer, a Railway Bridge Inspector, or Qualified Person to visually observe, from the track, an overhead bridge for which the railway authority does not have inspection and

maintenance responsibilities, to determine if there are any obvious conditions that may threaten safe railway operations.

“overhead bridge” means any structure carrying pedestrian, highway, or railway traffic that spans over all or a portion of the railway right of way.

“professional engineer” means a person who is authorized under a Canadian Provincial or Territorial Engineering Act to engage in the practice of professional engineering.

“railway authority” means the railway company responsible for the maintenance of a bridge.

“railway bridge” means any structure with a deck, regardless of length, which supports one or more railway tracks, or any other under grade structure with an individual span length of 10 feet or more located at such a depth that it is affected by live loads.

“railway company” means as defined in the Canadian Transportation Act.

“railway right of way” means any land on which a line of railway is situated, including yard tracks, sidings, spurs and other track auxiliary to the line of railway.

“safety evaluation” means the documented review conducted by a Railway Bridge Engineer of all relevant bridge inspections, evaluations, assessments, reports, information and circumstances relating to a bridge to ensure that it is safe for its intended use.

“visual inspection” means a documented inspection made by a Railway Bridge Engineer or a Railway Bridge Inspector under the direction of a Railway Bridge Engineer to record any changes or repairs and identify defects which may have developed or deteriorated since the last inspection. It includes measuring specific defects, verifying the general conditions of the bridge and its surroundings in order to confirm its general safety.

Section Analysis 0.1 - Definitions

Unloading pits, track scales, and waterfront structures such as piers and wharves that fall within the definition of a “railway bridge” are considered bridges for purposes of this guideline.

0.2 - Scope

This Guideline has been developed to assist a railway company in formulating a BSMP that will conform to the following:

- *Railway Safety Act;*

- *Guidelines – Engineering Work Relating to Railway Works (Section 11 – Railway Safety Act);*
- *Railway Safety Management System Regulations (SMS); and*
- *Track Safety Rules (TSR).*

It is applicable to a railway company in order for it to:

- a. Establish a BSMP that identifies and mitigates, to the extent possible, hazards to users and other parties, who may be exposed to risks associated with bridges and related activities;
- b. Implement, maintain and continually improve a BSMP;
- c. Assure itself of compliance with relevant legal requirements; and
- d. Determine and assess compliance with all legislative requirements and internal practices, procedures and instructions relating to safe railway operations as it applies to bridges.

Section Analysis 0.2 – Scope

This guideline outlines the minimum expectations for the management of bridge safety. Railway companies can adopt more stringent requirements.

0.3 - Application

This Guideline applies to a railway company to which the *Railway Safety Act* applies.

0.4 - Responsibility

The railway authority is responsible for the condition of bridges over which it or other railway companies operate trains regardless of any agreements, division of ownership or maintenance expense. The railway authority shall¹ ensure that the track is being adequately supported and shall² be able to control, and restrict if necessary, the movement of trains on its segment of track, including the track on a bridge.

For overhead bridges that the railway authority is responsible for with respect to inspection, evaluation, repairs, and the posting of load limits, the railway authority shall³ ensure that the structure is adequate for its use or posted load limit and that safe railway operations are being maintained.

The railway authority is expected to carry out cursory inspections of overhead bridges for which it does not have inspection and maintenance responsibilities, document any

¹ *Track Safety Rules* part I 6.

² *Track Safety Rules* part I 6.

³ Section 11 of the *Railway Safety Act*

obvious conditions that may threaten safe railway operations, notify the responsible authority of such conditions, and ensure corrective actions have been carried out.

If a railway authority, to which this part applies, assigns responsibility for the track and the bridge to another railway company, by lease or otherwise, written notification of the assignment should be provided to the appropriate TC Rail Safety regional office within 30 days following the assignment. The notification should be in writing and include the following:

- a. The name and address of the railway authority that is assigning responsibility;
- b. The name and address of the railway company to whom responsibility is assigned, (assignee);
- c. A statement of the exact relationship between the railway authority and the assignee; and
- d. A precise identification of the track segment and the individual bridges in the assignment.

Section Analysis 0.4 – Responsibility

TC can be notified of safety issues identified during a cursory inspection in order to help facilitate a resolution to the issue, in the event that one of the parties failed to recognize their responsibilities.

Part B – Bridge Safety Assurance

1.1 - Scope

This part outlines the requirements of a BSMP to ensure the structural integrity of bridges and safe railway operations.

1.2 - Safety Management Systems (SMS)

Under the *Railway SMS Regulations*, a railway company is required to implement and maintain systems to manage safety of all aspects of railway operations. The BSMP shall form part and be referenced in a railway company's SMS.

Section Analysis 1.2 - Safety Management Systems (SMS)

When a railway company is not the railway authority for the track over which it operates, that railway company must implement and maintain a system to ensure that the railway authority, over who's track they operate, demonstrates conformance with its BSMP and that safe railway operations are maintained with respect to bridges. This may include, but not be limited to, a review of the railway authority's internal safety audit for bridges.

Section 2 of the SMS regulation states: “A railway company shall implement and maintain a safety management system that includes, at a minimum, the following components:

(a) the railway company safety policy and annual safety performance targets and the associated safety initiatives to achieve the targets, approved by a senior company officer and communicated to employees;

(b) clear authorities, responsibilities and accountabilities for safety at all levels in the railway company; implementation of the railway company’s safety management system;

(c) a system for involving employees and their representatives in the development and implementation of the railway company’s safety management system;

(d) systems for identifying applicable

(i) railway safety regulations, rules, standards and orders, and the procedures for demonstrating compliance with them, and

(ii) exemptions and the procedures for demonstrating compliance with the terms or conditions specified in the notice of exemption;

(e) a process for

(i) identifying safety issues and concerns, including those associated with human factors, third-parties and significant changes to railway operations, and

(ii) evaluating and classifying risks by means of a risk assessment;

(f) risk control strategies;

(g) systems for accident and incident reporting, investigation, analysis and corrective action;

(h) systems for ensuring that employees and any other persons to whom the railway company grants access to its property, have appropriate skills and training and adequate supervision to ensure that they comply with all safety requirements;

(i) procedures for the collection and analysis of data for assessing the safety performance of the railway company;

(j) procedures for periodic internal safety audits, reviews by management, monitoring and evaluations of the safety management system;

(k) systems for monitoring management-approved corrective actions resulting from the systems and processes required under paragraphs (d) to (j); and

(l) consolidated documentation describing the systems for each component of the safety management system.”

Part C – Qualifications and Designations of Responsible Persons

2.1 - Scope

A railway authority's BSMP shall⁴ describe the qualification, training and designation of persons who perform safety-critical functions that affect the integrity and safety of bridges.

Section Analysis 2.1 – Scope

Railway Safety Management System Guide

H) Skills, Training and Supervision

2. (h) systems for ensuring that employees and any other persons to whom the railway company grants access to its property, have appropriate skills and training and adequate supervision to ensure that they comply with all safety requirements;

The Safety Management System should include:

- *identification of required position qualifications;*
- *identification of required qualification and training of customers, contractors, other railways and other third parties whose activities may directly affect railway safety;*
- *periodic reviews of qualification requirements that take into account the results of proficiency testing, compliance evaluations, risk assessments, accident/incident investigations and safety data analysis;*
- *procedures for ensuring that employees have received the necessary training and certification and that qualifications are kept current;*
- *procedures for keeping records of training and certification requirements as well as the status of employees relative to these requirements;*
- *procedures for compliance and proficiency testing in all disciplines and for record keeping and follow-up corrective action such as additional training;*
- *procedures for communicating to employees any changes to safety policies, work procedures, practices, requirements, rules and standards;*
- *supervisor job descriptions that identify responsibilities, including coaching and direct field observation;*
- *systems for ensuring accountability for these responsibilities; and*
- *adequate resources for supervision.*

⁴ Section 2(h) Railway Safety Management System Regulations

2.2 – Bridge Safety Management Responsibility

A railway company's BSMP shall⁵ identify clear authorities, responsibilities, and accountabilities for the management of bridge safety.

Section Analysis 2.2 - Bridge Safety Management Responsibility

*Section 4(1)(e) Railway Safety Management System Regulations
e.g. an organizational chart illustrating the chain of responsibility.*

2.3 – Railway Bridge Engineer

A Railway Bridge Engineer is a professional engineer, designated by a railway authority, who is responsible for, and has the related experience in, the following functions as they apply to the particular engineering work to be performed:

- a. Determine the forces and stresses in bridges and their components;
- b. Prescribe safe loading conditions for bridges;
- c. Prescribe inspection, maintenance, repair and modification procedures for bridges; and
- d. Design repairs and modifications to bridges.

The designated Railway Bridge Engineer shall⁶ decide the extent to which professional engineers shall⁷ be directly involved in the engineering work related to railway works.

A Railway Bridge Engineer should be authorized to restrict the operation of traffic over a bridge according to its immediate condition or state of repair.

Section Analysis 2.3 - Railway Bridge Engineer

The designated Railway Bridge Engineer who has related experience in the field of railway bridge engineering and is responsible for the development of all inspection procedures, reviews inspection reports, and determines whether bridges are being inspected according to the applicable procedures and frequency, and reviews any items noted by an inspector as exceptions. He shall also take responsibility for design, construction, evaluation or alteration work and procedures to be followed in association with a railway work that affects safety to the public, employees of the railway company, or the environment.

⁵ Section 4(1)(e) *Railway Safety Management System Regulations*

⁶ Section 11 of the *Railway Safety Act*

⁷ Section 11 of the *Railway Safety Act*

In fulfilling their responsibilities, professional engineers assure that all engineering work relating to railway works is carried out using good engineering judgment, with sound engineering practice, and with the appropriate level of oversight needed for providing reasonable assurance regarding safety. This includes reasonable assurance that the appropriate systems are in place for the prudent implementation of the engineering work including, but not limited to: design, construction, evaluation, alteration, operation, maintenance, training, environmental, quality assurance, safety, accident investigation, corrective measures, records, and emergency procedures.

Railway Bridge Engineering is based on the same principles of engineering as all other structural engineering work, but the applications of many of those principles are unique to this particular field. The live loads carried on railway bridges are generally much higher than the loads on highway bridges or other transportation structures. Overall configuration and details of construction of railway bridges differ greatly from other classes of structures, to the extent that dealing with these features requires some experience with them as well as an understanding of the fundamentals of engineering. It is understood that not all Railway Bridge Engineers will be faced with all aspects of railway bridge engineering. For example, an engineer engaged to prescribe safe loads for short steel spans and timber trestles on a particular railway might never have to perform a detailed analysis of a large truss bridge. The basic premise is that the engineer be competent to perform the functions that are encompassed by that individual's employment or engagement. The determination of qualifications by the railway authority includes either employment or engagement of the engineer by the railway authority, and designation of the engineer to exercise the authority called for in this part.

It is believed that given the critical nature of railway bridge engineering work, it will be required that persons meet a minimum educational and experience requirement which is common to the engineering profession and which is necessary for an individual who will perform the functions of a Railway Bridge Engineer.

2.4 – Railway Bridge Inspector

A Railway Bridge Inspector is a person who is designated by a railway authority and deemed to be technically competent and have the related experience to view, measure, report and record the condition of a bridge and its individual components, under the direction of the designated Railway Bridge Engineer.

A Railway Bridge Inspector should be authorized to restrict the operation of traffic over a bridge according to its immediate condition or state of repair.

Section Analysis 2.4 - Railway Bridge Inspector

This section proposes the qualifications that a Railway Bridge Inspector should meet. Effective inspection of bridges is essential to preserving their integrity and serviceability. Railway Bridge Inspectors must be able to understand and carry out the inspection procedure, including accessing inspection points on a bridge, measuring components and any changes, describing conditions found in a standard, unambiguous manner, and detecting the development of conditions that are critical to the safety of the bridge. It is essential that a Railway Bridge Inspector who detects a potential hazard to the safe railway operations should be authorized by the railway authority to place appropriate restrictions on the operation of traffic pending review as necessary by a Railway Bridge Engineer. He should ensure that there is a process in place, which may include audits, field trips and training of the Railway Bridge Inspector, to assure the quality of the inspections reported. An individual who is not competent in railway bridgework should not be permitted to overrule a determination made by a designated Railway Bridge Inspector, or Railway Bridge Engineer.

2.5 - Qualified Person

A Qualified Person is a person who is designated by a railway authority in respect to a specified duty, because of knowledge, training and experience is qualified to perform that duty safely and properly.

2.6 - Designation of Individuals

Each railway authority should designate individuals qualified as Railway Bridge Engineers, Railway Bridge Inspectors, and Qualified Persons. For each individual designated, the records should include the basis for the designation (qualifications and related experience) in effect.

Section Analysis 2.6 - Designation of Individuals

This section proposes that each railway authority designate certain individuals as qualified Railway Bridge Engineers, Railway Bridge Inspectors, and Qualified Persons and provide a recorded basis for each designation in effect. The railway authority should record designations of individuals, whether employees, consultants or contractors. If a consultant or contractor has several individuals performing the described functions under a contract or other engagement, then one or more individuals should be designated as being responsible to the railway authority for the work performed under that engagement, with the others working under the responsible charge of that individual.

Part D – Capacity of Bridges

3.1 - Scope

Each railway authority's BSMP should prevent the operation of equipment that could damage a bridge by exceeding safe stress levels in its components or by extending beyond the horizontal and vertical clearance limits of the bridge.

Section Analysis 3.1 – Scope

This section proposes that procedures be incorporated in BSMP to prevent the operation of equipment that could damage a bridge by exceeding safe stress levels in its components or by extending beyond the horizontal or vertical clearance limits of the bridge. Protection of bridges and their components from overstress is essential to the continued integrity and serviceability of the bridge. It is also essential that equipment or loads that exceed the clearance limits of a bridge not be operated owing to the potential for severe damage to the bridge.

3.2 - Determination of Bridge Load Capacities

- a. Each railway authority should determine the load capacity of each of its bridges. The load capacity is intended to be the safe load capacity not the ultimate or maximum load capacity.
- b. The load capacity of each bridge should be documented in the railway authority's BSMP, together with the documented method by which the capacity was determined.
- c. The load capacity shall⁸ be determined by a Railway Bridge Engineer using engineering methods and standards applicable to the particular class, configuration, and type of bridges being evaluated.
- d. Bridge load capacity may be determined from existing design and modification records of a bridge, provided that the bridge substantially conforms to its recorded configuration. Otherwise, the load capacity of a bridge should be determined by measurement and calculation of the properties of its individual components, or other methods as determined by a Railway Bridge Engineer.
- e. Where a bridge inspection reveals that the condition of a bridge or its component might adversely affect the load capacity of the bridge to carry the traffic operated, a Railway Bridge Engineer should determine a new capacity.
- f. Railway bridge load capacity may be expressed in terms of numerical values related to a standard system of railway bridge loads, but should in any case be stated in terms of weight and length of individual or combined cars and locomotives, for the use of transportation personnel.

⁸ Section 11 of the *Railway Safety Act*

- g. Bridge load capacity may be expressed in terms of both normal and maximum load conditions. Operation of equipment that produces forces greater than the normal capacity should be subject to any restriction or conditions that may be prescribed by the Railway Bridge Engineer.

Section Analysis 3.2 - Determination of Bridge Load Capacities

a. Each railway authority should determine the load capacity of each of its bridges. It is essential that the railway authority know that loads operated over a bridge not exceed the safe capacity of that bridge. However, once it is determined that a bridge has adequate capacity to carry the loads being operated, no additional effort is required to precisely calculate the additional capacity of that bridge although that might well be useful from a planning or economic standpoint.

A railway authority should schedule the rating of bridges for which the load capacity has not already been determined. It is intended that the unrated railway bridges be given relative priority for rating, based on the judgment of the Railway Bridge Engineer. This prioritization can be accomplished either by observation or by evaluation of certain critical members of a railway bridge, as determined by the Railway Bridge Engineer using professional judgment.

b. The load capacity of each bridge should be documented in the railway authority's BSMP, together with the method by which the capacity was determined. Once the load capacity is determined, the value should be recorded in order for it to be useful. Examples of methods of determination could be the original design documents, recalculation, or rating inspection.

c. Section 11 of the Railway Safety Act states " All the engineering work related to railway works, including design, construction, evaluation or alteration, shall be done in accordance with sound engineering principles. A professional engineer shall take responsibility for engineering work " Therefore, a professional engineer competent in the field of railway bridge engineering, must determine railway bridge capacity. Load capacity determination requires the education, experience and training of an engineer who is familiar with railway bridges and the standard practices that are unique to that class of structure.

While the present standard references for railway bridge design and analysis are found in the "Manual for Railway Engineering" of the American Railway Engineering and Maintenance of Way Association (AREMA), and that the chapters in this Manual dealing with Timber, Concrete and Steel structures, and Seismic Design, are under continuous review by committees consisting of leading engineers in the railway bridge profession, it is recognized that alternative methods and standards exist and are employed by some railway authorities to determine load capacity.

d. Bridge load capacity may be determined from existing design and modification records of a bridge, provided that the bridge substantially conforms to its recorded configuration. Determination of bridge load capacity requires information on the configuration of the bridge and the dimensions and material of its component parts. If the bridge is found to conform to the drawings of its original design and modifications, those drawings may serve as the basis for any rating calculation that might be performed, thus simplifying the process. Lacking that prior information, it may become necessary that the configuration, dimensions and properties of the bridge and its components be determined by on-site measurement of the bridge, as it currently exists.

e. It is proposed that a Railway Bridge Engineer determine a new capacity when a bridge inspection record reveals that the condition of a bridge or its component might affect its load capacity. Accurate determination of current bridge capacity depends on accurate information about the current configuration and condition of the bridge. The Railway Bridge Engineer might determine that a change in condition or configuration calls for a revised rating calculation.

f. The railway bridge load capacity may be expressed in terms of numerical values related to a standard system of railway bridge loads, but should in any case be stated in terms of weight and length of individual or combined cars and locomotives, for the use of transportation personnel. Railway Bridge Engineers use standard definitions of loading combinations for design and rating of railway bridges. Common among these standard definitions is a series of proportional loads known as the Cooper System. The capacity of a railway bridge and its components can be described in terms of a Cooper Rating, and the effect of a load on a railway bridge can also be related to a Cooper System value. Proper application of this system requires a full understanding of its use and limitations. However, the results of its application can be translated into terms of equipment weights and configurations that can be effectively applied by persons who manage regular transportation operations of the railway company. This enables them to determine if a given locomotive, car or combination can be operated on a railway bridge with no further consideration, or if the equipment must be evaluated as an exceptional movement.

g. The bridge load capacity may be expressed in terms of both normal and maximum load conditions. Normal bridge ratings generally define the loads that can be operated on a bridge for an indefinite period without damaging the bridge. In some cases, mostly involving steel or iron bridges, a higher rating, up to a maximum rating, can be given to the bridge to permit the operation of heavier loads on an infrequent basis. These heavier loads should not, in themselves, damage the bridge, but the cumulative effect of the higher resulting stresses in its members could cause their eventual deterioration.

This paragraph also proposes that operation of equipment that produces forces greater than the normal capacity should be subject to any restrictions or conditions that may be prescribed by a Railway Bridge Engineer. A Railway Bridge Engineer can often prescribe compensating conditions that will permit the movement of equipment that is heavier than normal. Examples include speed restrictions to reduce the impact factor of the rolling load, the insertion of lighter weight spacer cars between the heavier cars in a train, or the installation of temporary bents or other supports under specific points on the railway bridge.

3.3 - Protection of Bridges from Over-weight and Over-dimensional Loads

A railway company should know what rolling stock is allowed to operate on its network, their equipment rating, and restrictions required. A railway company should have, and ensure the implementation of documented procedures for the operation of equipment exceeding the normal weight or dimension restriction on a bridge. Equipment exceeding the normal weight or dimension restriction should only be operated under conditions determined by the Railway Bridge Engineer, who has properly analyzed the stresses resulting from the proposed loads.

The railway authority is expected to advise other railway companies operating over a railway bridge of the normal loads permitted over it. Railway companies should develop, maintain, and enforce written procedures to restrict a load that exceeds those limits, unless specific authority has been granted and in accordance with restrictions placed by the railway authority.

Each railway company should issue instructions to the personnel who are responsible for the configuration and operation of trains over its railway bridges to prevent the operation of cars, locomotives and other equipment that could exceed the capacity or dimensions of its railway bridges. The Railway Bridge Engineer should be informed of any substantial change in train operation or traffic patterns, which may affect bridge safety. These instructions should:

- (a) be expressed in terms of maximum equipment weights, and either minimum equipment lengths or axle spacing.
- (b) be expressed in terms of feet and inches of cross section and equipment length, in conformance with common railway industry practice for reporting dimensions of exceptional equipment in interchange in which height above top-of-rail is shown for each cross section measurement, followed by the width of the car of the shipment at that height.
- (c) apply to individual structures, or to a defined line segment or group(s) of line segments where the published capacities and dimensions are within the limits of all structures on the subject line segments.

Section Analysis 3.3 - Protection of Bridges from Over-weight and Over-dimensional Loads

Bridges can be seriously damaged by the operation of loads that exceed their capacity. Movement of equipment that exceeds the clear space on a bridge is an obvious safety hazard. This section proposes that each railway company should issue instructions to personnel who are responsible for the consist and operation of trains over railway bridges to prevent the operation of cars, locomotives and other equipment that would exceed the capacity or dimensions of bridges. Transportation personnel of a railway company are ultimately responsible for the movement of trains, cars and locomotives. It is essential that they should know and follow any restrictions that are placed on those movements.

(a). The instructions regarding weight should be expressed in terms of maximum equipment weights, and either minimum equipment lengths or axle spacing. Transportation personnel have information on the weights and configuration of cars and locomotives, and they must be able to relate that information to any restrictions placed on the movement of that equipment.

(b). The instructions regarding dimensions should be expressed in terms of feet and inches of cross section and equipment length, in conformance with common railway industry practice for reporting dimensions of exceptional equipment in interchange in which height above top-of-rail is shown for each cross section measurement, followed by the width of the car or the shipment at that height. In the industry, a standard format exists for the exchange of information on dimensions of railway equipment. This standard practice is practical, even if it is not intuitive. Use of the industry practice is necessary to avoid error and confusion.

(c). The movement instructions may apply to individual structures or to a defined line segment or groups of line segments where the published capacities and dimensions are within the limits of all structures on the subject line segments. Railway authorities commonly issue instructions related to equipment weights and dimensions to be effective on line segments of various lengths. It is not necessary that transportation personnel be advised of the capacity of every bridge as long as each railway bridge in the line segment has the capacity to safely carry the loads permitted on that line.

When there is a change proposed in train operation or traffic patterns, which may affect railway bridge safety, the transportation department should have a procedure in place for ensuring that the designated Railway Bridge Engineer is advised of the change so that the safety of the railway bridges can be verified.

3.4 - Protection of Safe Railway Operations during Repairs or Modifications

Each railway authority's BSMP should specify procedures for any repair or modification that materially modifies the capacity of a bridge or the stresses in any primary load-carrying component of a bridge. At a minimum, design for repairs or modifications shall⁹ be performed under the direction of a Railway Bridge Engineer. The design should specify the manner in which traffic or other live loads may be permitted on the bridge while it is being modified or repaired.

Designs and procedures for repair or modification of bridges of a common configuration, such as timber trestles, or instructions for in-kind replacement of bridge components, may be issued as a common standard. Where the common standard addresses procedures and methods that could materially modify the capacity of a bridge or the stresses in any primary load-carrying component of a bridge, the standard shall¹⁰ be designed under the direction of a Railway Bridge Engineer.

Each repair or modification pursuant to this part should be performed under the direction of a Railway Bridge Engineer who is designated and authorized by the railway authority to supervise the particular work to be performed. He should ensure that the repair or modifications were completed in conformity with the design.

Section Analysis 3.4 - Protection of Safe Railway Operations during Repairs or Modifications

Minimum standards to be incorporated in railway authority's BSMP to provide for adequate design and effective supervision of those bridge modifications and repairs which will materially modify the capacity of the bridge or the stresses in any primary load-carrying component of the bridge. This section provides for correct design and adequate supervision of repair and modification of bridges where the work could materially affect the capacity of the bridge, or its continued integrity. TC does not intend that minor repairs that do not affect the capacity of the bridge must be designed by a Railway Bridge Engineer, but the supervision of that work should be performed by a person who is competent to assure that the work does not inadvertently compromise the integrity of the bridge. For instance, arc welding handrails to the members of a through truss might appear to some to be a minor repair, but it could seriously compromise the structural integrity of the bridge.

Design of entire railway bridges, modifications and repairs which materially modify the capacity of the bridge or the stresses in any primary load-carrying component of the bridge require the intelligent application of the principles of engineering and can be performed only by a Railway Bridge Engineer with training and experience in the field of

⁹ Section 11 of the *Railway Safety Act*

¹⁰ Section 11 of the *Railway Safety Act*

railway bridges. Railway authorities have typically issued standard instructions for the performance of common maintenance repairs, such as replacement or upgrading of components of timber trestles. This section specifically permits such a practice. For purposes of this part, a primary load-carrying component is a railway bridge component, the failure of which would immediately compromise the structural integrity of the bridge.

Designs and procedures for repair or modification of bridges of a common configuration, such as timber trestles, or instructions for in-kind replacement of bridge components, may be issued as a common standard. Although it may be a standard procedure, the standard should be designed and issued by a qualified Railway Bridge Engineer.

Part E – Bridge Inspection

4.1 - Scope

Each railway authority's BSMP should provide for an effective bridge inspection program.

The railway authority should clearly define and document the different types of inspections to be undertaken for their bridges, including the frequencies of these inspections in their BSMP.

Section Analysis 4.1 – Scope

Bridge inspection is a vital component in BSMP. A bridge with undetected or unreported damage or deterioration can present a serious hazard to the safe railway operations. Bridge inspection and evaluation is a multi-tiered process, unlike many other types of inspection on a railway. While track, equipment and signal inspectors usually can compare measurements against common standards to determine whether the inspected feature complies with the standards, such is not the case with most bridges. The evaluation of a bridge requires the application of engineering principles by a competent person, who is usually not present during the inspection. It is therefore necessary that an inspection report should show any conditions on the bridge that might lead to a reduction in capacity, initiation of repair work, or a more detailed inspection to further characterize the condition.

Types of inspections include but are not limited to cursory, visual, detailed, mechanical, electrical, underwater, special, etc.

4.2 – Bridge & Overhead Bridge Inventory

The railway authority is expected to maintain an inventory of all bridges, located on its right of way. At a minimum, this inventory is expected to include the following information:

- a. Location (i.e. subdivision and mileage),
- b. Bridge type,
- c. Total length,
- d. Individual / average span length,
- e. Maximum height,
- f. Year built,
- g. Deck type,
- h. Obstacle being crossed (i.e. water body, roadway etc),
- i. Geo-referenced coordinates (i.e. longitude, latitude),
- j. Bridge rating, which may be expressed in terms of the individual bridge capacity or line capacity based on the governing bridge rating on the line segment,
- k. Line / load capacity,
- l. Date of line / load capacity evaluation, and
- m. The name of the party responsible for the inspection and maintenance of the bridge.

The railway authority is expected to have a complete inventory of all overhead bridges on its right of way, which at a minimum is expected to include the location (including geo-referenced coordinates) and, where available, the name of the party responsible for its inspection and maintenance.

4.3 - Scheduling of Bridge Inspections

- a. Each BSMP should include a visual inspection for each bridge in service at least once each calendar year with not more than 540 days between any successive inspections.
- b. Each BSMP should include a cursory inspection for each overhead bridge for which the railway authority does not have inspection and maintenance responsibilities, at least once each calendar year with not more than 540 days between any successive inspections.
- c. . A bridge should be inspected more frequently when a Railway Bridge Engineer determines that such inspection frequency is necessary considering the conditions

- noted on prior inspections, the type and configuration of the bridge, and the weight and frequency of traffic carried on the bridge.
- d. Each BSMP should define requirements for the special inspection of a bridge, as per Section 4.5 of this Guideline.
 - e. Any bridge that has not been in service and has not been inspected in accordance with this section within the previous 540 days should be inspected and the report of said inspection reviewed by a Railway Bridge Engineer prior to resumption of service.

Section Analysis 4.3 - Scheduling of Bridge Inspections

a. The railway authority should conduct regular comprehensive visual inspections of each bridge, at least once every year with not more than 540 days between any successive inspections, and maintain records of those inspections that include the date on which the inspection was performed, the precise identification of the bridge inspected, the items inspected, and accurate description of the condition of those items, and a narrative of any inspection item that is found by the inspector to be a potential problem.

Annual inspection of railway bridges has been an industry practice for over a century, and has proven to be an effective tool of bridge management. Even where a bridge sees very low levels of traffic, the potential still exists for damage from external sources or natural deterioration. This paragraph calls for one inspection per calendar year, with not more than 540 days between successive inspections. Both criteria apply. For example, if a bridge is inspected on January 3, 2011, it becomes overdue for inspection on June 27, 2012, 541 days later. If it is inspected on December 18, 2011, it becomes overdue on January 1, 2013, since it was not inspected in calendar year 2012.

b. The railway authority should carry out a cursory inspection of all overhead bridges, for which it does not have inspection and maintenance responsibilities at least once every year with not more than 540 days between any successive inspections, and maintain records of those inspections that include the date on which the inspection was performed.

c. A bridge should be inspected more frequently than the period referenced in paragraph a. and b., above; when a Railway Bridge Engineer determines that such inspection frequency is necessary. The responsibility for adequate inspection remains with the railway authority, with the conditions prescribed by a Railway Bridge Engineer. The inspection regime for every bridge should be determined from its condition, configuration, environment and traffic levels.

d. Each BSMP should define requirements for the special inspection of a bridge to be performed whenever the bridge is involved in an event which might have compromised the integrity of the bridge, including flood, fire, earthquake, derailment, or other vehicular or vessel impact. It is essential that safe railway operations be protected from damage from an event caused by natural or non-railway agents. The railway authority should have in place a means to receive notice of such an event, including weather and earthquakes, and a procedure to conduct an inspection following such an event.

e. Any bridge that has not been in railway service and has not been inspected in accordance with this

section should be inspected and the inspection report reviewed by a Railway Bridge Engineer prior to the resumption of railway service. The inspection frequency requirements of paragraph a. do not apply to bridges that are not in service, but that does not relieve a railway authority from responsibility for any damage to outside parties that might be caused by the condition of the bridge. If a bridge not in service has been inspected within the previous 540 days, the railway authority may accept that inspection and begin railway service, subject to any determination in that regard by a Railway Bridge Engineer. The inspection period would date from the last inspection, with no credit for out-of-service time.

4.4 – Bridge Inspection Procedures

- a. Each BSMP should specify the procedure to be used for inspection of individual bridges or classes and types of bridges.
- b. The bridge inspection procedures shall¹¹ be as specified by a Railway Bridge Engineer who is designated as responsible for conducting and reviewing the inspections. The inspection procedures should incorporate the methods, means of access, and level of detail to be recorded for the various components of that bridge or class of bridges.
- c. The bridge inspection procedures should ensure that the level of detail in the inspection procedures are appropriate to the configuration of the bridge, conditions found during previous inspections, and the nature of the traffic moved over the bridge, including equipment weights, train frequency and length, level of passenger and hazardous materials traffic, and vulnerability of the bridge to damage.
- d. The bridge inspection procedures should be designed to detect, report, and protect deteriorations and deficiencies before they present a hazard to safe railway operations.

Section Analysis 4.4 – Bridge Inspection Procedures

Each BSMP should specify the procedure to be used for inspection of individual bridges or classes and types of bridges. A Railway Bridge Engineer who is designated as responsible for conducting and reviewing the inspections should specify the bridge inspection procedures. The bridge inspection procedures should provide reasonable assurance that the level of detail and the inspection procedures are appropriate to the configuration of the bridge. Additionally, the bridge inspection procedures should be designed to detect, report, and protect deterioration and deficiencies before they present a hazard to safe railway operations. The responsibility for adequate inspection remains with the railway authority, with the conditions prescribed by a Railway Bridge Engineer. The inspection regime for every bridge should be determined from its condition, configuration, environment and traffic levels. The instructions for a bridge inspection may be both general, as by bridge type or line segment and specific as needed by particular considerations for an individual bridge.

4.5 - Special Inspections

Each railway authority's BSMP should include a procedure for the protection of traffic and for the inspection of any bridge that might have been damaged by natural or accidental event, including but not limited to flood, fire, ice flows, debris flows, sub-grade instability, rock instability, effect of beaver dam failure, earthquake, derailment, vandalism, vehicular or vessel impact.

Section Analysis 4.5 - Special Inspections

It is essential that traffic be protected from possible bridge failure caused by damage from an event. The railway authority should have in place a means to receive notice of such an event, including weather conditions and earthquakes, and a procedure to conduct an inspection following such an event.

The Railway Bridge Engineer may be required to supplement his/her competencies with outside expertise to provide for a reasonable level of bridge safety, (e.g. geotechnical or Underwater Inspection).

4.6 – Underwater Inspections

Each railway authority's BSMP should include provisions for underwater inspections for the detection of scour or deterioration of bridge components that are submerged and where the foundation cannot be inspected due to the depth of water, high water flow or poor visibility.

The railway authority should have in place an underwater inspection program to identify which bridges to inspect, the items to inspect, and the frequency of underwater inspections to provide reasonable assurance of the foundation's integrity.

The railway authority should be knowledgeable of the risks posed by scour, erosion and stream stability hazards.

Section Analysis 4.6 - Underwater Inspections

Each railway authority's BSMP should provide for the detection of scour or deterioration of bridge components that are submerged or subject to water flow. The condition of bridge components located under water is usually not evident from above. Means to determine their condition might be as simple as using measuring rods from the surface, or might call for periodic or special diving inspections. Advanced technology might also provide devices that can be used to determine underwater conditions.

It is recognized that not all bridges require an underwater inspection, nor will every part of a bridge over water require an underwater inspection. The intent in this section is that if a bridge is deemed by the Railway Bridge Engineer to be susceptible to conditions that will require underwater inspections, provisions and procedures should be put in place.

4.7 – Inspection of Brush and Drainage Channel Conditions

- a. Each railway authority's BSMP shall¹² include provisions for the inspection of brush conditions under and adjacent to bridges and ensure that vegetation is controlled to reduce the fire hazards to bridges and enable a thorough bridge inspection to be carried out.
- b. Each railway authority's BSMP shall¹³ include provisions to ensure each drainage or other water carrying facility under or immediately adjacent to the bridge is maintained and kept free of obstruction, to accommodate expected water flow for the area concerned.

4.8 – Bridge Inspection Records

- a. Each railway authority should keep a record of each inspection that has been performed on those bridges under this part.
- b. Each record of an inspection under the BSMP described in this part should be prepared from notes taken on the day(s) the inspection is made, supplemented with sketches and photographs as needed.
- c. Each BSMP should specify that every bridge inspection report should include, as a minimum, the following information:
 1. A precise identification of the bridge inspected, (including geo referenced coordinates);
 2. The date(s) on which the inspection was carried out;
 3. The identification and written or electronic signature of the inspector;
 4. The type of inspection performed, in conformance with the definitions of the inspection types in the railway authority's BSMP;
 5. An indication on the report as to whether any item noted thereon requires expedited or critical review by a Railway Bridge Engineer, and any restrictions placed at the time of the inspection; and
 6. The condition of components inspected, which may be in a condition reporting format prescribed in the railway authority's BSMP, together with any narrative description necessary for the correct interpretation of the report.
- d. Each railway authority's BSMP should specify the retention period and location for bridge inspection records. The retention period should be no less than five

¹² *Track Safety Rules* part II B.II(a)

¹³ *Track Safety Rules* part II B.I

years following the completion of the inspection, or until the completion of the next two inspections of the same type, whichever is greater.

Section Analysis 4.8 - Bridge Inspection Records

a. Each railway authority should keep a record of each required inspection that is to be performed on those bridges under this part.

b. A bridge inspection has little value unless it is recorded and reported to the individuals who are responsible for the ultimate determination of the safety of the bridge. Railway Bridge Inspectors may use a variety of methods to record their findings as they move about the bridge. These include, but are not limited to, notebooks, voice recordings, having another individual transcribe notes, and photographs. These notes and other items are usually compiled into a prescribed report form at the end of the day or at the conclusion of the inspection.

c. Delineates the essential elements that should be addressed and reported in any bridge inspection.

d. This provision was drafted with the intent that the actual conduct of the inspection should be reported and recorded, showing the fact that the bridge was actually inspected on a certain date, the type of inspection performed, by whom it was performed, and whether or not any critical conditions were detected. Inspection and reporting procedures vary widely among different railway authorities and circumstances. In many cases, a Railway Bridge Inspector may prepare the report before leaving the bridge. The reports might be forwarded by mail, by electronic means, or by hand delivery. They might be forwarded daily, weekly, or even less frequently. In other circumstances, a consulting engineer might be engaged by a railway authority to inspect all of the bridges on all or part of the line, and the final report might be prepared by the engineering firm after all of the inspections are completed. Similarly, a railway authority might begin a comprehensive inspection and evaluation of a large bridge that will take several weeks to complete.

TC recognizes the wide range of time periods required for these various inspections and reporting procedures, so this provision is recommended as a means for the railway authority to track inspection progress, bridge by bridge, with a simple line item showing:

- 1. The identification of the bridge inspected;*
- 2. The date(s) on which the inspection was carried out;*
- 3. The identification of the Railway Bridge Inspector;*
- 4. The type of inspection performed; and*
- 5. An indication on the report as to whether any item noted thereon requires expedited or critical review by a Railway Bridge Engineer, and any restrictions placed at the time of the inspection.*

d. Further proposes that each BSMP specify the retention period and location for bridge inspection records. There are several good reasons for retaining bridge inspection reports over the period of several years or inspection cycles. First, a comparison of successive reports can reveal any accelerating rates of deterioration or degradation of bridge components. Second, an audit or review of the effectiveness of a bridge inspection program requires comparison of previous inspection reports with the actual condition of a bridge included in the audit. It provides a valuable factor in determining the effectiveness of a BSMP.

4.9 - Review of Bridge Inspection Reports

Each railway authority's BSMP should specify the manner and timeline in which bridge inspection reports should be reviewed by the Railway Bridge Engineer to:

- a. Determine whether inspections have been performed in accordance with the relevant schedule and specified procedures;
- b. Evaluate whether any items on the report represent a present or potential hazard to safety;
- c. Require any modifications to the inspection procedures or frequency for that particular bridge;
- d. Schedule any repairs or modifications to the bridge that are required to maintain its structural integrity; and
- e. Determine the need for further higher-level review.

A Railway Bridge Engineer shall¹⁴ review potentially imminent failure conditions identified during bridge inspections prior to the next train movement.

A safety evaluation should be carried out in accordance with timeline identified in the Bridge Safety Management Program. Records of a safety evaluation should identify, at a minimum, the bridge evaluated, the date of the evaluation, the responsible Railway Bridge Engineer, and the conclusions and recommendations resulting from the safety evaluation.

Section Analysis 4.9 - Review of Bridge Inspection Reports

A Railway Bridge Engineer should review inspection reports and determine whether bridges are being inspected according to the applicable procedures and frequencies, and review any items noted by a Railway Bridge Inspector as exceptions. The record of safety evaluation need not necessarily be a stand-alone document.

¹⁴ Section 11 of the *Railway Safety Act*

4.10 – Bridge Hazard Identification and Risk Assessment

A railway company is required to implement and maintain processes for the identification of safety issues and concerns¹⁵, evaluating and classifying risks by means of a risk assessment¹⁶, and necessary control strategies¹⁷.

Section Analysis 4.10 - Bridge Hazard Identification and Risk Assessment

Railway Safety Management System Guide February 2001 (TP13548)

Part E) Risk Management Process

2. (e) a process for

- (i) identifying safety issues and concerns, including those associated with human factors, third parties and significant changes to railway operations, and*
- (ii) evaluating and classifying risks by means of a risk assessment*

Risk management does not mean taking risks, but rather it means identifying risks and working to mitigate or eliminate them. The Safety Management System should include a formal risk management process that includes the following steps:

Step 1 – Identification of Safety Issues and Concerns

- Mechanisms for employees to identify safety issues and concerns on a routine, ongoing basis that have high levels of visibility and participation*
- Input from incident/accident investigations and safety data collection and analysis*
- Analytical methods such as failure mode and effect analysis, hazard and operability studies, and fault-tree analysis and event-tree analysis for new equipment, systems, practices and procedures where experience and a safety history are not available*
- Special consideration of safety issues and concerns related to human factors, third-party interfaces and the introduction of significant changes to operations*
- Feedback from Safety Management System processes such as incident and accident investigation, safety data collection and analysis, proficiency testing, and internal audit*
- Safety monitoring technology such as hotbox detectors, wheel impact detectors, high water detectors and on-train monitoring systems*
- Input from the public (1-800 numbers), customers (complaint monitoring) and regulatory agencies (findings of non-compliance or unsafe situations)*

¹⁵ Section 2(e) of *Safety Management System Regulations*

¹⁶ Section 2(e) of *Safety Management System Regulations*

¹⁷ Section 2(f) of *Safety Management System Regulations*

Railways are expected to do a thorough analysis of both new operations and significant changes to existing operations. In the case of new equipment, systems, operations, practices and procedures where experience and a safety history are not available, formal analytical techniques should be applied. These techniques are more demanding in terms of data, time, effort and expertise; however, this extra effort is justified for new equipment, systems, operations, practices and procedures and should be considered a normal part of the process of implementing change.

Examples of significant changes requiring a risk assessment process include

- *railway company mergers,*
- *major organizational transitions,*
- *the introduction of new technology (e.g., Light Emitting Diodes), and*
- *major operational changes (e.g., new commuter lines, speed changes).*

A complete analysis of existing operations is not required provided that current risk mitigation strategies are documented (see component 2(f)). Input from accident and incident investigation, safety performance data collection and analysis, and complaints, inspections and audits should be used to identify areas of existing operations that require a thorough analysis.

Step 2 – Risk Estimation

Assessment of the probability and severity of the safety issue/concern either qualitatively or quantitatively

Quantitative estimates of the probability and severity of the safety issue/concern can sometimes be developed from safety performance data, illness and injury records, etc. Probability estimates based on historical data assume that future conditions will mirror those of the past. Where no relevant historical data are available, other methods such as fault-tree or event-tree analysis may be used to generate estimates.

Severity is normally measured in terms of the number of deaths or injuries, the value of property damage, or the cleanup costs and environmental impact, either as an average based on the experience of the company or industry over a certain time period or as a range. Other types of losses associated with accidents and incidents that are less easily measurable, such as damage to the company's reputation and degradation of the quality and timeliness of service to customers, should also be evaluated in assessing the severity of risks. Where quantitative probability and severity estimates cannot be derived due to a lack of relevant data, qualitative estimates based on expert judgment may be substituted.

Step 3 – Risk Evaluation

Evaluate and determine whether the associated risk is tolerable, tolerable with mitigation or unacceptable using a predetermined company risk classification methodology

Risk evaluation is the process of assessing the significance of risks and determining which risks are tolerable, tolerable with mitigation or unacceptable.

2. (f) risk control strategies;

Risk control strategies are required for risks that have been classified as unacceptable or tolerable with mitigation. In generic terms, these strategies can focus on

- *eliminating the situation, substance, condition or activity that generates the risk;*
- *reducing the probability of occurrence; or*
- *mitigating (reducing) the consequences.*

It is expected that railways will identify some or all of the risks included in the table on the following pages as unacceptable or tolerable with mitigation. This list is not exhaustive, but it is intended to exemplify common risks and typical control strategies and to indicate the process each railway company should undertake.

For existing operations, many of the risks will have already been considered and risk control strategies will form part of the railway's current rules, standards, procedures and operating practices. In this case, the risk assessment process would document this link and then focus on the results of accident and incident investigations, safety data analysis, complaint follow-up, inspections, and audits to ensure that the risk is being mitigated to an acceptable level. This analysis should point a railway company to areas where they could undertake initiatives beyond their current practices in an effort to improve their overall safety performance.

For new operations, or for changes to technology, staffing levels, types of operation or other areas where a railway company lacks historical data and experience, a formal risk management process as described in component 2(e) should almost always be undertaken.

The Safety Management System should include procedures for the development of the required strategies, approval at an appropriate management level and effective implementation. Employees and their organizations should be involved in the development of risk control strategies, particularly for risks that they have identified, and they should be informed of the actions that are being taken or that are planned.

Railways are expected to do a thorough analysis of both new operations and significant changes to existing operations. In the case of new equipment, systems, operations, practices and procedures where experience and a safety history are not available, formal analytical techniques should be applied. These techniques are more demanding in terms of data, time, effort and expertise; however, this extra effort is justified for new equipment, systems, operations, practices and procedures and should be considered a normal part of the process of implementing change.

Examples of significant changes requiring a risk assessment process include:

- 1. railway company mergers,*
- 2. major organizational transitions,*
- 3. the introduction of new technology (e.g., Light Emitting Diodes), and*
- 4. major operational changes (e.g., new commuter lines, speed changes).*

A complete analysis of existing operations is not required provided that current risk mitigation strategies are documented. Input from accident and incident investigation, safety performance data collection and analysis, and complaints, inspections and audits should be used to identify areas of existing operations that require a thorough analysis.

Part F – Requirements of Section 11 – *Railway Safety Act*

5.1 - Scope

Pursuant to section 11 of the *Railway Safety Act* “All the engineering work relating to railway works, including design, construction, evaluation or alteration, shall be done in accordance with sound engineering principles. A professional engineer shall take responsibility for the engineering work”.

5.2 - Engineering work related to Bridges

Engineering works includes but is not limited to:

- Preparing bridge design and specifications;
- Determining bridge load capacities;
- Developing construction, repair and modification procedures;
- Developing inspection and evaluation procedures;
- Reviewing bridge inspection reports and conducting safety evaluations;
- Evaluating proposed maintenance deferrals;
- Verifying that construction, repair and modification work is completed in accordance with design and specifications.

Section Analysis 5.2 – Engineering work related to Bridges

Professional engineers shall assume responsibility for maintenance and construction of bridges and should:

- *develop or adopt documented standards or drawings with procedures for the maintenance or construction of bridges, including requirements for items such as safety of bridges, the employees and the environment.*
- *maintain documented procedures to ensure that the maintenance and construction work is completed and carried out in accordance with standards and procedures.*
- *maintain documented procedures to ensure that maintenance and construction activities are not deferred without first being assessed, recorded and approved by a Railway Bridge Engineer.*
- *maintain documented bridge maintenance and construction procedures that establish the method and format to be used to record and document all bridge maintenance and construction.*
- *maintain records that identify, at a minimum, the bridge work carried out, the maintenance work undertaken (specific locations and items on the bridge), the date the work was undertaken, the name of the persons undertaking the maintenance work, the name of the Railway Bridge Engineer responsible for the maintenance and construction of bridges and all outstanding maintenance work yet to be completed. In addition all work done from engineered drawings should include an “as-built” revision to the drawings as may be required.*

Part G – Documentation, Records and Audit of BSMP

6.1 - Scope

Each railway authority’s BSMP should provide for the verification of the effectiveness of the program and the accuracy of the resulting information, including the validity of bridge inspection reports and bridge inventory data, and the correct application of movement restrictions to railway equipment of exceptional weight or configuration.

6.2 – Audits, General

A railway company shall¹⁸ implement and maintain procedures for periodic internal safety audits, reviews by management, monitoring and evaluations of its BSMP to determine whether it:

- a. Meets the requirements of this guideline;
- b. Has been properly implemented and maintained; and
- c. Is effective in continually reducing the risk associated with bridges.

Section Analysis 6.2 - Audits, General

From the “Railway Safety Management System Guide February 2001” (TP13548):

Part J) Safety Audit and Evaluation

2. (j) procedures for periodic internal safety audits, reviews by management, monitoring and evaluations of the safety management system;

Safety audits and evaluations of the Safety Management System are important mechanisms for ensuring that all of the organizational elements, functions and procedures in the Safety Management System are working well. Internal audits and evaluations are one of the key feedback loops for identifying required changes to the system.

The Safety Management System should include

- *periodic audits of the performance of the components of the organization’s Safety Management System, including audit frequencies, methodologies, responsibilities and reporting processes;*
- *audits by suitably qualified personnel who are impartial and objective;*

¹⁸ Section 2(J) of Safety Management System Regulations

- *use of recognized audit methodologies that include validation through interviews, random spot checks, etc.;*
- *audit reports that include recommendations for corrective action;*
- *reporting of audit results to senior management;*
- *retention of audit reports for review by Transport Canada;*
- *periodic evaluations of the Safety Management System to ensure the continued suitability, adequacy and effectiveness of the policy, annual safety targets, procedures and other components of the System, taking into account changing circumstances and the results of compliance evaluations, risk assessments, accident/incident investigations, safety performance analyses and audits;*
- *feedback gathered from employees and other relevant stakeholders; and*
- *consideration and approval of evaluation reports as well as the resulting recommendations by senior management.*

Audit and evaluation frequencies are expected to vary depending on the size and complexity of the railway, the risks involved, and the railway's safety performance history.

6.3 - Audits of Inspections

- a. Each railway authority's BSMP should incorporate provisions for an internal audit to determine whether the inspection provisions of the program are being followed, and whether the program itself is effectively providing for the continued safety of the subject bridges.
- b. The inspection audit should include an evaluation of a representative sampling of bridge inspection reports at the bridges noted on the reports to determine whether the reports accurately describe the conditions of the bridge.

Section Analysis 6.3 - Audits of Inspections

One of the most important indicators of the effectiveness of a BSMP is a comparison of recent bridge inspection reports against actual conditions found at the subject bridges. It is therefore important that the Railway Bridge Engineer, who evaluates the condition of the bridge based on the inspection report that he receives from the Railway Bridge Inspector, carry out an internal audit on his own on a yearly basis. This is fundamental to an effective audit of a BSMP. Therefore, in this section, it is proposed that each BSMP incorporate provisions for an internal audit to determine whether the inspection provisions of the BSMP are being followed, and whether the BSMP itself is effectively providing for the continued safety of the subject bridges. Additionally, the inspection audit should include an evaluation of a representative sampling of bridge inspection reports at the bridges noted on the reports to determine whether the reports accurately describe the condition of the bridge.

6.4 - Documents and Records

Each railway authority should document their BSMP and keep records under this part. The BSMP documents and records shall¹⁹ be made available to Transport Canada's Rail Safety Inspector, in Canada, upon request, as soon as reasonably practicable.

The railway authority should retain, where possible, pertinent drawings for as long as they are responsible for or own the bridge and inspection records as per Section 4.8 of this guideline.

When maintenance responsibilities for track and bridges are assigned to another railway company, it should be assigned or given access to pertinent bridge documents and drawings.

Section Analysis 6.4 - Documents and Records

Each railway authority should keep records (standards, procedures, drawings, inspection reports, evaluations, ratings, etc.) under this part and make those documents and records available for inspection and reproduction upon request as per section 28 of the Railway Safety Act. Access to the documents and records of the Bridge Safety Management Program is required for carrying out regulatory oversight.

6.5 - Electronic Record Keeping

(a) General

A railway authority should make it known to Transport Canada, upon request, whether they are maintaining paper or electronic records, or a combination thereof.

A railway authority may create and maintain any of the records required by this part through electronic transmission, storage, and retrieval provided that all the following conditions are met:

1. The system used to generate the electronic record meets all requirements of this subpart;
2. The electronically generated record contains the information required by this part;
3. The railway authority should train its employees who use the system on the proper use of the electronic record keeping system; and
4. The railway authority maintains an information technology security program adequate to ensure the integrity of the system, including the

¹⁹ Section 28 of the *Railway Safety Act*

prevention of unauthorized access to the program's logic or individual records.

(b) System security

Where applicable, the integrity of the bridge inspection records should be protected by a security system that incorporates a user identity and password, or a comparable method, to establish appropriate levels of program and record data access meeting all of the following:

1. No two individuals have the same electronic identity;
2. A record cannot be deleted or altered by any individual after the record is certified by the employee who created it;
3. Any amendment to a record is either:
 - i. Electronically stored apart from the record that it amends, or
 - ii. Electronically attached to the record as information without changing the original record.
4. Each amendment to a record uniquely identifies the person making the amendment; and
5. The electronic system provides for the maintenance of inspection records as originally submitted without corruption or loss of data.

Section Analysis 6.5 - Electronic Record Keeping

(a) and (b) TC proposes minimum requirements for electronic record-keeping provisions that a railway authority may elect to utilize to comply with the record-keeping provisions of this part.

For clarity, paragraph (a) provides that a railway authority express to TC beforehand whether or not it considers its record keeping system to be electronic. This will prevent any confusion or misunderstanding when reviewing records by TC as part of its regulatory activities. If electronic record keeping is in place, the provisions of this section will apply. If not, then TC will consider the railway authority to be maintaining paper-based records, which may be generated using a computer, when carrying out its activities. It is not expected that a railway authority will be changing from paper to electronic to paper, etc.