

## **APPENDIX C**

### **DIGITAL SYSTEMS**

**SPONSORED CONCESSION OF PUBLIC SERVICES FOR CONSTRUCTION, OPERATION,  
MAINTENANCE AND INVESTMENTS NECESSARY FOR THE EXPLORATION OF THE SANTOS-  
GUARUJÁ IMMERSSED TUNNEL**

## 1. INTRODUCTION

- 1.1. This APPENDIX outlines the digital systems and the respective details for their implementation and operation by the CONCESSIONAIRE, without prejudice to the provisions of the AGREEMENT and EXHIBITS.
- 1.2. For all the systems implemented, the future integration with the information systems of the REGULATORY AUTHORITY shall be considered, observing speed, secrecy, guarantee, integrity, reliability of information security, in terms aligned and updated with the best market practices; the REGULATORY AUTHORITY's approval is essential in all aspects of the provisions established herein.
  - 1.2.1. Annually, the CONCESSIONAIRE shall carry out an independent audit, with the submission of the respective report to the REGULATORY AUTHORITY, on the digital systems that involve the calculation of IQD or that are a source of information for the inspection carried out by the REGULATORY AUTHORITY. The audit shall be carried out by a specialized company previously approved by the REGULATORY AUTHORITY.
- 1.3. The digital systems shall comply with the following mandatory conditions:
  - (i) portal with access via web and/or mobile app at the discretion of the REGULATORY AUTHORITY, with user/password pairs made available to the REGULATORY AUTHORITY for consultation and eventual download of files and information, validation of information, registration of comments and upload of documents in formats defined by the REGULATORY AUTHORITY. User/password pairs may also be made available to the PMRv in order to facilitate the management of its competencies within the scope of the INTERCONNECTION SYSTEM;
  - (ii) export of 100% of the registered information to editable documents and standards and/or format defined by the REGULATORY AUTHORITY. The confidentiality of users' personal information shall be guaranteed, in accordance with legal parameters defined by the REGULATORY AUTHORITY;
  - (iii) integration with the REGULATORY AUTHORITY's electronic document and information systems for the same purposes;
  - (iv) systemic integration and data architecture aligned with the CCI and compatible with the technologies defined and adopted by the REGULATORY AUTHORITY, which supports all existing and future demands, should they occur;
  - (v) delivery and return, at the end of the AGREEMENT, of all digital content on high-capacity electronic media, as well as a backup of all data stored during the term of the agreement, including databases in current and performing formats, image banks, digital collections, historical collections, together with all technology transfer for the software developed;
  - (vi) approval from the REGULATORY AUTHORITY's technical area(s) for each module developed;
  - (vii) in case of systems development, the following shall be delivered: source codes, requirements documentation, as well as the functional and procedural workflow of all computerized systems implemented by the CONCESSIONAIRE or by third parties contracted by it, provided that the licenses applicable to the systems allow it;
  - (viii) for systems that depend on valid licenses, the CONCESSIONAIRE shall ensure at least two (2) years of licenses after the end of the AGREEMENT;
  - (ix) issuing management reports in spreadsheet format or another format defined by the REGULATORY AUTHORITY;
  - (x) exchange of information among the several systems, when applicable;

- (xi) integration of information with databases of BIM models of the CONCESSION, generated from the EXECUTIVE PROJECTS relating to expansion works, prepared by the CONCESSIONAIRE during the course of the AGREEMENT, as well as the models generated from the restitution work in BIM modeling, as provided for in the APPENDIX to EXHIBITS 5, 6 and 7;
  - (xii) integration and synchronization of information, whenever possible in real time, with SIGSIS – which should act as the main management system for CONCESSION information;
  - (xiii) basic registration linked to location information, including for purposes of registering elements, as well as research and consultation;
  - (xiv) full compatibility with the SIRGAS2000 coordinate system or any other that the REGULATORY AUTHORITY may adopt; and
  - (xv) coding mechanisms or similar to guarantee the personal data protection, for any purposes of consultation and extraction of summaries, in order to fully comply with the provisions of the General Data Protection Law – LGPD.
- 1.3.1. At its discretion, the CONCESSIONAIRE may propose the development of a single platform to meet the requirements provided in the NOTICE, provided that a modular development architecture is maintained (modules that are basically independent of each other for purposes of implementation and operation).
- 1.4. Notwithstanding the sharing of data and documents virtually, through SISPROJ, SISQUALI and SISSOND, the CONCESSIONAIRE shall respect the deadlines and file, if requested by the REGULATORY AUTHORITY, the deliveries in physical copies at the REGULATORY AUTHORITY for purposes of instrumentalizing the corresponding physical administrative processes.
- 1.5. Failure to comply with the requirements set out in this APPENDIX shall subject the CONCESSIONAIRE to the penalties set out in EXHIBIT 11.
- 1.6. Within one hundred and twenty (120) days of executing the AGREEMENT, the CONCESSIONAIRE shall present a detailed schedule for implementing and operating the systems, for approval by the REGULATORY AUTHORITY.
- 2. INTEGRATED DIGITAL SYSTEM FOR MANAGEMENT OF SOCIETY DEMANDS – SISDEMANDA**
- 2.1. In the first year of the CONCESSION, the CONCESSIONAIRE shall implement SISDEMANDA, which shall allow the receipt of automatic communications, consultation, downloading or files and information, as well as the registration of information, data and documents by the technical areas of the REGULATORY AUTHORITY. The system shall be able to store and manage the several requests and demands received from society and the various public participation bodies (Public Administration, Local Governments, Chambers, Associations, etc.).
- 2.2. A web portal and/or mobile app at the discretion of the REGULATORY AUTHORITY shall be in place, where the several sectors of society will be able to register their users and subsequently register their respective demands, by filling in a form, with fields pre-defined by the CONCESSIONAIRE jointly with the REGULATORY AUTHORITY – minimum information necessary for technical analysis of the requests and socio-economic justifications, including sending a preliminary project of the investment demanded and any proof of payment of analysis fees, when the REGULATORY AUTHORITY so defines.
- 2.3. On this portal, other USERS will also be able to consult requests previously registered by other USERS on the portal by consulting the location (route, type of investment requested, etc.) and, if necessary, also contribute to the same pre-existing request with the possibility of attaching

documents and justifications that corroborate the need to prioritize the investments requested at the location.

- 2.4. SISDEMANDA shall be able to synchronize basic information contained in the CONCESSIONAIRE's database on the sites under study, such as the current geometry of the road, the existence of safety features (barriers, footbridges, etc.), average daily volumes, peak hour volumes, accident rates, regional socio-economic growth rates (GDP, per capita income, population, etc.), as well as assigning weights to these elements, in accordance with rules pre-established by the REGULATORY AUTHORITY, in order to define technical priorities for the investments required. This system should include an option to correlate investment request locations with georeferencing for applications in GEO latitude and longitude system maps and SIGGIS. The REGULATORY AUTHORITY will define which information will be visible to the general public and which will only be visible to the REGULATORY AUTHORITY and the CONCESSIONAIRE.
- 2.5. SISDEMANDA shall also inform the user, at the time of registration, when the investment site requested is located outside the CONCESSIONAIRE's area of jurisdiction/administration. All management shall be carried out by the CONCESSIONAIRE and the stages of the process can be monitored by all USERS. Integration with the REGULATORY AUTHORITY's digital systems should be provided for the same purposes.
- 2.6. All third-party requests, as well as the inclusion of new investments not provided for in the POI and the details of the relevant activities, related to the functions specified in EXHIBIT 5, shall be registered and made available on SISDEMANDA, in accordance with the rules established in the AGREEMENT and, in particular, in accordance with the processing described in EXHIBIT 7, observing the rules applicable to ORDINARY REVISIONS.
- 2.7. SISDEMANDA should facilitate and instrumentalize the processing of ORDINARY REVISION and have an exclusive service channel for local authorities. The Digital Platform, which is not to be confused with the ombudsman's office and citizen service channels, should serve as the appropriate channel for authorities, USERS and other interested parties to submit suggestions for improvements and new investments, the implementation of which, if appropriate, should be included as an obligation of the CONCESSIONAIRE for the coming years of the AGREEMENT. The CONCESSIONAIRE shall ensure that the REGULATORY AGENCY has access to all the information necessary to properly understand each suggestion submitted via the Digital Platform.
- 2.8. The CONCESSIONAIRE shall comply with the specifications presented in this APPENDIX for the implementation of the SISDEMANDA Platform, through which it shall manage demands and, within one year prior to the ORDINARY REVISION, submit to the REGULATORY AUTHORITY, a document containing a compilation of investments, extensions and improvements, staggered in order of priority, for the improvement of the INTERCONNECTION SYSTEM (Consolidation of Demands for Ordinary Revision), together with the preliminary projects and/or related FUNCTIONAL PROJECTS that have been submitted and received by the CONCESSIONAIRE through SISDEMANDA and/or have already been prepared by the CONCESSIONAIRE itself.
- 2.8.1. The order presented in the Consolidation of Demands shall present the justifications for the need for the contractual modification that may arise from the demand received, as well as elements that demonstrate the advantage for the Administration and the interest of the USERS.

### **3. INTEGRATED DIGITAL PROJECT MANAGEMENT SYSTEM – SISPROJ**

- 3.1. In the first year of the CONCESSION, the CONCESSIONAIRE shall implement SISPROJ with web and/or mobile app access at the discretion of the REGULATORY AUTHORITY. The projects and BIM models shall be made available on the system with each delivery. Once available, the CONCESSIONAIRE will not be able to change versions in the system without proper registration and versioning control activated through an alert, warning, notice and/or acknowledgment workflow for registered users by the REGULATORY AUTHORITY. The coding standards (Work Id) for work/service items and project document coding in force and defined by the REGULATORY AUTHORITY shall be maintained.

- 3.2. For the execution of any services specified in EXHIBITS 5, 6 and 7, in which it is necessary to submit engineering projects, these shall be inserted into SISPROJ.

- 3.2.1. The CONCESSIONAIRE shall insert all the engineering projects previously submitted to the REGULATORY AUTHORITY within twelve (12) months of implementing SISPROJ.

#### **4. INTEGRATED DIGITAL SYSTEM FOR PROBING AND TESTING – SISSOND**

- 4.1. In the first year of the CONCESSION, the CONCESSIONAIRE shall implement SISSOND with web and/or mobile app access at the discretion of the REGULATORY AUTHORITY. The probing shall be updated in SISSOND with each probing carried out and validated by the CONCESSIONAIRE or third parties. It shall contain location information (georeferenced), a description of the layer horizons and their respective thicknesses and *Nspt* index, as well as water levels, rock occurrences and other relevant information. It should also include a module for recording the results of laboratory tests on the samples collected. It will allow for greater control, management and reliability of the information from probing used for geological mapping purposes, for design purposes and/or for investigating any geological/geotechnical irregularities.

#### **5. INTEGRATED DIGITAL MANAGEMENT SYSTEM FOR TECHNOLOGICAL CONTROL AND QUALITY OF WORKS – SISQUALI**

- 5.1. In the first year of the CONCESSION, the CONCESSIONAIRE shall implement SISQUALI in order to keep an updated record of the test results provided for in the applicable standards in force (REGULATORY AUTHORITY, ABNT and DER/SP), as well as processing this data through calculations using statistical procedures in order to demonstrate full compliance with the applicable standards and technical specifications in force. The works monitoring data shall be updated in SISQUALI online and in real time by the technical team responsible for quality control. It should be noted that the risks associated with the Quality Control of the works are the full responsibility of the CONCESSIONAIRE. Data integration shall be provided between SISPROJ and the Integrated BIM model for Construction Monitoring/As Built (MBIM-AB), as well as with SISGIS.
- 5.2. Without prejudice to the data and documents that will be available for digital access through SISQUALI, the CONCESSIONAIRE shall comply with the obligations to keep a physical copy signed by the company responsible for field control with the work documentation and, where applicable, to deliver and file physical copies of the documents, including for purposes of demonstrating compliance and calculating the relevant procedural deadlines.
- 5.3. The REGULATORY AUTHORITY reserves the right to issue recommendations and guidelines at any time, including for purposes of highlighting to the CONCESSIONAIRE the need for compliance with a given standard, which may also be done on the basis of information it has access to through SISQUALI.

#### **6. INTEGRATED DIGITAL GIS CONCESSION SYSTEM – SISGIS**

- 6.1. In the first year of the CONCESSION, the CONCESSIONAIRE shall implement SISGIS, which shall allow the receipt of automatic communications, downloading or files and information, as well as the registration of information, data and documents by the technical areas of the REGULATORY AUTHORITY. SISGIS shall have a robust interface capable of incorporating, integrating and managing, in georeferenced map layer format, all the information contained in the databases of the several digital systems provided for in the Concession, as well as relevant information contained in the BIM models generated throughout the CONCESSION and in the MDSR. SISGIS minimum characteristics:
- (i) be compatible with the SIRGAS2000 coordinate system or any other that the REGULATORY AUTHORITY may adopt
  - (ii) provide historical aerial images (satellite photos) with a minimum resolution of 10m on a weekly basis; and aerial images with a minimum resolution of 0.50m on a bimonthly basis,

as well as maintaining and managing these records (they shall be available for consultation and research by the REGULATORY AUTHORITY);

- (iii) provide, by default and from official or reliable sources, a digital map of the INTERCONNECTION SYSTEM, as well as the routes granted or not in the vicinity of the CONCESSION;
- (iv) be able to plot information from several databases on a map, based on geolocation information or approximate location, based on the physical reference of the INTERCONNECTION SYSTEM;
- (v) provide, from official or reliable sources, mapping (updated layers) of socio-economic data and indicators: population density; population growth, vehicle volumes; GDP, among others considered relevant for the analysis of society's demands, as well as the analysis of the feasibility of projects;
- (vi) provide, from official or reliable sources, mapping (updated layers) of land use and occupation data and indicators;
- (vii) provide, from official or reliable sources, mapping (updated layers) of data and historical records of climate indicators, such as: rainfall density (hourly, daily, weekly, monthly and annual); temperature (hourly, daily, weekly, monthly and annual) and hydrological data from the Santos Estuary;
- (viii) provide, from official or reliable sources, updated layers of geological maps and pedological maps;
- (ix) provide, from official or reliable sources, updated layers of topographic maps (land relief), accurate to 10 meters or more;
- (x) provide, from official or reliable sources, updated layers of river basin maps;
- (xi) enable real-time integration (automatic updating) with the databases of the CONCESSION's other digital systems, for example, with the databases of the SIR and SISATIVOS systems;
- (xii) enable navigation on an aerial map, aerial image and/or 'street view' (the latter by integrating data from the video-recording survey carried out by the Concessionaire and stored in the CRS database);
- (xiii) enable integration of information with the BIM models generated by the CONCESSION;
- (xiv) enable integration of information with the MDSR;
- (xv) visualization of the several pieces of information and maps mentioned above in a filterable layer format;
- (xvi) search by topographical coordinates or by address (lane, track, mileage);
- (xvii) the possibility of tracking images for overlay on an aerial map;
- (xviii) the possibility of importing and exporting vectorized lines to drawing software files;
- (xix) the possibility of developing a management interface for all the digital elements and systems of the CONCESSION for purposes of asset management and integrated operation, as well as visualization of several information in aerial map format;
- (xx) allow information to be shared with other public service providers such as the Highway Police, Fire Department, DER/SP, etc.



- (xxi) establish a procedure for indicating/mapping, registering in SISGIS and keeping an updated record of areas to be used as support for water supply (potential water reservoirs, available for use), as described in the Fire Fighting Service item in EXHIBIT 5;
  - (xxii) establish a communication plan, through SISGIS, including the possible provision of user/password pairs, or another alternative form (to be assessed by the REGULATORY AUTHORITY) for automatic communication of fire events and monitoring of the areas surrounding the CONCESSION via aerial photography or camera images to the competent authorities (fire department, CETESB, etc.); and
  - (xxiii) establish a procedure for registering fire incidents in SISGIS, in order to generate a database of critical events.
- 6.2. SISGIS will consist of a web interface (open GIS platform service or equivalent) that allows navigation on an aerial map and visualization/overlay and quick access to historical images collected and duly stored in databases. This platform shall also make it possible to browse and access the historical images of the video-recording surveys carried out by the CONCESSIONAIRE, in accordance with the obligation provided in EXHIBIT 6.
- 6.2.1. The data will be incorporated into the system used by the REGULATORY AUTHORITY by means of digital resolution. Thus, the primary database of the INTERCONNECTION SYSTEM will be obtained, including, but not limited to, graphic files (containing the spatial information registered) and tabular files (containing the attributes of each element registered).
- 6.2.2. The data from the monitoring of physical structures should be catalogued using files, which should already have the geographical address of the observed point, so that its entry in the database will already assume its link with the georeferenced graphic data. In the case of unregistered elements, GPS – Global Positioning System equipment shall be used to provide location data that is close enough to be perfectly defined.
- 6.2.3. The information corresponding to the georeferenced attributes, as well as the data from monitoring, will make up tables in the system database. Only these tables will have an index to link to the data stored in the graphic base, allowing double access to this data (access to attributes by consulting the graphic base and access to graphic elements by consulting the database).
- 6.3. During the first year of the CONCESSION, the CONCESSIONAIRE shall submit to the REGULATORY AUTHORITY for approval a publication schedule for the several layers of information relating to the CONCESSION prepared by the CONCESSIONAIRE, resulting from each of its contractual obligations. With each new piece of information included, the schedule shall be revised and sent to the REGULATORY AUTHORITY for information and approval. In this document, the CONCESSIONAIRE shall also provide what information will be visible to the several interested sectors: information for the general public, information for USERS of the INTERCONNECTION SYSTEM, information for public service providers, information for the REGULATORY AUTHORITY etc. The REGULATORY AUTHORITY reserves the right, at any time, to request the right to agree or request changes.
- 6.4. The REGULATORY AUTHORITY reserves the right, at any time, to request the registration and publication of new information in SISGIS, provided that this is within the scope of the CONCESSIONAIRE's contractual obligations. In this case, the CONCESSIONAIRE shall be provided with a period of time appropriate to the level of detail of the information requested. Once the CONCESSIONAIRE has given its consent, the agreed deadlines shall be met under penalty of the sanctions provided for in the AGREEMENT.
- 7. INTEGRATED DIGITAL CONSTRUCTION MONITORING SYSTEM – SISSOND**
- 7.1. In the first year of the CONCESSION, the CONCESSIONAIRE shall carry out the SISOBRA, in which it shall record, through a photographic register, the progress of each of the work fronts on the INTERCONNECTION SYSTEM, updated online and in real time, with at least one photo

per type of service/intervention. The photos shall contain information on time, date, location (georeferenced with latitude and longitude coordinates) and basic comments on the type of service carried out. The system shall have a tool for issuing reports. It should have filters for selecting a work item, type of intervention, date, location, etc.

## **8. INTEGRATED DIGITAL MANAGEMENT SYSTEM FOR CONSERVATION FUNCTIONS – SIGECON**

- 8.1. In the first year of the CONCESSION, the CONCESSIONAIRE shall implement SIGECON with web access for the REGULATORY AUTHORITY. User/password pairs shall be made available to the REGULATORY AUTHORITY for receiving automatic communications, consulting and downloading information by the REGULATORY AUTHORITY's technical areas.
- 8.2. SIGECON shall be able to store and manage routine conservation non-conformities found in the INTERCONNECTION SYSTEM, in accordance with the standards defined in this APPENDIX. The system shall be able to record and update photos and other relevant information (description, classification, date, location, etc.) of the non-conformities found in the INTERCONNECTION SYSTEM as and when it is taken over, with regard to compliance with the standards indicated in the routine conservation program. Both the CONCESSIONAIRE and the GRANTING AUTHORITY may update the "non-conformities" register.
- 8.3. The system shall also allow the CONCESSIONAIRE to record counter-evidence of the services carried out (upload photos and other relevant information). The photos shall contain information on time, date, location (georeferenced with latitude and longitude coordinates) and basic comments on the type of service carried out. The system shall have a tool for issuing reports. It should have filters for selecting type, class, date, time, location, etc. Integration with the REGULATORY AUTHORITY's digital systems should be provided for the same purposes.
- 8.4. SIGECON shall be able to record and account for the quantities of materials and services performed in a given period, in accordance with the coding standard described in this APPENDIX, the configuration of items contained in the TPU (DER/SP unit price table) or another standard that the REGULATORY AUTHORITY may define.

## **9. INTEGRATED DIGITAL ROAD INVENTORY REGISTRATION SYSTEM – SIR**

- 9.1. In the first year of the CONCESSION, the CONCESSIONAIRE shall carry out a web-based CRS for registering and updating the images and information collected in both conventional field surveys and video-recording surveys. The system should contain two modules: (1) an image viewing module and (2) a road inventory management module.
- 9.2. In the image viewing module, the system shall be able to synchronize the information recorded by the attributes when reproducing the images, as well as making it possible to search for images by kilometer reference. The functionalities to be offered by this system shall be similar, equivalent or higher than the DNIT's video library system (available at: <https://servicos.dnit.gov.br/videoteca>). For images collected with a drone and restituted 3D models, the system should include functionalities for 3D viewing of the elements and the possibility of checking the dimensions of the elements in the images;
- 9.3. In the road inventory management module, the system shall be able to keep an updated record of the inventoried road elements. Based on the registered data, the system should also be able to produce management reports consolidating and summarizing information according to the user's needs (for example: total length of grid barriers, number of signs by type, etc.).
- 9.4. The system should also be able to generate specific files for viewing the registered elements in specific mapping software (kmz, kml or equivalent files), as well as generate retigraphic diagrams representing registered elements along the road. Exporting the information registered in electronic spreadsheets shall be possible, as well as supplying, at the end of the AGREEMENT, high-capacity digital media, with a copy of all the files registered in standard electronic spreadsheet files. This system shall also be integrated with systems used by the REGULATORY AUTHORITY for the same purposes, as well as integration with the CCI.



**10. ELECTRONIC CONCESSION ASSET MANAGEMENT SYSTEM – SISATIVOS**

- 10.1. The CONCESSIONAIRE shall implement SISATIVOS, whose data shall be managed within SISGIS.
- 10.2. This system will have the function of keeping an updated database of all the assets (linear and non-linear) of the CONCESSION, as well as maintaining a history of maintenance, additions, deletions and modifications of such data.
- 10.3. Full integration between the SISATIVOS and MDSR databases should be in place, as and when the latter is implemented, so that data can be uploaded or consulted on both platforms or interfaces, i.e., certain information should be able to be consulted both from the MDSR and from the SISATIVOS system interface itself.
- 10.4. The data in the system shall be updated at least every six (6) months, except in the case of specific elements in which the REGULATORY AUTHORITY determines a different periodicity.
- 10.5. The CONCESSIONAIRE shall provide for the initial implementation of SISATIVOS in the first year of the CONCESSION. Any improvements may be implemented during the remaining years of the CONCESSION.

**11. PAVEMENT MANAGEMENT DIGITAL SYSTEM – SGP**

- 11.1. Within the first year of the CONCESSION, the CONCESSIONAIRE shall implement a SGP with web access. This system shall include at least the following modules/functions:
  - (i) geometric road network registration module – this module shall be able to keep the basic geometric registration of the INTERLINKING SYSTEM up to date in terms of nomenclature, mileage, length, number of tracks, number of traffic lanes, presence of shoulders;
  - (ii) traffic data registration module – the SGP should include a basic registration module for information relating to the road system's traffic data in VDM terms for purposes of design and/or characterization of the circulating fleet;
  - (iii) pavement structure registration module – this module should be able to keep an up-to-date register of existing and new pavement structures in terms of material characterization and thicknesses, as well as a register of drilling data and tests carried out on the respective materials;
  - (iv) works monitoring module and basic record of interventions carried out on the road system – this module should be able to keep an up-to-date record of the several interventions carried out on the pavement in the road segments throughout the CONCESSION, such as surface and deep repairs, partial and total reconstructions, implantations, etc. It should be able to illustrate the solutions applied to each section and lane using a retigraphic diagram. It also shall be able to record and account for the quantities of materials and services performed in a given period, in accordance with the coding standard and the configuration of items contained in the TPU (DER/SP unit price table). The interventions should be updated at the end of the day;
  - (v) module for recording quality index surveys – this module should be able to keep an up-to-date record of pavement quality index surveys carried out throughout the CONCESSION (periodic, extraordinary and project monitoring). The database shall be compatible with the one currently used by the DER/SP, so that it is possible to check the general state of the road network under any of the criteria of the control parameters. The system shall be able to identify and summarize any “gaps” (places on the registered network where surveys were not carried out or were carried out outside the standard set out in the notice and/or in current standards) so that the CONCESSIONAIRE can keep a record and inform/report to the REGULATORY AUTHORITY any problems that occurred

which made it impossible to obtain the survey data for that segment during the period of calculation (Concession year);

- (vi) individualized graphic control module for surface, deflection, comfort and safety parameters;
- (vii) module “single-line monitoring summary report (online)” – this module shall be developed in such a manner as to process the summary document of the annual pavement monitoring electronically and online, in accordance with the standards established by the REGULATORY AUTHORITY. The monitoring summary document consists of a diagram of the retigraphic type, which represents, in terms of segments, the traffic lanes (including shoulders) of the roads that make up the INTERCONNECTION SYSTEM, according to the standard pre-established by the REGULATORY AUTHORITY. After updating the data related to the annual pavement monitoring surveys, the system shall be able to determine the average values for each segment and traffic lane of the road network and classify, using a color legend, the places where the indices are classified as follows: good (green), fair (yellow) or poor (red), in accordance with the criteria established by the REGULATORY AUTHORITY. From then on, the CONCESSIONAIRE will inform the appropriate field of the solution to be applied and its respective completion date for each segment whose indices are outside the limits established in the AGREEMENT (repair period never exceeding ninety (90) days). Once this process has been completed, the CONCESSIONAIRE will submit this saved scenario via the web system for analysis and validation by the REGULATORY AUTHORITY, which will validate and/or request changes according to the needs detected, also via the system. A field should also be provided for the CONCESSIONAIRE to report on the progress of services on each critical section. Once the REGULATORY AUTHORITY has approved and validated the repair deadlines, it will be able to monitor the implementation of the proposed repair schedule in the system, and new changes to the surveys and/or deadlines set out in the repair schedule shall be submitted for further validation by the REGULATORY AUTHORITY;
- (viii) pavement performance model module – this module should be able to estimate, based on mathematical models established in the literature (HDM, MEPDG, etc.), the annual evolution of pavement quality indices over the remaining term of the CONCESSION, based on data updated annually in the SGP, and for pre-defined segments (normally considered to be the same as the homogeneous segments defined in the project). It should provide for the preparation of graphs and calculation of the remaining life of the segments, based on the limits established in the AGREEMENT for the quality indices;
- (ix) verification module for new pavement structure projects (reconstructions and expansions) – this module should be able to perform the verification calculation of the minimum thicknesses of the layers proposed for new pavement structures in a project, in accordance with the applicable standards in force, based on projected traffic data, updated test data, as well as other information relevant to the project provided by the USER (material specifications, finite element program outputs, etc.);
- (x) special maintenance project parameters verification and registration module – this module should be able to perform the verification calculation of the minimum reinforcement thickness to be applied to homogeneous segments of special pavement maintenance projects in accordance with the applicable standards in force and based on the most updated deflectometric survey of the system and projected traffic data, as well as other information relevant to the project provided by the USER (homogeneous project segments, deep repairs and planned reconstructions, etc.);
- (xi) paving service execution quality control module – this module shall keep an up-to-date record of the results of the tests carried out on site, in accordance with the standard contained in the applicable standards in force (ABNT, DER/SP and ARTESP), as well as processing this data through calculations using statistical procedures in order to verify full compliance with the applicable standards and technical specifications in force. The data should be updated in the SGP at the end of the day; and

- (xii) A module for determining the CONCESSION's performance indicators related to pavement indices.

- 11.2. These several modules shall collect information from each other for processing.
- 11.3. The system should include the possibility of integrating the SGP with the REGULATORY AUTHORITY's project management system in the future, so that the information registered and validated in the SGP regarding periodic surveys can automatically update the project documentation control system (pavement monitoring reports).
- 11.4. The CONCESSIONAIRE shall keep an updated record of the data relating to the pavement structure and traffic in the input format for the HDM-4 software and make it available annually to the REGULATORY AUTHORITY.

## **12. ELECTRONIC SYSTEM FOR MANAGING OAES AND FOOTBRIDGES – SISOAES**

- 12.1. The CONCESSIONAIRE shall implement SISOAES. The system shall provide web access. The CONCESSIONAIRE shall provide user/password pairs for use by the REGULATORY AUTHORITY.
- 12.2. Implementation shall be carried out in the first year of the CONCESSION and shall follow the rules provided for the other electronic management systems provided for in this APPENDIX.
- 12.3. The monitoring and management program shall be available and up to date. Its database should contain, as soon as the OAE and footbridge has been rehabilitated, reconnaissance photos of the pathologies and the respective therapies carried out and dated with the methodology and materials used.
- 12.4. The monitoring and management program shall also present the updated conditions with classifications of the structural, functional and durability aspects of the OAEs and footbridges, with electronic files containing the reports of the special inspections and projects that were used, including projects that may alter the original geometric records, such as widenings, extensions, installation of rigid fenders or replacement of OAEs and footbridges.
- 12.5. The database shall be updated with additional information on expansion and implementation works, geotechnical data and the mechanical properties of the materials making up the structures of these works, accidents and information on the passage of special loads.
- 12.6. The CONCESSIONAIRE shall always submit complete electronic files of the inspections of all the OAEs with photos, including those of repairs, identifying the services and dates.

## **13. ELECTRONIC RADAR DATA MANAGEMENT SYSTEM – SIS-RAD**

- 13.1. During the first year of the CONCESSION, the CONCESSIONAIRE shall provide an integrated digital system, through the web, for consulting the data collected by the radars (SIS-RAD).
- 13.2. User/password pairs shall be provided for consulting, searching and auditing information directly on the system – access to raw and consolidated speed and vehicle counts/volumes information.

## **14. ELECTRONIC ACCIDENT DATA MANAGEMENT SYSTEM – SIS-ACIDENTES**

- 14.1. The CONCESSIONAIRE shall provide the REGULATORY AUTHORITY with an accident database containing all accidents that have occurred on the INTERCONNECTION SYSTEM, with information on their nature, type of vehicle involved, time, consequences, georeferencing and other information, according to the model indicated by the REGULATORY AUTHORITY.
- 14.2. The accident database shall be made available by sending the data digitally from the OPERATION START DATE and sent to the REGULATING AUTHORITY's CCI online.

14.3. For this obligation, the CONCESSIONAIRE shall provide an integrated digital system, through the web, for consulting the accident data (SIS-ACIDENTES). User/password pairs shall be provided for consulting, searching and auditing information directly in the system – access to raw and consolidated accident information.

14.4. User/password pairs shall be provided for consulting, searching and auditing information directly in the system – access to raw and consolidated accident information.

## **15. EQUIPMENT ANALYSIS SYSTEM – SIS-EQP**

15.1. In the first year of the CONCESSION, the CONCESSIONAIRE shall put in place SIS-EQP, a central control system to be installed in the CCO, which will be responsible for managing the traffic sensors, PMV, CCTV and wireless user communication equipment, and have all the necessary resources to monitor the operation, with real-time consultation of the data collected by the equipment.

15.1.1. SIS-EQP shall enable equipment faults to be identified and alarms to be sent to operators.

15.2. SIS-EQP shall provide an integrated digital system, through the web for consulting the data collected by the equipment.

15.2.1. User/password pairs shall be provided for consulting, searching and auditing information directly in the system – access to raw and consolidated information on vehicle counts/classified volumes.

## **16. INTEGRATED DIGITAL ENVIRONMENTAL MANAGEMENT SYSTEM – SGA**

16.1. The CONCESSIONAIRE shall, within 24 (twenty-four) months of signing the INITIAL TRANSFER INSTRUMENT, implement an Integrated Management System, including an Environmental Management System in accordance with the requirements and guidelines of NBR ISO 14.001 and 14.004, and an Occupational Health and Safety System, in accordance with NBR ISO 45.001. Within this period, the Environmental Management System and the Occupational Health and Safety System shall be one hundred percent (100%) operational and ready for certification, with proof that the certifying company has been hired.

## **17. INTEGRATED DIGITAL NOTIFICATION SYSTEM – SISNOT**

17.1. The CONCESSIONAIRE shall, in the first year of the CONCESSION, implement a specific digital web-based system for managing information, data and documents related to penalties imposed by the REGULATORY AUTHORITY and the respective administrative procedures or processes initiated.

## **18. INTEGRATED DIGITAL SYSTEM FOR FREE AUTOMATIC GANTRY SYSTEM – SISFREEFLOW**

18.1. The CONCESSIONAIRE shall, within a maximum period of six (6) months prior to the OPERATION START DATE, implement and make available a specific digital web-based system for managing information, data and documents related to the operation of the GANTRY system.

18.2. This system will be responsible for automatically recording data on vehicle passages through each of the GANTRIES, as well as consolidating summaries of information according to standards defined by the REGULATORY AUTHORITY.

18.2.1. In principle, at least the following vehicle data should be collected and stored, without prejudice to additional data that may be requested by the REGULATORY AUTHORITY: (i) photographs of the front, rear, top and side views of the vehicle; (ii) automatic identification of the vehicle license plate; (iii) automatic identification of the vehicle color; (iv) vehicle model; (v) vehicle class; (vi) number of axles; (vii) tolling category;

- 18.2.2. In principle, the records that can be collected automatically cannot be deleted or changed; they may have additional fields for manual validation of the information collected;
- 18.2.3. In principle, the following summaries should be generated, without prejudice to others that may be required by the REGULATORY AUTHORITY: (i) monthly list and summary of all vehicles that have passed through the GANTRY and automatic payment via AVI has not been made, containing vehicle characteristics, number of axles, fare value, etc.; (ii) monthly list and summary of all vehicles that have passed through the GANTRY and evasion has been configured, containing vehicle characteristics, number of axles, fare value, etc.;
- 18.3. User/password pairs shall be provided for consulting, searching and auditing information directly in the system – access to raw and consolidated information on vehicle counts/classified volumes.
- 18.4. The system should also provide for possible integration with other databases, such as the SENATRAM database. In this case, the system should have a module where it will be possible to store the data from consulting these external databases, as well as a possible cross-checking of this data with that captured by the GANTRY to enable automatic validation or not of the information collected, to investigate possible fraud (cloned license plates, tampered license plates, among others), among other equally relevant purposes.
- 18.5. The REGULATORY AUTHORITY will audit the control software used to control and manage the transactions carried out on the GANTRY. For this purpose, the system to be implemented by the CONCESSIONAIRE should preferably have web access and update data in real time, with user/password pairs available for consultation by the REGULATORY AUTHORITY.
- 18.6. The CONCESSIONAIRE shall carry out an annual audit with an independent, reputable company and with notorious expertise and notify the REGULATORY AUTHORITY upon request, presenting the results or data on the progress of the audit. The audit with an independent company shall be carried out in such a way as to cover at least the following dimensions:
- (i) Sample audit of results: the audit should select, on a random sample basis, images of vehicles that have passed through the gantry during the year, and check whether the information contained in the database is correct (license plate, type of vehicle, number of axles; presence of AVI; etc.) or whether there are any inconsistencies in the registration. All the inconsistencies found should be noted and the percentage of error calculated for each element, as well as the overall percentage in relation to the total number of samples collected. Other non-gantry equipment can also be consulted to carry out the audit (images from CCTV cameras, among others). Detections of fraudulent behavior on the part of users shall also be reported (e.g. visibly tampered license plates, etc.) and accounted for in the statistics.
- 18.6.1. The reports resulting from the audits shall be made available to the REGULATORY AUTHORITY, by electronic means, preferably through the Concession SISPROJ.
- 18.7. The System shall also include a Telemetry System, meeting the basic and operational functionalities of the collection equipment with information made available on the GANTRIES.
- 19. MOBILITY CONTROL SYSTEM - SISMOB**
- 19.1. The CONCESSIONAIRE shall, within a maximum period of six (6) months prior to the OPERATION START DATE, implement and make available a specific digital web-based system for managing information, data and documents related to the operation of the system.



- 19.2. This system will be responsible for automatically recording data on vehicle passages at each of the OCR-recognition cameras at the Tunnel junctions, as well as consolidating summaries of information according to standards defined by the REGULATORY AUTHORITY.
- 19.2.1. In principle, at least the following vehicle data should be collected and stored, without prejudice to additional data that may be requested by the REGULATORY AUTHORITY: (i) photographs of the front and rear views of the vehicle and (ii) automatic identification of the vehicle's license plate.
- 19.2.2. In principle, the records that can be collected automatically cannot be deleted or changed; they may have additional fields for manual validation of the information collected;
- 19.2.3. In principle, the following summaries should be generated, without prejudice to others that may be required by the REGULATORY AUTHORITY: (i) monthly list of travel times per vehicle; (ii) minimum, average, maximum and 95<sup>th</sup> percentile value of travel time between the entry and exit points of the TUNNEL.
- 19.3. User/password pairs shall be provided for consulting, searching and auditing information directly in the system – access to raw and consolidated information on vehicle counts/classified volumes.
- 19.4. The System shall also include a Telemetry System, meeting the basic and operational functionalities defined by the REGULATORY AUTHORITY.

## **20. ELECTRONIC USER SERVICE SYSTEM – SIS-SAU**

- 20.1 The CONCESSIONAIRE shall, no later than six (6) months prior to the OPERATION START DATE, have the SIS-SAU, an electronic system that will monitor service times, from the moment the CCO becomes aware of the occurrence until the user support service (tow truck, APH and mechanical assistance) arrives at the scene of the event, using geopositioning data. Occurrences provided for in the technical specification in force during the month considered for inspection will be excluded.
- 20.2 SIS-SAU shall provide an integrated digital system, through the web for consulting the data collected.

## **21. ELECTRONIC SYSTEM FOR CALCULATING PERFORMANCE INDICATORS – SIS-CSP**

- 21.1 The CONCESSIONAIRE shall, no later than six (6) months prior to the OPERATION START DATE, put in place the SIS-CSP, an electronic system that will have the function of gathering and presenting to the REGULATORY AUTHORITY the scores for the indicators presented in EXHIBIT 3, integrating all the systems that are necessary for calculating the indicators.
- 21.2 SIS-CSP shall provide an integrated digital system, through the web for consulting the data collected.
- 21.3 The SIS-CSP shall be able to be fed by the REGULATORY AUTHORITY to include the measurement of indicators that can only be assessed manually.
- 21.4 Once the SIS-CSP has been fed by the REGULATORY AUTHORITY in the manner indicated in item 21.3, the SIS-CSP shall issue a CSP and IQD score, considering all the indicators, in accordance with EXHIBIT 3 and APPENDIX A.