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INTERNATIONAL ATOMIC ENERGY AGENCY

REPORT OF THE

ORPAS

OCCUPATIONAL RADIATION PROTECTION APPRAISAL SERVICE

MISSION

To the REPUBLIC OF GHANA

OCCUPATIONAL RADIATION PROTECTION APPRAISAL SERVICE

Conducted under IAEA Extra-budgetary Project and Technical Co-operation Project on Occupational
Radiation Protection

OCCUPATIONAL RADIATION PROTECTION APPRAISAL SERVICE

REPORT TO

THE GOVERNMENT OF REPUBLIC OF GHANA

Mission date: 5– 9 December 2016

Facilities and services: End-Users and Technical Service Providers

Location: Accra and Tema

Organised by: IAEA

ORPAS Team:

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(a)



(b)



(c)



(d)



Figure 1: ORPAS mission at (a) FOCOS (b) SGMC (c)NCRTNM
(d)Personnel Dosimetry Service

(a)



(b)



(c)



(d)



Figure 2: Photographs during ORPAS mission (a) SSDL (b)Engineering service (c) GSL and (d) Nick TC Scan

This mission was conducted under the Technical Cooperation Programme, using funds from the TC project RAF9057 - Strengthening National Capabilities on Occupational Radiation Protection in Compliance With Requirements of the New International Basic Safety Standards and the IAEA Extra Budgetary Project financed from USA: EBR-USA07-15-08: Strengthening Occupational Radiation Protection Appraisal Services (ORPAS) to the developing countries.

The number of recommendations, suggestions and good practices is in no way a measure of the occupational radiation protection status and arrangements of participating organisations in the hosting country. Comparisons of such numbers between ORPAS reports from different countries should not be attempted.

EXECUTIVE SUMMARY

At the request of the Government of the Republic of Ghana addressed to the International Atomic Energy Agency (IAEA) to conduct an Occupational Radiation Protection Appraisal Services (ORPAS) mission, the Agency organized the ORPAS in the Republic of Ghana during 5-9 December 2016 with a Team of three international experts that include a Team Leader and an Agency Coordinator. The Ghana Atomic Energy Commission (GAEC) acted as the national contact point for the mission.

The purpose of this mission was to appraise the regulatory and practical implementation of the occupational radiation protection arrangements in Ghana. Prior to this mission, a pre-mission was conducted to determine the participating organizations, arrange for a self-assessment by those organizations using the ORPAS questionnaires prepared by the Agency, and to agree upon the scope and dates of the mission. Accordingly, the organizations participated in the ORPAS mission were; the GAEC (national regulatory authority), one dosimetry service provider (GAEC), one Secondary Standard Dosimetry Laboratory (SSDL) (GAEC), various end-users including , a non-destructive testing company, four hospitals and the maintenance services in GAEC.

The review compared the Ghana's arrangements for occupational radiation protection against the IAEA Safety standards as the international benchmark for protection and safety. The mission was also used to exchange information and experience between the Team members and the Ghana's counterparts. GAEC provided the review team with advance materials that are relevant to the mission including the self-assessment carried out by the participating organizations.

This report provides the main findings, recommendations, and good practices identified during the mission. In general, the main conclusions of the mission are:

1. The Occupational Radiation Protection Programmes at the end user facilities are managed in compliance with the requirements stated in GSR Part 3;
2. The arrangements for provision of technical services comply with IAEA Safety Standards and other international standards such as those of ISO and IEC.

However, specific set of essential and important recommendations is directed to the Regulatory body and the Managements of the facilities that were covered during the ORPAS mission. Detailed of specific findings for the facilities are provided in Appendices I -VIII.

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1.0 INTRODUCTION

1.1 BACKGROUND

The International Atomic Energy Agency (IAEA) is authorized by its Statute to establish international standards for the safety and protection of health, environment and property against ionizing radiation. This has led to the publication, inter alia, of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (IAEA GSR Part 3). The IAEA has also a statutory responsibility to provide assistance for the application of these Basic Safety Standards (BSS) in Member States. To check whether the application of the standards is appropriate, the IAEA carries out appraisal reviews. This document is intended to assist in the appraisal of one area of application of the BSS, namely Occupational Radiation Protection (ORP).

To assist Member States in occupational radiation protection, the IAEA has published safety guides which are jointly sponsored by the IAEA and the International Labour Organization (ANNEX I). The IAEA has also published additional technical information on particular techniques. These are the specific publications against which the appraisal described in this document is conducted.

1.2 CONCEPT OF APPRAISAL

An evaluation, or appraisal, of occupational radiation protection arrangements following a development and implementation programme, and periodically thereafter, is an effective way to ensure that those arrangements are optimized and effective. An appraisal provides an opportunity for a Member State to have its occupational radiation protection programme independently assessed and evaluated. An independent assessment is often useful to maintain or enhance the effectiveness of the programme and to identify in an objective and unbiased manner the areas where improvements may be required. A secondary benefit is that an independent appraisal allows information on best practices from the host country to be made available to other Member States. It is also the intention that in due course, countries will be able

to carry out their own self-assessment using similar procedures to those described in this document.

1.3 SCOPE

This document is a report of an appraisal team's mission to the REPUBLIC OF GHANA, primarily to check the regulatory and practical implementation of occupational radiation protection arrangements. It includes some background as to the appraisal methods that were used. Conclusions and recommendations are made for the Republic of Ghana, but the document also includes recommendations to the IAEA with regard to the structure and conducts of future such appraisals.

1.4 STRUCTURE OF THE DOCUMENT

The document consists of four chapters of main text, supported by seven appendices that mostly provide the detailed findings of the mission.

2.0 OCCUPATIONAL RADIATION PROTECTION APPRAISAL

2.1. KEY OBJECTIVES

The purpose of the appraisal is to check the regulatory and practical implementation of occupational radiation protection arrangements. In other words, the review tries to answer the question "are the arrangements adequate and will they work?" given the national context in which they are applied. An appraisal also aims at identifying specific strengths and good practices that can be shared with other Member States. Finally, an appraisal provides a basis for determining where improvements may be required and for recommending actions to make such improvements.

In support of the purpose, the key objectives of the appraisal are to:

- provide the Republic of Ghana with an objective assessment of the provisions for occupational radiation protection;
- identify areas where performance should be improved to meet international standards;
- make recommendations on actions to be taken to achieve such improvements; and

- identify the strengths in the host country which are unique and worthy of bringing to the attention of others.

2.2. METHODOLOGY AND EVALUATION CRITERIA

The evaluation criteria applied are based on the performance requirements as set out in the following three Safety Requirements and Guides:

- Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (IAEA General Safety Requirements Part 3 No. GSR Part 3, 2014);
- *Occupational Radiation Protection* (IAEA Safety Standards Series No. RS-G-1.1, 1999); *Assessment of Occupational Exposure due to Intakes of Radionuclides* (IAEA Safety Standards Series No. RS-G-1.2, 1999);
- *Assessment of Occupational Exposure due to External Sources of Radiation* (IAEA Safety Standards Series No. RS-G-1.3, 1999).
- Draft safety guide on Occupational Radiation Protection - DS453 (currently under publication)
- The Management System for Technical Services in Radiation Safety (IAEA Safety Standards Series No. GS-G-3.2, 2008).

Accordingly, questionnaires have been developed by the IAEA for the purpose of gathering the necessary information against which to judge the appraised country's provisions for occupational radiation protection. The questionnaires were developed from the BSS and the supporting safety guides. Prior to the mission, these questionnaires were made available to all persons and organizations involved in the mission for their self-assessment.

2.3.EVALUATION OF FINDINGS -STRENGTHS WORTHY OF SPECIAL MERIT

It is far easier to criticize and point out failures than it is to identify aspects that represent best practice or are particularly good. However, throughout the mission, the

appraisal team was careful to identify those aspects that they considered to be representative of good practice in particular areas. In this context, **good practice** was considered to be an approach, methodology or system which, within the framework of the overall occupational radiation protection programme, was highly likely to achieve the required objective.

2.4. EVALUATION OF FINDINGS - WEAKNESSES AND CONSEQUENT RECOMMENDATIONS

Identified deficiencies were assessed according to their perceived impact on the protection of workers, and recommendations for improvements have been made to the Republic of Ghana.

The appraisal team considered the actual or potential consequences arising from each identified area of limited effectiveness, and has reflected this in the prioritization of the associated recommendations. The following priority categories have been used:

Essential, meaning that a delay in implementation could result in a substantial and immediate hazard to health, and/or that the recommendation addresses a serious deficiency in the occupational radiation protection programme.

Important, meaning that until the situation is corrected; occupational radiation protection effectiveness in a certain area is significantly compromised.

Advised, meaning that the recommendation identifies a relatively minor deficiency.

This system of prioritization is coupled to the following guidelines for the suggested timing of the implementation of the recommendations:

Priority	Timing of Implementation
Essential	Should be immediate, certainly without undue delay.
Important	Should be as soon as can be reasonably achieved.
Advised	Implementation enhances effectiveness but may be delayed.

3.0. APPRAISAL PROCEDURE

3.1. GHANA REQUEST AND IAEA RESPONSE

The Republic of Ghana requested the IAEA, in accordance with Milestone 2 of the model project on upgrading radiation protection infrastructure, to carry out a review of the occupational exposure control in the country. The National counterpart for the mission was the Ghana Atomic Energy Commission (GAEC). The IAEA Coordinator contacts the host country in order to arrange a date for the preparatory meeting to discuss the scope and expectations for the ORPAS self-assessment in preparation for the review mission.

3.2 PRE-MISSION VISIT AND OUTCOME

A pre-mission visit to the Republic of Ghana was conducted from 23 to 26 November 2016 by Mr Wilbroad Muhogora (TAEC, Tanzania) expert on behalf of the IAEA and Mr Jizeng Ma, Unit Head, Occupational Radiation Protection, Section of Radiation Safety and Monitoring, IAEA Division of Radiation, Transport and Waste Safety as the IAEA coordinator for the mission.

The mission was held in the facilities of the National counterpart at GAEC in Accra.

The mission objectives were to:

- discuss the scope of the full ORPAS mission;
- visit all potential facilities;
- provide a set of documents and tools for the self-assessment; and

- plan with the main counterpart and prepare a schedule for the subsequent appraisal mission.

The duration of the appraisal mission, the provisional schedule and the starting date were discussed with the host country, based on the availability of the participants and the completed questionnaires prior to the mission. Thus, one week mission during December 2016 was suggested. It was intended that participating organizations should complete their questionnaires and return them to the IAEA by October 2016 so that briefing material could be prepared for the mission team members. Discussions and visits were made to the potential participating facilities in Accra:

- Foundation For Complex Orthopaedic Spine (FOCOS);
- Sweden Ghana Medical Centre (SGMC);
- National Centre for Radiotherapy and Nuclear Medicine (NCRNM), Korle-Bu Teaching Hospital (KBTH);
- Radiation Protection Institute (RPI), GAEC – Regulatory Body;
- RPI, GAEC – TSOs (Personal Dosimetry Laboratory, SSDL, Maintenance Service);
- Gateway Services Limited (GSL) – Cargo Scanning Company.

3.3. AGREED SCOPE

During the pre-mission visit it was agreed that the mission should involve appraisals of service organizations (TSOs) and of practices (i.e. End Users of radiation). A provisional list of organizations was drawn up including some facilities in Accra (paragraph 3.2) and in Tema, like:

- GSL, a container scanning company with linear accelerator;
- Nick TC Scan, also a container scanning company with linear accelerator and Co 60 equipment.

3.4. TEAM

It was decided that the scope and duration of the appraisal required a team of three experts, including the IAEA coordinator, experienced specialists in ORP and

technical service providers. The team members were recruited for the appraisal mission in accordance with IAEA procedures.

3.5. MISSION PLANNING

After receiving the relevant information and self-assessment by the counterpart, detailed planning for the mission took place during the period 11 - 15 November 2016. This included:

- Detailed discussions with the IAEA coordinator;
- Study of a large amount of relevant background information and material;
- Creation of a guidance document for team members and for the GAEC counterpart (including draft programme for the full mission); and
- Compilation of an information package that was sent to team members.

3.6. MISSION PROGRAMME

The draft mission programme required slight amendments and the following programme was followed (ANNEX II):

Place	Facilities	Days
Accra	Arrival	Sunday 4 th Dec 2016
Accra	Initial team briefing	Sunday 4 th , pm
Accra	<ul style="list-style-type: none"> • Meeting with the DDG of GAEC 	Monday 5 th
Accra	<ul style="list-style-type: none"> • Visit to FOCOS • Visit to SGMC 	Monday 5 th
Accra	<ul style="list-style-type: none"> • Visit to Radiotherapy Centre, Korle Bu 	Tuesday 6 th
Accra	<ul style="list-style-type: none"> • Visit to SSDL (RPI) • Visit to Instrument Maintenance Lab (RPI, DENIC) 	Wednesday 7 th

	<ul style="list-style-type: none"> • Visit to Personnel Dosimetry Lab(RPI) 	
Tema	Visit to industrial facilities in Tema <ul style="list-style-type: none"> • GSL • Nick Scan 	Thursday 8 th am
Accra	Report preparation	Thursday 8 th pm, Friday 9 th am
Accra	Exit Meeting at GAEC	Friday 9 th pm
Accra	Departure	

3.7 CONDUCT OF VISITS

It was agreed at the initial briefing team meeting that visits should focus on the compilation of information and data necessary to complete the template questionnaire that was relevant to the purpose of the visit. Prior to each visit, the team members had the opportunity to evaluate the pre-mission questionnaires provided by each participating organization. This was valuable in preplanning aspects of each visit and concentrating on important issues. The list of the participants met during this mission is provided as ANNEX III.

Visits included a tour of each facility in order to obtain a comprehensive understanding of the information being gathered. It was noted that the briefing meeting organized on the first of the mission had provided valuable introduction of the purpose and conduct of the appraisal to the participating organisations and relevant staff.

During each visit, the opportunity was taken to collect available documentation evidence that would be of value in the subsequent evaluation of the findings. As appropriate to each individual visit, these documents included:

- Authorization;
- Radiation protection management structure ;
- Radiation protection programme ;

- Control and accountability of radioactive material (if applicable) ;
- Control of sealed sources (if applicable) ;
- Radiation protection measures ;
- Workplace monitoring programme ;
- Individual monitoring programme ;
- Staff selection, information and training ;
- Co-operation to ensure the protection and safety of itinerant workers ;
- Emergency arrangements (emergency plans) ;
- Health surveillance programme ;
- Quality management systems ;
- Procedures for dosimetry laboratories such as calibration protocols;
- Traceability;
- Results of performance tests or intercomparisons;
- Quality management documentation;
- Examples of optimization or ‘ALARA’ studies;
- Examples of local rules etc.; and
- Investigation reports on overexposures.

3.8 REPORTS

3.8.1 REPORTING SCHEDULE

The following reporting schedule was agreed at the exit meeting:

Action	Completion Date (<i>not later than</i>)
Compilation of first draft of report by team leader and circulation to team members for comments	4 weeks after the mission (31 st December 2016)
Comments from team members back to team leader	2 weeks after receipt from team leader members (15 th January 2017)
Final draft from team leader to IAEA coordinator for editing and internal approval	4 weeks after comments from team members (15 th February 2017)

Approved report back to team leader for final acceptance	4 weeks after receipt from IAEA coordinator (15 th March 2017)
Report returned to IAEA by team leader	Immediate (2 days)
Report sent from the IAEA to counterpart for comments	Immediate (2 days)
Comments by counterpart to IAEA coordinator	2 weeks after receipt from IAEA coordinator (5 th April 2017)
Issue of final report	4weeks after receipt from counterpart (30 th April 2017). A total of 20 weeks after the mission

The basic structure of the report includes:

3.8.2 PARTICIPATING ESTABLISHMENTS

End Users

The following establishments with the corresponding facilities were visited:

Establishment	Facilities
Foundation For Complex Orthopaedic Spine (FOCOS)	Radiology and CT
Sweden Ghana Medical Centre (SGMC)	Radiotherapy and CT
National Centre For Radiotherapy & Nuclear Medicine, Korle Bu Teaching Hospital (KBTH)	Radiotherapy and Nuclear medicine
Gateway Services Limited (GSL)	Containers scanning company
Nick Scan	Containers scanning company

Technical Services

Establishment	Services
Personnel Dosimetry Laboratory, RPI, GAEC	External Dosimetry
Secondary Standard Dosimetry Laboratory, Health Physics And Instrumentation Centre, RPI, GAEC	Calibration
Engineering Service Centre, National Nuclear Research Institute, GAEC	Maintenance

3.9 BRIEF DESCRIPTION OF THE FACILITIES

The Institutions were classified as End-Users and Technical Service Providers. All End-Users carry out work involving the use of ionising radiation in 3 medical practices (radiotherapy, nuclear medicine, radiology) and in 2 industrial facilities (containers scanners). Except the industrial facilities, which are located in Tema (about 30 km away), other establishments are all located in Ghanaian capital, Accra. Two radiology departments are in private sector while one radiotherapy facility is in private sector while one centre that has radiotherapy and nuclear medicine facilities is in public sector.

The Technical Service Providers group included: one external dosimetry service, one calibration Service and one service for nuclear equipment maintenance. External dosimetry and calibration services are provided by RPI of GAEC which until January 2016 was a Regulatory Body responsible for authorization, inspection and enforcement processes. At present, the independent regulatory body is the Nuclear Regulatory Authority (NRA). Maintenance services are provided by Engineering Service Centre which is under National Nuclear Research Institute (NNRI) of GAEC.

4.0 GENERAL CONCLUSIONS AND RECOMENDATIONS OF THE APPRAISAL

On 9thDecember 2016, the ORPAS Team presented the conclusions and recommendations of the appraisal to the counterparts of the ORPAS mission at the Exit Meeting at GAEC.

4.1 CONCLUSIONS

In general, the main conclusions of the mission are:

1. The Occupational Radiation Protection Programmes at end user facilities are managed in compliance with the requirements stated in GSR Part 3;
2. The arrangements for provision of technical services comply with IAEA Safety Standards and other international standards such as those of ISO and IEC.

However, a set of essential and important recommendations is directed to the Regulatory body and the Managements of the facilities that were covered during the ORPAS mission.

Some good practices were identified during the mission and are listed below:

1. It was interesting to find that all end users were complying with regulatory requirements. All facilities were authorized by regulatory body ;
2. Periodic maintenance of the TLD readers and its electronic quality control with documentary evidence ensured smooth operation of the equipment to serve its purpose;
3. A Dose Management System (DMS) has been adopted as a national dose registry system;
4. Accredited quality management system has been or is being established in some of the receiving facilities;
5. Innovative design of the collimator of Cs-137 irradiator proper use of the equipment for instrument calibration purposes ;

6. Strong instrument maintenance capability ensures the stable operation of the radiation protection equipment;
7. Most of the receiving facilities have qualified experts;
8. All facilities with high risk sources have radiation survey meters.

For facility specific detailed recommendations and good practices, please refer to Appendices prepared for each of the end-users and service providers

4.2 RECOMMENDATIONS

1. It is important that the existing SSDL is upgraded to enable improved calibration services;
2. Both service providers and end users are encouraged to establish and implement a quality management system;
3. A backup TLD reader should be acquired and sufficient dosimeters provided for individual monitoring service;
4. The personnel monitoring laboratory should regularly provide backup of the dose records in the DMS as required;
5. The radiation protection programme at the end user facilities should be established or strengthened to provide better radiation protection of workers;
6. Relevant bodies should work to standardize the RPO (RSO) qualification and training programme,
7. There is a need to strengthen workplace monitoring in some of the end user facilities by implementing the programmes and appropriate records keeping;
8. It is essential that facilities with potential high exposure acquire and use electronic personal dosimeters (EPD) for regular risk evaluation and related optimization;
9. The health surveillance procedures should be harmonized as the concept is mixed with periodic medical check-ups;
10. The procedures for over-exposure situations should be strengthened to provide better protection of workers in case of their occurrences.

There is a need to undertake certain improvements in the overall occupational radiation protection arrangements as specifically identified at end users and service providers (Appendices I-VIII).

4.3 RECOMMENDATIONS TO THE REGULATORY BODY

1. Establish requirements for the authorization of technical services
2. Issue regulatory guidance or enforce regulations for implementing occupational radiation protection program including health surveillance programme, qualification and training of RSOs etc,
3. Enforce requirements on regulatory compliance including authorization;
4. Share good practices observed during the appraisal mission with other national stakeholders and member states to promote their applications.

ANNEX I: REFERENCES

- Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards (IAEA General Safety Requirements GSR No. Part 3, 2014);
- Occupational Radiation Protection (IAEA Safety Standards Series No. RS-G-1.1, 1999);
- Assessment of Occupational Exposure due to Intakes of Radionuclides (IAEA Safety Standards Series No. RS-G-1.2, 1999);
- Assessment of Occupational Exposure due to External Sources of Radiation (IAEA Safety Standards Series No. RS-G-1.3, 1999);
- Calibration of Radiation Protection Monitoring Instruments
- Safety Reports Series No. 16, STI/PUB/1074, ISBN 92-0-100100-2; Vienna: IAEA, 1999.
- The Management System for Technical Services in Radiation Safety (IAEA Safety Standards Series No. GS-G-3.2, 2008);
- IAEA-Safety Reports Series No. 38 Applying Radiation Safety Standards in Radiotherapy;
- Occupational Radiation Protection (IAEA Draft Safety Standards DS453, 2015).

ANNEX II: MISSION PROGRAMME

Occupational Radiation Protection Appraisals Mission REPUBLIC OF GHANA 5 – 9 December 2016

Place	Facilities	Days
Accra	Arrival	Sunday, 4 th Dec 2016
Accra	Initial team briefing	Sunday, 4 th , pm
Accra	<ul style="list-style-type: none">• Visit to FOCOS• Visit to SGMC• Report Preparation	Monday, 5 th Dec 2016 Evening
Accra	<ul style="list-style-type: none">• Visit to Radiotherapy Centre, Korle Bu• Report preparation	Tuesday, 6 th Dec 2016 Evening
Accra	<ul style="list-style-type: none">• Visit to SSDL (RPI)• Visit to Instrument Maintenance Lab (RPI, DENIC)• Visit to Personnel Dosimetry Lab(RPI)• Report preparation	Wednesday, 7 th Dec 2016 Evening
Tema	Visit to industrial facilities in Tema <ul style="list-style-type: none">• GSL• Nick Scan• Report preparation	Thursday, 8 th Dec 2016 Evening
Accra	<ul style="list-style-type: none">• Exit Meeting• Report preparation	Friday 9 th Dec 2016, Afternoon Evening
Accra	Departure	

ANNEX III: LIST OF PARTICIPANTS

Name	Function	Organization
Prof,	Acting Director General	GAEC
Prof.	Director	RPI, GAEC
Dr, Joseph Amoako	Deputy Director, Main counterpart, SSDL	RPI, GAEC
Prof. Oheneba Boachtie-Adjei	Medical Director	FOCOS
Ms. Irene Wulff	Chief of Anesthesia	FOCOS
Ms. Leticia Osei-Poka	Chief Administrative Officer	
Mr. John Odarley	RPO, Radiographer	FOCOS
Mr. George Felix Acquah	RPO, Medical Physicist	SGMC
Dr. Joel Yarney	Director, Radiation Oncologist	NCRNM, KBTH
Mr. Evans Sasu	Acting RPO, Medical Physicist	NCRNM,KBTH
Mr. Michael Nyamadi	Medical Physicist	NCRNM, KBTH
Mr. Samuel Tagoe	Medical Physicist	NCRNM, KBTH
Mr. Philip Owusu-Manteaw	Personnel Monitoring Laboratory	RPI, GAEC
Ms. Edith Amoakie Amoatey	Personnel Monitoring Laboratory	RPI, GAEC
Mr. Hephzibah K. Agyeman	Personnel Monitoring Laboratory	RPI, GAEC
Dr. Stephen Inkoom	Training Services	RPI, GAEC
Mr. Daniel Nii Adjei	SSDL	RPI, GAEC
Mr. Ben Doe Gbekor	SSDL	RPI, GAEC
Dr. Banini Bright	Manager	ESC, NNRC
Mr. Emanuel Addison	Quality Manager	GSL
Mr. Ernest Quaye	Assistant Maintenance Officer	GSL
Mr. Alex da Roccha	Branch Manager	Nick TC Scan
Mr. Carl Lokko	RSO/ Maintenance Manager	Nick TC Scan
Mr. Jonathan Forson	RSO/Chief IT Manager	Nick TC Scan