DEVELOPMENT OF A WEB BASED MANAGEMENT INFORMATION SYSTEM FOR AUTOMATED SYSTEM LOSS CALCULATION AND MONITORING

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The project report titled "**Development of a Web Based Management Information System for Automated System Loss Calculation and Monitoring**" submitted by **Mohammad Jainal Abedin,** Student ID: **1009311004 P**, Session: October, 2009 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Post Graduate Diploma (ICT) held on 27th March 2019.

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Candidate's Declaration

It is hereby declared that neither this project nor any part of this project has been submitted elsewhere for award of any degree.

Mohammad Jainal Abedin

Dedicated

To

My Parents and My Beloved Son

Mohammad Irfan Abedin Affan

Acknowledgement

First, I express my heartiest thanks and gratefulness to almighty Allah for His divine blessing makes me possible to complete this project successfully. I feel grateful to and wish my profound indebtedness to **Dr. Md. Liakot Ali**, Professor, Department of Institute of Information & Communication Technology (IICT), Bangladesh University of Engineering & Technology, Dhaka. His endless patience, scholarly guidance, continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior drafts and correcting them at all stage have made it possible to complete this project. I also express my gratitude to him for providing me enough lab facilities to make necessary experiments of my research.

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Abstract

The gas distribution companies under Bangladesh oil, Gas and Mineral Corporation (PETROBANGLA) in Bangladesh now facing the most alarming issue of system loss. System loss of the company is increasing every year which in turn creates huge revenue loss for the Government. System loss is basically the amount of gas that is unaccounted for. That is, it is the difference between total amounts of gas supplied – the total amount of gas accounted for. It depends on a number of factors which is possible to mitigate if timely action is taken. Currently system loss is calculated from the manual records and documents which in turn makes it error prone, lack of transparency etc. This project is an initiative for adaptation of information and communication technology (ICT) for system loss calculation and monitoring which will help the authority to verify it and find out the source of system loss and take necessary action to enhance the performance of the company. In this project, a web based software system has been developed which is accessible via the Internet, cell phone, smart phone, Tablet etc. A number of tools such as C#, CSS, HTML and AngularJS as the Front End and .NET framework as the Back End and also use MSSQL as a database have been used to develop the software system. The software system is role based where each concerned user can access the system from their workplaces and different centers and key in the necessary data into the system. Then based on the information and data into the system a number of useful reports can be prepared earlier which was based on manual documents. The responsible officers and Directors of the company can view the report and take necessary action to root out the cause of system loss and enhance the performance of the company.

Table of Contents

Title **Page No.**

Chapter 3: System Design and Development

Chapter 4: Results and Discussions

Chapter 5: Conclusion

List of Figures Page No.

Chapter 2

Chapter 3

Chapter 4

List of Tables Page No.

Chapter 2

List of Abbreviations

HTTP	HyperText Transport Protocol
DFD	Data Flow Diagram
XML	Extensible Markup Language
HTML	HyperText Markup Language
ERD	Entity Relationship Diagram
UML	Unified Modeling Language
IIS	Internet Information Services
FCD	Flow Chart Diagram
DNS	Domain Name Server
FTP	File Transfer Protocol
AJAX	Asynchronous Javascript and XML
CSS	Cascading Style Sheet
DB	Data Base
OOP	Object Oriented Programming
SQL	Structured Query Language

Chapter 1
Introduction

1.1 Introduction

Natural gas is an important natural resource for our country. The development of our country is heavily dependent on this useful resource. So, its proper utilization must be ensured. Currently there are six gas distribution companies under Bangladesh oil, Gas and Mineral Corporation (PETROBANGLA) in Bangladesh to manage this gas resource [1]. Now the most burning issue in these companies is that its system loss is increasing every year which in turn creates huge revenue loss for the Government. System loss is basically the amount of gas that is unaccounted for. That is, it is the difference between total amounts of gas supplied – the total amount of gas accounted for. It depends on several factors. These are i. due to inaccuracy of the metering system and equipment ii. due to meter tampering and connection without metering/ illegal Connections iii. due to leakages in the pipe line of the distribution system and etc. [2-3]. Currently system loss is calculated from the manual records and documents obtained every month from its different sale centers, gas transmission vendors such as GTCL and different high pressure gas station TBS, CGS and DRS and so it is not possible to monitor and verify the information accurately and properly. Moreover it is not transparent too [1-3]. Now a day adaptation of information and communication technology (ICT) is essential for increasing the performance of any business organization. If a web based MIS is introduced for these Gas companies for system loss calculation and monitoring, then necessary data can be key-in in the MIS system from its different location and sale centers then it is possible to calculate the system loss dynamically and at the right time. Once system loss is calculated and stored in the system, the authority can monitor the system loss and verify its correctness based on different parameters such as length of the line, average inlet and outlet pressure, average inlet and outlet temperature, capacity of the station etc. and appropriate measures can be taken timely.

1.2 Objective with specific aims and possible outcome:

The objective of the project is to develop a web based MIS for system loss calculation for Gas Distribution company in Bangladesh to achieve the following aims and objectives:-

- To develop a user friendly GUI for the entire users (manger. System admin and Respective User).
- To develop modules for generation different types of useful Reports.
- To Eliminate of human intervention in data creation of gas metering and billing.
- To develop suitable MIS for middle & top management.

1.3 Organization of the Project Report

Chapter 1 – Introduction: The project documentation starts with the introduction followed by objectives and organization of the documentation.

Chapter 2 – Mineral Resource Management in Bangladesh and Software Requirement Analysis: In this chapter an overview of Gas sector and software functional and non-functional requirement, interface requirement, system loss description, feasibility study and system development process are included.

Chapter 3 – System Design and Development: In this chapter, the detail description of the components used is described along with the methodology of the project work and procedure of the design process is given including the flow chart and algorithm. The design part of the project which includes ERD, Database design, Use Case Diagram, UML diagram, DFD Diagram etc.

Chapter 4 – Result and discussion: In this chapter, the detail result and discussion of the project work is given.

Chapter 5 – Conclusion: Finally conclusion on the project and recommendation for the future is made.

- **The project documentation ends with References & Appendix.**

Chapter 2

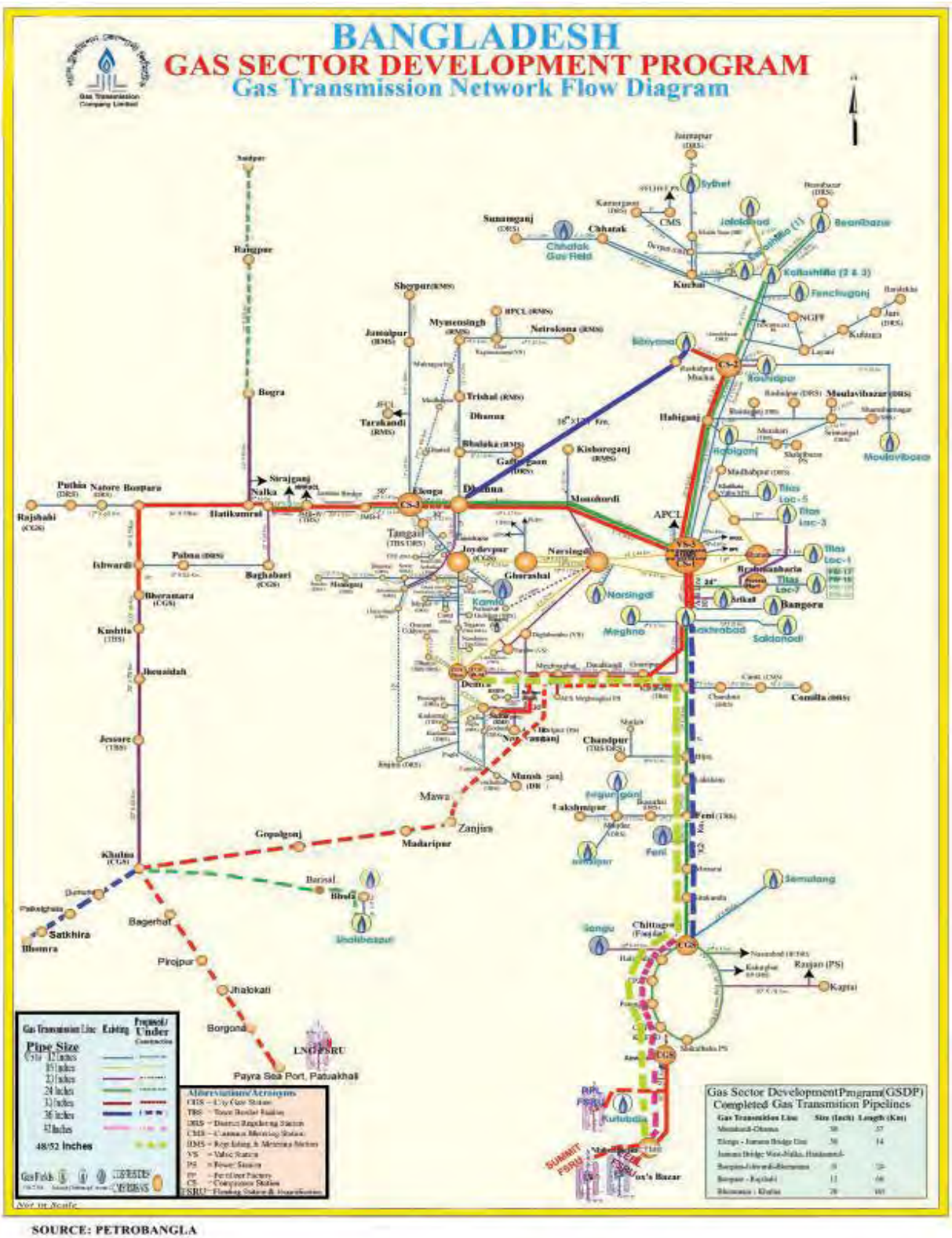
Mineral Resource Management in Bangladesh and Software Requirement Analysis

2.1 A Brief Description on Gas Sector of Bangladesh:

Among all the mineral resources in Bangladesh, natural gas is the most important and valuable resource and it is the main source of energy for the production of power and industrialization. Besides, natural gas has been used as raw material for producing chemical fertilizer, alternative fuel to vehicles, and staple fuel for commercial and household works.

The activities of the Petrobangla group encompass the whole spectrum of oil, gas and mineral sector of the country. The companies under Petrobangla are involved in each of the stages from the drill bit to burner tips. Through its companies, Petrobangla conducts geological and geophysical exploration with the help of its own crew, drills exploration and development wells with its own rig or with the help of hired contractors, processes raw gas to the pipeline specification, transports the processed gas through an increasing network of high-pressure transmission lines and distributes gas to the customers, be it a large Power plant or fertilizer factory or a single household. Value added LPG and liquid fuel such as Motor Spirit, Diesel, Kerosene etc. are extracted from NGL and condensate which are by-products of gas. Compressed natural gas (CNG) is extensively used in vehicles substituting for imported liquid fuels. Extraction of coal and granite are also conducted by Petrobangla. Furthermore, to rid the country from perennial fuel shortage, Petrobangla is set to import liquefied natural gas (LNG) in tandem with its endeavors to scale up exploration activities for new resources in the country.

Gas pipeline network continued to expand both in transmission and distribution. As in December, 2017 the pipeline network increased to about 24,070.23 km, which included about 2,753.59 km transmission lines, 2,380.72 km distribution lines, 16,697.69 km feeder main and service lines and the rest 2,024.66 km pipelines constructed under customer financing.[Source: Annual Report-2017,Petrobangla].The Gas Transmission Network Flow Diagram of Bangladesh is given bellow in Fig:2.1 which shows that Subsidiaries under Petrobangla are responsible for exploration, production, transmission, distribution and marketing of natural gas to the end users.



SOURCE: PETROBANGLA

Figure 2.1: Gas Transmission Network Flow Diagram of Bangladesh [Source: Annual Report-2017,Petrobangla].

2.2 Natural Gas Reserve of Bangladesh:

From the Following Table 2.2 we found that Total gas initially in place (GIIP) of 26 gas fields has been estimated to be at 39.0 trillion cubic feet (TCF), out of which estimated total recoverable gas reserve (Proved plus probable) is 27.12 TCF. Up to December 2017, as much as 15.22 TCF gas was produced, leaving only 11.91 TCF of recoverable gas.

Natural Gas Reserve of Bangladesh

(As of 31 December, 2017)

Figure in BCF

SL No.	Fields	Year of Discovery	Reserve Estimated By		GIIP	Proved (1P)	Proved + Probable (2P)	Proved + Probable + Possible (3P)	Cumulative Production (Dec, 2017)	Remaining Reserve w.r.t 2P (Jan, 2018)
			Company	Year						
A.	**Producing**									
1.	Titas	1962	RPS Energy	2009	8148.9	5384.0	6367.0	6517.0	4422.30	1944.70
2.	Habiganj	1963	RPS Energy	2009	3684.0	2647.0	2647.0	3096.0	2353.34	293.66
3.	Bakhrabad	1969	RPS Energy	2009	1701.0	1052.9	1231.5	1339.0	816.13	415.39
4.	Kailashtilla	1962	RPS Energy	2009	3610.0	2390.0	2760.0	2760.0	671.14	2088.86
5.	Rashidpur	1960	RPS Energy	2009	3650.0	1060.0	2433.0	3113.0	605.89	1827.11
6.	Sylhet/Haripur	1955	RPS Energy	2009	370.0	256.5	318.9	332.0	213.58	105.32
7.	Meghna	1990	RPS Energy	2009	122.1	52.5	69.9	101.0	65.95	3.95
8.	Narshingdi	1990	RPS Energy	2009	369.0	218.0	276.8	299.0	191.16	85.64
9.	Beani Bazar	1981	RPS Energy	2009	230.7	150.0	203.0	203.0	98.97	104.03
10.	Fenchuganj	1988	RPS Energy	2009	553.0	229.0	381.0	498.0	154.98	226.02
11.	Shaldanadi	1996	RPS Energy	2009	379.9	79.0	279.0	327.0	89.23	189.77
12.	Shahbazpur*	1995	Petrobangla	2011	677.0	322.0	390.0	488.0	38.91	351.09
13.	Semutang	1969	RPS Energy	2009	653.8	151.0	317.7	375.1	12.64	305.06
14.	Sundalpur Shahzadpur	2011	BAPEX	2012	62.2	25.0	35.1	43.5	9.98	25.12
15.	Srikail	2012	BAPEX	2012	240.0	96.0	161.0	161.0	68.03	92.40
16.	Begumganj	1977	BAPEX	2014	100.0	14.0	70.0	-	0.88	69.12
17.	Rupganj	2014	BAPEX	2014	48.0	-	33.6	-	0.68	32.92
18.	Jalalabad	1989	D & M	1999	1491.0	823.0	1184.0	1184.0	1140.68	43.32
19.	Moulavi Bazar	1997	Unocal	2003	1053.0	405.0	428.0	812.0	302.89	125.11
20.	Bibiyana	1998	D & M	2008	8350.0	4415.0	5754.0	7084.0	2972.46	2781.54
21.	Bangura	2004	Tullow	2011	1198.0	379.0	522.0	941.0	394.26	127.74
				Sub-total A:	**36691.6**	**20148.9**	**25862.5**	**29673.6**	**14624.63**	**11237.89**
B.	**Non-Producing**									
22.	Kutubdia	1977	HCU	2003	65.0	45.5	45.5	45.5	0.00	45.5
				Sub-total B:	**65.0**	**45.5**	**45.5**	**45.5**	**0.00**	**45.5**
C.	**Production Suspended**									
23.	Chattak**	1959	HCU	2000	1039.0	265.0	474.0	727.0	26.46	447.54
24.	Kamta	1981	Niko/Bapex	2000	71.8	50.3	50.3	50.3	21.1	29.20
25.	Feni	1981	Niko/Bapex	2000	185.2	125.0	125.0	175.0	62.4	62.60
26.	Sangu***	1996	Cairn/Shell	2010	899.6	544.4	577.8	638.7	487.91	89.85
				Sub-total C:	**2195.6**	**984.7**	**1227.1**	**1591.0**	**597.9**	**629.2**
				Grand Total (A+B+C) in BCF	**38952.2**	**21179.1**	**27135.09**	**31310.1**	**15221.93**	**11912.59**
				Grand Total (A+B+C) in TCF	**39.0**	**21.2**	**27.14**	**31.31**	**15.22**	**11.91**

Note: * Reserve evaluation of Shahbazpur East-1 is underway by BAPEX which will be included in Shahbazpur Field.
** Reserve of Chattak Gas Field is under re-evaluation due to excessive seepage caused by the two consecutive blowouts in 2005.
*** Production from Sangu Gas Field suspended since 1st October, 2013.
Source : Reservoir and Data Management Division, Petrobangla.

Table 2.1: Natural Gas Reserve of Bangladesh [Source: Annual Report-2017, Petrobangla]

2.3 Vision and Mission of Petrobangla:

Vision:

- To provide energy for sustainable economic growth and maintain energy security of the country.

Mission:

- To enhance exploration and exploitation of natural gas
- To diversify indigenous energy resources
- To promote CNG, LNG and LPG to minimize gas demand and supply gap as well as to improve environment
- To provide indigenous primary energy to all areas and all socio economic groups
- To develop coal resources as an alternative source of energy
- To contribute towards environmental conservation of the country
- To promote efficient use of gas with a view to ensuring energy security for the future

2.4 Companies of Petrobangla:

From the Following Figure 2.2 we found that there are 13 companies operating under Petrobangla, dealing in oil and gas exploration, production, transmission, distribution, conversion and promotion of LNG as well as development and marketing of coal and granite.

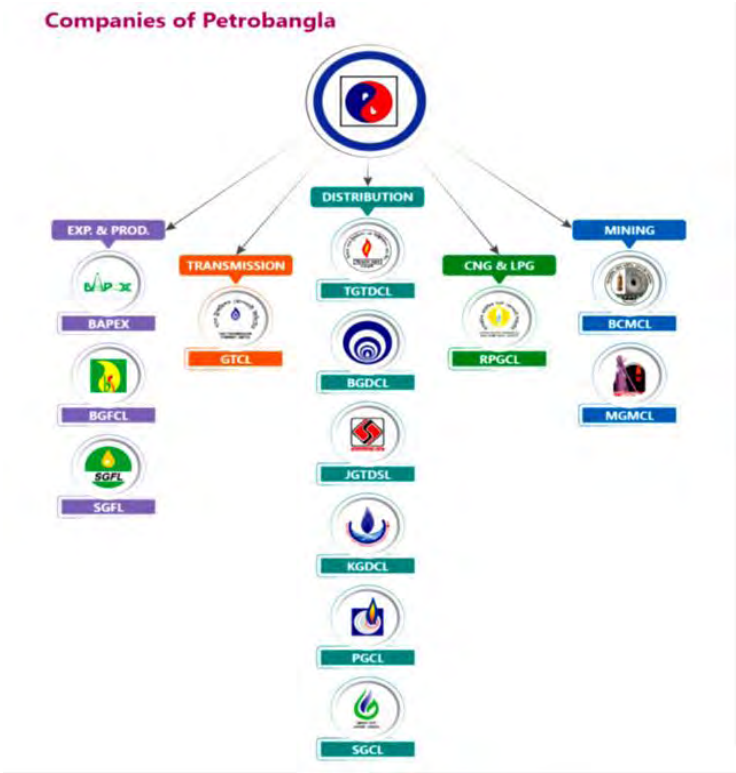


Figure 2.2: Companies of Petrobangla [Source: Annual Report-2017, Petrobangla].

2.4.1 Exploration and Production Companies:

2.4.1.1 Bangladesh Petroleum Exploration and Production Company Limited (BAPEX)

BAPEX is the lone public sector company conducting exploration for oil and gas in the country. BAPEX was established in 1989, as the national exploration company by abolishing the Exploration Directorate of Petrobangla with a view to accelerating oil and gas exploration in the country. The main functions of BAPEX were to undertake geological and geophysical surveys, and drilling operations for the purpose of exploring oil and gas in the country. The company also has laboratory and computer processing facilities. Aside from exploring oil and gas and drilling, BAPEX is now producing nearly 105 million cft of gas daily from Saldanadi, Shahbazpur, Fenchuganj, Semutang, Begumganj, Shahjadpur-Sundalpur, Srikail Gas Fields.

2.4.1.2 Bangladesh Gas Fields Company Limited (BGFCL)

With the rapid growth of gas consumption in the country, BGFCL has kept up its relentless effort to ensure uninterrupted gas supply and implements major projects. Bangladesh Gas Field Company Limited (BGFCL) is the largest state-owned natural gas production company in the country. The company is the successor to the Shell Oil Company established on 30 May 1956. Presently, BGFCL owns 6 gas fields - Titas, Habiganj, Bakhrabad, Narsingdi, Meghna and Kamta. This company continued gas production from 5 gas fields out of its 6 fields in the FY 2016-17. At present, daily on an average 850 million cubic feet gas is being supplied to the national grid from 42 wells of 5 producing fields. BGFCL shares about 31% of country's total gas production.

2.4.1.3 Sylhet Gas Fields Limited (SGFL)

Sylhet Gas Fields Limited is the second largest state-owned gas producing company in the country. The company, under its umbrella, currently operates Sylhet (Haripur), Kailashtila, Rashidpur and Beanibazar Gas Fields. A total of 14 wells (2 at Sylhet, 5 at Kailashtila, 5 at Rashidpur and 2 at Beanibazar) are presently on stream which produce an average of 141 MMscfd. The produced gas is supplied to Jalalabad, Bakhrabad, Pashchimanchal and Karnaphuli gas distribution companies franchised areas. SGFL shares about 5% of country's total gas production.

From the Following Table 2.2 we found that the Production of gas and condensate from Gas field under different Companies in Bangladesh.

Gas Fields in Production

(As in December, 2017)

Gas in MMscfd, Condensate in BBL

Company	Gas Field	Total Wells (No.)	No of Producing Wells	Production Capacity (MMscfd)	Production	
					Gas	Condensate
1. BGFCL	Titas	27	26	542	557	421
	Bakhrabad	10	6	43	35	13
	Habiganj	11	7	225	222	12
	Narsingdi	2	2	30	28	45
	Meghna	1	1	11	12	20
	Sub-Total	**51**	**42**	**851**	**854**	**511**
2. SGFL	Sylhet	8	2	8	6	44
	Kailashtila #1 (Silicagel)	4	1	13	11	65
	Kailashtila #2 (MSTE)	3	3	55	54	530
	Rashidpur	11	5	60	55	30
	Beanibazar	2	2	15	12	174
	Sub-Total	**28**	**13**	**151**	**138**	**843**
3. BAPEX	Saldanodi	4	2	10	4	1
	Fenchuganj	5	2	26	21	8
	Shahbazpur	5	3	50	40	7
	Semutung	6	2	3	1	0
	Sundalpur	2	2	0	0	0
	Srikail	4	3	40	37	102
	Begumganj	3	0	0	0	0
	Rupganj	1	1	8	1	1
	Sub-Total	**30**	**15**	**137**	**104**	**119**
	Sub-Total (1+2+3)	**109**	**70**	**1139**	**1096**	**1473**
4. IOCs						
CHEVRON	Jalalabad	9	7	270	259	1115
	Maulavibazar	9	5	42	39	3
	Bibiyana	26	26	1200	1250	9055
TULLOW	Bangora	6	5	103	98	281
	Sub-Total	**50**	**43**	**1615**	**1646**	**10454**
	Grand Total (1+2+3+4):	**159**	**113**	**2754**	**2742**	**11927**

Source : Production & Marketing Division, Petrobangla.

Table 2.2: Gas Fields in Production [Source: Annual Report-2017, Petrobangla].

2.5 Transmission Companies: GTCL

Gas Transmission Company Limited (GTCL) was incorporated on 14 December, 1993 with the objectives of

- centralized operation and maintenance of national gas grid; and
- expanding of national gas grid and as required, ensuring balanced supply and usage of natural gas in all regions of the country.

2.6 Distribution Companies:

2.6.1 Titas Gas Transmission and Distribution Company Limited (TGTDCL)

TGTDCL, the pioneer and the largest natural gas distribution Company in Bangladesh, distributes a lion's share of the total natural gas in our country. TGTDCL has entered the new era of imported LNG to bridge the demand-supply ratio of natural gas. The injection of imported 300 MMCFD LNG has resulted in an increase of nearly 70 MMCFD Natural gas in TGTDCL network which is being used for its fertilizer and non-bulk customers. As a leader among gas distribution companies, contribution of Titas Gas to the Bangladesh Economy is as evident as its eternal flame to the total economy of the country. Main objective of the company is to supply natural gas to customers of different categories under Titas Franchise Area, thereby reducing dependency on imported liquid fuel. Towards this end, the company has to construct, operate and maintain pipelines, stations and associated facilities. Currently the company distributes gas in the districts of Dhaka, Narayanganj, Narsingdi, Munshiganj, Manikganj, Gazipur, Tangail, Mymensingh, Jamalpur, Sherpur, Netrokona, and Kishoreganj.

2.6.2 Bakhrabad Gas Distribution Company Limited (BGDCL)

Bakhrabad Gas Distribution Company Limited (BGDCL), previously named as Bakhrabad Gas Systems Limited (BGSL), was established on 7 June, 1980 initially with the three-fold responsibilities of production, transmission and distribution. Gas supply was commenced on 20 May, 1984.

2.6.3 Jalalabad Gas Transmission & Distribution System Limited (JGTDSL)

Jalalabad Gas System supplies gas to the customers in its franchise area consisting of the customers Syihet division.

2.6.4 Pashchimanchal Gas Company Limited (PGCL)

Pashchimanchal Gas Company Limited (PGCL) is the 4th gas marketing company under Petrobangla set-up with the objective of distributing gas in the north-west region of the country. The company commenced its business on 23 April, 2000.

2.6.5 Karnaphuli Gas Distribution Company Limited (KGDCL)

Karnaphuli Gas Distribution Company Limited (KGDCL) was formed on 8 February, 2010, with greater Chattogram and Chattogram Hill tracts area which were under erstwhile BGSL franchise, pursuant to a government decision to rationalize and improve the services of the companies under Petrobangla. The commercial activities of the company commenced on 1 July, 2010.

2.6.6 Sundarban Gas Company Limited (SGCL)

The Sundarban Gas Company Limited (SGCL) was formed on 23 November, 2009 with the objective of supplying natural gas to the south-western region of the country which includes Khulna Division, Barishal Division and greater Faridpur district. The main responsibilities of the company are to construct distribution pipelines, provide gas connections and post connection services under its franchise area.

From the Following Figure 2.3 we found that natural gas is supply to the customers of different categories as follows. Most of this customers fall under Domestic category but power sector remained the largest consumer.

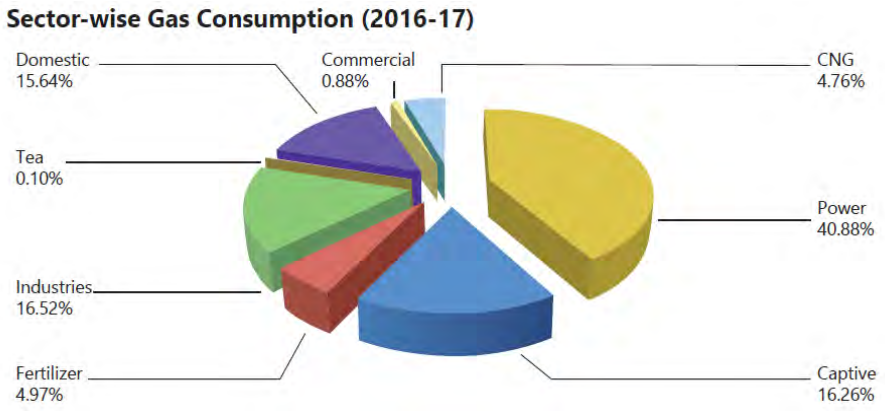


Figure 2.3.: Sector-wise Gas Consumption **[Source: Annual Report-2017, Petrobangla]**

The Following Figure 2.4 shows the sector wise gas demand up to 2022. It is imperative that the policy makers of the gas sector would think well ahead of time to explore and research for more natural gas resources and to increase the present production level to conform to the forecasted gas demand with a view to avoiding uncertainties in gas sector.

Sector wise Gas Demand Forecast (2017-2022)

Figures are in BCF

Sector	2017-18	2018-19	2019-20	2020-21	2021-22
Power	607	657	728	705	709
Captive	152	152	152	152	140
Fertilizer	98	98	98	98	98
Industry	191	253	321	366	390
Commercial	9	9	9	9	9
Domestic	133	133	134	133	133
Tea-Estate	2	2	2	2	2
CNG	41	41	41	39	34
Total	**1235**	**1346**	**1487**	**1505**	**1516**

Source : Production & Marketing Division, Petrobangla.

Table-2.3: Sector-wise Gas Demand Forecast [Source: Annual Report-2017, Petrobangla].

2.7 Rupantarita Prakritik Gas Company Limited (RPGCL)

Repatriate Prakritik Gas Company Limited (RPGCL) started its activity as a company of Petrobangla from 1st January 1987. RPGCL was organized as a company to convert vehicles to Compressed Natural Gas (CNG) and to popularize the use of CNG. Later, the company was also given the responsibility of production of LPG, Petrol and Diesel from NGL produced in the gas field. With gradual shift of CNG conversion and CNG retailing activity to private sector, RPGCL is now concentrating more on evolving necessary code and standards, providing advisory services and act as a supervisory entity in the CNG sector.

2.8 Mining:

2.8.1 Barapukuria Coal Mining Company Limited (BCMCL)

This is a new Company formed to operate the coal mine constructed at Barapukuria in Dinajpur district. This mine has a capacity to produce about 1 million tons of coal per year. The mine started partial production from 14th April 2002.

2.8.2 Maddhapara Granite Mining Company Limited (MGMCL)

Geological Survey of Bangladesh (GSB) discovered the deposits of hard rock at a depth of 136 meter at Maddhapara, Parbatipur of Dinajpur district in 1974. Granite mining in Bangladesh is important, as there is hardly any other source of construction aggregate.

2.9 LNG

With the object of reducing present gap between demand and supply of gas in the country, the Government has taken initiatives to import considerable quantity of liquefied natural gas (LNG). Bangladesh starting LNG imports from 2018 and is making efforts to move forward with the LNG import infrastructure.

2.10 Production Sharing Contract (PSC)

A major activity of Petrobangla is administering the PSCs. Under the Petrobangla Ordinance, Petrobangla administers and supervises the PSCs signed with IOCs.

2.11 Software Requirement Analysis and System Development Process

2.11.1 Systems Development Life Cycle (SDLC):

The systems development life cycle (SDLC), also referred to as the application development life-cycle, is a term used in systems engineering, information systems and software engineering to describe a process for planning, creating, testing, and deploying an information system. Various SDLC methodologies have been developed to guide the processes involved, including the waterfall model (which was the original SDLC method); rapid application development (RAD); joint application development (JAD); the fountain model; the spiral model; build and fix; and synchronize-and-stabilize. Some methods work better for specific types of projects, but in the final analysis, the most important factor for the success of a project may be how closely the particular plan was followed. In general, an SDLC methodology follows the following steps.

2.11.1.1 Planning

This is the first phase in the systems development process. It identifies whether or not there is the need for a new system to achieve a business's strategic objectives. This is a preliminary plan (or a feasibility study) for a company's business initiative to acquire the resources to build of an infrastructure to modify or improve a service.

2.11.1.2 Systems Analysis and Requirements

The second phase is where businesses will work on the source of their problem or the need for a change. In the event of a problem, possible solutions are submitted and analyzed to identify the best fit for the ultimate goal(s) of the project. Systems analysis is vital in determining what a business's needs are, as well as how they can be met, who will be responsible for individual pieces of the project, and what sort of timeline should be expected. There are several tools businesses can use that are specific to the second phase. They include:

- CASE (Computer Aided Systems/Software Engineering)
- Requirements gathering
- Structured analysis

During systems development life cycle (SDLC) methodology in the Planning and Systems Analysis and Requirements Phase we should conduct the following feasible study in order to determine the success and minimize the risks related to the Project.

Feasibility Study:

If the project is to proceed, the feasibility study will produce a project plan and budget estimates for the future stages of development. A more general description of the aims of a feasibility study is found, where it is defined as a having to cover four different dimensions:

- Technology (whether the project is technically feasible given the prevailing state of the art)
- Finance (whether it is financially feasible within cost and budget envisaged by the client)
- Time (whether it will beat the competition to the market)
- Resources (whether the organization has the required resources to attempt the project)

Economic Feasibility:

This section of feasibility study gives the top management the economic justification for the new system. This is an important input to the management because very often does not like to get confounded by the various technicalities that bound to be associated with a project of this kind. In the system, the institute is most satisfied by economic feasibility. Because, if the institute implements this system, it need not require any additional hardware resource as well as it will be saving lot of time.

Technical Feasibility:

According to feasibility analysis procedure the technical feasibility of the system is analyzed and the technical requirements such as software facilities, procedure, inputs are identified. It is also one of the important phases of the system development activities. The system offers greater levels of user friendliness combined with greater processing speed. Therefore, cost of maintenance can be reduced. Since processing speed is very high and the work is reduced in the maintenance point of view management convince that the project is operationally feasible.

Behavioral Feasibility:

People are inherently resistant to change and computer has been known to facilitate changes. An estimate should be made of how strong the user is likely to move towards the development of computerized system. These are various levels of users in order to ensure proper authentication.

2.11.1.3 Systems Design

The third phase describes, in detail, the necessary specifications, features and operations that will satisfy the functional requirements of the proposed system which will be in place. This is the step for end users to discuss and determine their specific business information needs for the proposed system. It's during this phase that they will consider the essential components (hardware and/or software) structure (networking capabilities), processing and procedures for the system to accomplish its objectives.

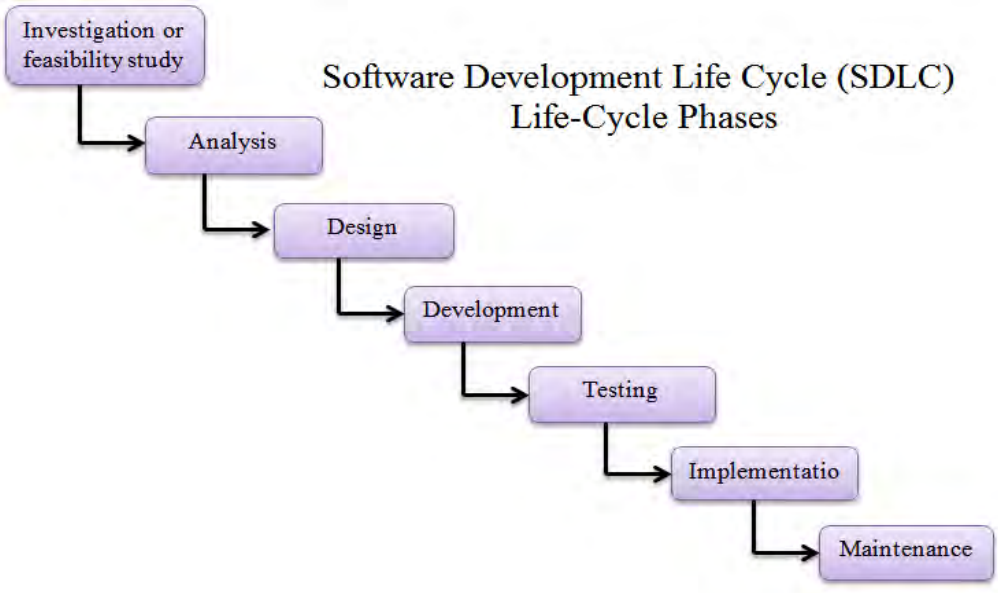


Figure 2.4: Software Development Life Cycle

2.11.1.4 Development

The fourth phase is when the real work begins—in particular, when a programmer, network engineer and/or database developer are brought on to do the major work on the project. This work includes using a flow chart to ensure that the process of the system is properly organized. The development phase marks the end of the initial section of the process. Additionally, this phase signifies the start of production. The development stage

is also characterized by instillation and change. Focusing on training can be a huge benefit during this phase.

2.11.1.5 Integration and Testing

The fifth phase involves systems integration and system testing (of programs and procedures)—normally carried out by a Quality Assurance (QA) professional—to determine if the proposed design meets the initial set of business goals. Testing may be repeated, specifically to check for errors, bugs and interoperability. This testing will be performed until the end user finds it acceptable. Another part of this phase is verification and validation, both of which will help ensure the program's successful completion.

2.11.1.6 Implementation

The sixth phase is when the majority of the code for the program is written. Additionally, this phase involves the actual installation of the newly-developed system. This step puts the project into production by moving the data and components from the old system and placing them in the new system via a direct cutover. While this can be a risky (and complicated) move, the cutover typically happens during off-peak hours, thus minimizing the risk. Both system analysts and end-users should now see the realization of the project that has implemented changes.

2.11.1.7 Operations and Maintenance

In this phase, periodic maintenance for the system will be carried out to make sure that the system won't become obsolete, this will include replacing the old hardware and continuously evaluating system's performance, it also includes providing latest updates for certain components to make sure it meets the right standards and the latest technologies to face current security threats.

2.11.2 Software Requirement Analysis

Natural gas is a valuable resource in our country. The development of our country is heavily dependent on this useful resource. So its proper utilization must be ensured. The prime objective of this project is to develop a web based MIS system for Automated System loss calculation and monitoring which can be used to fight against the System loss in our gas sector. If a web based MIS is introduced for the Gas companies for system loss

calculation and monitoring, then necessary data can be key-in in the MIS system from its different location and sale centers then it is possible to calculate the system loss dynamically and at the right time.

2.11.2.1 Description of the term "System Loss"

2.11.2.1.1 Introduction:

Titas Gas T & D Company Ltd. (TGTDCL) purchases gas from various gas fields and delivers gas to bulk customer in the Power and Fertilizer sectors as well as to large number of industrial, commercial and domestic consumers collectively called Non-bulk sector. The terms "System Loss" means the quantity of "Unaccounted For Gas (UFG)" prevailing between the Company's Gas purchase and sales volumes reported on a monthly basis. System Loss (or UFG, as it is terms in the gas industry) is expressed by the following equation:

Net Purchase=Total Purchase-GTCL Own use

Total System loss= Net Purchase-Total Sales

$$\text{UFG}=\frac{Net\ Purchase-(Total\ Sales+Allowable\ Transmission\ \&\ Distribution\ Loss)}{Net\ Purchase}\times 100\%$$

Total Sales=Total sales to Customer + Condensate Equivalent Gas

Allowable Transmission & Distribution Loss (TDLP) =2% Allowable transmission & distribution loss considered for gas Purchase through Titas Own transmission line and 2.25% Allowable transmission & distribution loss considered for gas Purchase through GTCL transmission line according to BERC (Bangladesh Energy Regulatory Commission) Rules. System Loss, UFG rates are normally shown based on Net Purchase.

2.11.2.1.2 Types of "System Loss" in gas transmission:

There are mainly two types of System Loss, which are: Technical Loss and Non-technical Loss. Another type of system loss is "Tariff related loss in domestic use" due to policy of social service & benefits.

2.11.2.1.3 Factors responsible for System Loss:

The factors responsible for System Loss in TGTDCL may be grouped under three board categories as under:

- **Technical/Operational Factors :**
  - ✓ Leakage in distribution network including customer service lines.
  - ✓ Leakage in un-metered customers' internal lines.
  - ✓ Gas blowing/venting during pipeline and station commissioning.
  - ✓ Metering inaccuracies.
  - ✓ Gas condensation.
  - ✓ Loss due to low flat rate domestic tariff base for un-metered domestic sector.
- **Manipulative Factors :**
  - ✓ Illegal connections to mains.
  - ✓ Illegal extension of existing service and internal lines.
  - ✓ Illegal reconnection after disconnected for default.
  - ✓ Illegal meter by-pass.
  - ✓ Unapproved additional appliances.
  - ✓ Unapproved excess load.
  - ✓ Suppression of actual load.
  - ✓ Obstructing meter movement.
  - ✓ Tampering meter index.
  - ✓ Meter removal.
  - ✓ Meter reversing.
  - ✓ Set pressure manipulation.
- **Coercive Factors :**
  - ✓ Pressure tactics by influential quarters.
  - ✓ Obstruction to meter reading, sealing and inspection.
  - ✓ Hindering disconnection by unruly elements.
  - ✓ Abusing legal means to solicit injunctions against possible actions.

2.11.2.1.4 Measures to be taken by the Company to prevent and reduction at acceptable stage in case of system loss: The following measures should be taken by the Company to prevent and reduction of System Loss at acceptable limit.

- **Technical / Operational:**
  - ✓ Improvement of Area wise Input Metering.
  - ✓ Zonal isolation of Metro Dhaka distribution network for zone wise input/output analysis.

- ✓ Field Survey and Identification.
- ✓ Up-gradation with new metering equipment.
- ✓ Continued input metering.

- **Improvement of Customer Metering.**
  - ✓ Changing meters more than 10 years old.
  - ✓ Study aimed at identifying, evaluating and developing improved, customer metering, equipment/system.
  - ✓ Inspection and necessary field scaling/re-scaling of all industrial and commercial customer RMS.
- **Minimization of Operational Losses.**
  - ✓ Extensive Leakage survey.
  - ✓ Cathodic protection survey.
  - ✓ Strengthening pipeline and station maintenance operations.
  - ✓ Customer Management :
  - ✓ Strengthening Customer Management System.
  - ✓ Creation of customer database facilities.
  - ✓ Customer load actualization.
  - ✓ Customer administration by grouping customers according to class/type of industries.
  - ✓ Establishing E-Governance management system.
- **Time Bound Program Administration.**
  - ✓ Development and improvement of System Loss Accounting procedure.
  - ✓ Identification of factors responsible for System Loss in sales areas against input.
- **Customer Administrative Drive.**
  - ✓ Vigilance of load intensive customers.
  - ✓ Assessment of merit of legal suits by legal consultants.
  - ✓ Disconnection of delinquent/defaulting customers and riser killing.
- **Restructuring Company Organogram /Method.**
  - ✓ Implementation of need based organogram along with detailed job description.
  - ✓ Strengthening general office Management System.

- **Augmenting Manpower and Logistics.**
  - ✓ Disposal of long outstanding promotion cases.
  - ✓ Recruitment of necessary and appropriate manpower.
  - ✓ Procurement of requisite transport and office equipment.
- **Media Campaign and Customer Relation.**
  - ✓ Development of campaign program and materials.
  - ✓ Effective use of Company website.
- **Policy / management Initiatives :**

  Government Level:
  - ✓ Immediate activation of the Energy Regulatory Commission for the enforcement of gas related articles.
  - ✓ Enactment of long overdue "Gas Act".

  Company Level:
  - ✓ Creation of a strong, well equipped and clearly defined Vigilance set-up in the Company focused specially at System Loss Reduction and Control actions.
  - ✓ Strengthening internal administrative discipline.
  - ✓ Special drive for expeditious disposal of current litigation by intensifying the ongoing out-of-court settlement efforts and close liaison with the office of the Attorney General.

2.11.2.2 Disadvantages of Current System:

- The current system is very time consuming.
- It is difficult to analyze.
- Data processing takes more time as it is done manually.
- It is not error free.

2.11.2.3 Functional Software requirement:

Software requirement is a functional or non-functional need to be implemented in the system. Functional means providing particular service to the user. Software requirement can also be a non-functional; it can be a performance requirement.

The functions of the Automated System Loss Calculation and Monitoring (ASLCM) are discussed below:

User registration system provides facility to get register any user in department if they wish to monitor the loss. User Registration done by an Admin. User login system allow registered user to login to the Automated System Loss Calculation and Monitoring (ASLCM) system. There may have different user like as follows:

- Admin
- Managing Director (MD)
- General Manager (GM)
- Deputy General Manager (DGM)
- Manager
- IT Admin
- Operator
- Other User (General User)

This application is supported by a database consisting number of transactions, purchase information, sales information and others activities. **Administrator** shall usually do anything on the site, in all pages. Administrator is responsible for updating and the maintenance of the web site content.

In this system admin can create new user type and each user type have all or some permission based on the requirement. After that admin create new user and assign a user type, without user type new user can't be created. Based on the user permission user can insert supplier, customer information, prepare sales and purchase invoice, can view report so that any gap easily sort out.

- **SRS Assumption Dependencies:** Requirements analysis is usually the first phase of large-scale software development project. It is undertaken after a feasibility study has been performed to define the precise costs and benefits of a software system. The purpose of this phase is to identify and document the exact requirements for the system. The customer, the developer, a marketing organization or any combination of the three may perform such study. In cases where the requirements are not clear e.g., for a system that is never been defined,

more interaction is required between the user and the developer. The requirements at this stage are in end-user terms.

- **Functional Requirement Specification (FRS):** Functional requirements specify a function that a system or system component must be able to perform. It can be documented in various ways. The most common ones are written descriptions in documents and use cases.

2.11.2.4 Non-Functional Requirements:

Non-functional requirement specifies how the system behaves in terms of constraints or prerequisites. We can list them with expressions like: it should be fast, should be secure, should be multi-platform, should be portable, should be scalable, etc.

The following non-functional requirements that we should always keep into account during our project planning.

- **Security Requirements:** The authorization mechanism of the system will block the unwanted attempts to the server and also let the system decide on which privileges may the user have. The system has different types of users so there are different levels of authorization. There will be also a firewall installed on the server so the incoming transactions can be filtered. Data integrity for critical variables will also be checked. We should keep in mind the following questions regarding Security:-
  - ✓ Does the system need to control the user access and session?
  - ✓ Does it need to store the data in a secure location, stored in a secure format?
  - ✓ Does it require a secure communication channel for the data?
- **Concurrency and Capacity:** We should keep in mind the following questions regarding Concurrency and Capacity:-
  - ✓ Is the system going to be able to handle multiple computations executing simultaneously, and potentially interacting with each other?
  - ✓ What is the minimum, average and maximum number of concurrent users?
  - ✓ How much data can the system store and for how long? Are the data constraint validations contemplated?
  - ✓ Is there a threshold for data transmission quota?

- **Performance:** We should keep in mind the following questions regarding Performance:-
  - ✓ Is it any quantitative metric for the system to meet?
  - ✓ Performance is generally perceived as a time expectation. This is one of the most important considerations especially when the project is in the architecture phase. Choosing the right technology is crucial at this point.
- **Reliability:** We should keep in mind the following questions regarding Reliability:-
  - ✓ Is it necessary to ensure and notify about the system transactions and processing? As simple as keep a system log will increase the time and effort to get it done from the very beginning.
  - ✓ Is the data transferred in a reliable way and using trustful protocols?
- **Maintainability:** Well done system is meant to be up and running for long time. So it will regularly need preventive and corrective maintenance. Maintenance might signify scalability to grow and improve the system features and functionalities. The requirements, modules that are explained in this document are enough to satisfy the customer's needs and wants.
- **Usability:** End user satisfaction and acceptance is one of the key pillars that support a project success. Taking the user experience requirements into account from the project conception is a win bet, and it will especially save a lot of time at the project release as the user won't ask for changes or even worst misunderstandings.
- **Documentation:** Last but not least, all projects require a minimum of documentation at different levels. In many cases the users might even need training on it, so keeping good documentation practices and standards will do this task spread along the project development; but as well this must be establish since the project planning to include this task in the list.

2.11.2.5 Interface Requirement:

- **User Interfaces:** The Software shall be designed as a web based that has a main user interface. Format of main screen shall be standard and flexible. The system shall be user friendly designed. Pages shall be connected each other in a consistent way. Operations can be done with the system shall be repeatable. The design of the pages should allow users to do this.
  - ✓ Login Screen
  - ✓ Menu selection Screen
  - ✓ Dashboard with summary
  - ✓ User information Details
  - ✓ Supplier, Customer
  - ✓ Authentication & Authorization
  - ✓ Report
- **Hardware Interfaces:**
  - ✓ Minimum 2GB RAM
  - ✓ Core i3 processor or higher
  - ✓ Smart phone
- **Software Interfaces:**
  - ✓ Operating system: widows 10, Windows Server 2012+
  - ✓ Framework: .Net 4.5, ASP.Net Framework
  - ✓ ORM: Entity Framework (EF) 6
  - ✓ Language: C#, LINQ
  - ✓ Client-Side: AngularJS (1.7), Auth interceptors, Single Page Application (SPA), HTML5, CSS3, Bootstrap 3, jQuery
  - ✓ Database: MSSQL
- **Communications Interfaces:** Communications interfaces can be provided through e-mail, web browser, network server communications protocols, electronic forms, and so on. The default communication protocol for data transmission between server and the client is Transmission Control Protocol/ Internet Protocol (TCP/IP). At the upper level Hyper Text Transfer Protocol (HTTP, default port=80, default of apache port=8080) will be used for communication between the web server and client. FTP or HTTP provides security using encryption algorithms and synchronization mechanisms.

Chapter 3
System Design and Development

3.1 Introduction:

The purpose of the System Design process is to provide sufficient detailed data and information about the system and its system elements to enable the implementation consistent with architectural entities as defined in models and views of the system architecture.

Before developing a system, we must design our system like how workflows of our system. Data Flow Diagram (DFD) provides a view of how the system or business flows that able to increase the efficiency and effectiveness to achieve system objectives. Flow Chart Diagram (FCD) will tell us how it is going to work. For native user we have Use Case Diagram thus they could easily understand about our system. Entity Relationship Diagram (ERD) will tell us about our database. We can know our system structure when we will design it and that is Class Diagram, Context Level Diagram showing entities that interact with this system. Sequence Diagrams are interaction diagrams that detail how operations are carried out

3.2 Workflow Diagram:

A Workflow Diagram is a simple form of Flow chart depicting the flow of tasks or actions from one person or group to another. It is typically consists of a set of symbols representing actions or individuals connected by arrows indicating the flow from one to another. Different symbols represent different aspects of the workflow. For example, a process is represented by a rectangle while a diamond is used to depict a decision. Figure3.1: shows a Workflow Diagram of Automated System Loss Calculation and Monitoring (ASLCM) of my Project.

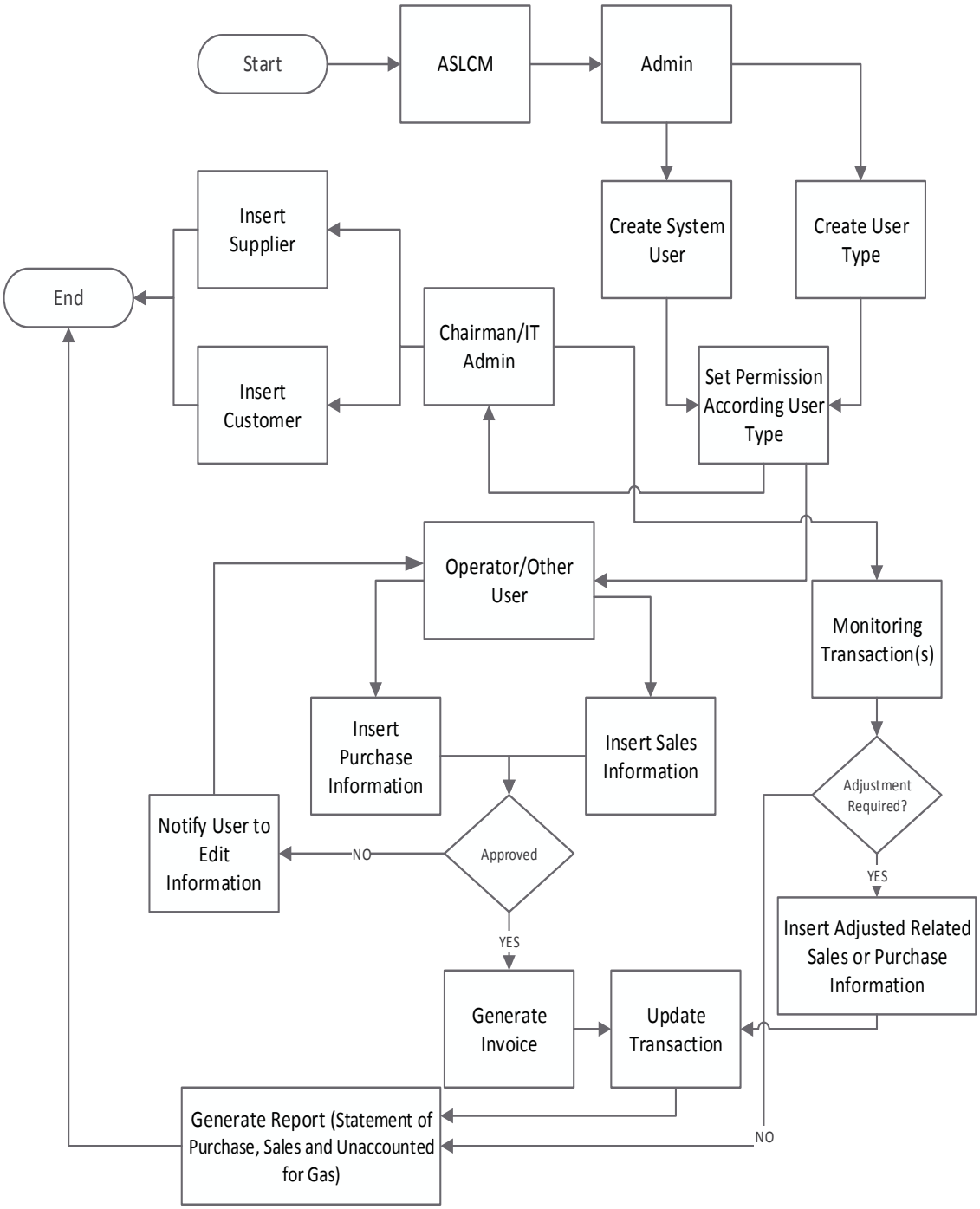


Figure-3.1: Workflow Diagram of Automated System Loss Calculation and Monitoring (ASLCM)

3.3 Use Case Diagram:

In the Unified Modeling Language (UML), a use case diagram can summarize the details of a system's users and their interactions with the system. Use Case Diagrams (UCD) is used to describe the functionality of a system in a horizontal way. That is, rather than merely representing the details of individual features of a system, UCDs can be used to show all of its available functionality. It is important to note, that UCDs are fundamentally different from sequence diagrams or flow charts because they do not make any attempt to represent the order or number of times that the systems actions and sub-actions should be executed.

A use case diagram in UML is use for:

- Representing the goals of system-user interactions
- Defining and organizing functional requirements in a system
- Specifying the context and requirements of a system
- Modeling the basic flow of events in a use case

3.3.1 User Management

The following Use Case Diagram Figure3.2: depicts that different user type is created by Admin and role wise user permission is also set by Admin.

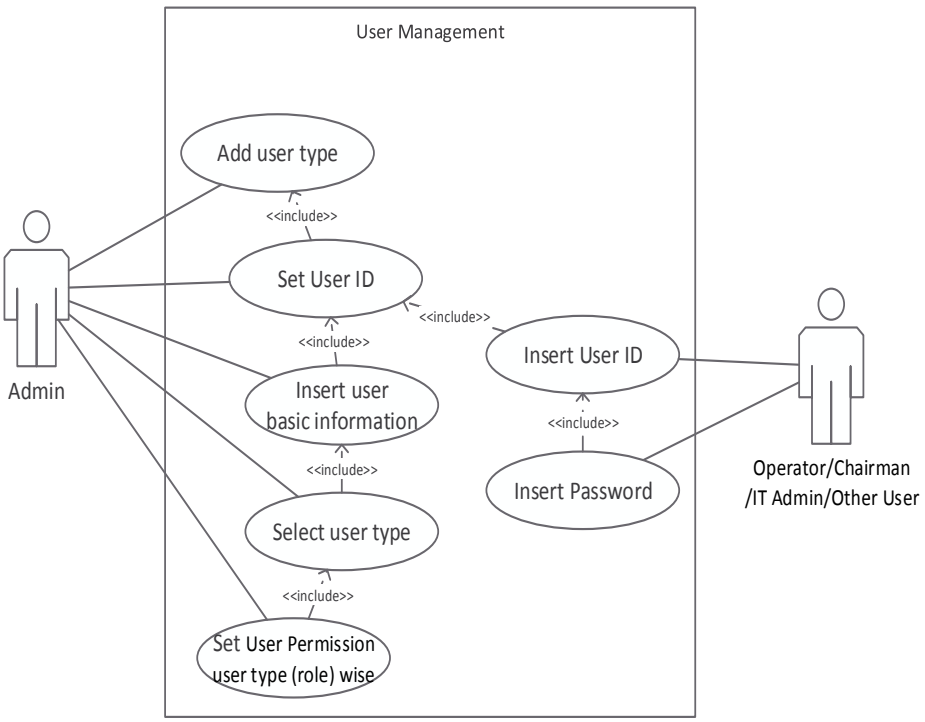


Figure-3.2: Use Case of User Management (Admin Part)

3.3.2 Supplier Management

The following Use Case Diagram Figure3.3: depicts that different Supplier type is created by Admin and designated user permission is also set by Admin.

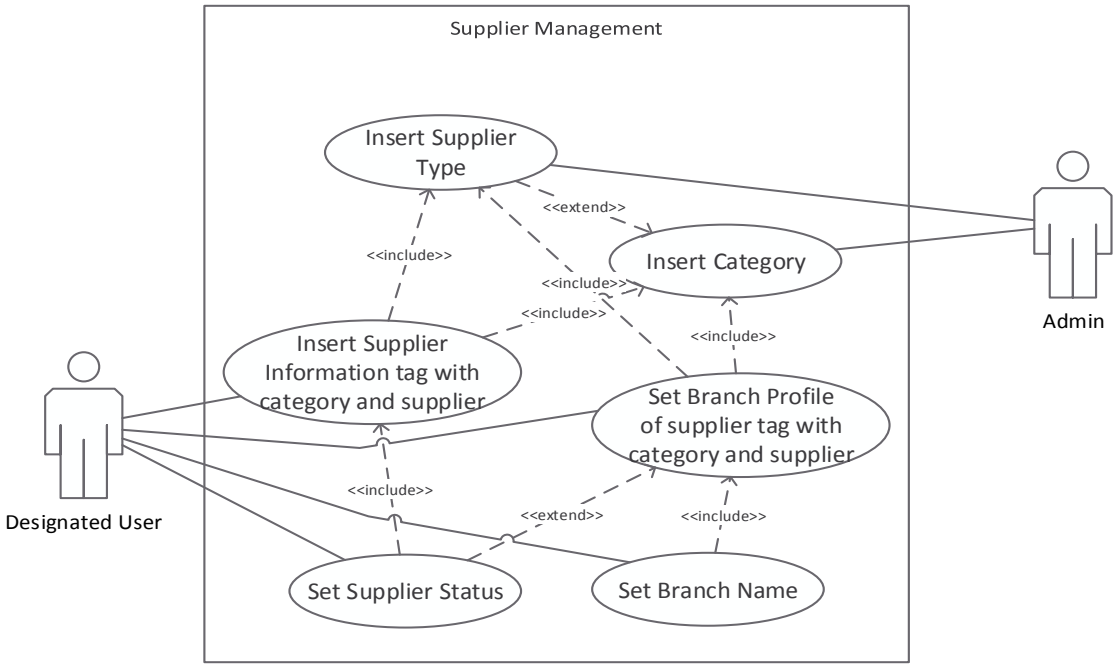


Figure-3.3: Use Case of Supplier Management (Supplier)

3.3.3 Customer Management

The following Use Case Diagram Figure3.4: depicts that different Customer type is created by Admin and designated user permission is also set by Admin.

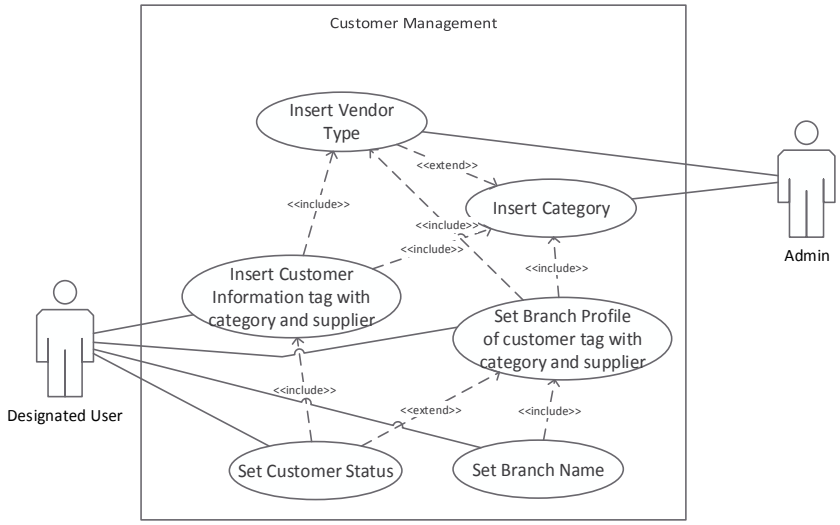


Figure-3.4: Use Case of Customer Management (Customer)

3.3.4 Invoice Management

The following Use Case Diagram Figure3.5: depicts that different Purchases and Sales type Invoice is created by Admin and designated user permission is also set by Admin.

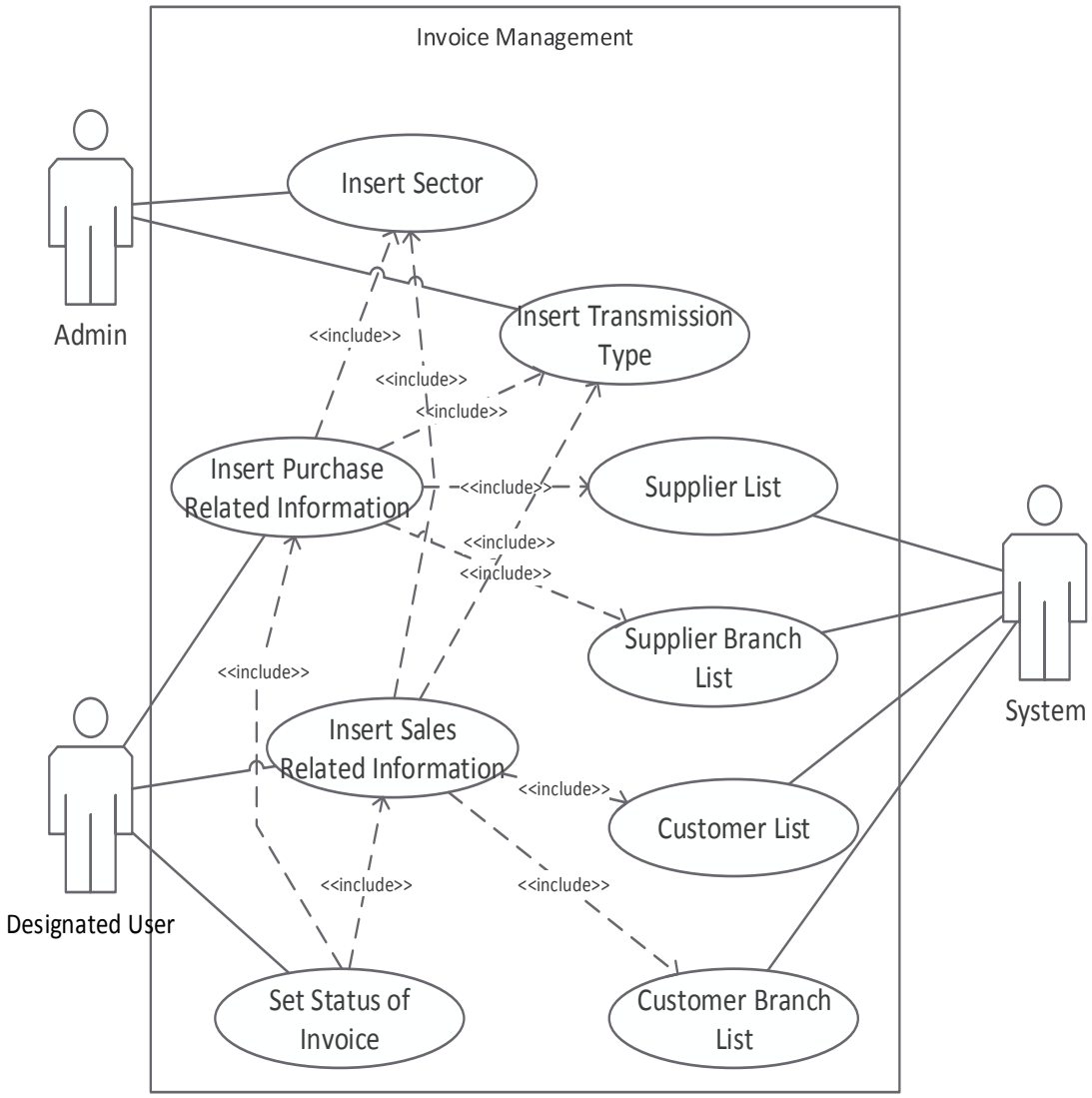


Figure-3.5: Use Case of Invoice Management (Purchase/Sales)

3.3.5 Adjustment of Purchase and Sales

The following Use Case Diagram Figure3.6: depicts that different Adjustment of Purchase and Sales is created by Admin and designated user permission is also set by Admin.

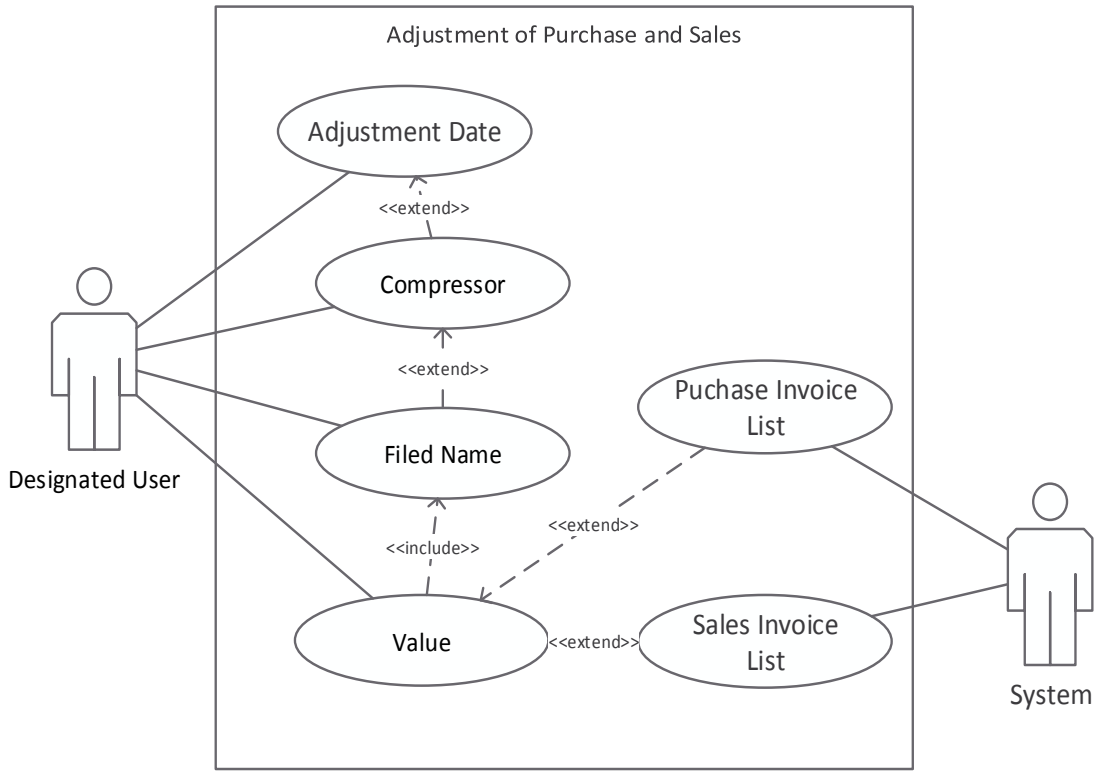


Figure-3.6: Use Case of Adjustment of Purchase and Sales

3.4 ERD (Entity Relationship Diagram)

An Entity Relationship (ER) Diagram is a type of flowchart that illustrates how "entities" such as people, objects or concepts relate to each other within a system. ER Diagrams are most often used to design or debug relational databases in the fields of software engineering, business information systems, education and research. An entity is a piece of data-an object or concept about which data is stored. The following Figure3.7: ER Diagram of ASLCM shows all the entities in my project with a relational structure among the "entities".

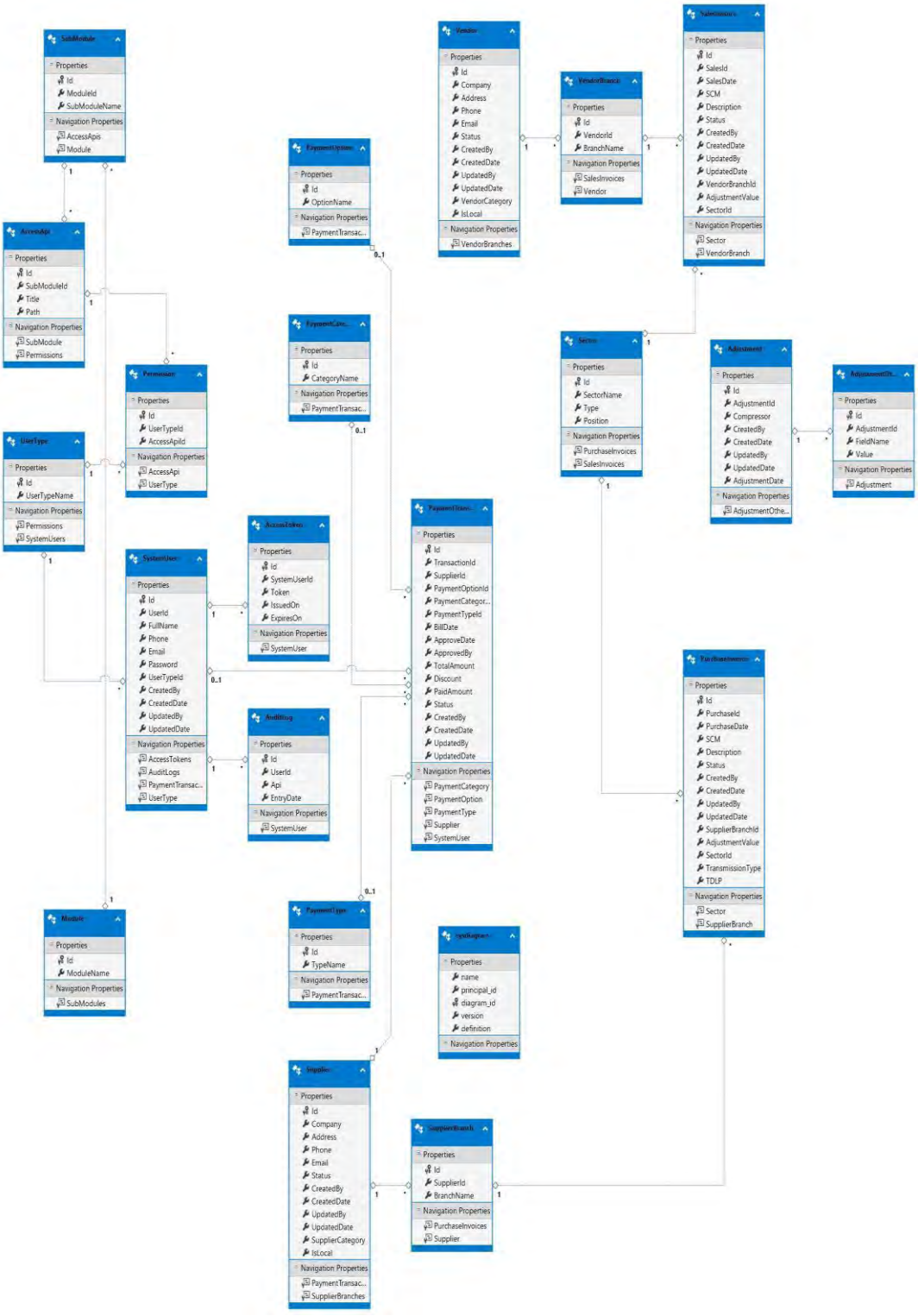


Figure-3.7: ER Diagram of ASLCM

3.5 Sequence Diagram

Sequence Diagrams are interaction diagrams that detail how operations are carried out. They capture the interaction between objects in the context of collaboration. Sequence Diagrams are time focus and they show the order of the interaction visually by using the vertical axis of the diagram to represent time what messages are sent and when.

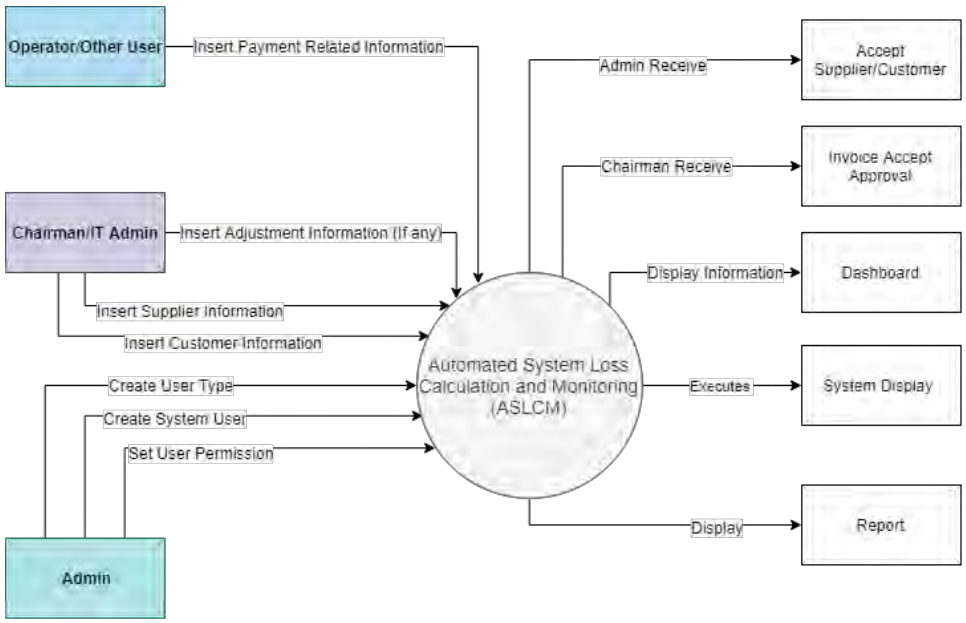


Figure-3.8: Sequence Diagram of ASLCM

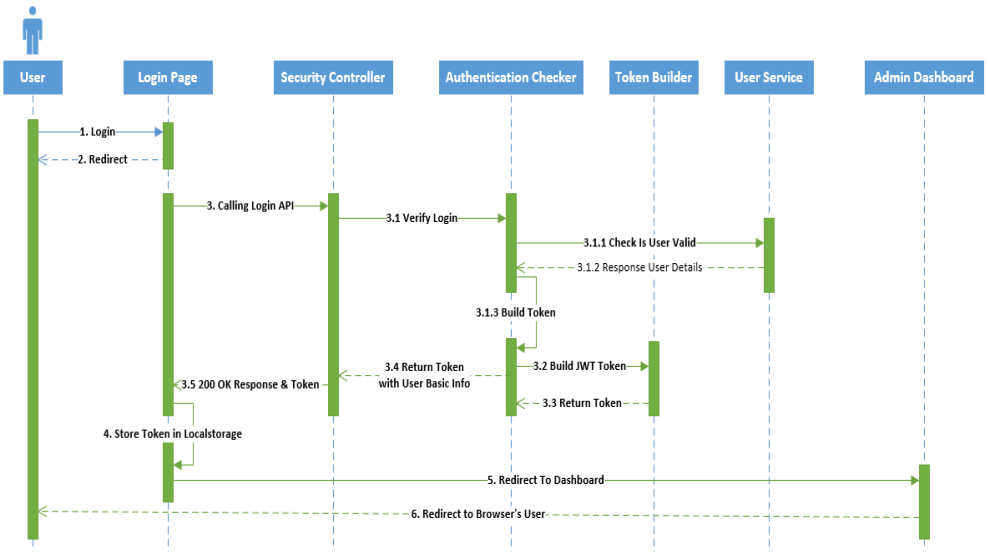


Figure-3.9: Sequence Diagram of Login System

3.6 Data Flow Diagram (DFD)

We usually begin withdrawing a context diagram, a simple representation of the whole system. To elaborate further from that, we drill down to a level 1 diagram with additional information about the major functions of the system. This could continue to evolve to become a level 2 diagram when further analysis is required. Progression to level 3, 4 and so on is possible but anything beyond level 3 is not very common. Please bear in mind that the level of detail asked for depends on a process change plan.

3.6.1 Context diagram (Level 0 DFD)

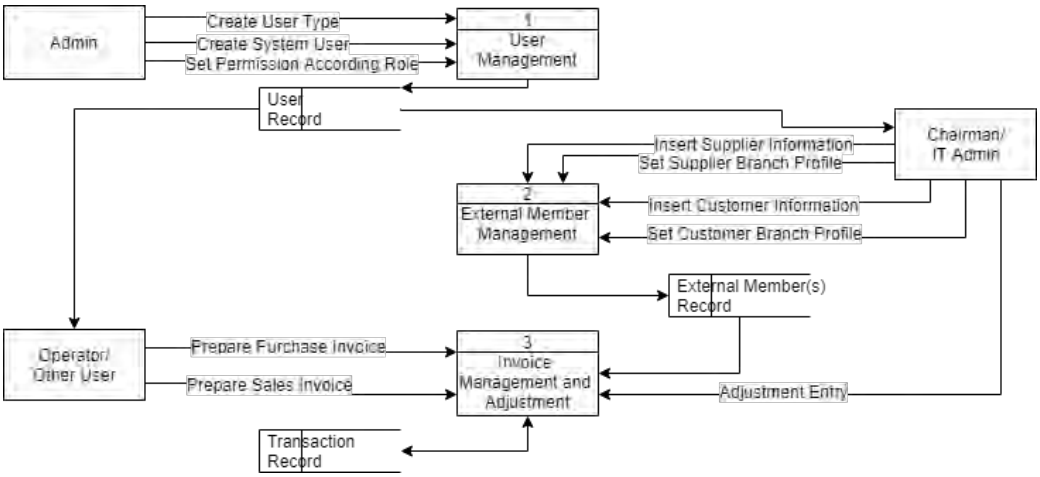


Figure-3.10: DFD Level 0 of ASLCM

In this DFD, we showed the diagram up to level 2. In level zero, we present three entity user management, external member management and invoice management and adjustment where as we break down invoice management and adjustment in level one and separate invoice management and adjustment and prepare two individual entities. Furthermore, in level two we break external member management and divide it by supply management and customer management.

3.6.2 Level 1 DFD

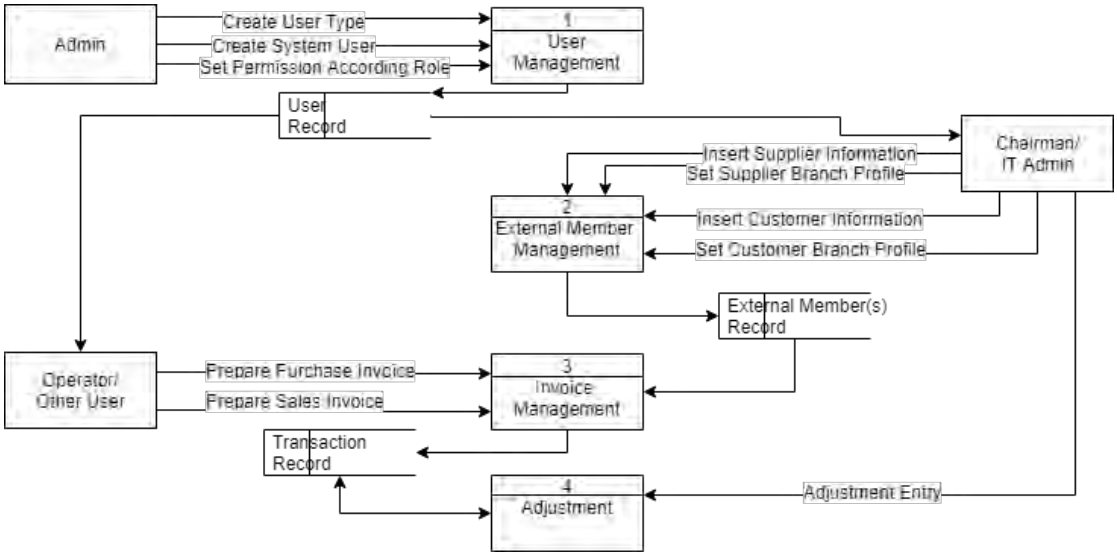


Figure-3.11: DFD Level 1 of ASLCM

3.6.3 Level 2- DFD

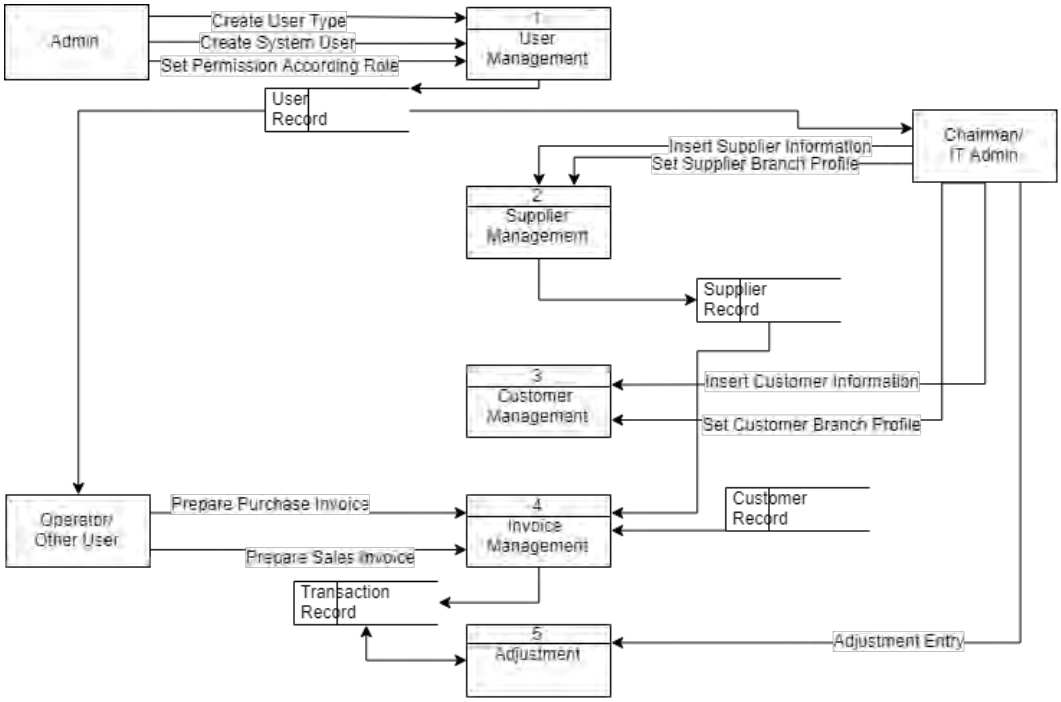


Figure-3.12: DFD Level 2 of ASLCM

3.7 Component Based Architecture Components (Server Side)

The Component Based Architecture Components (Server Side) is shown in the following Figure3.13: A brief Explanation about the each Component is given bellow:

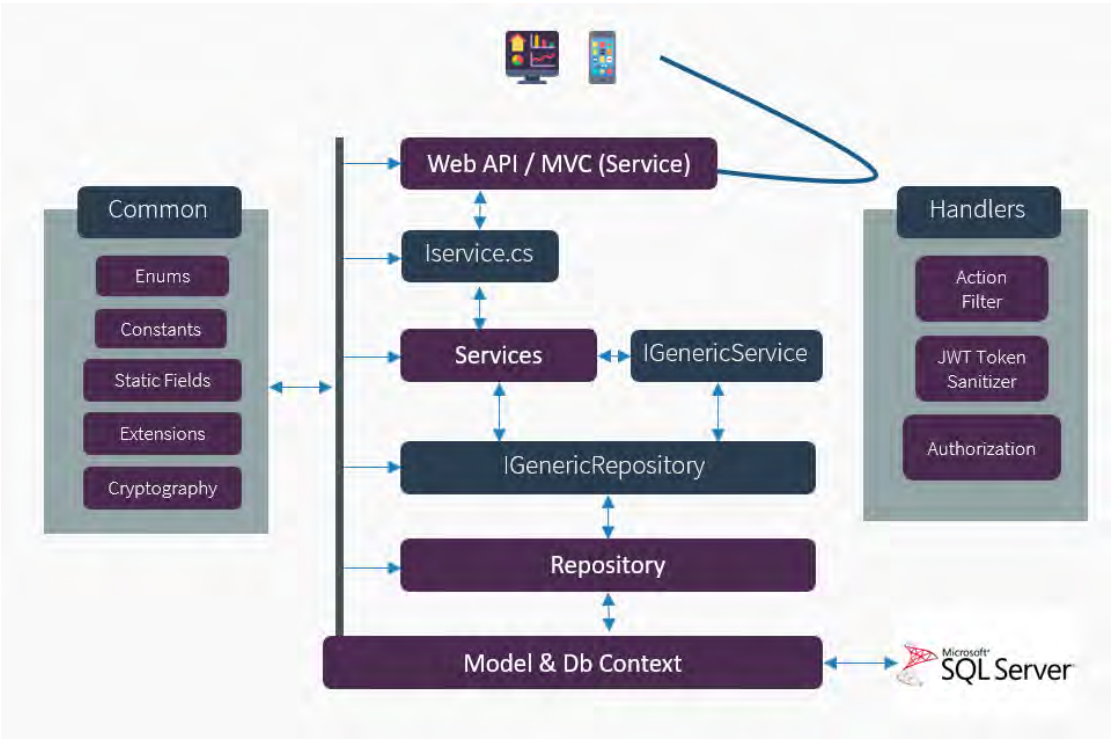


Figure-3.13: Component Based Architecture of the ASLCM

i. **Web API:** HTTP Request Handler (As Backend Application Service)

ii. **Model:** Model represents domain specific data. It maintains the data of the application. Model objects retrieve and store model state in the persistence store like a database. Model class holds data in public properties.

iii. **IService:** Interface between an API Controller and Service Class (Concrete Implementation). Interface resolves the dependency between two classes.

iv. **Service:** Represents the business logic of each model. Service structure with IGenericService and IGenericRepository.

v. **IGenericService:** This interface defines the common CRUD (Create, Read, Update& Delete) operations.

vi. **IGenericRepository:** Dependency resolver and an Abstract layer between Service Class and GenericRepository.

vii. **GenericRepository:** It is a data access pattern that prompts a more loosely coupled approach to data access. We create a generic repository, which queries the

data source for the data, maps the data from the data source to a business entity and persists changes in the business entity to the data source.

viii. **DbContext:** DbContext is the primary class that is responsible for interacting with the database. A DbContext instance represents a combination of the Unit of Work and Repository patterns such that it can be used to query from a database and group together changes that will then be written back to the store as a unit.

ix. **Action Filter:** Filter the http request before calling the API. Web API includes filters to add extra logic before or after-action method executes. Filters can be used to provide cross-cutting features such as logging, exception handling, performance measurement, authentication and authorization.

x. **JWT Token Sanitizer:** A JSON Web Token (JWT) is a JSON object that is defined in RFC 7519 as a safe way to represent a set of information between two parties. The token is composed of a header, a payload, and a signature.

xi. **Authorization:** Allowing the user to access routes, services, and resources that are permitted with that token. Authorization handled by Action Filter Attribute.

xii. **Enums:** An enumeration is a set of named integer constants. An enumerated type is declared using the **enum** keyword. Its helps to represent an integer value with a name.

xiii. **Constants** are fields whose values are set at compile time and can never be changed.

xiv. **Static Fields:** Static Fields are used by across the application, it's holds the data till application live.

xv. **Extensions:** Extension methods are static methods, which are called as if they were instance methods on the extended type. With Extension methods, you can add methods to existing types without even creating a new derived type, recompiling, or modifying the original type.

xvi. **Cryptography:** Cryptography deals with the actual securing of digital data. It refers to the design of mechanisms based on mathematical algorithms that provide fundamental information security services.

3.7.1 Features of ASP.NET Web API:

- Support All Architecture
- Separation of Design Concern
- Focus on Data
- POST, GET, DELETE, PUT etc.
- Reduce Memory Cost
- Request Filter Facility
- No HTML Anymore
- Response JSON/XML
- System-to-System Interaction
- Smart Routing

3.7.2 Features of AngularJS:

- Mobile & Web App
- Single Page Application (SPA)
- Smart Routing
- Two Way Data - Binding
- Smart Response with Responsive Design
- Speed & Performance
- Module & Controller Based Development

3.8 System Testing

In this phase, the system is tested. Normally programs are written as a series of individual modules, these subjects to separate and detailed test. The system is then tested as a whole. The separate modules are brought together and tested as a complete system. The system is tested to ensure that interfaces between modules work (integration testing), the system works on the intended platform and with the expected volume of data (volume testing) and that the system does what the user requires. As we introduce new code, tests ensure that our API is working as intended. We can write and run tests in Postman for each request. In the Postman app, the request builder at the top contains the Tests tab where we write our tests. The response viewer at the bottom contains a corresponding Test Results tab where we can view the results of our tests.

3.9 Characteristic of the Proposed System

The web-based automated system loss calculation and monitoring system has following features:

- In comparison to the present system the proposed system will be less time consuming and is more efficient.
- Analysis will be very easy in proposed system as it is automated.
- News and notification will be declared in very short span of time by using Email or SMS.
- Information of the users is stored and can be kept as back up for future use.

3.10 Uses of System and Limitation

3.10.1 System Administrator

Admin of the user have all the permissions. A system administrator, or sys admin, is a person who is responsible for the upkeep, configuration, and reliable operation of computer systems; especially multi-user computers, such as servers. The system administrator seeks to ensure that the uptime, performance, resources, and security of the computers and manage the needs of the users, without exceeding a set budget when doing so. To meet these needs, a system administrator may acquire, install, or upgrade computer components and software; provide routine automation; maintain security policies; troubleshoot; train or supervise staff; or offer technical support for projects.

3.10.2 Limitations

Anticipated issues or limitations during the implementation, without effective training, the IT personnel might end up in improper configuration of software and inefficient backup and recovery solutions.

3.11 Distributed Cache

We can store the generated token for authorization check in RAM's cache, so that data can retrieve more quickly. Caching is the process of storing some data in Cache. Cache is a temporary storage component area where the data is stored so that in future, Data can be served faster. Now the system filters the token in run-time request.

Chapter 4

Results and Discussions

4.1 Introduction

This Chapter covered the data presentation, analysis, and interpretation section. We present the results, show the analysis, and interpret the outcome of the analysis.

Web page design is the process of organizing content and images on a web page for the purpose of viewing System loss calculation and monitoring of Titas gas across this website.

4.2 User Login

This page is made for security purpose. So an authentic user only has an access in to the project. User can login into the system using user id and password and inserted information must be matched with database if match user successfully, then server will response with an encrypted token to the client, client keeps the token to browser local storage, and the token contains some confidential info like user id, type, token expire time. If the user credential is invalid, then server will through the 401 unauthorized responses.

Input:

Sl. No	Input	Data Type	Processing	Remarks
1	User ID	Alphanumeric	Mandatory	
2	Password	Alphanumeric	Mandatory	

Output: Login Page: The following Figure:4.1 shows the ASLCM Login Page

Register user login into the system (dashboard) using user id and password. And browser keeps the response token for coming http request.

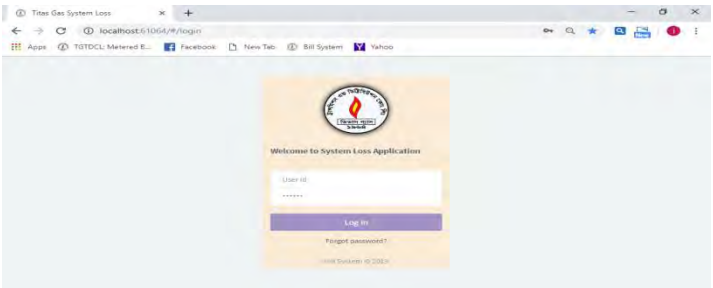


Figure 4.1: ASLCM Login Page

4.3 Dashboard:

After Successfully login by the Authentic User according to Figure-4.2: ASLCM Dashboard is appeared in front of user. If a user is authenticate, it will see dashboard panel base on their user role.

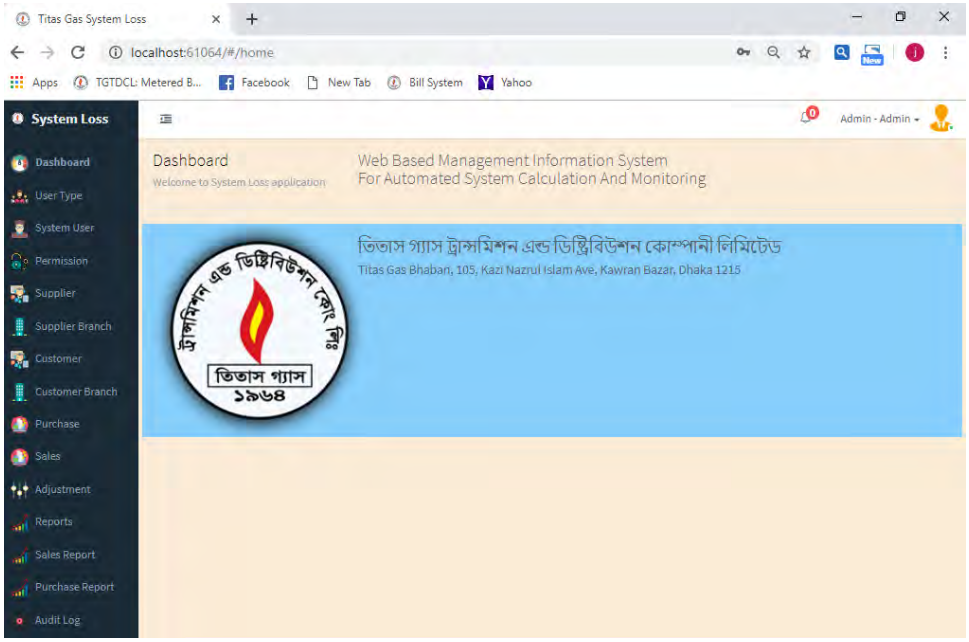


Figure 4.2: ASLCM Dashboard

4.4 Add User Type:

New user can be inserted into the system from user type and based on the requirement and demand. Admin can inserted new user type. User Type helps to create group of users for the authorization module.

Input:

Sl. No	Input	Data Type	Processing	Remarks
1	User ID	Numeric	Mandatory	ID automatically generate from the system
2	User Type	Alphanumeric	Mandatory	

Output: New user type inserted into the system successfully and then the following Figure-4.3: shows the ASLCM User type Page is appeared in front of user.

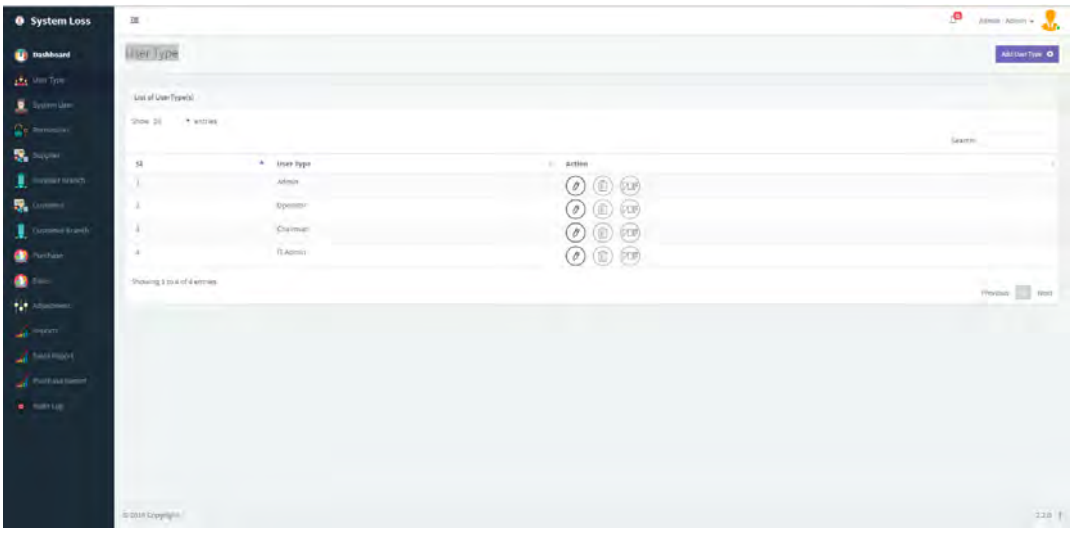


Figure 4.3: ASLCM Insert User Type

4.5 System User:

New system user inserted into the system and each user must tag with a created user type. Without a user type new user can't be created.

Input:

Sl. No	Input	Data Type	Processing	Remarks
1	User ID	Alphanumeric	Mandatory	User ID must be unique.
2	Full Name	Alphanumeric	Mandatory	
3	Phone	Alphanumeric	Mandatory	
4	Email	Alphanumeric	Mandatory	
5	Password	Alphanumeric	Mandatory	
6	Confirm Password	Alphanumeric	Mandatory	Only for client-side validation
7	User Type	int	Mandatory	Dropdown appear based on user type list

Output: Successfully new user inserted into the system and then the following Figure-4.4: ASLCM insert System User Page is appeared in front of user.

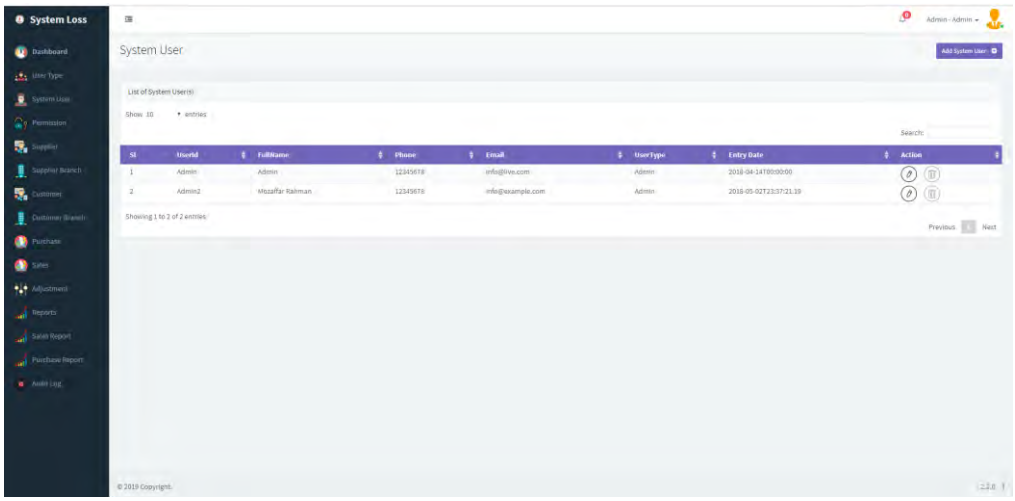


Figure 4.4: ASLCM insert System User

4.6 Permission:

Permission features structured with user type, module, sub-module and access API. By this module we can assign allowable access API to the required user type. Access API grouped by sub-module and sub-module grouped by Module. Once the permission assigned to specific user type, all user of that user type will be authorized for specific module. When user makes any operation with an API, the system will detect the user type and check the authorization records in run-time. There is no HTTP session has been used, we can say token as a temporary session for authorization.

Input:

Sl. No	Input	Data Type	Processing	Remarks
1	User Type	int	Mandatory	
2	Functions	Alphanumeric	Mandatory	

Output: New permission given to the user type. Figure-4.5: shows that ASLCM set permission according user type and that page is appeared in front of user. Colour box indicate Permission.

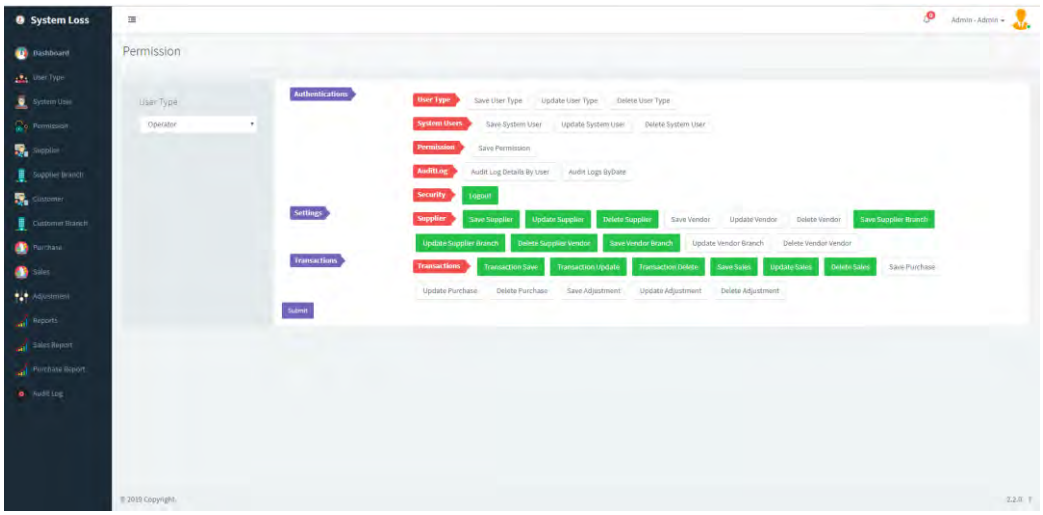


Figure 4.5: ASLCM set permission according user type

4.7 Supplier Profile:

To insert new supplier, need to fill a form along with some information of supplier(s). Supplier status can be set active or inactive. Before create supplier, profile need to create category and supplier type.

Input:

Sl. No	Input	Data Type	Processing	Remarks
1	Supplier Name	Alphanumeric	Mandatory	
2	Address	Alphanumeric	Mandatory	
3	Phone	Alphanumeric		
4	Email	Alphanumeric		
5	Category	int	Mandatory	Dropdown appear based on category list
6	Supplier Type	int	Mandatory	Dropdown appear based on supplier type list
7	Status	byte	Mandatory	Select Active or Inactive

Output: New supplier added into the system successfully and then the following Figure-4.6: ASLCM Set supplier profile Page is appeared in front of user.

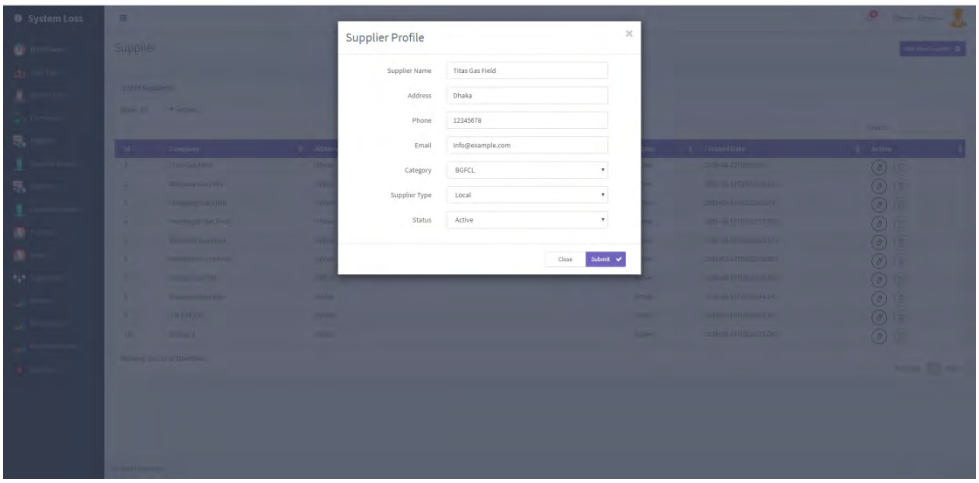


Figure 4.6: ASLCM Set supplier profile

4.8 Branch Profile (Supplier):

Each branch crated based on inserted category and supplier. To set branch profile need to give a branch name.

Input:

Sl. No	Input	Data Type	Processing	Remarks
1	Category	int	Mandatory	Dropdown appear based on user type list
2	Supplier	int	Mandatory	Dropdown appear based on user type list
3	Branch Name	Alphanumeric	Mandatory	

Output: Branch Profile inserted successfully to the system and then the following Figure-4.7: Set supplier branch Page is appeared in front of user.

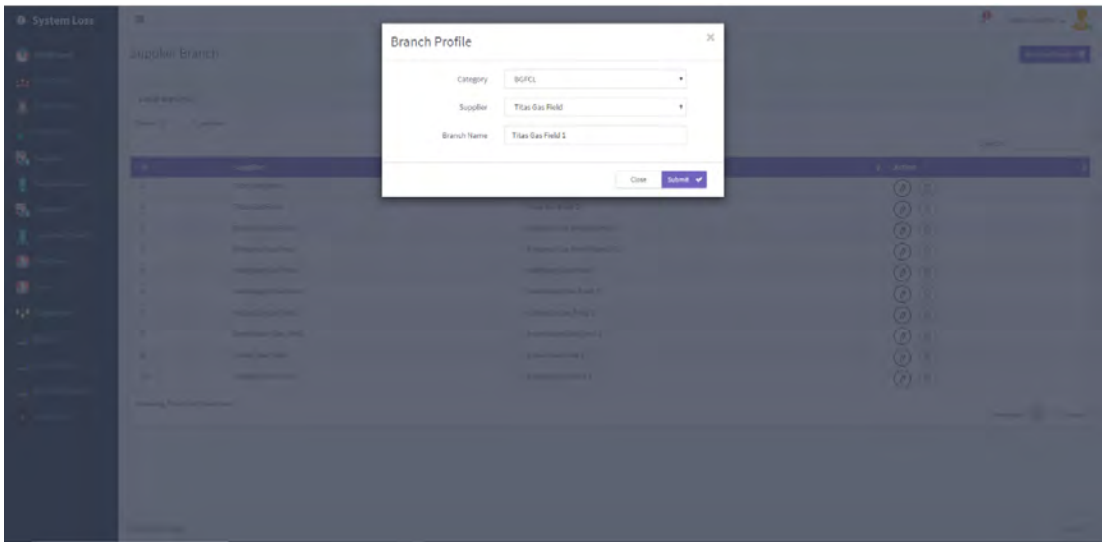


Figure 4.7: Set supplier branch

4.9 Customer Profile:

To insert new customer, need to fill an entry form along with his/her required information. Moreover, customer status can be set active or inactive.

Input:

Sl No	Input	Data Type	Processing	Remarks
1	Company	Alphanumeric	Mandatory	
2	Address	Alphanumeric	Mandatory	
3	Phone	Alphanumeric	Mandatory	
4	Email	Alphanumeric	Mandatory	
5	Category	int	Mandatory	Dropdown appear based on category list
6	Vendor Type	int	Mandatory	Dropdown appear based on vendor type list
7	Status	byte	Mandatory	Select Active or Inactive

Output: Successfully inserted customer information and set a profile for each customer and then the following Figure-4.8: ASLCM create customer profile Page is appeared in front of user.

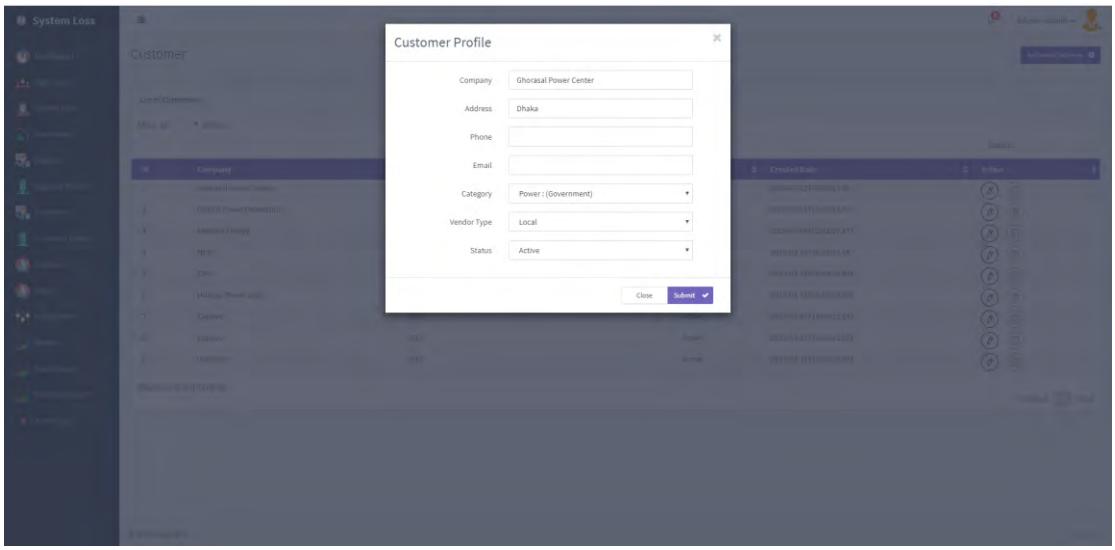


Figure 4.8: ASLCM create customer profile

4.10 Branch Profile (Customer):

Each customer under which branch easily can be identified and monitor from the system. Based on the input branch profile show in a list.

Input:

Sl. No	Input	Data Type	Processing	Remarks
1	Category	int	Mandatory	Dropdown appear based on user type list
2	Customer	int	Mandatory	Dropdown appear based on customer list
3	Branch Name	Alphanumeric	Mandatory	

Output: Branch profile successfully into the system and then the following Figure-4.9: ASLCM Customer Branch Page is appeared in front of user.

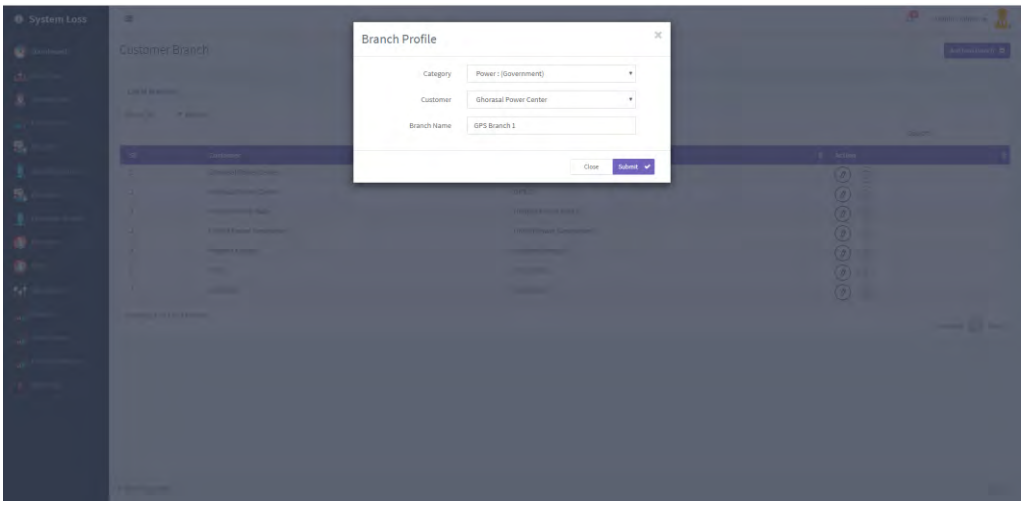


Figure 4.9: Set customer branch

4.11 Purchase Invoice:

How much amount purchased an invoice required and this invoice information must insert into the system. So that in future purchase and sales discrepancy easily can be identified.

Input:

Sl. No	Input	Data Type	Processing	Remarks
1	Purchase ID	Alphanumeric	Mandatory	ID automatically generate from the system
2	Sector	int	Mandatory	Dropdown appear based on Sector list
3	Category	int	Mandatory	Dropdown appear based on Category list
4	Supplier	int	Mandatory	Dropdown appear based on Supplier list
5	Supplier Branch	int	Mandatory	Dropdown appear based on Supplier Branch list
6	Purchase Date	DateTime	Mandatory	
7	SCM (Standard cubic meter)	Numeric	Mandatory	
8	Adjustment	Numeric	Mandatory	
9	Transmission Type	byte	Mandatory	Dropdown appear based on Transmission Type list
10	TDLP (Transmission and distribution loss percentage)	Numeric	Mandatory	
11	Description	Alphanumeric	Mandatory	
12	Status	byte	Mandatory	Select Active or Inactive

Output: Successfully Purchase Invoice inserted into the system and then the following Figure-4.10: ASLCM insert purchase invoice information Page is appeared in front of user.

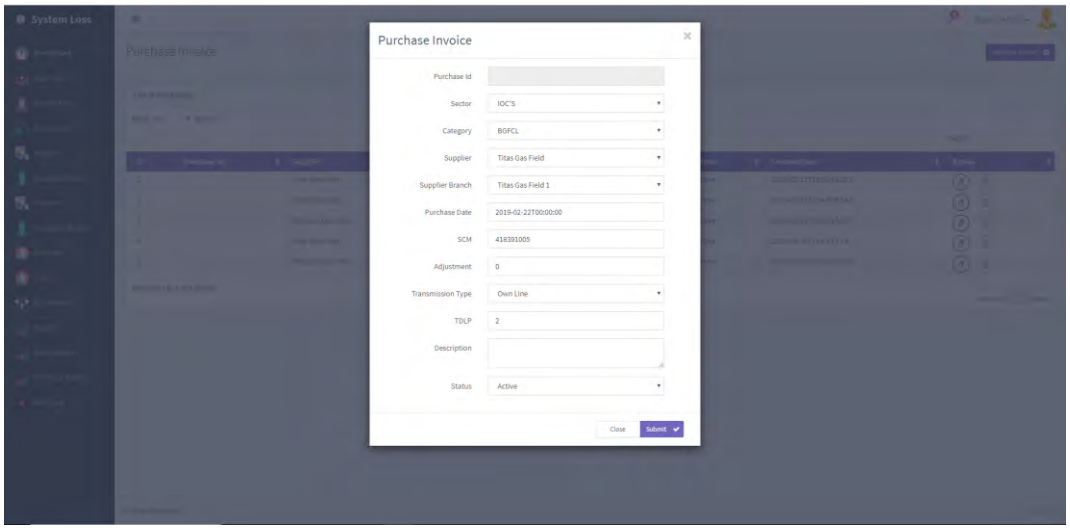


Figure 4.10: ASLCM insert purchase invoice information

4.12 Sales Invoice:

How much amount sales an invoice required, and this invoice information must insert into the system? So that in future sales and purchase discrepancy easily can be identified.

Input:

Sl. No	Input	Data Type	Processing	Remarks
1	Sales ID	Alphanumeric	Mandatory	ID automatically generate from the system
2	Sector	byte	Mandatory	Dropdown appear based on Sector list
3	Category	int	Mandatory	Dropdown appear based on Category list
4	Customer	int	Mandatory	Dropdown appear based on Customer list
5	Customer Branch	int	Mandatory	Dropdown appear based on Customer Branch list
6	Sales Date	DateTime	Mandatory	
7	SCM (Standard cubic meter)	Numeric	Mandatory	
8	Adjustment	Numeric	Mandatory	
9	Description	Alphanumeric	Mandatory	
10	Status	byte	Mandatory	Select Active or Inactive

Output: Successfully sales invoice inserted into the system and then the following Figure-4.11: ASLCM insert sales invoice information Page is appeared in front of user.

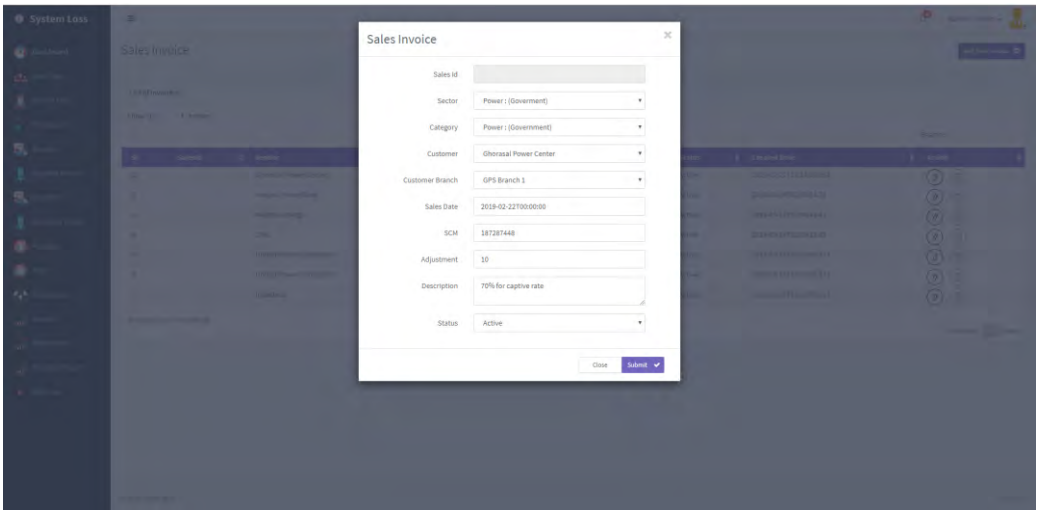


Figure 4.11: ASLCM insert sales invoice information

4.13 Adjustment:

If any adjustment required because of surplus or deficit amount in consume and supply must insert into the system so that gap between this two easily can be identified.

Input:

Sl No	Input	Data Type	Processing	Remarks
1	Adjustment ID	Alphanumeric	Mandatory	ID automatically generate from the system
2	Adjustment Date	DateTime	Mandatory	
3	Compressor	Numeric	Mandatory	
4	Filed Name	Alphanumeric	Mandatory	
5	Value	Numeric	Mandatory	

Output: Surplus or deficit amount can be easily identified and then the following Figure-4.12: ASLCM Adjustment of Purchase and Sales Page is appeared in front of user.

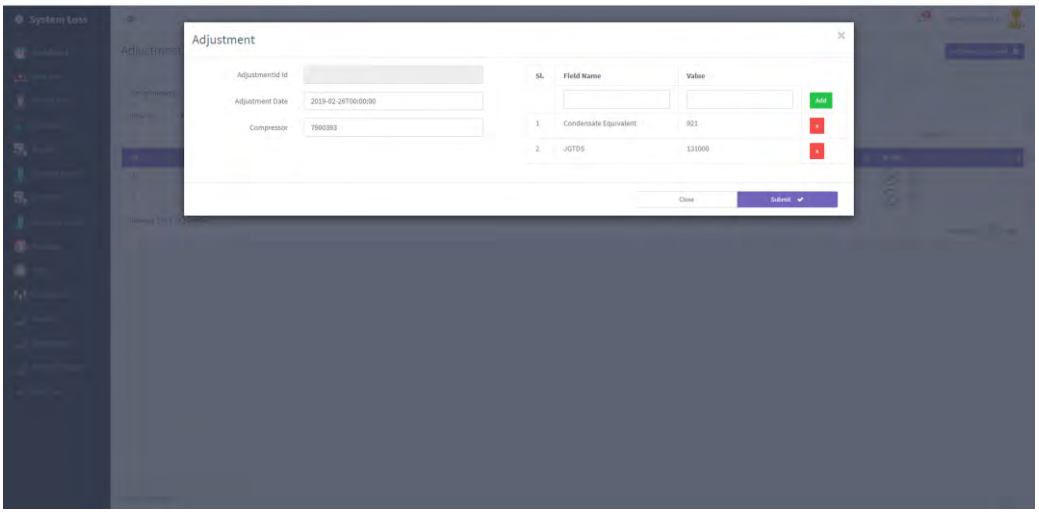


Figure 4.12: ASLCM Adjustment of Purchase and Sales

4.14 Report

Statement of Purchase Sales and Unaccounted for Gas. An option is included here for generate two types of Report that is Details Report and Summary Report.

Search Parameter

- Details Report
- Summary Report
  - Start Date
  - End Date

Titas Gas Transmission and Distribution Co. Ltd.

105, KaziNazrul Islam Avenue

Kawran Bazar C/A. Dhaka-1215

Statement of Purchase, Sales and Unaccounted for Gas for the Month of Dec 20XX.

Purchase		**Sales**	
Total Purchase		Total Sales	
GTCL's compressor station use		Others	
Net Purchase		Sub Total	
		Total Sales	
		Total System Loss (in percentage)	
		##Allowable transmission and distribution loss (in percentage)	
		UFG (in percentage)	

Output: The following Figure-4.13 & 4.14: ASLCM purchase and sales report that represent the monthly system loss calculation in the Details format and Summary format.

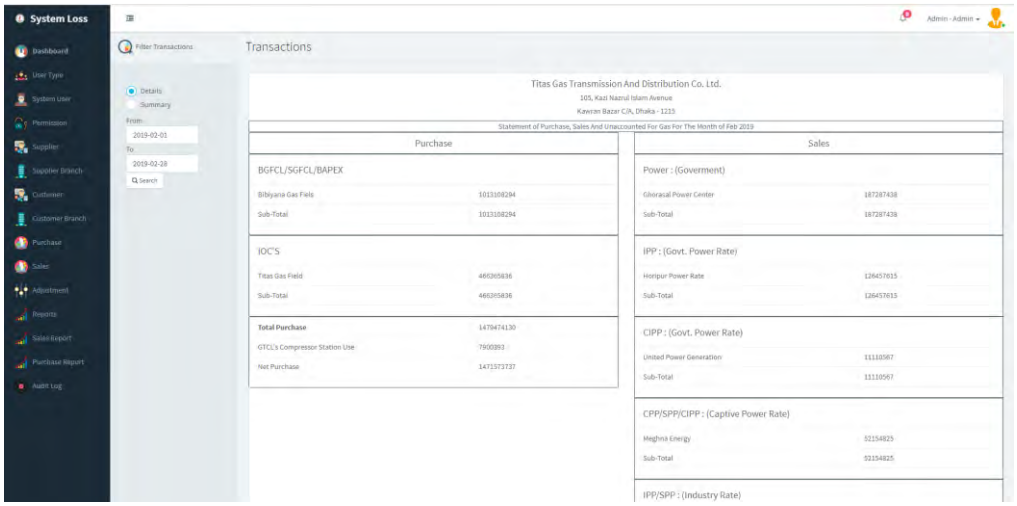


Figure 4.13: ASLCM purchase and sales report: Details

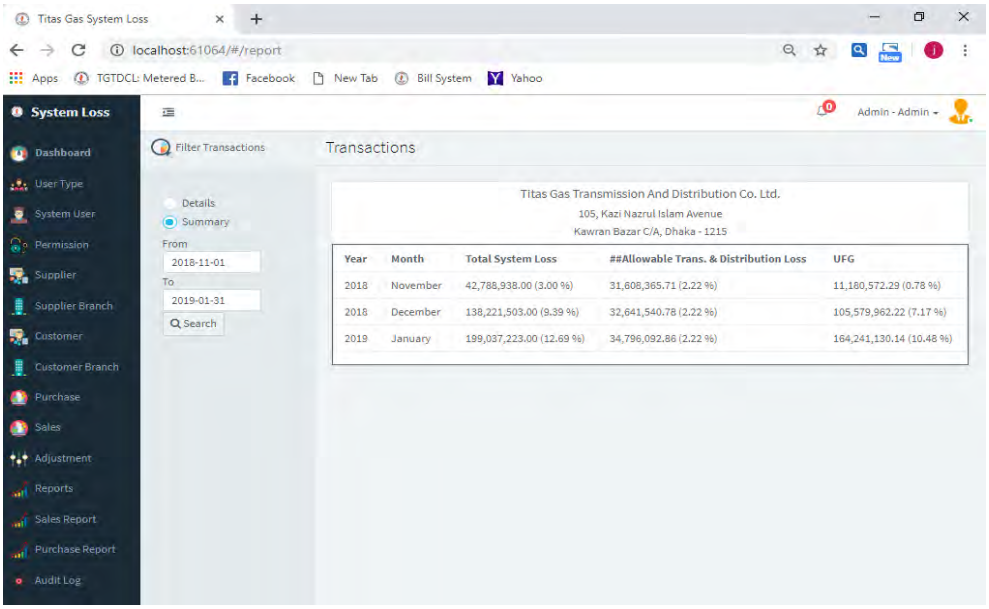


Figure 4.14: ASLCM System loss report: Summary

4.15 Purchase Report: The following Figure-4.15: ASLCM purchase report show the purchase of gas of a categorically customer.

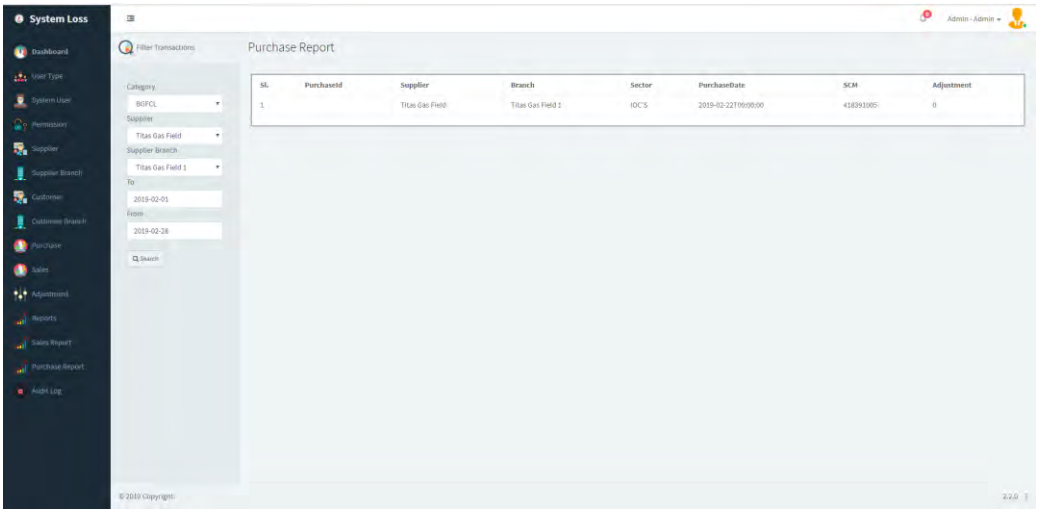


Figure 4.15: ASLCM purchase report

4.16 Sales Report: The following Figure-4.16: ASLCM sales report show the sales of gas of a categorically customer.

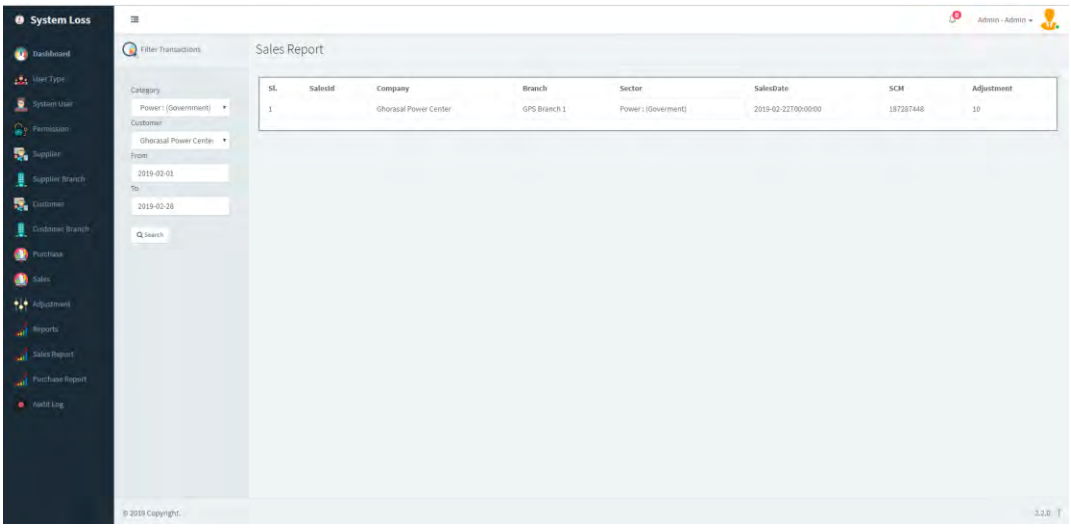


Figure 4.16: ASLCM sales report

4.17 Audit Log:

Audit logs means to examine what activities have occurred on the system and are typically used for diagnostic performance and error correction. System Administrators, network engineers, developers, and help desk personnel all use this data to aid them in their jobs and maintain system stability. A log file event will indicate what action was attempted and if it was successful. This is critical to check during routine activities like updates and patching, and also to determine when a system component is failing or incorrectly configured. The following Figure: ASLCM Auditlog file show the event that indicate what action was attempted.

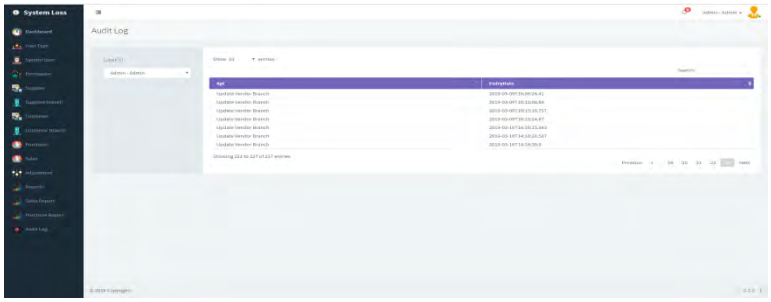


Figure 4.17: ASLCM Audit log

4.18 System Test: Postman

The following Figure:4.18 show that the system is tested by Postman method where the get and post method applied. From the test of Postman the response is accepted found without error.

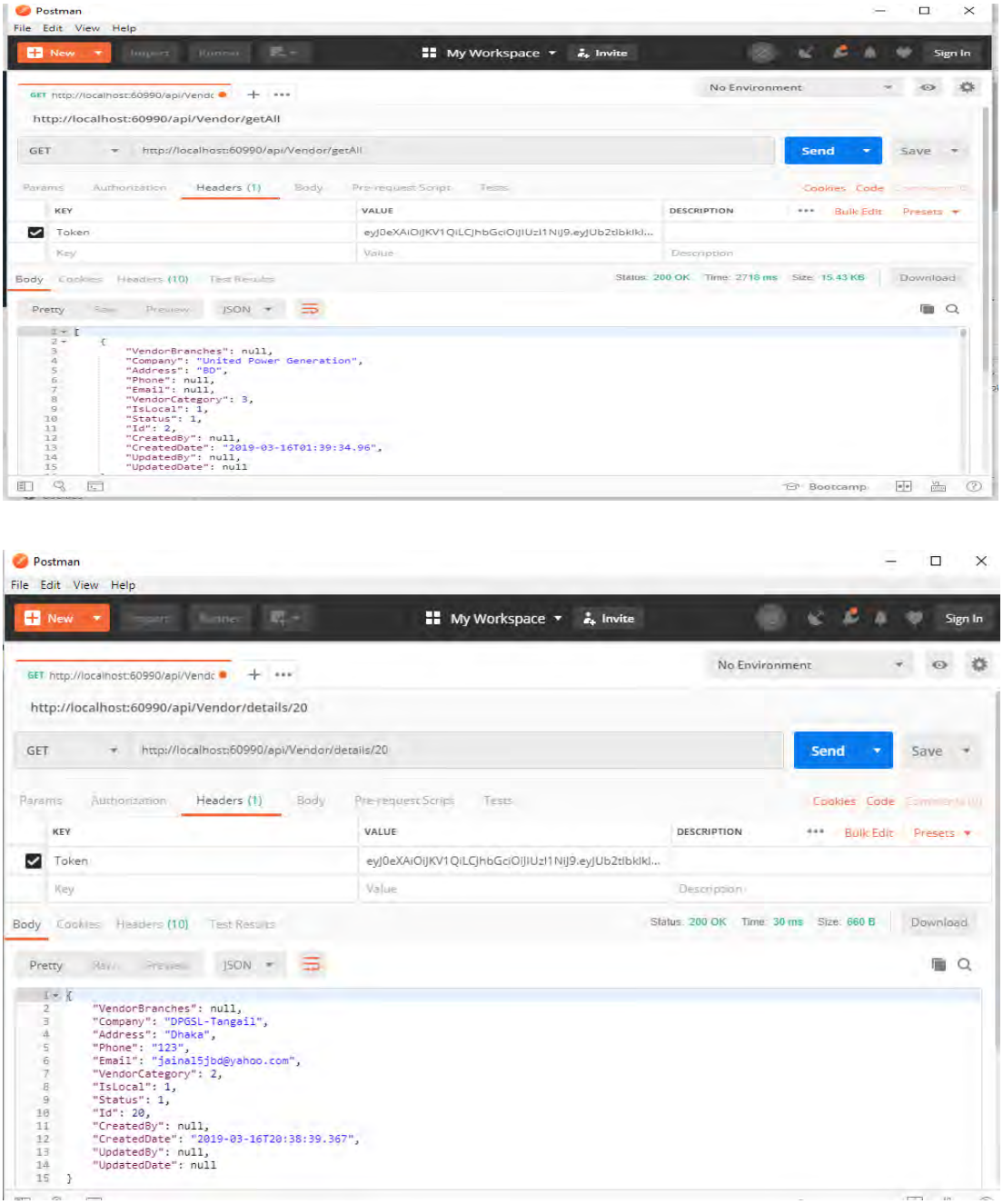


Figure 4.18: ASLCM System Test by Postman

Chapter 5
Conclusion

5.1 Conclusion

System loss is now a burning issue for Gas distribution companies under PETROBANGLA. The government of Bangladesh should promote adequate skills and expertise among the personnel employed in the entire gas sector to ensure efficiency and farsightedness in the management of the gas sector. All-out endeavors should be undertaken to combat system loss by all the people concerned, chalking out appropriate plans and course of action. The objective of the project is to introduce information and communication technology to calculate the system loss at the right time for properly monitoring by the concerned officers of the company. A full feature web based Automated System Loss Calculation and monitoring (ASLCM) software system is developed under this project. The software is user friendly and device responsive. It can be accessed from anywhere using any electronic device and the concerned officers can perform his actions. Then from the information and data stored in the system, system loss can be calculated and viewed. Then we can analysis gas purchase from different gas field under different gas Company and also gas consumption of different categories of customer on the monthly basis. It also helps the Top Management to compare gas purchase, gas consumption and over all the system loss from different month to month what is very important to find out the gap between purchase and sale. Thus it can eliminate human intervention in data creation of consumer metering and can be used to fight against the misuse of gas due to maintain a database.

5.2 Suggestion for Future Work

There are many new features that can be added to the software system as presented in this report such as to calculate the system loss according to category and department which play an important role to reduce system loss. At present due to Reading collection problems of different department of TGTDCL we cannot calculate the system loss departmentally but there is a scope to apply in future.

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Appendix A

Some .Net and HTML code segments

.Net and HTML code for Home page of the proposed system

```
<!DOCTYPE html>

<html ng-app="billApp">

<head>

<meta charset="utf-8" />

<title>Bill System</title>

<meta name="description" content="Accounting" />

<meta name="viewport" content="width=device-width, initial-scale=1, maximum-
scale=1" />

<link href="assets/img/logo.png" rel="shortcut icon">

<!--Angular theme related css-->

<link rel="stylesheet" href="assets/angularTheme/libs/assets/animate.css/animate.css"
type="text/css" />

<link rel="stylesheet" href="assets/angularTheme/libs/assets/font-awesome/css/font-
awesome.min.css" type="text/css" />

<link rel="stylesheet" href="assets/angularTheme/libs/assets/simple-line-
icons/css/simple-line-icons.css" type="text/css" />

<link rel="stylesheet"
href="assets/angularTheme/libs/jquery/bootstrap/dist/css/bootstrap.css"
type="text/css" />

<link rel="stylesheet" href="assets/angularTheme/css/app.min.css" type="text/css" />

<!--Datatable related css-->

<link href="assets/datatableAngular/angular-datatables.min.css" rel="stylesheet" />

<link href="assets/datatableAngular/dataTables.bootstrap.css" rel="stylesheet" />



<!--SweetAlertcss, jasnyBootstrap-->

<link href="assets/sweetalert/sweetalert.css" rel="stylesheet" />
```

```
<link href="assets/jasnyBootstrap/css/jasny-bootstrap.min.css" rel="stylesheet" />
<link href="assets/toastr/angular-toastr.css" rel="stylesheet" />
</head>
<body>
<!--Rendering ui-view-->
<div class="app app-header-fixed ">
<div ui-view></div>
</div>
<!--Angular theme js-->
<script src="assets/angularTheme/js/app.min.js"></script>
<!--Datatable related js -->
<script src="assets/datatableAngular/jquery.min.js"></script>
<script src="assets/datatableAngular/jquery.dataTables.min.js"></script>
<script src="assets/angular/angular.min.js"></script>
<script src="assets/datatableAngular/angular-datatables.min.js"></script>
<!--Ui-router related js-->
<script src="assets/angular-ui-router/angular-ui-router.min.js"></script>
<!--Ui-bootstrap for modal js-->
<script src="assets/angular-ui-router/ui-bootstrap-tpls-2.5.0.min.js"></script>
<!--SweetAlertjs, jasnyBootstrap-->
<script src="assets/sweetalert/sweetalert.min.js"></script>
<script src="assets/jasnyBootstrap/js/jasny-bootstrap.min.js"></script>
<script src="assets/toastr/angular-toastr.tpls.min.js"></script>
<script src="assets/angular-base64/angular-base64.js"></script>
<!--main app.js and customDirectives.js-->
<script src="app.js"></script>
<script src="directives/customDirectives.js"></script>
```

```
<script src="common/constants.js"></script>
<!--All services and controllers-->
<script src="controller/homeController.js"></script>
<script src="services/transactionServices.js"></script>
<script src="controller/transactionController.js"></script>
<script src="services/userTypeServices.js"></script>
<script src="controller/userTypeController.js"></script>
<script src="services/systemUserServices.js"></script>
<script src="controller/systemUserController.js"></script>
<script src="controller/permissionController.js"></script>
<script src="services/permissionServices.js"></script>
<script src="services/loginServices.js"></script>
<script src="controller/loginController.js"></script>
<script src="controller/commonController.js"></script>
<script src="services/supplierServices.js"></script>
<script src="controller/supplierController.js"></script>
<script src="services/supplierBranchServices.js"></script>
<script src="controller/supplierBranchController.js"></script>
<script src="services/transactionServices.js"></script>
<script src="controller/transactionController.js"></script>
<script src="services/paymentOptionServices.js"></script>
<script src="services/paymentCategoryServices.js"></script>
<script src="services/paymentTypeServices.js"></script>
<script src="services/auditLogServices.js"></script>
<script src="controller/auditLogController.js"></script>
<script src="services/vendorServices.js"></script>
<script src="controller/vendorController.js"></script>
```

```
<script src="services/vendorBranchServices.js"></script>
<script src="controller/vendorBranchController.js"></script>
<script src="services/salesInvoiceServices.js"></script>
<script src="controller/salesInvoiceController.js"></script>
<script src="services/purchaseServices.js"></script>
<script src="controller/purchaseInvoiceController.js"></script>
<script src="services/sectorServices.js"></script>
<script src="services/adjustmentServices.js"></script>
<script src="controller/adjustmentController.js"></script>
<script src="controller/reportController.js"></script>
<script src="https://cdn.plot.ly/plotly-latest.min.js"></script>
</body>
</html>
```