

DRAFT TECHNICAL SPECIFICATIONS (PRELIMINARY DOCUMENT)

THE OFFICIAL DOCUMENT WILL BE PUBLISHED ON THE OFFICIAL PLATFORM (SICOP)

ENGINEERING SERVICES FOR SPECIALIZED ADVICE AND VALIDATION OF THE STRUCTURAL ANALYSIS OF THE ARCO DE CACHÍ DAM OF THE COSTA RICAN ELECTRICITY INSTITUTE

I. Background

An engineering service is required to perform the structural analysis of the Arco Cachí dam, which to date has 56 years of normal operation. To guarantee the safety of the dam for about 50 more years, it is intended to generate the evaluation of the structural performance of the Cachí dam under current conditions, specifically oriented to seismic conditions and overdraft during the design avenue. If the structural assessment indicates that an intervention is required, the repair proposals must be presented – at a general level – according to the shortcomings found. For this purpose, it is required to hire a company that provides the experts to advise and validate the analysis that the Costa Rican Electricity Institute (ICE) must develop.

Generally speaking, the Cachí Dam is a double-curvature arch dam, it has a maximum height of 78 m, a ridge width of 65m, so the height ridge length ratio is 0.83. Its thickness varies from 5.0m at the base to 2.28m at the ridge. The dam was built in the period 1963 to 1967. The basin has an area of 919 km², with a reservoir area of 3.24 km² and a gross storage capacity of 51 E6 m³.

Structurally, the Cachí Dam is defined as a vaulted dam, thin, double curvature, with accentuated vertical collapse in order to achieve a maximum stabilizing effect with the vertical component of the hydrostatic pressure. It is a symmetrical vault, with arches of 3 centers, having greater radii in the area of the stirrups. The horizontal sections of the dam (arches) are defined, upstream and downstream, by arcs of circumference of three centers, with greater radii in the areas of the stirrups. This type of work allows a greater use of concrete, achieving thicknesses of only 2.28 m in the area near the ridge and 5.0 m at the base of the central area.

The following figures and photographs show details of the vault of the Cachí dam.



Figure2. Photographs of Presa Cachí. Rear, front and air.

II. Requirements

It requires the hiring of a company with vast experience in the design, analysis and evaluation of arc dams. The Cachí dam has the following characteristics: double arch, built in vibrated and reinforced concrete, with a post-tension system in its crown and has been in operation for about 56 years. This company must provide technical advice for ICE to generate analyses and conclusions regarding the current state of the dam.

It is required that the company through its knowledge and experience validate the results obtained by the ICE in the analysis and diagnosis, ensure that the analyzes were carried out according to international standards and that the final results reflect, as faithfully as possible, the real behavior of the dam in the operating and seismic conditions.

For the analyses, one or more models are required, which must include the interaction dam-rock massif-reservoir, the behavior of the joints and the effect of the post-tension on dam crest. The software used must be SAP2000 or alternatively MIDAS GTSNX. The Contractor must define the recommendations for generating and calibrating the model.

The contracted company must define all the terrain movement design parameters required in the analyses, according to the state of the art and adjusted to the international standards of earthquake-resistant design defined to date for related structures. In addition, it must generate a procedure that allows evaluating the structural state of the post-tension system at the crest of the dam and its level of participation in seismic loads. In addition to field testing, it is required, using forced vibration at the dam crest to estimate the actual oscillation modes of the dam.

III. Activities to be carried out by the Contractor

- Review the general information regarding the following topics: topographic, geological, hydrogeological, hydrological, hydraulic, seismological and geotechnical of the dam site that ICE has prepared.
- Make a visit to Costa Rica, in order to observe the environmental conditions of the dam and check its current state of conservation and its post-tension system.
- Generate recommendations, based on their observations and experience, that allow evaluating through field tests or other technology, the state of the post-tension system in dam crest and its level of participation in seismic loads.
- Generate with your equipment, technology and pre-established methodologies, physical studies to estimate at least the first 7 real oscillation modes of the dam. Since the dam already has more than 56 years of service, it is considered appropriate to have forced vibration tests. With the results of these studies, the structural model can be calibrated and in the future, through a new forced vibration test, it could be evaluated if the dam has modified its structural behavior. To meet the objective, a sufficient number of motion sensors must be installed at strategic points to define the deformations of the dam at these points in an appropriate way and obtain the oscillation modes necessary for an adequate structural analysis.

- It should propose an International Seismic Design Standard that may be applicable to Arc Dams (NIDSPA). It must state that the Seismic Threat Study presented by ICE conforms to theseismological procedures in accordance with that Standard. If necessary, it must generate recommendations to adjust the Seismic Threat study prepared by ICE.
- Based on international standards of related structures and its experience, it must define the Performance Parameters that the arch dam must meet.
- Based on international standards, it must advise ICE on the definition of the Erraine Measurement Design Parameters required in the analyses. Based on the results of the analyses and the Performance Parameters, define whether the dam is safe, or failing that, estimate the current level of risk presented by the dam.
- Generate recommendations for modeling the arc dam using SAP2000 or MIDAS GTSNX software. It is necessary to generate the premises of the structural model of the dam and its strategy to consider: the boundary conditions due to the effect of the stirrups, the inelastic behavior in the joints (caused by the posttension system) and the interaction dam-rock massif-reservoir. Recommendations for calibrating the model must be defined. At least two methodologies for seismic analysis should be developed: Dynamic Spectral Method and History analysis over time. The advisability of developing non-linear gasket opening analyses using SAP2000 or MIDAS GTSNX should be discussed.
- Define methodologies to evaluate the stability of the slope restricted to the area of the massifs in the dam-foundation contact.
- Define the instrumentation system of the dam that allows to establish early warning signals.
- Generate intervention proposals. If required, proposals for intervention actions in the dam should be proposed. For this stage, the design is not requested, only a range of optimal options must be established, depending on the structural deficiencies estimated in the analyses.
- Make five reports based on the stages of study, stages that will be described later in this report. Each report must present the recommendations, observations, and technical references that the Contractor has generated for each stage.
- Be available to respond to inquiries by ICE remotely, throughout the execution of the contract.
- Validate the final results obtained from the modeling carried out by the ICE and make recommendations aimed at improving the safety of the work and its auscultation.
- The fifth report (final report of the work) must be presented to a group of ICE engineers, by videoconference that will be recorded.

IV. Mandatory eligibility requirements

The following table shows the mandatory requirements that bidders must meet. A tender that does not comply with these conditions will be excluded from the evaluation and award process. The tender shall include the relevant documents supporting and demonstrating compliance with these requirements, with their respective reference or contact.

The offer must provide 2 certificates of good execution of contracts made in the last 10 years.

TABLE 1. Mandatory minimum criteria and requirements.

Criteria	Minimum requirements mandatory
1. Overall company experience	The company must be legally incorporated at least 15 years ago. You must have carried out the design or evaluation on at least 2 arch dams over 70 m high in the last 15 years.
2. Experience and academic training of the professionals (Work Team) offered for the analysis object of the contract (if for any justified reason, the awarded company requests a change for any of its members, it must formally communicate it and demonstrate that the proposed official has a profile equal to or superior to the initial official, this will be subject to approval by ice).	<p>a) Specialist 1 Specialist in post-tension systems:</p> <p>You must have a minimum academic degree of Civil Engineer or Bachelor of Civil Engineering.</p> <p>Must have participated or advised the design or analysis of aftervoltage systems in at least 2 works of hydroelectric projects with post-voltage systems in the last 15 years. In the last 15 years, he must have participated in at least one dam with a postension system. The maximum horizontal ground design acceleration for the Safety Evaluation Earthquake (SEE) of at least one of these dams must be equal to or greater than 0.15g.</p> <p>b) Specialist 2 Specialist in numerical modeling with SAP2000 or alternatively MIDAS GTSNX</p> <p>You must have a minimum academic degree of Civil Engineer or Bachelor of Civil Engineering.</p> <p>You must have performed numerical modeling with the SAP2000 or MIDAS GTSNX program on at least 3 concrete dams in the last 15 years; of those dams, at least one must be arc prey. The maximum horizontal ground design acceleration for the Safety Evaluation Earthquake (SEE) of at least one of these dams must be equal to or greater than 0.15g.</p> <p>c) Specialist 3 Specialist in the definition of seismic action on arc dams</p> <p>You must have a minimum academic degree of Doctorate in Civil Engineering or Geological Engineering or Geotechnical Engineering or Seismological Engineering.</p>

Must have actively participated or advised the definition of seismic action (Parameters of Ground Movement), also defining design earthquakes, in at least 3 concrete dams in the last 15 years. The maximum horizontal ground design acceleration for the Safety Evaluation Earthquake (SEE) of at least one of these dams must be equal to or greater than 0.15g.

d) Specialist 4
Specialist in auscultation or
Instrumentation of concrete dams

You must have a minimum academic degree of Bachelor of Civil Engineering or Geotechnical Engineering.

You must have defined or supervised auscultation systems on at least 3 concrete dams in the last 15 years. The maximum horizontal ground design acceleration for the Safety Evaluation Earthquake (SEE) of at least one of these dams must be equal to or greater than 0.15g.

e) Specialist 5
Specialist in Geotechnics or Geology

You must have a minimum academic degree of Bachelor of Civil Engineering or Geotechnical Engineering.

Must have participated or advised the design or evaluation of foundations in at least 2 concrete dams in the last 15 years, The maximum acceleration of horizontal soil design for the Safety Evaluation Earthquake (SEE) of at least one of these dams must be equal to or greater than 0.15g.

f) Specialist 6
Specialist in Structural Analysis and
Diagnosis of Arco dams

	<p>You must have a minimum academic degree of Doctorate in Civil Engineering.</p> <p>Must have participated or advised the Analysis and Diagnosis of arc dams, in at least 3 arc dams in the last 15 years. The maximum horizontal ground design acceleration for the Safety Evaluation Earthquake (SEE) of at least one of these dams must be equal to or greater than 0.15g.</p> <p>g) Specialist 7 Specialist in Dynamic Characterization by Forced Vibration Tests of Arc Dams</p> <p>You must have a minimum academic degree of Doctorate in Civil Engineering.</p> <p>You must have participated in Dynamic Characterization by Forced Vibration Testing of Dams on at least 3 arc dams in the last 15 years. The maximum horizontal ground design acceleration for the Safety Evaluation Earthquake (SEE) of at least one of these dams must be equal to or greater than 0.15g.</p> <p>The Work Team may be made up of a number of professionals ranging from 7 to no less than four.</p> <p>All seven functions must be covered by the Task Force.</p> <p>It is required that at least one of the specialists in: Postension, Seismic Action, Geotechnics, Structural Diagnosis, Forced Vibrations; have a PhD degree.</p> <p>The Task Force must have the knowledge, experience and attestations requested for the 7 specialists indicated in this table.</p>
<p>3. Software available in the company</p>	<p>The company must have the SAP2000 finite element program version 20 at least and also with the corresponding license. Alternativamente MIDAS GTSNX.</p>

Along with the offer, the attestations must be presented for each specialist where the information requested in the previous table is specified. For each specialist the following breakdown should be included:

- Full name.
- Academic degree (Attach copy of title).
- List in chronological order of works in which he has participated as an expert specifying the functions he performed. Mention the reports, tests and designs of dams with their main characteristics such as: country, dimensions, volume and customers.

V. Scope of services required

In the **First Stage**, the Contractor must make a visit to Costa Rica, with a dedication of 5 working days. Before the first visit, you should review the information prepared by ICE about the dam and environmental data. It must generate recommendations that allow defining the structural state of the after-voltage system.

The Contractor must recommend an international standard that allows establishing the design parameters of the Erraine Movement, including the selection of seismic signals to be used in dynamic analysis. It is important to add that the ICE has an Estudy of Amenaza Sísmica, which will be available to specialists. The Contractor, based on its experience, must provide seismic signals from other sites, to be used in the analysis of stories over time. Ice's seismology department will participate in the process of selecting the seismic records to be used.

Define the premises and the detailed description that allows the ICE to elaborate the Basic Structural Model of the dam considering the solid-dam interaction using the SAP2000 software or alternatively MIDAS GTSNX. This Basic Structural Model only considers the structural elements that make up the dam-foundation system and the static loads, defining for stage 3 the application of dynamic loads.

In the **Second Stage**, the Contractor will carry out a Forced Vibration test on the structure of the Cachí dam. You must provide the necessary equipment and transportation. The equipment must be complete, for the execution of the test and the collection of data, with sufficient sensors located at strategic points of the dam defined according to their experience. The installation of all equipment and sensors is at the expense of the Contractor. It must include mathematical processing and modeling with the software and hardware it deems appropriate in such a way that it estimates at least the first 7 modes of oscillation of the dam, and present the results of the tests and mathematical modeling in a report with its conclusions. It is understood that this stage is due to a turnkey contracting scheme.

For the **Third Stage**, the Contractor will present a proposal that allows the ICE to generate the final numerical models that it must develop with the SAP2000 or alternatively MIDAS GTSNX, considering through different calculation methodologies the dynamic effects of the dam-foundation-reservoir system. Methods must be defined to enable their models to be calibrated. Performance parameters must be defined and the processed results of forced vibration field tests presented, defining the methods of the dam's real scilation.

The **Fourth Stage** will aim to establish the estimated service status of the dam, based on the execution of the dynamic analyses, which must be endorsed by the Contractor whomay request some additional analysis. Also, together with the ICE staff, it will define the final recommendations of the work aimed at improving the safety of the dams or even their intervention. This will include recommendations regarding the auscultation of the work.

VI. Program of work

Next, the ICE proposes the following basic list of the activities subject to this contract, however, it is clarified that the Contractor may propose a different list according to its experience. The Contractor shall, within a period not exceeding one month of notification of the contract, propose a work program to achieve the objectives set.

Before the first visit to the country, the Contractor must review the general information regarding the following topics: topographical, geological, hydrogeological, hydrological, hydraulic, seismological and geotechnical of the dam site that ICE has prepared.

STAGE 1:

Evaluate the post-tension system, generate the basic model in SAP2000 or alternatively MIDAS GTSNX, define the design parameters of the Ground Movement and estimate the Modes of Real Oscillation of dam.

The Contractor shall carry out the following activities:

- Visit the Cachí dam including the post-tension system on the dam crest.
- Generate recommendations, based on their observations and experience, that allow evaluating through field tests or other technology, the state of the post-tension system in dam crest and its level of participation in seismic loads.
- With its equipment and technologies, forced vibration analysis to be carried out to estimate the actual oscillation modes of the Cachí dam according to the work programme referred to in point VI.
- Verify that the Seismic Threat Study presented by ICE conforms to the requirements of a recognized international standard, which allows defining the design parameters of the Terrain Movements. If necessary, you must generate the adjustment indications.
- Present a description of the recommended methodology to evaluate the structural performance of the dam when subjected to static and dynamic loads.
- Define all the aspects that cannot be conclusive due to the limitations of SAP2000 or MIDAS GTSNX and based on these inconclusive aspects, define the level of uncertainty that will be reached in the evaluation of the service status of the dam.
- Define the premises and the detailed description that allows the ICE to elaborate the structural model of the dam considering the solid-dam-reservoir interaction using the SAP2000 or MIDAS GTSNX software. The detailed description must include at least the following aspects: maximum and minimum number of SOLID or Shell elements to be used in the dam model and its foundation; indications to include vertical joints and post-tension systems; description of the elements to consider the post-tension system on the crest of the dam; zoning of the elements that allow considering the hydrostatic and hydrodynamic loads; definition of the mechanical properties that describe the elements of the dam and its foundation; dimensions that define the periphery of the foundation, indications of the boundary conditions. The basic model should include only static loads.
- Issue recommendations in relation to the types of analysis to be carried out, for the different seismic scenarios: unusual and extreme that consider the action of the Operating Basis Earthquake (OBE) and Safety Evaluation Earthquake (SEE) respectively.

- Define methodologies to evaluate the support conditions imposed by the lateral abutments and assess the stability of the slope and stirrup on both banks of the dam. It should be noted that the Cachí dam rests on the left bank on a pillar of the pourer (concretor reinforced) while on the right bank it rests on a pillar against the hillside.

Depending on the instructions of the Contractor, at the end of Stage 1, the ICE may:

- Define the Ground Movement Design Parameters, namely: elastic and inelastic design spectra, seismic signals, seismic coefficients, etc.
- Generate the basic models with the SAP2000 or MIDAS GTSNX, which include only static loads.
- Compare the oscillation modes of the sap2000 or MIDAS GTSNX basic models with the actual oscillation modes defined in the forced oscillation tests.
- Establish a procedure to evaluate the state of the post-tension system at the crest of the dam that includes the activities and field tests required for this purpose.
- Define the necessary information and methodology to evaluate the stability of the slopes and stirrups of the dam.

Stage 2

Test and analysis of Forced Vibration, in the structure of the Cachí dam.

The Contractor must generate a work program specifying:

- Execution times and activities.
- Contractor personnel required in Costa Rica for field testing.
- Equipment that the Contractor must transfer to Costa Rica.

It is clarified that the ICE will not provide: transport, cranes or tools, since this item of the service is considered as "turnkey".

The Contractor is responsible for:

- Provide the necessary equipment to carry out the forced vibration test in the Cachí dam, which must be transported to the dam premises, in particular eccentric mass vibrator, cable systems, data acquisition units, computers for the processing of data and results and others that are required.
- Perform forced vibration tests, including assembly and disassembly of equipment, testing and compilation of specific elements.
- The total transport of all test equipment, so it must include all the planning that allows transport from the country of origin to the Cachí dam and then its return and repatriation. It must also include all the temporary installation processes that will be carried out at the dam to carry out the tests. At least 15 instruments must be installed to define deformations during vibration tests.
- The processing of the results of the forced vibration test and interpretation through mathematical modelling of the dynamic behaviour of the dam, using calculation programmes developed by the contractor. At least the first 7 modes of oscillation of the dam must be estimated.
- Have the switches or adapters that allow the connection that the ICE will provide and that is available according to the electrical standards of Costa Rica (Three-phase power supply 240 V, frequency 60Hz, depending on the consumption of the equipment, the Contractor will be responsible for the electrical sub-minister if it exceeds 50 Amp).

ICE will be responsible for:

- Ensure access to work areas.
- Provide a place of storage of equipment in a site near the dam (*).
- Facilitate drill rigs on dam crest to fix the oscillator and equipment to mobilize the oscillator over the crest of the dam.
- Ensure direct primary energy.

(*) The location of the site is:

Province: 03 Cartago, Canton: 02 Paraíso, District: 04 Cachí

Postal code: 30204

The location available for the storage of the equipment: Left Bank Cachí Dam, at the top of the Landfill, location that is outdoors, there is no roof or cellar, there is space for the Contractor to install a small standard container 6m long by 2.4m wide.

This is located about 500m from the crest of the dam.

Stage 3:**Develop the Final Model, define performance evaluation parameters and verify the Real Oscillation Modes of the Cachí dam.**

This stage will begin once ICE approves the STAGE 1 reports.

ICE generates the adjusted models, model characteristics, calibration process and static analysis results using SAP2000 or MIDAS GTSNX.

The Contractor shall carry out the following activities:

- Describe the advantages and functions of forced vibration studies, based on the results of the structural analysis; commenting also on their function during the monitoring of the behavior of the dam during the life of the dam in case of repetition of the forced vibration tests.
- Compare the Real Oscillation Modes with the Theoretical Oscillation Modes of the Cachí dam. Discuss the repercussions regarding the similarities and differences found. Propose adjustments to the models according to the oscillation modes, such as calibrating the elastic modules.
- Present the recommendations for assigning the seismic action to be used in the analysis stage, specifically in the methodology to define the design spectra (elastic and inelastic) and the seismic acceleration records for two levels of seismic action, Operating Basis Earthquake (OBE) and Safety Evaluation Earthquake (SEE).
- Review the SAP2000 or MIDAS GTSNX models and results presented by ICE.
- Issue the assessment and recommendations for improvement of the SAP2000 or MIDAS GTSNX Models.
- Generate recommendations for post-processing of analysis results.
- Define the parameters for evaluating the structural performance of the Cachí dam, based on its experience and international regulations of related works. Performance criteria must meet, but not be limited to: permissible stress, permissible deformations, maximum permissible opening of joints and safety factors.

Depending on the instructions of The Contractor, at the end of this Stage 3, ICE may:

- Generate the elastic and inelastic models with SAP2000 or MIDAS GTSNX adjusted according to the indications of The Contractor.
- Compare the oscillation modes of the SAP2000 or MIDAS GTSNX models with the actual oscillation modes defined in the forced oscillation tests
- Verify the stability of the slopes and ensure that it meets the requirements (support conditions) estimated in the dam models.

Stage 4:**Establish the service status and auscultation system; if necessary, generate recommendations for intervention.**

This stage will begin once ICE approves the STAGE 2 and 3 report.

The ICE will generate a presentation to the Contractor using tables and graphs that show the post-processing of the results of the static and dynamic analysis of the SAP2000 or MIDAS GTSNX models. It will provide the SAP2000 or MIDAS GTSNX files of the final models.

The Contractor shall carry out the following activities:

- Review the static and dynamic models of the SAP2000 or MIDAS GTSNX and results of the post-processing of the analyses.
- Issue the assessment and recommendations of these analyses.
- Once the results of the calculation are validated, it performs a joint work session so that, based on the results obtained, establish the service state of the dam for static and dynamic scenarios.
- In the event that the results indicate that the work does not satisfactorily comply with an adequate state of service, the Contractor must present recommendations for additional analysis, for example, analysis that allows taking into account the non-linear behavior of the materials (concrete and rocky massif).
- If necessary, generate general recommendations and graphic schemes, which must be implemented to improve the service status of the dam or even its structural intervention.
- Develop details and technical specifications of the equipment of the new auscultation system that will be installed in the dam body.

Depending on the instructions of The Contractor, at the end of Stage 4, ICE may:

- Evaluate the state of service of the dam in conjunction with the Consultancy.
- Diagnose whether or not the dam complies with international standards and recommendations for arc dams.
- At all stages the Advice will be available to remotely clarify the doubts that arise. A report will be delivered at the end of each Stage 1, 2, 3 and 4, and a fifth Final Report.

At all stages the Contractor will be available to remotely clarify any doubts that arise. A report will be delivered at the end of each Stage.

The fifth report corresponds to the Final Report of the work, so it should include all the topics discussed in the previous stages. This last report must be presented to a group of ICE engineers, by videoconference that will be recorded. The original file of your presentation (not the PDF of your images) will be delivered to ICE as part of the contract.

It is the obligation of the Contractor that the entire work team is available to carry out work sessions remotely, during the time that ICE deems necessary. The offer must consider a minimum of 150 "Consultation Hours" to specialists remotely. In case of exceeding these hours, the surplus will be paid according to the breakdown of costs indicated in Table 2 with the ruble "Consultation Hours".

ICE Work Schedule

It is clarified that the ICE has a work schedule from Monday to Friday from 7 in the morning to 16.5 hours, so, during the visit made by the Contractor to Costa Rica, it must adjust to this schedule, therefore, the Contractor should not consider in its work program the days SATURDAY, SUNDAY and holidays by law, neither to THE STAFF NOR THE FACILITIES OF ICE.

VII. Expected products

The Contractor shall deliver the following products:

- Work program where the proposed activities to achieve the objectives set and the resources to be used will be indicated.
- Report 1, corresponding to the end of Stage 1.
- Report 2, corresponding to a preliminary report of forced vibration tests (Stage 2).
- Report 3, corresponding to a final report of the forced vibration tests (Stage 2).
- Report 4, corresponding to the end of Stage 3.
- Report 5, corresponding to the end of Stage 4.
- Final Report including in summary form the relevant topics of the 4 previous stages.

VIII. Confidentiality clause

The Contractor shall enter into a confidentiality agreement where it undertakes not to disclose or use the information provided by ICE in studies that are part of the scope of this contract. The results and recommendations arising from the analyses carried out may not be disclosed.

IX. Other Responsibilities with the Contractor

An offer may be submitted that is made up of a consortium of two or more companies, but this consortium must be indicated in the offer, associating in Table 1 each specialist with the company to which it belongs. Once the offer has been submitted, no part of the services object of this contract may be subcontracted, nor will it assign, or in any other way dispose of or dispose of in whole or in part, the rights and obligations arising from this contract. Excluded from this clause are activities related to the transport, handling and installation of all equipment required to perform forced vibration tests.

During the visit to Costa Rica, the Trips Hotel – ICE building DIPOA – Hotel will be made at the expense of the Contractor, as well as the trips from the airport to the hotel and from the hotel to the airport. Transportation of technical equipment between San Jose and the dam site will be provided by ICE.

The Contractor shall have the appropriate means to accept videoconferencing.

During your visit to Costa Rica, The Contractor staff must have a risk policy that protects you from accidents on the trip.

X. Quality control

The quality control of the execution of the services, including periodic reviews of the progress, will be verified by the Administrator of the Contract assigned by the ICE, who will have all the power to review that the deadlines, reports, results and other conditions of this contract are being fully complied with.

XI. Cost breakdown

This contract includes two different professional services. The first concerns the monitoring and validation of the analyses. The second oriented to estimate the real oscillation modes of the dam, using the forced vibration methodology. The first service may require an additional adjustment in cost, for an extension in the hours of consultations. In the second service, the Contractor is responsible for the logistics associated with the activities associated with mobilizing the equipment to Costa Rica. In order to consider these differences in the contract and given that in Costa Rica 25% is paid in taxes only in remittances, not in reimbursable expenses, the following tables are required, which allow defining the total cost of the contract, considering these details.

1. Costs for Stages 1, 3 and 4.

1.1 Professional Fees

These costs should already include administrative expenses, company profits and Costa Rican taxes on remittances (25%).

Table 2. Costs for professional fees

Task	Unit cost (USD)	Quantity	Total cost (USD)
Cost in preparing reports and analyses (1)		unitary	
"Consultation Hours" (2)		150 hours (estimated)	
Visit fees, 5 business days in C.R. (3)		unitary	
Professional Fees			

(1) Cost in preparing reports and analysis, which represents a single cost in the contract, so it can not be adjusted during the execution of the works. This cost does not include the cost in the visit to Costa Rica. The cost should include:

- The time spent generating specific indications and recommendations to generate the analyses and diagnosis. In addition, in generating the conclusions to the ICE engineers responsible for the analyses. It also includes the reports with their submissions for the final report.
- Review of all documentation that ICE sends to the Contractor in Stage 1.

(2) "Consultation Hours" refers to the hours that the Contractor will use in the specific attention of the consultations made by the ICE professionals in charge of the analyzes. The 150 hours

corresponds to an estimate, so this amount may be adjusted to what is consumed in the execution of the contract. This period includes specific meetings, as well as the time used by the Contractor to develop the corresponding responses.

(3) It must include only the total cost for the fees of the technical team that will make the visit to Costa Rica. It should not include other costs such as tickets, hotels, per diems, etc.

1.2 Reimbursable expenses

The estimated reimbursable expenses in the execution of the service consider only the expenses that will actually be incurred during the visit to Costa Rica. ICE will cancel these expenses against invoices submitted by the Contractor.

Table 3. Reimbursable expenses

Concept	Unit cost (USD)	Quantity	Total cost (USD)
Airfare			
Hotels and travel expenses			
Transport			
Insurance			
Reimbursable Expenses			

(*) Reimbursable expenses do not apply to the payment of Costa Rican taxes for remittances.

2. Costs for Stages 2 (Forced Vibration Analysis).

These costs should only include the total costs required to generate the entire forced vibration study. By effect of payment of tax must be divided into two payment items:

- "Technical and Professional Services", which must include, but not be limited to the costs of professional services in all analyses, technicians responsible for the logistics, installation and application of the tests.
- "Expenses in mobilizing and installing equipment", which must include, but not be limited to, necessary expenses in insurance, customs taxes, mobilizing and installing the equipment, etc.

Table 4. Costs for estimating vibration modes

Concept	Cost (USD)
"Technical and professional services" (*)	
"Expenses in mobilizing and installing equipment s"	
Total amount of the requested service	

(*) The cost includes administrative expenses, company profits and costa rican taxes is in the form of remittances (25%).

3. Total Contract Costs

Table 5. Total contract costs and expenses

Task	Total cost (USD)
"Professional Fees" (1)	
Total reimbursable expenses (2)	
"Technical and Professional Services" (1)	
"Expenses in mobilizing and installing equipment s" (2)	
Other (1)	
Total contract amount	

(1) The cost includes administrative expenses, company profits and Costa Rican taxes on remittances (25%).

(2) The cost should not consider Costa Rican taxes.

For the comparison of the offers, only two items will be taken into account: "Professional Fees" and "Technical and Professional Services".

CONTRACTUAL CONDITIONS

I. Runtime

The contractor's visit to Costa Rica must be made within a maximum period of 1 month from the notification of the request by ICE. The total duration of the service will be extended for an approximate period of 10 to 18 months.

II. Place where the service will be developed

El Contractor's visit will take place at ICE's Engineering and Construction offices, which include visits to the Cachí dam site. Physical tests of forced vibration on dam crest should be performed at the Cachí dam site. The rest of the service corresponds to the attention of queries remotely that the Consultancy will provide.

III. Method and method of payment

A bank transfer will be made, 30 days after the acceptance of the respective invoice.

Payments will be made against progress, attending the following payment lines:

- Fees for working days in Costa Rica for specialized advice and follow-up
- Hourly fees for remote consultations by electronic means with specialists
- Fees for analysis of the information to be provided by ICE and for the preparation of reports
- Costs of transporting equipment used in Forced Vibration Tests
- Recognition of costs incurred in the visits.

The reimbursable expenses (tickets, lodging, taxi, food, etc.) generated in each visit to Costa Rica will be recognized without withholdings against presentation of the invoices.

The flow of payments will be made as follows:

TECHNICAL ACCOMPANIMENT.

- Payments corresponding to Costs for "Professional Fees" will be paid according to the cost indicated in Table 2. The first payment corresponds to 35% of, which will be paid at the end of STAGE 1. At the end of STAGE 2 it will be 20%, at the end of STAGE 3 the payment will be 20%, at the end of STAGE 4 a payment of 15% will be made and with the acceptance of the Final Report a last payment for 10% of said item.
- Along with the payments of the fees of Stage 1, the payment of the invoices of reimbursable expenses of visit 1, indicated in Table 3, will also be made.
- In the event that there is an extension in the "Consultation Time", these will be recognized and quantified according to the unit values presented as "Consultation Hours" indicated in Table 2. A monthly control of the "Consultation Time" must be kept and sent at the end of each month, for review by ICE.

ESTIMATION OF OSCILLATION MODES

- The reimbursement of the reimbursable costs related to the shipment of the forced vibration test equipment will be made in two moments: one corresponding to 100% (one hundred percent) of the shipping costs with the arrival of all the equipment at the Cachi Dam, as well as the team of specialists for the realization of the test and, another, 100% (one hundred percent) of the shipping costs with the arrival or repatriation of all the equipment. These payments will be made based on the expenses indicated as "reimbursable expenses in mobilizing and installing equipment" in Table 4.
- Payment for professional fees (specific in forced vibration tests) will be made at two times. 50% with the delivery of the partial results of the tests and the remaining 50% with the approval of the forced vibration report. These payments will be made based on the expenses indicated as "Cost of testing, includes professional services" in Table 4.

Two weeks after the completion of each Stage, the Contractor will submit a draft report, as well as a report of remote consultation hours for ICE to review and comment. No later than ten business days after receipt of the draft and report, ICE will return them with comments for the specialist to integrate (if applicable) and send the final signed report and report. At that time, the report and the time report can be approved, and the specialist can present the invoice for ICE to manage the payment.

It is clarified that the government of Costa Rica makes a withholding tax on remittances of 25%. This tax applies only to fees and not to reimbursable expenses (Cost per trip, shipment of equipment etc.).

Any company that wants to sell goods and services to the government of Costa Rica has to comply with the procedures of the Integrated System of Public Procurement of the Government of Costa Rica, a system called SICOP (more information in <https://www.sicop.go.cr/>).

IV. Receipt in accordance with the progress made

The contractor's compliant receipt and the requested validation will be given once the following has been achieved:

- Compliance with the proposed activities has been verified
- Each of the requested reports (5 reports) has been accepted to satisfaction.

Once the Contractor has submitted the corresponding report, ICE will have a period of 30 calendar days to provide the receipt of the contract or make the corresponding claim. In case of not pronouncing within the indicated period, the service will be considered accepted and the corresponding payment will be made.

Failure to comply with any of the elements indicated will cause ICE not to give the receipt of the entire service.