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Technical Specification for SAFE Platform Annual Software Maintenance with Developments for 2 years:

1. Overview and Introduction of Ed-Tech Platforms Implemented at IIT Bombay

IIT Bombay (IITB), set up by an Act of Parliament, was established in 1958 at Powai, a northern suburb of Mumbai. Today, the Institute is recognized as one of the centers of academic excellence in the country. The Department of Computer Science and Engineering (CSE) within IIT Bombay is a top-ranking CSE department in the country. Many faculty members within the CSE department and some from the outside wish to create a large-scale education outreach effort in the domain of Computer Science. Towards this, a few ed-tech (educational technology) platforms that have been developed in-house at IIT Bombay need to be enhanced and maintained. The objective is to use these platforms to conduct courses at scale, including Artificial Intelligence technology. The ed-tech platforms implemented at IIT Bombay include:

1. BodhiTree: A Learning Management System
2. cLab: A Platform for conducting Labs
3. SqrePage: A platform for saving questions and exporting them as question papers
4. SAFE: Smart Authenticated Fast Exams

SAFE is already compatible with other platforms as outlined below:

1. SAFE quizzes can be consumed on the Bodhitree platform.
2. Quizzes can also be generated from the SqrePage platform and consumed by SAFE
3. The SAFE quiz format is a standard for all the other existing ed-tech platforms.

The SAFE app plays a crucial role in modern classroom settings, supporting various academic activities such as quizzes, attendance tracking, and exams. It offers multiple exam-conduct modes, enabling rapid assessments with near-instant result generation.

The current technology stack for SAFE is as follows:

Server-side: Django and Python, VueJS

Client-side Mobile App: Android, Java, Kotlin, iOS: Swift

1. More details (including architecture and technology stack used) can be found in section [3. SAFE Platform Details:](#)

2. SAFE Platform Annual Software Maintenance Services with Developments

The CSE Dept Ed-Tech R&D group is seeking a partner to take over the software development and maintenance of the SAFE(Smart Authenticated Fast Exams) application with the goal of transforming the prototype into an industry-grade platform. This is essential for the suite of education technology platforms mentioned above, especially SqrPage. The selected partner will be responsible for implementing systematic software development and testing processes, ensuring a seamless user experience, optimizing performance, and maintaining a reliable, largely bug-free system that can scale effectively. Given SAFE's critical role in classroom settings – supporting quizzes, attendance, and various exam modes, including rapid assessments with near-instant results, it is essential that the platform meets high standards of reliability and efficiency.

3. SAFE Platform Details:

(Please write to br@cse.iitb.ac.in if you require any further information on the platforms.)

SAFE (Smart Authenticated Fast Exams) is a secure, scalable, and feature-rich platform designed to facilitate objective exams, classroom assessments, and surveys while ensuring a paper-free, proxy-free, and cheating-free experience.

With SAFE, institutions can automate attendance, conduct quizzes effortlessly, streamline subjective exam corrections, and enhance engagement through quick feedback mechanisms.

SAFE's robust tools for question creation, real-time monitoring, automated grading, and post-exam analysis make it ideal for academic and professional use.

Among the other education technology platforms in our suite above, SAFE interacts closest with SqrPage, as SqrPage generates the questions for the exam to be conducted on the SAFE platform.

3.1 Features of SAFE in Details

A. Question Types & Flexibility

1. Supports multiple question formats:
 - I. Integer, String, and Real Number Answers
 - II. Multiple Choice (Single/Multiple Correct)
 - III. Manual Answer Submission (Handwritten answers via photo upload)
2. Supports math equations and embedded images in questions.
3. Allows explanation text for answers (not auto-evaluated).

B. Exam Administration & Monitoring

1. Real-Time Dashboard for Exam Authorities:
 - I. Print exam papers and partial candidate submissions as PDFs.
 - II. Monitor candidate status: logged in, attempting, finished.
 - III. Security alerts for potential cheating attempts.
2. Security & Customization Options:
 3. Configurable exam duration and marks per question.
 4. Optional negative marking and visual password for high-security exams.
 5. Randomization of question and option order to prevent cheating.
 6. Question modules for structured question sets.
 7. Option to allow candidates to view marks at the end of the exam.

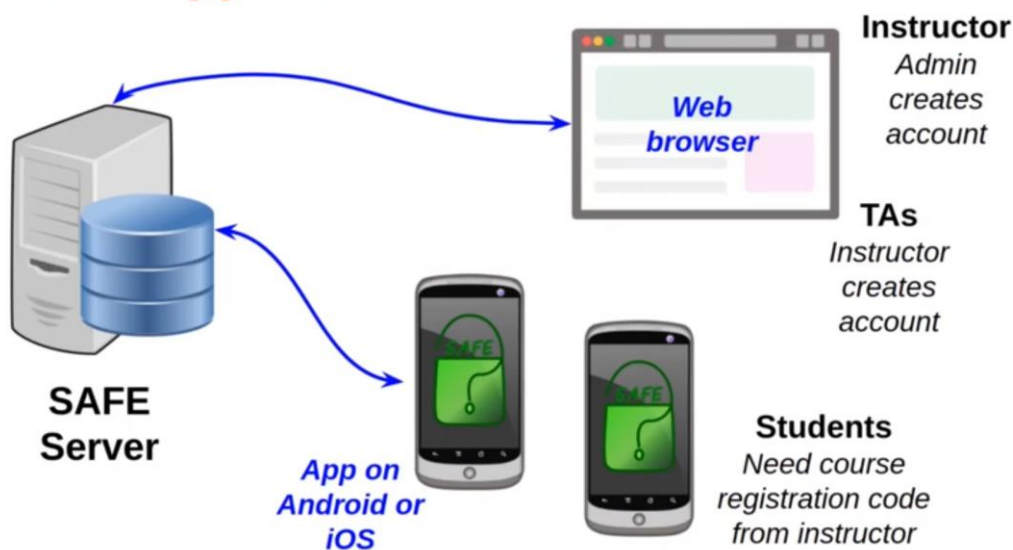
C. Post-Exam Evaluation & Analysis

1. Supports multiple marks download per candidate and per question.
2. Answer key modification with re-evaluation support.
3. Manual grading support for subjective answers.
4. Statistics & graphical analysis for objective questions.
5. Detailed logs for post-exam review and auditing.

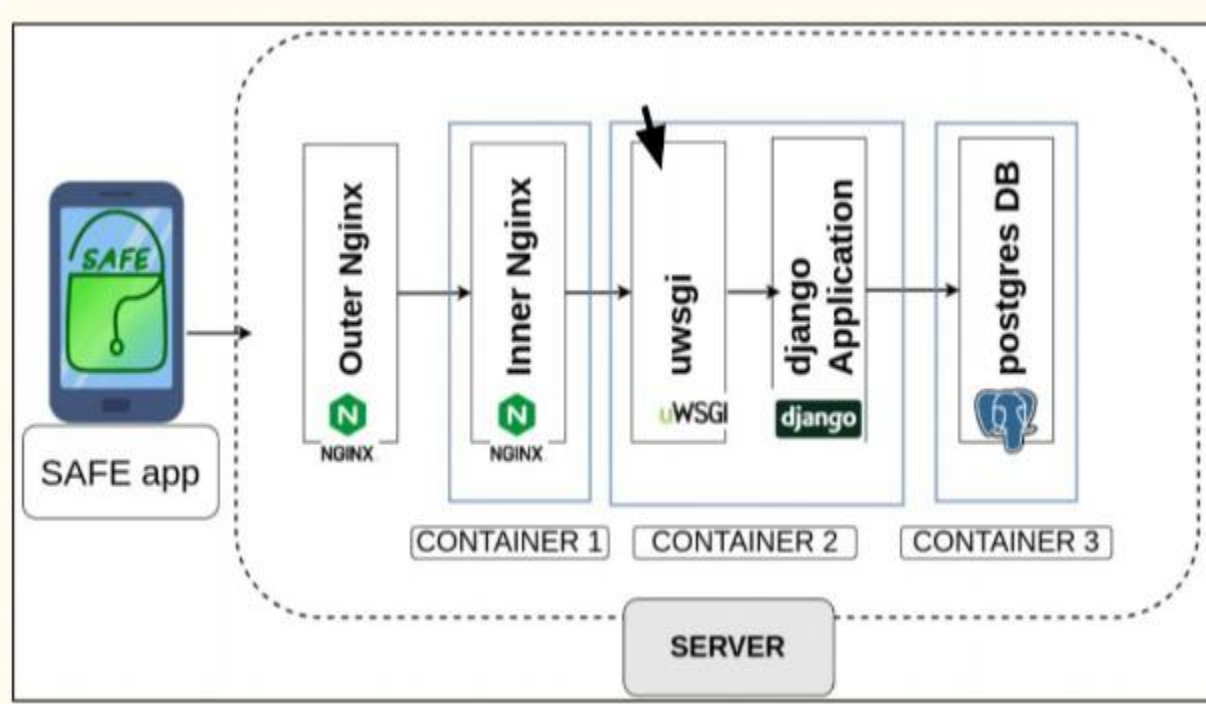
SAFE ensures secure, authenticated, and fast examination experiences while providing powerful administrative tools to enhance efficiency, maintain integrity, and enable insightful post-exam analytics.

3.1.1 SAFE Application and Server Communication

SAFE: App and Server



3.1.2 SAFE Architecture



1. SAFE is built on a robust microservices-style architecture using Django and Django REST Framework (DRF) as the core backend for handling API requests.
2. It leverages uWSGI as the application server, interfacing with Nginx for reverse proxying, load balancing, and static file handling.
3. Tornado is used for handling asynchronous WebSocket connections, enabling real-time communication.
4. Redis acts as an in-memory data store and message broker for Celery, which manages background tasks and asynchronous job execution.
5. PostgreSQL serves as the primary relational database, providing scalable and reliable data storage.
6. The platform is containerized using Docker, ensuring consistent deployment across environments and easier scalability.
7. This stack ensures high performance, scalability, and efficient handling of concurrent requests.
8. SAFE enables secure, paper-free, and cheating-free objective exams, quick attendance marking, instant short quizzes, and seamless online evaluation of subjective exams.

3.1.3 Stable Versions of SAFE

The current production version of the SAFE server uses Python version 3.9, Django version 4.2.9, and VueJS version 2.5.22. It also uses the Postgres database version 14.10, celery version 5.3.6, and Redis version 5.0.1. It is set up using nginx version 1.27.0, uwsgi version 2.0.23, and tornado version 5.0.

The current production version of the SAFE Android app supports the Android minimum version of SDK 34. To compile, it uses Gradle version 8.9, and JDK version 17.

The current production version of the SAFE iOS app supports iOS minimum version of 18 and uses XCode version 16.2 to compile.

SAFE has been used extensively within IIT Bombay to run many courses each semester. However, it requires polishing in terms of UI for user-friendliness, ensuring everything is working correctly without any known bugs, ensuring acceptable performance and scalability to a few thousand users, and completing a few pending features and adding new features.

As part of the tender, the details of expected development, maintenance, and operations for SAFE are given in [4 Scope of Work](#).

The SAFE Youtube Playlist for the demo purpose is available at: tinyurl.com/safeytpl

3.2 SqrePage and SAFE Common Functionality

Smart Question Repository and Paper Generator (SqrePage) is a platform for storing questions in Question Banks, which can later be used to generate Question Papers for tests. SqrePage supports features for manually adding questions into the Question Banks(QB) using the web interface or uploading question files in particular templates. It supports different types of questions and tagging questions with difficulty level, topic-wise. Questions can be filtered according to different parameters as well. In SqrePage, the users can generate question papers either manually or automatically in multiple formats such as PDF, Docx, ODT, SAFE HTML, and SAFE ODT formats. It also supports peer collaboration, where users can share question banks and papers with others in various access modes (view, comment, and edit).

4. Scope of Work

The nature of work to be carried out by the resources provided by the vendor is broadly along the lines given below.

4.1 Development Work:

This is an **approximate** plan of work for two years. Note, this is not set in stone, some later work may be prioritized and brought forward. Some new work may be added and some current work dropped as per what transpires during our use of the platforms in the next 2 years. We expect the below work to take up resources as mentioned in [4.3 Resource Allocation Plan for 2 years](#). When assigning work, we will respect and conform to this allocation plan.

Table 1: Development Work

<p>Year1: First half</p> <p>Admin interface workflow in SAFE server - add/deactivate accounts, account usage tracking, usage limits, payment gateway integration. The admin interface, usage limits, and payment interface must integrate smoothly with the SqrPage functionality in the suite of education technologies. Upgrading the SAFE server software to the latest LTS of Django and Python framework. Android code cleanup, removal of dead code. Upgrade Android support to the latest SDK 35 and JDK 23. Reinforce support for desktop-browser based client for SAFE quizzes.</p>
<p>Year1: Second half</p> <p>Revival and completion of an automated testing framework on the server side (selenium), revival and completion of a testing framework on the Android side (Appium). Server-side testing to include testing of integration functionalities with SqrPage.</p>
<p>Year2: First half</p> <p>Performance fixes in the SAFE server, Android/iOS code cleanup, app-side logging framework, and corresponding checking scripts at the server.</p>
<p>Year 2: Second Half</p> <p>Tie up all pending work, and implement some new features based on feedback obtained from field usage.</p> <p>Moving to an integrated framework like Flutter for the app side</p>

4.2 Application Support Maintenance for SAFE:

The vendor should provide exhaustive functional and technical support, troubleshooting, problem resolution, maintenance, and upgrade services for the SAFE platform.

The vendor will be responsible for configuring, managing, and maintaining all systems (Development, Testing, Quality, Production). Each platform can have multiple “production” server instances catering to different user needs (Max instances SAFE server: 3, SAFE Android App: 2, SAFE IOS App: 2). Instances can run on physical servers within IITB premises or on the cloud. Maintenance has to be done accordingly.

Table 2: Application Support Maintenance for SAFE

Platform	Activity	Details
SAFE Platform,	Installation	1. Instances have to be setup on physical

Platform	Activity	Details
SAFE Apps: Android and IOS	Installation	<ol style="list-style-type: none"> 1. Instances have to be setup on physical servers or the cloud 2. Installation should be cost-effective and scale with user load 3. Customization of the landing page per instance may also be needed
SAFE Platform	System backup	<ol style="list-style-type: none"> 1. Monitor and validate backup of files/database/code on a daily basis. 2. Maintain an audit trail of configuration, backup, and restore tasks 3. Run quarterly drills to restore, recover, and test data from the backup system 4. Raise alerts for failures.
SAFE Platform	System health-check	<ol style="list-style-type: none"> 1. All instances should run properly with very little downtime. 2. Track health and performance metrics of each instance of the platform. Alert relevant personnel for immediate action if systems/components are down. 3. Example metrics to track <ol style="list-style-type: none"> I. Individual Container running status II. CPU usage III. Memory consumption IV. Storage V. Storage I/O rates VI. Physical temperatures of servers VII. Network capacity VIII. User activity levels

Platform and Apps	Error logging	<ol style="list-style-type: none"> 1. Errors should be clearly and elaborately recorded in the Error Log file of the system 2. The following details are to be shared in the error log report <ol style="list-style-type: none"> I. Timestamp: The exact date and time the event occurred II. Source: where the error occurred. III. Level: Severity IV. Message: Descriptive text that provides details about the event. V. Context: Additional data that can help in diagnosing the issue. VI. Action: Troubleshooting and resolution plan VII. Status: Resolved or Pending
Platform and Apps	Security	<ol style="list-style-type: none"> 1. Ensure server certificates are all up to date 2. Monitor and apply the latest security patches in all components/libraries being used 3. Do twice-a-year security audit to ensure best security practices of frameworks are being followed in the code
Platform and Apps	Customer Support	<ol style="list-style-type: none"> 1. As customers use these platforms, any technical issues (e.g., forgot password, unable to upload a file, incorrect marks, unable to install the app, unable to login, etc) have to be addressed via appropriate channels such as email, WhatsApp, phone, teams/meet etc. Setup of such channels is also part of the vendor's job.
Platform and Apps	Bug fixes	<p>Issues/ errors/ bugs in a solution (implemented or developed as part of this contract) should be taken up for troubleshooting and resolution.</p>

Platform and Apps	Documentation	<ol style="list-style-type: none"> 1. User manuals for customers 2. Architecture/Workflow documentations 3. Standard Operating Procedures 4. Proper code/API documentation, best practices employed 5. Quarterly reports on work done, root-cause analysis of issues faced, corrective actions taken, pitfalls to avoid, suggestions for improvement, etc.
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4.2.1 As part of the above, the following apply on top of what was covered as part of the [Service Level Agreement \(SLA\)](#)

- A. IIT Bombay & the vendor will meet weekly to monitor the work and plan timelines for proposed tasks which will be maintained in an issue-tracking platform (e.g., Jira or Github). The vendor will do adequate testing and due diligence before marking a task as done. IIT Bombay will verify and reopen tasks as needed.
- B. The vendor should provide contact numbers, email addresses, and an escalation matrix of a dedicated support team to ensure urgent problems are resolved according to Service Level Agreements. IIT Bombay shall be kept informed well in advance in case of any changes in the contact details.
- C. The vendor should maintain source code versions and track carefully configurations being used across various instances.
- D. The vendor should provide and maintain coding standards and quality control to ensure coding readability, performance and sustainability.
- E. The vendor should ensure that all software modifications and upgrades are deployed carefully after proper testing. And post this monitored carefully for smooth running without any loss in performance or usability.
- F. The vendor should begin and end each upgrade effort within the timeframes established as part of discussions and issue priority resolution.
- G. The vendor should make proper resource arrangements to ensure support continuity during holiday seasons.

4.3 Resource Allocation Plan for 2 years

The following is an indicative Resource Allocation Plan to help the vendor allocate and propose specific named resources for the project. This provides a timetable of how the named resources mentioned above will be deployed over the next two years across two major work profiles:

- A. Annual Maintenance Service
- B. One-time development

Table 3: Resource allocation for One-time development for two years

	Team Members	Working Days	Person Months for every month [P]	Total Person Months [T = 24 * P]	Total Person Days [D = 22 * T]
1	Project Manager with Full Stack Development Experience	1 day/week	0.2	4.8	105.6
2	Development Operations (DevOps)	half day every 3 days/week	0.3	7.2	154.8
3	Developer Backend	3 days/week	0.6	14.4	316.8
4	Developer Android/iOS	3 days/week	0.6	14.4	316.8

Table 4: Resource allocation plan for AMS

	Team Members	Working Days	Person Months for every month [P]	Total Person Months [T = 24 * P]	Total Person Days [D = 22 * T]
1	Project Manager with Full Stack Development Experience	1 day/week	0.2	4.8	105.6
2	Development Operations (DevOps)	half day every 3 days/week	0.3	7.2	158.4
3	Developer Backend	2 days/week	0.4	9.6	211.2
4	Developer Frontend	2 days/week	0.4	9.6	211.2

The Commercial Bid Value will be a sum of the costs (over a period of two years) effective from the date of the Purchase Order.

5. Service Level Agreement (SLA)

5.1 SLA Definitions and Compliance Clauses

A. IIT Bombay Working Hours

The normal working hours of service are Monday to Friday, 8.30 AM to 6 PM. The Institute holiday calendar is published on the website of IIT Bombay, which may be revised from time to time as per Government notices.

B. Resources on Payroll

All the team members assigned on this contract must be named and on the payroll of the vendor during the contract period.

C. Incident/Issue Reporting

IIT Bombay will make all efforts to report all incidents/issues as early as possible, and/or through other means of written communication. The issue priority (P1, P2, P3, P4) is defined in the Issue Priority-Resolution table [5.2 Issue Priority and Resolution Matrix](#).

D. Availability of Resources

a. Project Manager

- i. Must be available on-site (IIT Bombay, Powai, Mumbai) for one day a week
- ii. Must submit a monthly status review report
- iii. Must be available for meetings in the Design phase, Monthly Review, and Quarterly Resource Planning meetings

b. Design phase

- i. The resource team is required to be present on-site during the requirement gathering and solution-designing phase.

c. Review meetings

- i. Daily online standups (of less than 30 mins) between Resources and the IIT Bombay team
- ii. Monthly online sprint reviews of the progress and future timeline planning

d. Quarterly Resource Planning

- i. Every quarter, the IIT Bombay team and the Vendor will jointly plan the deliverables for that quarter.
- ii. The Program Manager and the entire team should be present on-site for these meetings

E. Response Time from the Resources

Response time refers to the maximum time the support team takes to

- a) acknowledge an issue reported to the DevOps Manager
- b) provide a probable immediate/root cause,

c) an estimate of the issue resolution time.
Response time should be adhered to as per details provided in [5.2 Issue Priority and Resolution Matrix](#)

F. Availability for the task

This refers to the duration the resources must be available to resolve an issue. See table [5.2 Issue Priority and Resolution Matrix](#) for issue-specific details.

G. Performance Metric

A quarterly performance evaluation will be carried out for all the Resources in the project. The performance of a team member will be quantified using rubrics on the following criteria

- a. Response time
- b. Availability for task
- c. Attending review meetings
- d. On-site availability as per plan
- e. Quality of solution and documentation
- f. Adherence to project timelines and scheduled resolution time
- g. Workplace ethics

H. Absence (short i.e. less than 10 days) of Resources

Intimation about short planned absences must be through the Project Manager (PM). In case the PM is on short absence, an alternate PM must be provided.

I. Replacement of Resources

The vendor must reasonably ensure that the resources assigned to this project must be maintained for the entire duration of the contract. IIT Bombay reserves the right to request the replacement of resources at any time on the basis of performance or any other justifiable reason. In the event any proposed team member is not available to work on this project (due to long leave absence, attrition, or planned exit), the vendor shall provide a list of alternate resources (within one week of notification) of the same or higher qualification, experience, and capability, from which IIT Bombay can choose a suitable replacement. There should be at least one week of overlap between the outgoing and the incoming resources for knowledge transfer.

J. High-priority issues in case of Resource Absence

For incidents/issues of Emergency (P1) or High (P2) priority, the vendor must ensure that the issue is attended by appropriate alternate resources in the event of absence of the named resources.

K. Sub-letting of the O&M AMS contract

The clauses related to the Termination of contract/ Black-listing shall be invoked in case the vendor sublets/ subcontracts the

AMS services to any third party without explicit permission from IIT Bombay. IIT Bombay reserves the right in deciding whether any kind of subletting would be permitted for any of the aspects of the AMS Contract.

L. Deficit of service availability

Members of the Vendors team are expected to be available for planned meetings and to act on the issues as per agreed time table, that may be jointly revised by IIT Bombay and the Vendor from time to time. Any deficit in the availability, due to a planned absence, unplanned absence, incompetence or non-cooperation to carry out the tasks as per the Issue Priority-Resolution Matrix given below, will be quantified and recorded as a deficit in availability. This deficit will be adjusted against services rendered as per the planned resource availability or any excess at other times of the year.

M. Project Escalation Matrix

Table 5: Project Escalation Matrix

Role	Triggers when
Project Manager	<ol style="list-style-type: none"> 1. Delay in responding to urgent issues 2. Unavailability of resources assigned on the project 3. Delay in issue resolution 4. Poor service or solution quality
Chief Executive Officer	<ol style="list-style-type: none"> 1. Issues impacting the business and prestige of IIT Bombay 2. Inability of the Project Manager to efficiently handle the entire project team

N. Knowledge Transfer (KT) obligations

- a. **Initial KT:** Prior to the start of this engagement, the vendor will be required to take over from IIT Bombay's team within a duration not exceeding one calendar month. The vendor should provide specific requirements at least two weeks prior to the takeover phase.
- b. **Termination KT:** After termination of this AMS contract with the vendor, the vendor will be required to hand over to IIT Bombay's new support vendor within a duration not exceeding two calendar months.
- c. The handover process should be conducted onsite.
- d. IIT Bombay will not make any separate payment for the Knowledge Transfer transition phase.

5.2 Issue Priority and Resolution Matrix

Table 6: Issue Priority and Resolution Matrix

Severity	Generic definition	Definition (in terms of this project)	Team members	Response Time	Availability for task
P1: Emergency	Production Incident within the Service that severely impacts the Customers; any issue that results in a loss of production data	<ol style="list-style-type: none"> 1. Entire customer base is affected. (login not working, server is down, videos not showing etc) 2. Security violations 3. Incident has a serious impact on critical tasks 	Project Manager	30 minutes	24x7
P2: High	P2 is a major Incident within the Service where the Customer's system is functioning but in a reduced capacity, or there is a chance of potential loss or interruption of service.	<ol style="list-style-type: none"> 1. Several users are directly affected (access to site is sluggish, requires multiple attempts to upload files etc) 	All relevant	3 hours	9 am to 7 pm all days of the week

P3: Medium	P3 is a medium-to-low impact Incident that affects certain partial and/or non-critical functions. Incidents for which there is limited loss or functionality or impact to Customer's operation and for which there is an easy workaround	<ol style="list-style-type: none"> 1. Small number or small group of users are directly affected. 2. Isolated 3. incident. 4. Slow/Degraded performance 	All relevant	2 working days	IIT Bombay Working hours
P4: Low	P4 is a general usage question or issue that may be minor or cosmetic in nature or documentation related, and may include improvement requests, but	<ol style="list-style-type: none"> 1. User requests general information, service or consultation. 2. Cosmetic enhancements 3. Report enhancements 	All relevant	4 working days	IIT Bombay Working hours
	the Service works without interruption.				

Penalties associated with missed deadlines are provided in the section [SLA Violations](#) of this document. The Institute reserves the right to invoke the penalty clause in an event of violation of any of the afore-mentioned SLA clauses.

5.3 SLA Violations

1. A resource is expected to obtain at least 50% on the consolidated Performance metric defined above. IIT Bombay reserves the right to replacement of a resource on a failure to achieve this benchmark metric.
2. For each replacement of a resource, a Deficit of availability of 50% of

- the quarterly person days for that resource will be recorded.
3. In the event of a resource service failing to meet the performance metric for more than three consecutive quarters, or several emergency/high-priority issues not adequately handled over three quarters, IIT Bombay reserves the right to invoke the Termination Clause.
 4. Deficits of availability will be adjusted against any excess services rendered as per the planned resource availability.

6. Termination of Contract

1. IIT Bombay reserves the right to withdraw/ terminate the contract with the vendor in any of the breaches of contract terms or Service Level Agreement
2. IIT Bombay can terminate the contract by giving a 3-month notice to the vendor.